T. 8 • № 2 • 2020 ISSN 2308-944X (Print) ISSN 2311-0279 (Online)

Review of Business and Economics Studies

Вестник исследований бизнеса и экономики

DOI: 10.26794/2308-944X

Издание перерегистрировано
в Федеральной службе по надзору
в сфере связи, информационных
технологий
и массовых коммуникаций:
ПИ № ФС77–67072
от 15 сентября 2016 г.

**Периодичность издания —
4 номера в год**

Учредитель: «Финансовый университет»

Журнал включен в ядро Российского
индекса научного цитирования (РИНЦ)

Журнал распространяется по подписке.
Подписной индекс 42137
в объединенном
каталоге «Пресса России»

The edition is reregistered
in the Federal Service for Supervision
of Communications,
Informational Technologies
and Mass Media:
PI No. ФС77–67072
of 15, September, 2016

**Publication frequency —
4 issues per year**

Founder: "Financial University"

The Journal is included in the core of the
Russian Science Citation Index (RSCI)

The Journal is distributed by subscription.
Subscription index: 42137
in the consolidated
catalogue "The Press of Russia"

Vol. 8 • No. 2 • 2020

Review of Business and Economics Studies

DOI: 10.26794/2308-944X

Review of Business and Economics Studies

REVIEW OF BUSINESS AND ECONOMICS STUDIES (ROBES) is the quarterly peer-reviewed scholarly journal published by the Financial University under the Government of Russian Federation, Moscow. Journal's mission is to provide scientific perspective on wide range of topical economic and business subjects.

CONTACT INFORMATION
Financial University
Leningradsky prospekt, 53,
office 5.6
123995 Moscow
Russian Federation
Telephone: +7 (499) 943-98-02
Website: https://rbes.fa.ru/jour

AUTHOR INQUIRIES
Inquiries relating to the submission of articles can be sent by electronic mail to zemezhva@fa.ru.

ISSN 2308-944X

Вестник исследований бизнеса и экономики

Редакция научных журналов Финансового университета
123995, Москва, ГСП-5, Ленинградский пр-т, 53, комн. 5.6
Тел. 8 (499) 943-98-02.
Интернет: https://rbes.fa.ru/jour

Журнал "Review of Business and Economics Studies" («Вестник исследований бизнеса и экономики») зарегистрирован в Федеральной службе по надзору в сфере связи, информационных технологий и массовых коммуникаций 15 сентября 2016 г. Свидетельство о регистрации ПИ № ФС77-67072.

Подписано в печать: 10.06.2020.
Формат 60 × 84 1/8.
Заказ № 270
Отпечатано в Отделе полиграфии Финуниверситета (Ленинградский проспект, д. 49).
16+

Review of Business and Economics Studies
Volume 8, Number 2, 2020

Вестник исследований бизнеса и экономики

№ 2, 2020

Review of Business and Economics Studies
2020, Vol. 8, No. 2, 6-18
DOI: 10.26794/2308-944X-2020-8-2-6-18

Central Bank Policy in Times of Turbulence on Financial Markets

Mikhail Zharikov

Doctor of Economics, World Economy and World Finance Department, Professor; Financial University under the Government of the Russian Federation, Moscow, Russia
michaelzharikoff@gmail.com
http://orcid.org/0000–0002–2162–5056

Abstract

This article is devoted to a central bank's response to a financial crisis based on a case study of the US Federal Reserve's handling of the financial crisis in 2008–2010. This article will also be focusing on the intense phase of the financial crisis. It is focusing primarily on the lender of last resort function of a central bank. The article concludes with the most significant issues about the aftermath and the recovery, as well as lessons to deal with financial failure during the coronavirus and its aftermath.

Keywords: central bank policy; lender of last resort function; financial crisis; coronavirus; too big to fail; Volcker rule; regulatory framework; securitisation; credit ratings
JEL Classification: F37

1. The Background of the Federal Reserve's Response to the Financial Crisis

As soon as lockdowns have hit the financial markets, meltdowns of major economies and enterprises across the globe caused by the pandemic in early 2020, policymakers have tried to pursue different kinds of policies. The article finds it best to turn to the experience in dealing with financial crises based on lessons of the Federal Reserve from the previous financial crunch of 2008.

A central bank has two main responsibilities: financial stability and economic stability. For financial stability, the main tool that central banks have is the lender of last resort powers by providing short-term liquidity to financial institutions replacing lost funding. For economic stability, the principle tool is monetary policy. That involves adjusting the level of short-term interest rates.

The vulnerabilities in the financial system transformed the decline in housing prices and led to a very severe crisis. Private sector vulnerabilities included excessive debt. A bank's inability to monitor its risks and excessive reliance on short-term funding makes it ***vulnerable to a run***. There was also increased use of exotic ***financial instruments like credit default swaps*** and others that concentrated risk in particular companies and particular markets (Avdokushin & Kovalenko, 2012).

The public sector had its vulnerabilities, including gaps in the regulatory structure, with important firms and markets that did not have ***adequate oversight***. Although there was adequate oversight, it existed at least basically in law. However, sometimes the supervisors and regulators did not pay enough attention to forcing banks to do better ***monitoring and managing their risks***. Finally, a significant gap in a central bank's policy was that there was not enough attention paid to the stability of the financial system taken as a whole.

Another crucial public sector vulnerability involved government-sponsored enterprises (***GSEs)*** Fannie Mae and Freddie Mac. ***They*** are private corporations. They have shareholders in their board, but Congress established them in support of the housing industry. Fannie and Freddie ***do not make mortgages***. They are the ***middleman between the originator of the mort-***

gage and the ultimate holder of the mortgage. For example, a bank makes a ***mortgage loan*** and then sells it to Fannie or Freddie. They will, in turn, take all the mortgages that they collect, put them together into ***mortgage-backed securities (MBS)***. ***A mortgage-backed security is a security that is a combination of hundreds of thousands of underlying mortgages***. Then they sell that to the investors. That is a process called ***securitisation***. Fannie and Freddie pioneered this basic approach to getting funding from mortgages (Bernanke, 2015).

In particular, when the GSEs sell their mortgage-backed securities, they provide ***guarantees*** against credit loss. Fannie and Freddie were permitted to operate with ***adequate capital***. While many aspects of the financial crisis were not well anticipated, this one was. The Fed said that Fannie and Freddie just ***did not have enough capital and that they were, in fact, a danger to the stability of the financial system***.

What made the situation even somewhat worse was that Fannie and Freddie besides selling these mortgage-backed securities to investors, also ***purchased on their account large amounts of mortgage-backed securities both their own and some that were issued by the private sector***. They made profits from holding those mortgages.

An important trigger of the crisis was that this was not just a ***house-price boom and bust***, but it was the ***mortgage products and practices*** that went along with the house price movements that were particularly damaging. There were a lot of exotic mortgages by which economists mean non-standard and standard mortgages, thirty-year, prime, fixed-rate mortgages, etc. There were all kinds of mortgages being offered and often to people with weaker credit and poor credit ratings (Binder, 2013).

One feature that many of these mortgages had was that for them to be repaid, one had to have ***ongoing increases in house prices***. So, for example, someone might be a mortgage borrower who would buy an ***adjustable-rate mortgage or ARM*** where the initial interest rate was, say, 1 per cent which meant that one could afford the payment for the first year, too. After two years the mortgage rate might go up to 3 per cent and after four years 5 per cent and then higher and higher. So, in order to avoid that, the borrower had to at some point refinance into a ***more standard mortgage***. And as long as house prices were going up, creating equity for homeowners, it was possible to do that refinance (Burlačkov, 2012).

But once home prices stopped rising [and by 2006 they were already declining quite sharply] borrowers, rather than having building equity, found themselves underwater. They could not refinance, and they found themselves stuck with these increasing payments on their mortgages. There are, of course, some examples of bad mortgage practices. There are so many of them that it is impossible to go through all of them. But they all have the same characteristics. Most of these mortgages had the feature that they reduced monthly payments at least early in the mortgage but allowed mortgage payments to rise overtime.

The other aspect of lousy mortgage practices like ***no-doc loans***, for example, was that there was ***minimal underwriting which means very little analysis to make sure that the borrower was creditworthy*** and was able to make the payments on the mortgage.

Mortgage companies, banks, savings and loans enterprises and a variety of other different kinds of institutions made these mortgages. Some of them were kept on the balance sheet of the ***mortgage originator***, but many or most of these ***exotic or sub-prime mortgages*** were packaged in securities and sold off into the market.

Some of the securities that were created were very complex and very hard to understand. An example would be a ***collateralised debt obligation (CDO)***. It would often be ***security to combine mortgages and other kinds of types of debt in one package***. A mortgage company would ***sell to one investor the safest part of the security, and to another investor the riskiest part of the security***. One reason that many investors were willing to buy these securities was that ***they had the comfort of the rating agencies*** whose job it is to ***rate the quality of warrants and other securities, giving AAA ratings to many of these securities, essentially saying that they were very safe.*** And therefore, one did not have to worry about the credit risk of these securities (Butorina, 2011).

Many of these securities were sold to investors including pension funds, insurance

companies and foreign banks, even, in some cases, wealthy individuals, but also the financial institutions that either made these loans or created these securities and often retained some of them as well.

For example, sometimes they would create an ***accounting fiction or off-balance-sheet vehicle*** which would hold these securities and finance itself by cheap ***short-term funding like commercial paper***. Some of these securities went to investors. Some of them stayed with the financial institutions themselves.

Besides, there were companies like AIG that were ***selling insurance***. They were using various kinds of ***credit derivatives*** to basically to say that a borrower had to pay them a ***premium***. If the mortgages in the borrower`s mortgage-backed security went bad, they would make it good. And that was AAA-rated.

Of course, these practices made the underlying securities no better. But what they also did was they created a situation where ***risks could be spread throughout the system***. Sub-prime mortgage securitisation worked very peculiarly. There were ***low quality-mortgages***, which meant one might have a mortgage company or a ***thrift company*** making the loans.

The ***thrift company*** or the mortgage company does not care too much about the quality of the loan because they are going to sell it anyway. So, they take the mortgages, and they sell them to large financial firms who take those mortgages, and maybe other securities as well, combine them into security which is essentially an ***amalgamation of all the underlying mortgages and other securities***.

The financial firm that created the security might negotiate with the credit rating agency to say what one had to do to get AAA rating, and there would be negotiations and discussions. In the end, the security will be rated AAA. The financial firm will then take the security, could carry it up in different ways or just sell it as it is, sells it to investors like a pension fund or some other type of investor. But also, financial firms kept many of these securities on their books or in ***related investment vehicles***. And finally, there were ***credit insurers*** like AIG and other ***mortgage insurance companies*** that for a fee provided insurance in case the underlying mortgages went bad (Goldberg & Cédric, 2008).

2. Central Bank Policy Lessons

The crisis of 2008–2010 was basically a ***classical financial panic but in a different institutional setting***: not in the bank setting but in a broader financial setting. So, in particular, as house prices fell in 2006 and 2007, people who borrowed on a sub-prime mortgage were not able to make the payments. It was increasingly evident that more and more were going to be ***delinquent or default***, and that was going to impose losses on the financial firms, the investment vehicles they created and also credit insurers like AIG.

Unfortunately, the securities were so complex, and the monitoring of the financial firms of their risks was not sufficiently strong that it was not just the losses. A very striking fact is that if one took all the sub-prime mortgages in the United States and put them all together and assume they are all worthless, the total losses to the financial system would be about the size of one rotten egg at the stock market. ***But the problem was they were distributed throughout different securities and different places, and nobody really knew where they were and who was going to bear the losses***.

So, there was a lot of uncertainty in the financial markets. As a result, wherever one had short-term funding, whether it was commercial paper or other short-term types of funding, banks had all kinds of funding that were not deposit-insured — so-called ***wholesale funding*** — and it came from investors and other financial firms (Griesgraber, 2009).

Whenever there was a doubt about a firm, just like in a standard bank run, the investors, the lenders and the counterparties would pull back their money quickly for the same reason that a depositor would pull back their money out of a bank that was thought to be having trouble. So, there was a whole series of runs which generally had tremendous pressures on key financial firms as they lost their funding and were forced to sell their assets quickly. And many important financial markets were badly disrupted.

In the depression of the 1930s, there were thousands of bank failures. Almost all of the banks that failed in the 1930s, at least in the United States, were small banks. And some larger banks failed in Europe. The difference in 2008, many small banks failed in the United States,

but there were also intense pressures on quite a few of the largest financial institutions in the United States (Jordà & Schularick, Taylor, 2011).

There are cases in a shortlist of some of the firms that came under intense pressure. Bear Stearns, which is a broker-dealer, came under intense pressure in the short-term funding market in March of 2008. It was sold to J.P. Morgan with Fed's assistance in March 2008. Things calmed down a bit after that, and over the summer, there was some hope that the financial crisis would moderate. But then in the late summer things really began to pick up. On September 7th 2008, Fannie and Freddie were clearly insolvent. They did not have enough capital to pay the losses on their mortgage guarantees. The Federal Reserve worked with the Fannie and Freddie's regulator and with the Treasury to determine the size of the short-fall. Over the weekend, the Treasury with the Fed's assistance came in and took those firms and put them into a form of ***limited bankruptcy called conservatorship***.

At the same time, the Treasury got authorisation from Congress to ***guarantee all of the Fannie and Freddie obligations***. If one held a Fannie or Freddie mortgage-backed security, the company itself was now on a ***partial bankruptcy***. There was an enormous intensification of the crisis because investors all over the world held hundreds of billions of those securities literally. Famously, in mid-September 2008, Lehman Brothers, a broker-dealer, had severe losses. It came under tremendous pressure. It could not find either anybody to buy it or to provide capital for it. On ***September 15th 2008 it filed for bankruptcy***. On the same day, Merrill Lynch, another big broker-dealer, was acquired by the Bank of America, saving the firm from potential collapse.

On September 16th 2008, AIG, which was the ***largest multi-dimensional insurance company in the world*** which had been selling the credit insurance, came under enormous attack from the people demanding cash either through margin requirements or through short-term funding. The Fed provided emergency liquidity assistance for AIG and prevented the firm from failing.

Washington Mutual was one of the biggest ***thrift companies***, a big provider of sub-prime mortgages, was closed by regulators later in September 2008, after parts of the company were taken off. J.P. Morgan acquired this company as well.

On October 3rd 2008, Wachovia, one of the five biggest banks in the United States, came under severe pressure. It was acquired by Wells Fargo, another large mortgage provider. All of these firms were among the ***top ten or fifteen financial firms*** in the United States. Similar things were happening in Europe. It was not a situation where only small firms were being affected. Here were the biggest, most complex international and financial institutions at the brink of failure (Kadayan, 2014).

Lessons from the crisis going back are two. First, in a financial panic, the central bank has to lend freely according to the ***Bagehot's rules*** to hold runs and to try to stabilise the financial system. The second lesson of the crisis — the Fed should do enough to prevent deflation and contraction of the money supply. It needs to have an ***accommodative monetary policy*** to help the economy avoid a deep depression.

Keeping in mind those lessons, the Federal Reserve and the Federal government did take vigorous actions to stop the financial panic, work with other agencies and work internationally with foreign central banks and governments (Kasekende, Brixova & Ndikumana, 2010).

One aspect of the crisis, which does not get quite enough attention, is the fact that it really was, first of all, a global crisis. In particular, Europe, as well as the US, were suffering very severely from the crisis. It was also an imposing example of ***international cooperation*** like G7 or G20. ***The G7 are the seven largest industrial countries***. The central bank governors and the finance ministers of those seven countries came and met in Washington. They were going to work together to stop this crisis which was threatening the global financial system. Finally, they came up with a statement that was written from scratch, based actually on some Fed proposals and was circulated, and there were several principles and statements involved in that (Kaufman, 2001).

Among those were first that the G7 countries were going to work together to prevent the failure of any more ***systemically important financial institutions***. It was after Lehman Brothers had failed. They were going to make sure that banks and other financial institutions had ac-

cess to funding from central banks and capital from governments. They were going to work to restore ***depositor confidence and investor confidence***. And then they were to cooperate as much as possible to normalise credit markets (Lane & Milesi-Ferretti, 2011).

It was a global agreement, and subsequent to this agreement just in the following week, ***the UK was the first to announce a comprehensive programme to stabilise its banking system***. The US announced significant steps to put capital into the country's banks, and so on. So, a lot really happened in just the next couple of days after this meeting.

Just to show that this cooperation worked, the following should be said about the interest rate charged on loans between banks. It is the ***inter-bank interest rate***. So, if Bank A lends to Bank B overnight, this is the interest rate that was charged. ***Typically, the overnight interest rate between banks is extremely low, way less than 1 per cent***, because banks need someplace to park their money overnight, and they have a lot of confidence that it is safe to lend to another bank overnight. As one can see starting in 2007, banks lost trust in each other, and that is shown by the increase in the rates they charged to each other to make loans.

What was indicative of that was that suddenly there was no trust whatsoever even between the largest financial institutions because nobody knew who was going to be next, who was going to fail and who was going to come under ***funding pressure***. After the international announcements, within a few days, one began to see a reduction in the pressure, and there was an enormous improvement in the funding pressures in the banking system (Schindler, 2009).

The Fed played an important role, however, in providing liquidity and making sure that the panic was controlled. The Federal Reserve has a facility called the ***discount window***, which it uses routinely to provide short-term funding to banks. Maybe a bank just finds itself short off funding at the end of the day. It wants to borrow overnight. It has collateral with the Fed. Based on that collateral, it can borrow overnight at what is called the ***discount rate,*** which is the interest rate that the Fed charges. No extraordinary steps were needed to lend to banks. The Fed always lends to banks. The Fed did make some modifications in order to reassure the banks about the availability of credit. To get more liquidity into this system, they extended the maturity of this kind of window loans which were enormous overnight loans. The Fed made them longer term. The Fed had auctions of these discount window funds where firms bid on how much they would pay. The idea there was by having a fixed amount that they were auctioning. They would at least assure themselves that they got a lot of cash in the system. Anyway, the point here is that the discount window, which is the Fed's usual lender-of-last-resort facility, lending to banks was opportunitive, and they used aggressively to make sure that banks had access to cash to try to calm the panic (Wade, 2008).

The Fed also had to go beyond the discount window. It had to create a whole bunch of other programmes. These special liquidity and credit facilities allowed them to make loans to other kinds of financial institutions, again on the Bagehot's principle that providing liquidity to firms that are suffering from the loss of funding is the best way to calm the panic. All these loans were secured by collateral. They were not taking chances with taxpayer money. The cash was going not just to banks, but more broadly to the system. The purpose of this was to enhance the stability of the financial system and get credit flows moving again. And just to emphasise: this is the traditional lender-of-last-resort function of central banks that have been around for hundreds of years. What was different was that it took place in a different institutional context than just the traditional banking context.

There are some of the institutions and markets that the Fed addressed through special programmes. Banks, of course, were covered by the discount window. Still, another class of financial institutions — broker-dealers, which are financial firms that deal in securities and derivatives, were also facing severe problems. It included Bear Stearns and Lehman Brothers, Merrill Lynch, Goldman Sachs, Morgan Stanley and others, and the Fed provided cash or less short-term lending to those firms on a collateralised basis as well.

Finally, in the modern economy, the current financial system has a lot of the funding which

one gets for not just mortgages but auto loans and credit cards. All three kinds of consumer credit are funded through the securitisation process. It means that a bank might take all of its credit card receivables, bundle them together to security and then sell them in the market to investors in much the same way that mortgages were sold. It is called the ***asset-backed securities market***.

The asset-backed securities market dried up during the crisis, and the Fed created some new liquidity programmes to help it. These types of lending required the Fed to involve ***emergency authorities***. There is a clause in the Federal Reserve Act 13–3 which says that under ***unusual and exit circumstance, basically an emergency, the Fed can lend to other types of entities, other than just*** banks. The Fed had not used this authority since the 1930s. In this particular case, with all these other problems emerging in different institutions and different markets, the Fed invoked this authority. It used it to help stabilise a variety of different markets.

For example, money-market funds are basically investment funds in which one can buy shares, and money-market funds take someone`s money and invest it in short-term liquid assets. Money-market funds historically have almost always maintained a one-dollar share-price. So, they are very much like a bank actually. Institutional investors like pension funds frequently use them.

A pension fund with 30 million dollars in cash probably would not put that into a bank because that much money is not insured. There are limits to how much deposit insurance covered. What a pension fund might do instead of putting the cash in a bank, it will be to put the money into a money market fund which promises one dollar for each dollar put in plus a little bit of interest on top and invest in very short-term safe liquid-type assets. So, it is a pretty good way to manage one`s cash if one is an institutional investor of some kind (Yu, 2014).

Many investors were putting their money into money-market funds. Money market shares are not insured. They do not have deposit insurance, but the investors who put their money into a money market fund expect that they can take their money out at any time dollar for dollar. So, they treat it like a bank account basically.

3. Acute Measures to be Taken in a Financial Crisis

The money-market funds, in turn, have to invest in something, and they tend to invest in safe short-term assets like commercial paper. ***Commercial paper is a short-term debt instrument issued typically by corporations.*** Short-term is ninety days or less, typically. A non-financial corporation might issue commercial paper to allow it to manage its cash flows. It might need some short-term money to meet its payroll to cover its inventories.

Ordinary manufacturing companies like GM or Caterpillar would issue a commercial paper to get cash to manage their daily operations. Financial corporations, including banks, would also issue commercial paper to get funds that they can then use to manage their liquidity positions, and they can use again to make loans to the private economy.

The investors were investing their assets to cash in a money-market fund. The money market fund buys commercial paper, which is a funding source for both non-financial businesses like manufacturers and for financial companies who would lend it on to other borrowers.

Lehman Brothers created a huge shock wave because Lehman Brothers was an investment bank. It was a global financial services firm. It was not a bank. So, it was not overseen by the Fed. It was an investment company. It held lots of securities. It did a lot of business in the securities markets. It could not take deposits, not being a bank. Instead, it funded itself in short-term funding markets, including the commercial paper market.

Lehman invested heavily in ***mortgage-related securities*** and also in commercial real estate during the 2000s. As house prices fell and delinquencies on mortgages rose, Lehman's financial position got worse. They were again using lots of money in the commercial real estate. Lehman was becoming ***insolvent***. It was losing money, all of its investments, and it was coming under a lot of pressure. Indeed, as Lehman's creditors lost confidence, they started withdrawing funding from Lehman.

For example, investors refused to roll over Lehman's commercial paper. And other business partners said they were not going to do business if Lehman did not do anymore, because due to

a failure the latter may not be here next week. Lehman tried with the Federal Reserve and the Treasury`s help to either find somebody willing to put more capital into the firm or to acquire the firm. It was unable to do that. So, on September 15th 2008, as was already mentioned it filed for bankruptcy. It was ***an enormous shock that affected the whole global financial system***.

This time in 2020, it was the coronavirus. In particular, one of the many implications of the failure was again in the money-market funds. There was one particular fairly large money-market fund that held among its other assets commercial paper issued by Lehman. When Lehman failed, that commercial paper was either worthless or at least entirely illiquid for a long time. Suddenly this money-market fund could no longer pay off its depositors at a dollar per share. It did not, and it lost money.

The Fed and the Treasury responded very quickly to the situation. The Treasury provided a ***temporary guarantee*** which said that they guarantee that a person gets his/her money back if he/she just do not pull it out right now. The Fed created a ***back-stop liquidity programme*** under which they lent money to banks who in turn used that money to buy some of the assets of the money-market funds. That gave the money. There were the money outflows from the money-market funds. It is a two-trillion-dollar industry. Following that announcement for about two days there about a hundred billion dollars a day was flowing out of these funds. Within two days the Treasury announced a guarantee programme. The Fed came to support the liquidity of these funds. The runs ended pretty quickly. It is an absolutely classic bank run and a traditional response, i.e. providing liquidity to help the institution being run, provide the cash to its investors, providing the guarantees, and that successfully ending the run.

But that was not the end of the story, because the money-market funds were also holding the commercial paper. As they began to face runs, they, in turn, began to dump commercial paper as quickly as they could. As a result, the commercial paper market went into shock. It is a really nice example of how financial crises can spread in all different directions.

Furthermore, as the money-market funds withdrew from the commercial paper market, there was a sharp increase in the rate in the ***commercial-paper market***. Lenders ran willingly to lend from more than maybe one day to commercial-paper borrowers, which in turn affected the ability of those companies to function and the ability of those financial institutions to fund themselves.

The Federal Reserve was responding in a way that Bagehot would have had his respond and established special programmes. Basically, the Fed stood as a ***back-stop lender***. The Fed said that the banks should make their loans to these companies, and the Fed would be there right to back-stop the banks if there was a problem rolling over these funds. And that restored confidence in the commercial-paper market.

The Fed was working with these critical markets and providing broad-based liquidity to financial institutions to try to bring the panic under control. But the Fed and the Treasury also got involved in trying to address problems with some individual critical institutions. In March of 2008, as was mentioned before, a Fed loan facilitated the take-over of Bear Stearns by J.P. Morgan Chase avoiding failure of that firm. The reason the Fed undertook that action was first that at the time the financial markets were quite stressed, and the Fed was fearful that the collapse of Bear Stearns would significantly add to that stress and perhaps set off a ***full-fledged financial panic***.

Moreover, it was the Fed`s judgement at least that Bear Stearns was solvent, at least J.P. Morgan thought so. They were willing to buy the firm, and they guaranteed its obligations so that by lending to Bear Stearns the Fed was consistent with the proposition that it should be making loans that were likely to be paid back. And the Fed also felt that it was well secured in making the loan that it did.

In a second example, in October of 2008, AIG was very close to failure. It again was the largest insurance company, perhaps among the largest in the world. Let us just discuss a little bit about that case.

AIG was a complicated company. It was, on the one hand, a multinational financial services company with many constituent parts, including several insurance companies and global insurance companies. But it had a part of the company that was called ***AIG Financial Products*** that was

involved in all kinds of exotic derivatives and other types of financial activities including, as was mentioned before, ***the credit insurance*** that it was selling to the owners of mortgage-backed securities. So, when the mortgage-backed securities started going wrong, it became evident that the AIG was in big trouble. And its counterparties began demanding cash or refusing to fund AIG.

AIG was coming under tremendous pressure. The failure of AIG and the Fed`s estimation would have been the end. It was interacting with so many different firms. It was so interconnected with both the US and the European financial systems and global banks that the Fed was quite concerned that if AIG went bankrupt, that it would not be able to control the crisis any further.

Fortunately, from the perspective of ***lender-of-last-resort theory***, AIG was taking a lot of losses in its ***financial products` division***. But underlying those losses, that was the world's largest insurance company. So, it had lots of perfectly good assets, and as a result, it had ***collateral*** which it could offer to the Fed to allow them to make a loan to provide the liquidity it needed to stay afloat.

And so, to prevent the collapse of AIG, the Fed used AIG assets as collateral and loaned AIG 85 billion dollars, obviously a relatively severe amount of money. Later the Treasury provided additional assistance to keep AIG afloat. And again, it was highly controversial. It was both, the Fed thought, legitimate in terms of lender-of-last-resort theory because it was a collateralised loan. The Fed is not fully paid, in this case. And, secondly, because it was a critical element in the global financial system.

Over time, as was said before, AIG has stabilised. It has repaid the Fed with interest. The Treasury still owns a majority share of its stock, but AIG has been paying back the Treasury as well. It has been in the process of doing that.

The Fed likes to emphasise that what they had to do with Bear Stearns and AIG is obviously not a recipe for future crisis management. First of all, it was a very difficult and, in many ways, the ***distasteful intervention*** that the Fed had to do on the grounds of their need to do to prevent the system from collapsing. But clearly, it is something fundamentally wrong with a system in which some companies are ***'too big to fail'***. If a company is so big that it knows it is going to be bailed out, even putting aside the fairness of that, it is not at all fair to other companies, but even beyond that obviously, they have an incentive to take big risks. They will say they will take big risks, ***heads they win, tails they lose***.

If the risks pay off, then they will make plenty of money. And if they do not pay off, the government will save them. That is ***too big to fail***, and that is a situation which one cannot tolerate.

So, the problem the Fed had in September of 2008 was that it really did not have any tool, or legal tools and policy tools, that allowed it to let Lehman Brothers and AIG and these other firms go bankrupt in a way so that it had not had incredible damage or created astonishing damage on the rest of the system.

Therefore, the Fed chose the lesser of the two evils and prevented AIG from failing. But that being said, going forward the Fed wanted to be sure that this never happens again. It needed to be sure that the system has changed so that if a large systemically critical firm like AIG comes under this kind of pressure in the future that there will be a safe way not to let it fail so that it can fail. The consequences of its mistakes can be borne by its management, shareholders, and creditors. But in doing so, it does not bring down the whole financial system, and the following step it is going to make is about the progress the Fed made collectively in ***instituting a system*** that will, as the Fed hopes, eventually at least, end too big to fail.

Finally, a couple of words about the consequences of the crisis should be said. The Fed did stop the meltdown. It avoided what would have been a ***collapse of the global financial system***. That was obviously a good thing. But to give a sense one thing that the Federal Reserve was always sure of was that the collapse of some of these big financial firms were going to have very serious collateral consequences. Some people are arguing even as late as September of 2008, why just not let the firms collapse, because the system can take care of it. The US has a bankruptcy code. Why not let them fail? And the Fed never thought that that was a good option.

Remarkably, the whole system had collapsed, they would have had extraordinarily serious consequences, as it was even though they prevented the ***total meltdown.*** There was still evident, as is known, a severe collateral

impact on not just the US economy but the global economy as well.

So, following the crisis, though the crisis was brought under control, the US economy, and much of the global economy, went into a ***sharp recession***. In the United States, the GDP fell by more than 5 per cent, which is a remarkably deep recession. There are some other statistics: eight and a half per cent of people lost their jobs. And unemployment rose to 10%. So, it was a very consequential impact.

And as was said before, this was not just the US situation. The US recession was, in fact, an ***average recession***. There were many countries around the world with worse declines, particularly those who depended upon international trade. It was a global slowdown. And as all of this was happening, fears of a great depression, or a repetition of the 1930s depression, were genuine.

Nevertheless, the Great Depression was much worse than the recent recession. And the Fed thinks the view is increasingly gaining acceptance that without the forceful policy response that stabilised the financial system in 2008 and early 2009, the world could have had a much worse outcome in the economy.

4. Concluding Remarks

There are a couple of indicators just to close the discussion. The pretty striking thing is that for the first 15 or 16 months in 2008 stock prices in the United States behaved pretty much in this crisis as they did in 1929 and 1930. But about 15 or 16 months into the recent crisis, which would have placed it in early 2009, about the time when the financial crisis was stabilising, look what happened. In the Depression Era, the stock prices kept falling. And as was already mentioned, in the end, stock prices lost 85 per cent of their value.

In the United States, by contrast, stock prices recovered and began a long recovery, and now they more than doubled where they were three years ago.

One can see in this case that the fall in industrial production was not as quiet as severe and incredibly as fast as in the Depression. But one gets the same basic phenomenon that about 15 or 16 months into the episode, about the time that the financial crisis was brought under control, industrial production bottomed out and began a period of steady recovery. In contrast, in the Depression, the collapse continued for several more years.

So, that is a very rapid overview of the crisis of 2008–2010. The article went more profound into how the monetary policy responded to the recession. Why has the recovery been relatively sluggish? What has happened to financial regulation to try to make sure this never happens again? And what lessons has the Fed taken from this experience?

The article mentioned the increased insurance of exotic securities and sub-prime mortgages. Why are these financial institutions willing to lend such mortgages and bear so much risk to even poker borrowers? And if they are forcing a decrease in prices on the housing market, why they do the same thing? There were a couple of reasons for that. One reason was simply the fact that firms were probably too confident about house-price increases, and said that house prices were likely to keep rising. In a world in which house prices are rising, these are not such bad products altogether, because people can afford to pay for a year, but then they can refinance this something more stable. And this might be a way to get people in the housing, but of course, the risk was that house prices would not keep rising, and of course, that is ultimately what happened.

The other aspect of this was that the ***demand for securitised products grew very substantially during this period***. In part, there was a great international demand from Europe and Asia for ***high-quality assets***. And the ever-clever US financial firms figured out that they could take a variety of different kinds of underlying credits, whether it be sub-prime mortgages or whatever. And through the ***miracles of financial engineering,*** they could create from that at least some securities that would be high-quality and would be rated AAA, and which they could then sell abroad to other investors.

Unfortunately, that sometimes left them with the remaining bad pieces which they kept or sold to some other financial firms. So, there were trends in the financial markets, including ***overconfidence about their ability to manage those risks***, a belief that house prices would probably keep rising, a sense that they could, even if they made those mortgages, then sell

them off to somebody else, and that that other person or another investor would be willing to acquire them. There was a big demand for quote ***'safe assets'***.

For all these reasons, it was actually a very profitable activity. But it lasted only when the house prices began to fall did it becomes a big loser.

The article was also talking about the major things the Fed had to do to figure out how to get liquidity flowing again in the market, and it reminds the Volcker Rule. As can be understood, the ***Volcker Rule***, of course, ***bans perpetrating*** by financial banks. Still, there is also this spacious area for ***principle trade*** which is very important for ***money-makers to create markets and find liquidity***. So, what does the Fed think about that? Does not that seem ***counter-intuitive***?

The Volcker Rule is a part of the ***Dodd-Frank Financial Regulatory Reform***, and which the Fed and other agencies are tasked with implementing. The purpose of the Volcker Rule is to ***reduce the risk of financial institutions by preventing banks and their affiliates from doing quote 'proprietary trading'***, which means that banks should do their short-term trading on their own account so that in the future they will be prevented from taking those kinds of risks.

The law recognises that there are legitimate exceptions for why banks might want to acquire short-term securities, and those include, for example, ***hedging against risk***. Still, one particular exception is to make markets serve as the ***intermediaries*** who buy and sell to create liquidity for a specific market. And that is exempted from the Volcker Rule, and one of the challenges of implementing this rule is trying to figure out how to work out a ***set of standards*** that allows the so-called ***exempted or legitimate activities like market-making and hedging*** while ruling out the proprietary trading. And that is obviously very difficult.

The Fed is still working on that. They put out a rule where they have got thousands of comments. They are looking at that and trying to figure out how best to do that. But the point the question raised is that liquidity in markets is essential. During the crisis, it was a much worse problem than just a little bit of lack of trading volume. There were big financial institutions unable to fund themselves, unable to find the funding to support their asset positions, the assets that they held, which left them with one of two possibilities either defaulting because they did not have enough funding or the fact that many of them took which was the sort ***selling off assets as quickly as possible***, which in turn spread to panic because if there is a huge sellers' market for, say, ***commercial real estate bonds***, that is going to drive prices very sharply. Then anybody else who was holding those bonds finds their position being eroded, and that created pressure on them.

The Fed did not officially use the word ***contagion*** in its discussion. Contagion, just as in an illness context, is the spreading of panic and the spreading of fear from one market or from one institution to another. And contagion was a major problem in many waves of financial panic, but certainly in this one too. And that was one of the mechanisms that led the funding pressures to jump from firm to firm and create such a broad-based problem.

There is a question specifically about global collaboration during the financial crisis. The article talked about G7. Specifically, multinational corporations began to go beyond the brink of failure. What pressures came from the international community? One decision to say bail-out AIG was being debated.

There were not any real pressures. Everything was happening too fast. In fact, one area where collaboration was not as good as the Fed would like to was exactly dealing with some of these multinational firms. For example, there were problems between the UK and the US over the Lehman Brothers' failure and inconsistencies which caused problems for some of the creditors of Lehman. So, one of the things that the Fed is trying to do under the ***Dodd-Frank Financial Reform Legislation*** which includes, as was mentioned before, ***provisions for safely allowing large financial firms to fail***.

But one of the complexities there is that many of the firms that this would be applied to are multinational firms. It does not mean to say just two or three countries. It may involve dozens of countries. And so, collaboration with other countries in figuring out how they would work together to help a large multinational firm fail as safely as possible was part of what was going on as they worked internationally. During

the crisis, they tried to cooperate in a mostly ***ad hoc*** way.i.e. the Fed was in touch with regulators in the UK and elsewhere. But given the time frames and the lack of preparation, they did not do as much as they would be able to do with a lot more lead time.

So, that was a weakness of international collaboration. For the most part, though, countries cooperated in dealing with the financial institutions that were based in their own countries. AIG was an American company. And the Fed dealt with that, whereas a company like Dexia, which was a European company, was dealt with by the Europeans.

Also, there was a lot of cooperation between central banks, and there were a lot of European banks that used dollars that needed dollar funding as opposed to euro funding. They used dollar funding because they held dollar assets. They made dollar loans. They made loans to support trade, which is often done in dollars, so, they needed dollars.

The European Central Bank cannot provide dollars. So, what the Fed did was what was called a ***swap***, where the Fed gave the European Central Bank dollars. And the European Central Bank delivered the Fed euros. They took the dollars, the Fed gave them and lent them under their own reconnaissance to European banks taking off the dollar-funding pressure and easing dollar-funding tensions around the world.

Those swaps which are still in existence now because of the recent issues with the coronavirus in the world were an important example of collaboration.

Also, right as this crisis was intensifying, the Federal Reserve and five other central banks all announced interest rate cuts on the same day. So, they coordinated even their monetary policy. They did their best to coordinate. There were some areas where a lot more preparation was needed, like working on multinational firms. And the Fed is still working on those things cooperatively today.

What are the ***off-balance-sheet vehicles*** that were being used, and why they were allowed to be used? And why were they allowed to keep much sham information on their books?

It has to do with ***accounting rules***, basically. Someone creates this particular vehicle, and the bank might have a substantial interest in that vehicle. It might, for example, have ***partial ownership***. It might have some promises to provide ***credit support*** if it goes wrong, or ***liquidity support*** if it needs cash. But it does not have to under those rules that existed in those times if the amount of control that the bank had on this off-balance-sheet vehicle was sufficiently limited. Then according to the accounting rules, it could treat it as a separate organisation, so to speak, not part of its balance sheet. And that allowed the banks to get away with somewhat less capital, for example, than they would have had to carry if they had all these assets on their balance sheet.

One of the many promising developments since the crisis is that these rules have been reworked, and many of the off-balance-sheet vehicles that existed before the crisis would no longer be allowed. They would have to be consolidated, which means they would have to be brought back on to the balance sheet, made part of the bank's balance sheet, have appropriate capital and so on. So, those practices are not entirely gone, but the accounting rules have considerably toughened up. The situation and the circumstances under which one can put something off the balance sheet into a separate investment vehicle are quite acute.

The article mentioned several large firms that came under pressure in 2008 and also the Fed's doctrine of *too big to fail*. The question is where one can draw the line between bailing out a bank and allowing it to fail? Is it arbitrarily, or is there some sort of methodology that goes behind?

First of all, the Fed would like to resist that word ***doctrine*** a little bit. These firms proved to be ***too big to fail*** in the context of the global financial crisis. There was a judgement the Fed made at the time based on their size, their complexity and their ***interconnectedness***. It was not something that they ever thought it was a good thing. And again, one of the main goals of the financial reform is to get rid of it, because it is bad for the system and it is bad for the firms. Also, it is unfair in many ways. And it will be a great accomplishment to get rid of ***too big to fail***.

So, it is not something that the Fed advocates or supports in any way. And they were just forced into a situation where they had to choose the least bad of a number of different options.

During the crisis, the Fed had basically to make judgements on a case-by-case basis, and they were trying to be as conservative as possible. In the case, indeed, of AIG, there was really not much doubt in the Fed`s mind. It was a case where the action was necessary if at all possible.

Lehman Brothers were in itself probably too big to fail in a sense that its failure had an enormous negative impact on the global financial system. Still, they were helpless because it was almost an insolvent firm. It did not have enough collateral to borrow from the Fed. The Fed could not put capital into an insolvent firm. It was before the ***TARP,*** or anything else had provided the capital that the Treasury could use, so the Fed just ***had no legal way to do it***.

If the Fed could have avoided that, they would have done so. It was somewhat *ad hoc*, although the two cases in which the Fed intervened — Bear Stearns and then AIG – the case was pretty straightforward, given not only the firms themselves but also the context and the environment that was going on at the same time.

Interestingly, the Fed had to get much more into this issue since the crisis, because there are several different rules and regulations which actually require the Fed and other regulatory agencies to make some determination about how ***systemically critical*** a firm is. For example, the new ***Basel III capital requirements*** require the largest, most systemically critical firms to have a ***capital surcharge*** for them to have more capital than firms which are not as systemically critical. And as part of that process, the international bank regulators have worked together to try to set a set of criteria relating to size, complexity, interconnectedness, derivatives, a whole bunch of criteria that help determine how much extra capital they have to hold.

Likewise, the Fed, when it proves a merger of two banks, it has to evaluate whether the merger creates a systemically more dangerous situation. The Fed has worked hard, and they have put out a variety of criteria including some ***numerical thresholds*** that they look at to try to figure out if a merger creates a systemically critical firm. If it does, they are not supposed to allow that merger to happen. The science of doing this is progressing. It is still very in its infancy. But again, in the crisis, the Fed`s actual interventions were Bear Stearns and AIG along with other agencies. And they also assisted a couple of other institutions, but nothing nearly to the extent that the AIG situation involved.

However, the Fed is moving forward. It is looking very seriously at this, and indeed now the Fed has become much more focused on financial stability. They have a whole division of people working on a various matrix and various indicators both to try to identify risks to the system and also to try to identify firms that need to be particularly carefully supervised and may hold extra capital because of the potential risk that they bring to the system.

One vulnerability that was mentioned in the article was that the credit rating agencies were assigning AAA ratings to securities that carried much more risks than perhaps a AAA rating might want. It seems like the incentives would be aligned for the buyers to seek out more accurate ratings because they would be taking on more risk. Was there a systemic problem as far as how incentives were aligned within the credit rating system that allowed these faulty ratings to propagate throughout the system?

There were some incentive problems and one of them which is that instead of the seller of the security being the one who hires and pays the credit-rater. One would think that would be in the interest of the buyers who after all are the ones who are bearing the risk to band together somehow and pay the credit-rater to give them the best opinion they can about what the credit quality is of the security. Unfortunately, that model does not seem to work. The very few examples if any that the Fed knows of where it works, and the problem is what economists call ***the free-rider problem***.

Basically, if five investors get together and pay Standard and Poor's to rate a particular issuance unless they can keep that completely secret, anybody else can find out what the rating was. Then they can take advantage of that without having to pay and having to be part of the consortium that pays. There have been a lot of ideas out there about how one can restructure the payment system to create better incentives for credit-raters. But it is a challenging problem because of an obvious solution of having the investors pay only works if the investors collectively can share the cost and somehow keep that information from being spread among other investors.

References

Avdokushin, Y.F., Kovalenko, V.N. (2012). Perspektivy internatsionalizacii kitaiskogo ûanâ [The prospects of Chinese yuan's internationalisation]. *Voprosy novoi ekonomiki*, 2, 43–49.

Bernanke, B. (2015). *The Courage to Act: A Memoir on a Crisis and its Aftermath*. New York: W.W. Norton, 126–130.

Binder, A.I. (2013). Nekotorye aktual'nie aspekti transformacii ûanâ v mirovuû valûtu [Some critical aspects of transforming yuan into a world currency]. *Den'gi i kredit*, 11, 59–62.

Burlačkov, V.K. (2012). Reforma mirovoi valûtnoi sistemy i ispol'zovanie èkonomičeskogo invatianta [The reform of the world system of currencies and the use of economic invariant]. *Voprosy èkonomiki*, 1, 151.

Butorina, O.V. (2011). Valûtnye voiny. Kto zaplatit za preodolenie krizisa? [The currency wars. Who will pay for overcoming the crisis?]. *Rossiâ v global'noi politike*, 1(9), 165–178.

Goldberg, L.S., Cédric, T. (2008). Vehicle currency use in international trade. *Journal of International Economics*, 2(76), 177–192.

Griesgraber, J.M. (2009). Reforms for major new roles of the International Monetary Fund? The IMF Post-G-20 summit. *Global Governance*, 15(2), 179.

Jordà, Ò., Schularick, M., Taylor, A.M. (2011). Financial crises, credit booms, and external imbalances: 140 years of lessons. *IMF Economic Review*, 59(2), 340–378.

Kadayan, H. (2014). Indian rupee's role as an international currency. *Abhinav — National Monthly Refereed Journal In Commerce & Management*, 2(3), 35–43.

Kasekende, L., Brixova, Z., Ndikumana, L. (2010). Africa: Africa's counter-cyclical policy responses to the crisis. *Journal of Globalization and Development*, 1, 1.

Kaufman, G.G. (2001). Emerging economies and international financial centers. *Review of Pacific Basin Financial Markets and Policies*, 4(4), 365–377.

Lane, P.R., Milesi-Ferretti, G.M. (2011). The cross-country incidence of the global crisis. *IMF Economic Review*, 2011, 59(1), 77–110.

Schindler, M. (2009). Measuring financial integration: A new data set. *IMF Staff Papers*, 1(56), 222–238.

Wade, R. (2008). The first world debt crisis of 2007–2010 in global perspective. *Challenge*, 51(4), 23–54.

Yu, Y. (2014). How far can renminbi internationalisation go? *Asian Development Bank Institute's Working Paper*, 461, 9–15.

Политика Центробанка РФ в условиях турбулентности на финансовых рынках

Михаил Жариков

Доктор экономических наук, доцент, профессор Департамента мировой экономики и мировых финансов, Финансовый университет, Москва, Россия

Аннотация. В статье рассматривается и сравнивается политика Центробанка РФ с деятельностью Федеральной резервной системы США в период интенсивной стадии глобального финансового кризиса 2008–2010 гг. Особое внимание акцентируется на функции ЦБ в качестве кредитора последней инстанции. Систематизированы наиболее значительные вопросы, которые необходимо учитывать при ликвидации последствий нынешнего экономического и финансового кризиса, вызванного коронавирусной инфекцией.

Ключевые слова: центральный банк; кредитор последней инстанции; финансовый кризис; коронавирус; проблема банкротства крупных предприятий и организаций; правило Волкера; финансовое законодательство; секьюритизация; кредитные рейтинги

Review of Business and Economics Studies
2020, Vol. 8, No. 2, 19-25
DOI: 10.26794/2308-944X-2020-8-2-19-25

Macroeconomics and Development of Seaport. Case of Vietnam

Thi Hong Van Pham, Thi Mai Thom Do

Vietnam Maritime University, vanpth@vimaru.edu.vn

Abstract

Seaport industry plays an important role in local and national economic development. The development of the seaport industry creates a competitive advantage, promotes international trade and speeds up the integration process of nations, especially in developing countries. Many studies have noted the importance of seaports to economic development. Economic development is also one of the crucial factors in seaport development. Economic growth will promote domestic production and improve investment efficiency. The development of import and export activities directly affects the supply of goods and the scale of operations of seaports; the increasing in industrial-agricultural output will increase the volume of goods, thereby promoting the seaport industry. This research analyses the relationship between economic growth, export-import operations, industry & agriculture to cargo through ports based on statistical data for the period 2000–2019. This study selects the case of Vietnam, a developing economy with a long coastline along with the country, and its shipping capacity ranked 4th in the ASEAN region.

Keywords: seaport industry; cargo through ports; GDP; import-export; industry and agriculture
JEL Classification: L9

Introduction

The role of seaports in local and national economic development has been confirmed in numerous studies (Bayar Caglak et al., 2011; Boonadir et al., 2012; Dwarakish & Salim, 2015; Park & Seo, 2016; Jouili, 2016). Not only contributing directly to economic growth, but the development of the seaport industry also promotes international trade and economic integration of nations (Dwarakish & Salim, 2015). The development of the seaport industry also creates jobs, reduces production and transportation costs, promotes domestic production to the world market as well as creates goods distribution centres among economic sectors (Park & Seo, 2016). In 2012, the seaport industry contributed directly 56 million euros to GDP in European countries, and the total contribution to GDP, including the indirect portion was up to 145 billion euros (Goodwin, 2016). In the UK, the seaport industry contributed 21.2 billion GBP to the economy, 6.2 billion GBP to income taxes in 2011 and created 391,800 jobs (Oxford Economics, 2013).

For developing countries, the seaport industry plays a very crucial role in several countries having coastal advantages. Specifically, 95 per cent of total cargo trade between Tunisia and the rest of the world was made by maritime roads in the period 1983–2011 (Jouili & Allouche, 2016). Chowdhury and Erdenebileg (2006) show that landlocked countries which own no seaports may face significant cost disadvantages due to higher transportation costs. They even have to pay the costs related to policies, politics such as tax imposed on goods passing international borders. The study also indicates that landlocked regions would encounter a lower level of GDP compared to port regions. The difference in GDP could be as large as approximately 40 per cent in the case of developing countries.

Seaport development becomes an essential aspect of many countries' economic development strategy, and this is also a topic that attracts many researchers. Many studies have analysed the role of seaports and the impact of infrastructure no seaports development.

However, the analysis of factors affecting seaport development is still limited, especially as concerns macroeconomics factors in the case of developing countries. Seaports contribute and promote economic development, industrial development, international trade growth, and foreign investment. There are also important macroeconomic factors in promoting seaport development. With these factors, policies and economic development strategies have essential impacts on the development of seaport enterprises. Recognising this gap, in this research, the authors focused on analysing the influence of macroeconomic factors on the development of seaport enterprises. The study will use the case of Vietnam, a developing country which has an important geographic location in international trade in the Asia Pacific region. The total volume of goods through Vietnam's seaports achieved 524.7 million tons and 17.8 million TEUs in 2018 (Vietnam Maritime Administration Statistics, 2019).

Literature Review

How to promote the development of seaport enterprises is one of the questions that many countries and researchers are interested in. Indeed, the macroeconomic environment has impacts on seaport development. Macroeconomic factors will build an appropriate environment to develop seaport enterprises (Tukan et al., 2015). This paper will address the impact of GDP growth, FDI, industry, import-export on the development of seaport enterprises.

Seaport firms contribute significantly to local and national GDP growth (Jiang, 2010; Chang et al., 2014; Bottasso et al., 2014; Jouili & Allouche, 2014; Dwaralish & Salim, 2015). On the other hand, economic growth also influences the seaport industry. Economic growth means domestic production and investment also increase. The rise in output leads to higher demand for transport and trade of goods, that is the basis for the development of seaport activities. Likewise, economic growth will raise the government's revenue from income tax and corporate tax. As a result, the government will expand public investment in infrastructure, which is also a factor that promotes the development of seaports. The positive impact of the development of infrastructure on seaport's development is mentioned in the study of Baird (1998) and Jouili (2016). Tukan et al. (2015) show that local economic development will affect the rate of seaport development. Specifically, GDP growth will boost the volume of cargo handling at ports and the likelihood fleet and dock length. Economic growth also supports the efficiency of the transport system. This research also indicates a positive relationship between economic growth and seaport development. Recognising the importance of the seaport industry, governments implement policies and strategies for economic growth, thereby contributing to the development of seaport enterprises.

Besides, import and export activities affect the development of seaports by directly affecting the volume of goods through ports (Jouili, 2016). Sea transport is one of the most economical and cost-effective means of transportation, which is the main transportation channel used by major countries in their import and export activities. Thus, the rapid growth of import and export will directly affect the volume of goods through ports, thereby increasing revenue and creating favourable conditions for seaport development.

Thirdly, seaport development also depends on the level of the national industry. The development of the national industry will increase the volume of goods, thus leading to the development of international trade, thereby increasing the activities of seaport service. The study of Nguyen and Nguyen (2018) also shows that industrial value affects the volume of goods passing through ports and has an impact on seaport revenue. In contrast, the study by Norcliffe (1981) also shows the effect of seaports on the development of industrial zones; in fact, many industries depend on seaports. The development of seaports creates competitive advantages for industrial zones in saving transportation costs, facilitating trade from the supply of goods to suppliers as well as to consumers; attracts local manufacturers and distributors to take advantage of cost and geographical distance. Many governments have built industrial parks near seaports to attract foreign investment (Park & Seo, 2016). Besides, Jung (2011) examined the contribution of seaports to Korea's economy

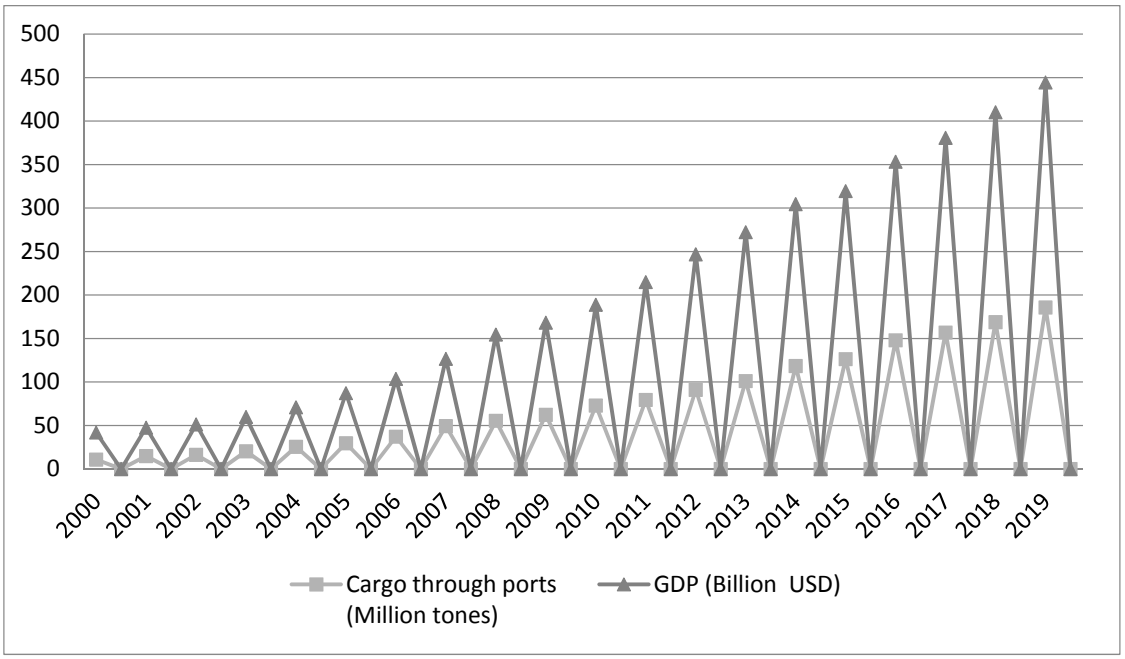

Fig. 1. Cargo through seaports and GDP value of Vietnam in the period 2000–2019

Source: Vietnam General Statistics Office and the Vietnam Maritime Administration, 2019.

and concluded that seaports play a vital role in the development of heavy industries such as steel, shipbuilding and petrochemical industry.

Along with the national industrial development, the development of agriculture and fishing also affects the development of seaport by increasing the volume of goods through seaports (Nguyen & Nguyen, 2018). It is evident in countries exporting agriculture and seafood processing products such as Thailand and Vietnam. According to statistics of the Ministry of Agriculture and Rural Development of Vietnam, Vietnam's agricultural, forestry and fishery export turnover in 2019 reached the US $41.3 billion, accounting for about 27 per cent of the total export turnover. Likewise, the growth of agriculture, fishery and forestry contributes to the increase in cargo and the development of seaport services.

The above analysis denotes that economic growth, export-import, industrial and agricultural development have a positive impact on the volume of goods through seaports. This impact will be considered in the context of Vietnam, a developing economy, in which seaport activity plays an important role in the economy.

Case Study of Vietnam

Vietnam has a developing economy in which the seaport industry plays an important role. With a strategic geographic location, Vietnam Sea in the Pacific Ocean occupies one of the busiest international maritime trade routes in the world, connecting the Indian Ocean and the Pacific Ocean. Vietnam's shipping capacity currently ranks 4th in ASEAN and 30th in the world with more than 1,500 ships of all kinds. Vietnam logistics service is presently ranked 64/160 in terms of development level and ranked 4th in ASEAN (Report Buyer, 2019). Vietnam has currently signed trade agreements with 26 countries. As of mid-2019, according to the statistics of the Maritime Administration, Vietnam has 281 ports with a total capacity of over 550 million tons *per annum*. Cargo through Vietnam's seaports are continually rising; the average growth rate of goods in the 2000–2017 period was approximately 10.4 per cent[1]. Seaport development contributes to promoting local and national economies. In order to achieve the above results, economic policies, as well as macroeconomic factors, play an important role in promoting the seaport industry. To better understand the relationship of macroeconomic factors and the development of seaport, this paper uses statistical data over 19 years, from

[1] Website of Vietnam Maritime Administration: http://www.vinamarine.gov.vn.

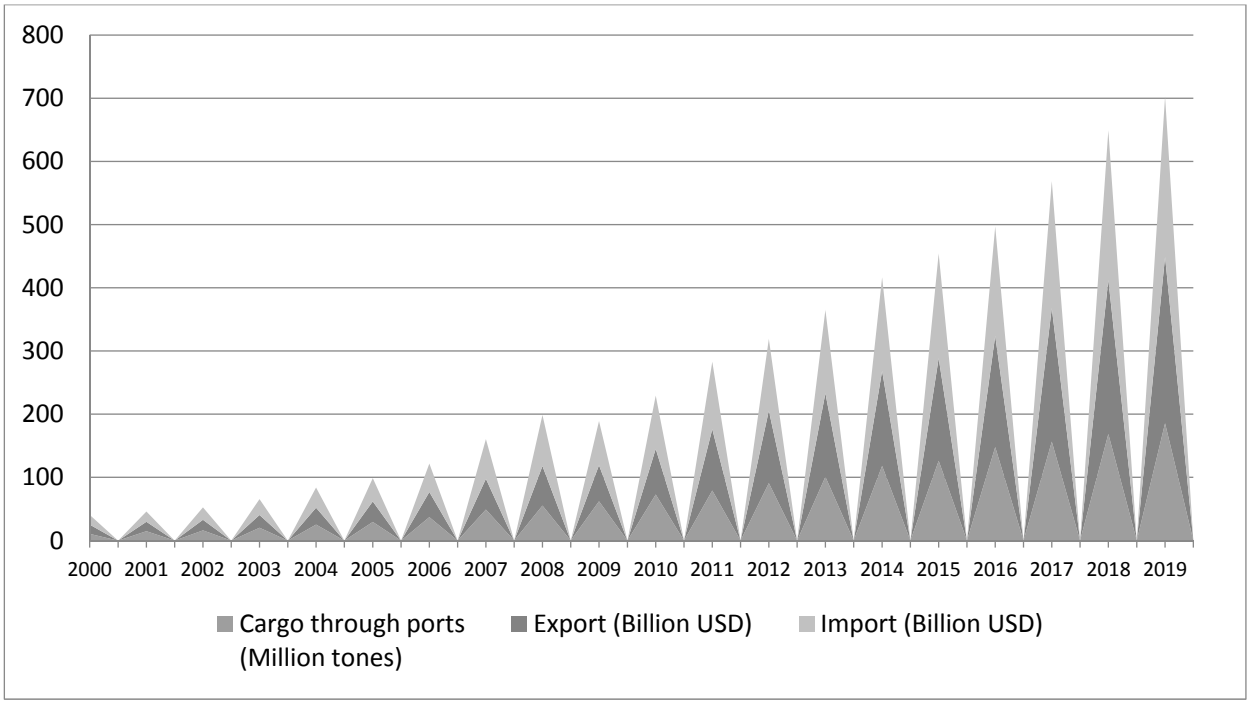

Fig. 2. Cargo through seaports and import-export value of Vietnam in the period 2000–2019

Source: Vietnam General Statistics Office and the Vietnam Maritime Administration, 2019.

2000 to 2019, to analyse the trend and fluctuations of cargo through ports and macroeconomic factors (GDP, export-import value and industrial-agricultural value). Statistical data over a long period shows the relationship between macroeconomic variables and seaport activity. First of all, GDP has led to the development of seaport.

The graph above shows that GDP and cargo through Vietnam's seaports grew in the same direction from 2000 to 2019. This result is consistent with previous studies in different countries. In recent years, Vietnam has been ranked in one of the countries with high and stable economic growth. The result is due to the government's flexible management of macroeconomic policies as well as the determination to improve business and investment environment to attract foreign investment and create resources for economic development in the country. The attraction of foreign investment, as well as domestic economic growth, have increased the volume of goods, which means that the demand for transport and circulation of goods has increased, thereby increasing the output of goods through ports and promote the activities of seaport enterprises. However, data shows that the growth rate of GDP seemed to be higher than that of cargo through ports. For the seaport development to respond adequately with the demand of the economy, the seaport industry needs to improve the quality of services, especially services to support shipping; developing modern fleets, large vessels and specialised vessels.

Along with economic growth, the development of import-export activities has mainly contributed to the increase in cargo through ports, as shown in the following graph.

The statistics in the period 2000–2019 show that Vietnam's export-import activities grew strongly in the same direction as the growth of goods through ports. The import-export activities directly and positively associated with increased cargo. It is understandable because Vietnam is a country that has a coastline along with the country, so maritime transportation is an advantage of Vietnam in international trade. Marine transportation allows reducing costs and creating a competitive advantage. Therefore, the development of import-export activities will increase cargo and promote the development of seaport services. Especially in 2009, the volume of goods through seaports had the largest growth rate in the period 2000–2019. One of the factors that led to this result was that Vietnam became a member of WTO in 2007, which increased the total volume of

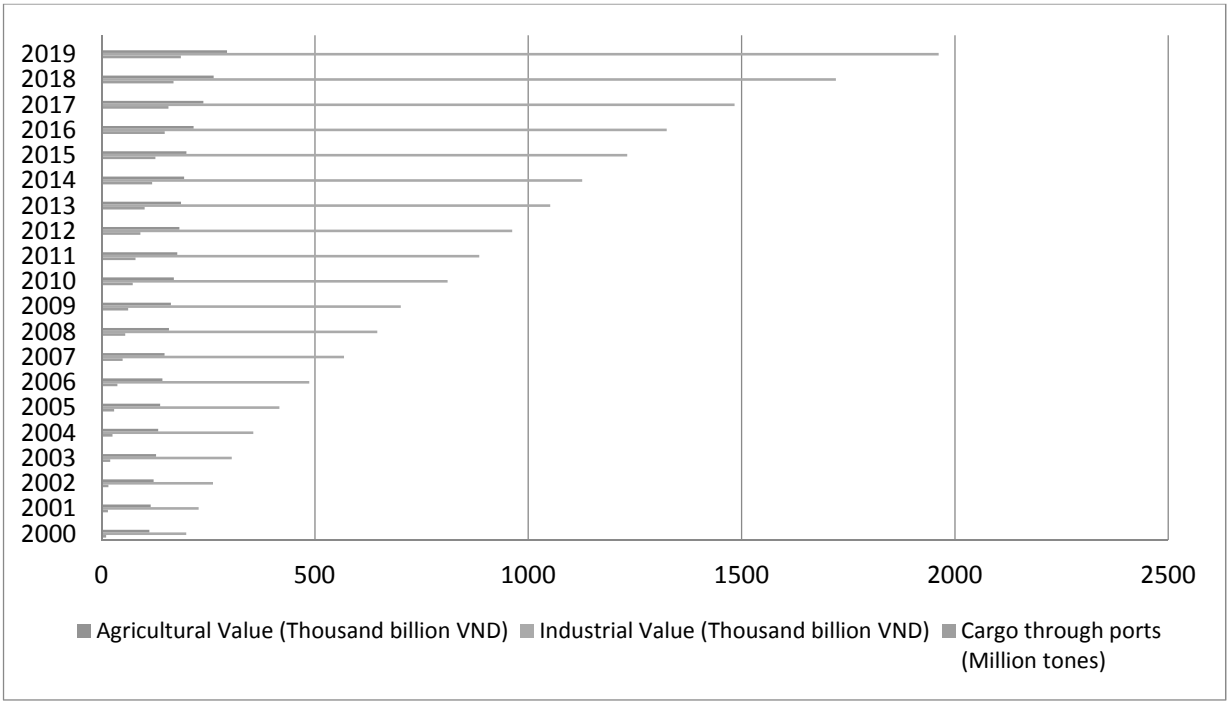

Fig. 3. Cargo through seaports and industrial & agricultural value of Vietnam in the period 2000–2019

Source: Vietnam General Statistics Office and the Vietnam Maritime Administration, 2019.

goods exported and imported through Vietnam's seaports (Nguyen & Ngo, 2017). Since 2014, import and export activities have grown by an average of 15 per cent. At the same time cargo through ports has also increased sharply, with an average rate of 10 per cent. It shows the positive impact of import-export activities in seaport development.

Besides promoting the development of international trade through import-export activities, the development of industry and agriculture has a definite impact on the development of seaports. For Vietnam, will the development of industry and agriculture promote the development of seaport enterprises? The growth rates of these two activities between 2000 and 2019 partly reflect this relationship.

From 2000 to 2019, Vietnam's industrial-agricultural value increased continuously, in which the industrial growth value was larger than agriculture. The graph depicts a growing, steady and positive trend in industry, agriculture and cargo through ports over the years. The increase in industrial-agricultural output has increased the volume of domestically produced goods and affected the volume of goods through seaports. With the coastline along with the country, maritime transportation is not only used for import-export goods but also domestic trade. According to the statistics of the Maritime Administration, the proportion of domestic goods through ports accounted for over 20 per cent of the total volume of goods through ports. It means that the development of industry and agriculture will positively affect the volume of goods through Vietnam's ports.

Vietnam's statistics show that macroeconomic factors have a positive effect on the volume of goods through ports, namely the impact of GDP, the value of import-export and value of industry-agriculture. As the economy grows and economic integration deepens, it will expand the trade between Vietnam and the world, which will create favourable conditions for seaport development. We can say that the seaport industry of Vietnam in particular and of other countries, in general, depend significantly on the economic policies and level of the economic integration of the states. Indeed, domestic maritime transportation in Vietnam only accounts for more than 20 per cent of cargo through ports; the rest comes from import-export activities. Therefore, strengthening the integration and implementation of macroeconomic policies to promote economic development, attract foreign investment, promote import-export activities are an important

base for the development of seaport activities. Besides, Vietnam should invest in infrastructure, upgrade seaport infrastructure, improve logistics and customs services to enhance the quality of Vietnam's seaport service.

Conclusion

With the advantage of 3,260 km of a long coastline, many deep-water bays, near international maritime routes and the location right next to the South China Sea, Vietnam's seaport industry plays an important role in economic development and integration. However, seaports in Vietnam have been focused and developed since 2015 and became active since 2017 when Vietnam expanded economic integration (Nguyen & Ngo, 2017). It shows that macroeconomic policies have profound impacts on seaport activities. According to statistics, the study points out the positive movement between economic growth, import-export value, industrial-agricultural value and goods through the port. Therefore, to develop the seaport industry, it is necessary to have appropriate macroeconomic policies, especially international trade policies, to accelerate the trade process to promote import-export activities. Likewise, it is the increase of industrial-agricultural value to increase the volume of goods, thereby increasing the supply-demand of goods through Vietnam's seaports system. The study highlights the relationship between macroeconomic factors and seaport development. Still, the research stops at analysing statistical data, which suggests further quantitative research to measure and evaluate the impact of each macroeconomic factor on cargo through seaports.

References

Baird, B. A. (1998). Public Infrastructure and Economic Productivity, Transportation Focused Review. *Journal of Transportation Research Board*, *1932*, 54–60.

Bayar Caglak, S., Alkan, G., & Aydin, G. (2011). The impact of seaport investments on regional economics and developments. *International Journal of Business and Management Studies*, *3*(2), 333–339.

Boonadir, N., Jeevan, J. Aslamm, N. M., & Hamid, S. A. (2012). Seaport development: A study on customer attraction to Westport, port Klang, Malaysia. *Business Management Dynamics*. *2*(8), 08–19.

Bottasso, A., Conti, M., Ferrari, C., & Tei, A. Ports and regional development: a spatial analysis on a panel of European regions. Transportation Research Part A: Policy and Practice. 65, 44–55.

Chang, Y-T., Shin, S-H., & Lee, Pt-W. (2014). Economic impact of port sectors on the South African economy: An input-output analysis. *Transport Policy*, *35*, 333–340.

Chowdhury, A., & Erdenebileg, S. (2006). Geography against Development: A Case for Landlocked Developing Countries. United Nations, NewYork.

Dwarakish, D. S., & Salim, A. M. (2015). Review on the role of ports in the development of a nation. *Aquatic Procedia, 4*, 295–301.

Jiang, N. (2010). Seaport investment and economic development in China. Dailian Marine University Press.

Jouili, T. (2016). The role of a seaport in the process of economic growth. *Developing Country Studies*, *6*(2), 64–69.

Jouili, T., & Allouche, M. A. (2014). The impact of public investment in seaports infrastructures on economic growth: the Tunisian context. *International Journal of Management Research and Development*, *25*, 25–33.

Jouili, T. A., & Allouche, M. A. (2016). Impacts of seaport investment on economic growth. Transportation Economy Preliminary Communication. DOI: 10.7307/ptt.v28i4.1933.

Jung B. M. (2011). Contribution of Ports to the Local Economies in Korea. *The Asian Journal of Shipping and Logistics, 27*(1), 1–30.

Goodwin, A.P. (2016). The economic value of shipping and maritime activity in Europe. Oxford Economics. Retrieved from https://www.oecd.org/sti/ind/Session%201_c%20-%20Andrew%20Goodwin%20-%20Presentation%20for%20Website.pdf

Nguyen, T.K.C., & Ngo, T.Q. (2017). Seaport industry report. FPT Securities.

Nguyen, X. P, & Nguyen, P. Q. P. (2018). Strategies for maritime development: A case in Vietnam. *European Journal of Engineering Research and Science, 3*(12), 14–19. DOI: http://dx.doi.org/10.24018/ejers.2018.3.12.986

Norcliffe, G. B. (1981). Industrial Change in Old Port Areas. The Case of the Port of Toronto. *Cahiers de géographie du Québec, 25*(65), 237–253. DOI: 10.7202/021515ar.

Oxford Economics. (2013). The Economic Impact of the UK Maritime Services Sectors: Ports, A Report for Maritime UK.

Park, J. S., & Seo, Y-J. (2016). The impacts of seaports on the regional economies in South Korea: Panel evidence from the augmented Solow model. *Logistics and Transportation Review*, *85*, 107–119.

Report Buyer. (2019). Vietnam logistics industry comprehensive report Q4/2019. Report ID: 5843680.

Tukan, M., Achmadi, T., & Widjaja, S. (2015). *International Journal of Technology*, *3*, 422–431.

Vietnam Maritime Administration Statistics: http://www.vinamarine.gov.vn.

Макроэкономика и развитие морского порта. Пример Вьетнама

Тхи Хонг Ван Фам, Тхи Май Тхон До

Вьетнамский морской университет, Хайфон, Вьетнам

Аннотация. Портовая промышленность играет важную роль в развитии местной и национальной экономики Вьетнама. Развитие морской отрасли создает конкурентные преимущества, способствует развитию международной торговли и ускоряет процесс интеграции государств, особенно в развивающихся странах. Экономическое развитие также является одним из важнейших факторов развития вьетнамских морских портов. В первую очередь развитие импортно-экспортной деятельности, которое напрямую влияет на масштабы их деятельности. В настоящем исследовании на основе данных за 2019–2000 гг. анализируется взаимосвязь между экономическим ростом, экспортно-импортными операциями, промышленностью, сельским хозяйством и объемом грузооборота через порты Вьетнама, обладающего протяженной береговой линией и входящего в «четверку» ведущих судоходных стран в регионе АСЕАН.

Ключевые слова: портовая промышленность; грузы через порты; ВВП; импорт-экспорт; промышленность и сельское хозяйство

Review of Business and Economics Studies
2020, Vol. 8, No. 2, 26-42
DOI: 10.26794/2308-944X-2020-8-2-26-42

Development of Banking Activities in Emerging Market Economy Countries

Otgontugs Narangua

BA in Economics, International Finance Faculty, Department of the World Economy and International Finance, Financial University, Moscow, Russia. Scientific advisor A.S. Fedunin, Ph.D. in Economics, Associate Professor, Department of the World Economy and International Finance, Financial University, Moscow, Russia

Abstract

This paper aims to understand the development of banking activities in emerging market economies not only for evaluating the impact of them for encouraging emerging economies' growth, but also establish the overall effect of these processes to the global financial market. The object of study is the banking activities of emerging market economies, and the subject is the impact of banking activities development on the economic growth of emerging market economies. The author substantiated the thesis that for emerging market economies' financial development should be examined in terms of banking stability, competition, and economic growth. The author also reveals specific characteristics that distinguish banking activities of emerging market economies from developed countries by evaluation of bank performance using criteria of stability, profitability, and efficiency.

Keywords: banking activities; emerging market economy; banking crises; financial crisis of 2008

JEL Classification: G21, G28

Introduction

Over the last decades, the banking sector worldwide transformed continually. The substantial transformation of banking activities was triggered by numerous changes in national and global level such as technological development, international competition, deregulation of financial services, banking crises, privatisation of state-owned banks, and others. Notably, during the last few years, the role of the emerging economy in the world economy is increasing substantially due to its economic growth, industrial potentials and a massive supply of resources and labour to the advanced economy countries. As most of these transitions take place in emerging economies, and the role of those countries boosts, it is highly valuable to understand the development of banking activities in emerging market economies not only for evaluating the impact of them for encouraging emerging economies' growth, but also establish the overall effect of these processes to the global financial market. In the context of banking activities of emerging market economies, the historical impact of its development, current trend and its impact in economic potential should be highlighted in advance.

The global financial crisis of 2008 has shown the importance of a sound and profitable banking industry in developed, developing, and emerging countries as well. But in comparison with banks in a developed and developing market, banks of the emerging market were impacted by the crisis in less extend due to the prudent policy and healthy macroeconomic condition. Thus, emerging market economies' banking performance should be measured and sustained at an appropriate level to secure from negative consequences. The current research mostly highlighted the importance of emerging countries' banking stability and profitability on the economic growth of the country. In recent years, there has been an increasing number of studies conducted in examining the relationship between financial development and economic growth and established a direct relationship between them. But as for emerging market economies' financial development should be examined in terms of banking stability, competition, and

economic growth. There are many articles and research are conducted for evaluating the current trends in the banking sector and its relationship with economic growth, which mostly concerns countries with developing economies. Whereas previously, most of the works are highlighted the development process of banking activities in developed countries and revealed positive trends in economic growth and productive capacity of the individual country.

The current trend in the analysis of many types of research is concentrated on banking activities of emerging economies of Asia, Latin America and Sub-Saharan Africa and its impact on encouraging economic and financial growth to the global level. Also, because of deregulation and liberalisation, the number of foreign banks in emerging market economies increased by 74 per cent and their market share doubles between 1995 and 2009. Currently, the trends continue with more moderated pace, but the role of them in the development of emerging market economies' banking sector is irreplaceable. The number of studies conducted on the problem concentrated on two opposing opinions stating the foreign banks either encourage overall efficiency or cause financial instability. Despite a massive literature on this topic, the risk foreign banks impose on emerging market countries' domestic banks should be evaluated in advance.

The primary goal of this research work is to evaluate the extent of development of banking activities in emerging market countries and provide an analysis of the performance of emerging market banks. The objective of assessing modern trends in the development of banking activities of emerging economy countries and establishing the role of them in encouraging economic and financial growth in the rough competition of global market would be performed by use of different statistical and non-statistical methods. Moreover, the object of study is banking activities of emerging market economies, and the subject is the impact of banking activities development on the economic growth of emerging market economies. For the accomplishment of the goal of this paper, the following tasks should be fulfilled:

To observe current trends in development and determinants that characterise banking activities of emerging market economy countries

To reveal specific characteristics that distinguish banking activities of emerging market economies from developed countries

To evaluate bank performance using stability, profitability, and efficiency

To establish relationship and effect of banking activities development and economic growth for emerging market economies

To determine any characteristic differences of banking activities' development for emerging economies and developed economies

To present a practical example by analysing trends and relationships for emerging economies region and a particular country.

The Banking Sector in Emerging Market Economies

Main Determinants of Banking Activities Development in Emerging Market Economies

Much improved economic fundamentals stimulated emerging market banks to join the ranking of the largest banks in the world. Emerging-market banks are growing faster than banks in developed and developing countries. In 2018, 10 of the world's 50 largest banks by market capitalisation come from emerging markets and together merging market banks account for one-third of global banking revenues[1]. Whereas 50 of the world's top banks by asset 12 is from emerging economies, i.e. all of them from China[2]. Chinese banks dominate the largest banks of the world, i.e. from top 100 banks, 20 are Chinese, 5 Brazilian and 5 South Korean. Table 1 presents the largest banks of the world from emerging market economies in terms of market capitalisation and assets.

The banking activities are one of the most important achievements of economic civilisation in the financial intermediation process, which encompasses multiple tools for regulating and maintaining the stability of the whole economy. The banking activities perform five functions which are providing information on allocation of resources, facilitating the exchange of goods

[1] Biggest Banks in the World 2018, Global Finance Magazine, 2018. https://www.gfmag.com/magazine/november-2018/biggest-banks-world-2018.

[2] Top 100 banks in the world, 2018. Bank around the world, 2018. https://www.relbanks.com/worlds-top-banks/assets.

Table 1
World's largest banks from emerging market economies 2018

N	Company name	Country	Market capitalisation, billion $	Assets, million $
1.	Industrial and Commercial Bank of China	China	308.63	4,006,242
2.	China Construction Bank	China	253.3	3,397,688
3.	Agricultural Bank of China	China	181.4	3,233,212
4.	Bank of China	China	167.89	2,989,653
5.	China Development Bank	China	121.67	2,450,812
6.	Bank of Communications	China	64.54	1,388,024
7.	China Merchants Bank	China	110.84	967,141
8.	Itau Unibanco Holding	Brazil	71.19	901,764
9.	Industrial Bank	China	43.63	985,448
10.	Banco Bradesco	Brazil	49.84	897,512

Source: Global Finance Magazine, 2018.

and services, encouraging trading and risk diversification, pooling and mobilising deposits, and monitoring investments. Therefore, banking activities development defines the efficiency of conducting these functions. The number of literature and studies highlight the irreplaceable role of banking activities in an increase in economic productivity and efficiency of companies. The banking sector development differs from country to the country depending on economic growth, openness to trade and capital, financial and political institutions, income level, geographical endowments, and human capital. Thus, establishing what makes banking sector to develop is essential to encourage economic growth for specific countries.

The banking activities are multi-dimensional by its nature, and evaluating determinants of its development is complicated. In many empirical studies, gross domestic products (GDP) is used as the primary determinant of banking sector development. Still, the single measure is not enough to provide comprehensive information on the development of a multi-dimensional phenomenon. Measuring the development of the financial sector and particularly the banking sector is complicated and mainly depends on the development of the financial system of the concrete country. Feyen and Levine, in their work, identified four dimensions of banking sector development as depth, access, efficiency, and stability (Feyen & Levine, 2013, pp.17–21). As for emerging economies' banking, the measures of depth, efficiency and stability are more sensitive. Thus, the composition of different indicators is required to be used in determining banking activities development. Banking activities development as a critical element of economic growth can be estimated by the used of numerous theories including endowment theory, law and finance theory, financial liberalisation theory, interest group theory, inflation, and finance theory. All these theories identify and highlight determinants that either promote or deter banking activities development.

First, the endowment theory states the significance of institutions in banking activities development and emphasises the dependence of the quality of banking activities upon its development (Filippidis & Katrakilidis, 2014, pp. 501–507). This theory examines institution and geography as the main determinants of banking activities development. As for emerging countries the geographic location is closely interrelated to its development, i.e. the countries that are in borders of developed and developing countries which provides possibilities to share knowledge, experience, and practices to improve institutions. The theory stipulates two assumptions:

The historical conditions do not influence the formation of institutions, and current institutions are independent of a historical one

The influence of historical conditions on current formation and development still exists.

The developed financial institutions primarily decrease the cost faced by economic agents which increase the efficiency of the banking sector. The significance of financial institutions in the development of banking activities was studied by Law and Azman-Saini, Asiama and Mobolaji (2015), Herger, Filippidis and Katrakilidis (2014). Law and Azman-Saini (2012, pp. 217–220) in their work highlighted the positive role of institutions in banking activities development. They emphasised the high-quality institutional environment is a defining factor in enormous growth in the banking sector in developed and developing countries. In contrary, Asiama and Mobolaji explained the negative impact of inefficient and ineffective institutions on banking activities growth (Asiama & Mobolaji, 2015). Currently, the best measure of institutional efficiency in international level is an institutional quality index (IQI) developed by World Bank which ranks 191 different countries in terms of the rule of law, corruption, voice and accountability, freedom of the press, global competitiveness, economic freedom and doing business. Table 2 provides the raking of emerging countries in terms of institutional quality in 2017.

Table 2

Institutional quality index of emerging market economies in 2017

	Country	IQI score	Ranking
1	Argentina	0.3082	138
2	Brazil	0.4397	104
3	Czech Republic	0.8181	25
4	China	0.3727	118
5	Turkey	0.4903	91
6	India	0.4940	90
7	Indonesia	0.5114	86
8	Malaysia	0.6478	53
9	Nigeria	0.2480	151
10	Republic of Korea	0.7842	29
11	Poland	0.7861	28
12	Russian Federation	0.3497	126
13	Thailand	0.4790	94
14	Philippines	0.5148	85
15	South Africa	0.5923	59

Source: Institutional quality index in 2017.

Second, the theory of law and finance is closely related to institutions and reveal the importance of law and legal systems in the development of banking activities. The relationship between law and development of banking activities was researched widely. Coyle and Turner (2013, pp. 810–813) stated that if right and appropriate law is as itself guarantee for the development of banking activities. The regulation of the financial market in emerging economies must deal with institutional constraints to promote financial stability. In emerging economies, the banks are mainly regulated through capital requirements, resolution mechanisms on failing banks, increasing transparency, liquidity risk and leverage management, and coordination among regulations (Eswar, 2017).

Third, the concept of financial liberalisation developed by McKinnon and Shaw emphasises on financial liberalisation and consequent possibilities of banking activities development. The banking sector is considered as liberalised when the restrictions imposed on its activities by the government and other institutions are eliminated, and capital flows are permitted. But the liberalisation of banking activities does not necessarily lead to the development of banking activities, i.e. the most of developed countries experienced crises as a result of liberalisation. Atiq and Haque (2013) established that financial liberalisation should be at an appropriate level, not to restrain banking sector development. Whereas, Ahmed (2013, pp. 261–265) in his work highlighted the positive effect of financial liberalisation in most of the emerging countries by examining by means of empirical assessment. Banking Z-score measures the extent of liberalisation of the individual country's banking sector, which primarily establishes the probability of bank default. It is calculated as Z-score of every bank in the country and then weighted as average for the overall banking sector. Higher the Z-score higher the process of liberalisation and vice versa. The Z-scores for banking activities of emerging market countries

Table 3
Z-score of emerging market economies in 2017

	Country	Z-score
1	Argentina	6.83
2	Brazil	15.21
3	Czech Republic	13.93
4	China	20.83
5	Turkey	8.07
6	India	18.17
7	Indonesia	6.08
8	Malaysia	16.31
9	Nigeria	15.44
10	Republic of Korea	10.2
11	Poland	8.47
12	Russian Federation	5.82
13	Thailand	7.33
14	Philippines	17.74
15	South Africa	14.69
	World average	12.67

Source: Bank Z-score. World Bank, 2017. https://databank.worldbank.org/data/reports.aspx?source=1250&series=GFDD.SI.01.

Table 4
Trade and financial openness index for emerging countries

	Country	TOI (%)	FOI
1	Argentina	25.02	0.05
2	Brazil	24.12	0.1
3	Czech Republic	151.70	0.7
4	China	37.80	0
5	Turkey	54.12	0.7
6	India	41.07	0.1
7	Indonesia	39.54	0.3
8	Malaysia	135.84	0.2
9	Nigeria	26.35	0.9
10	Republic of Korea	80.78	0.9
11	Poland	104.56	0.2
12	Russian Federation	46.73	0.55
13	Thailand	122.80	0.05
14	Philippines	71.83	0.1
15	South Africa	58.18	0.25

Source: UNCTAD Statistics. UNCTAD, 2017. https://stats.unctad.org/handbook/MerchandiseTrade/Indicators.html.

shows the favorable result for eight countries out of selected 15 (see Table 3). Also, for most emerging market countries' banking sector, the Z-scores are increasing from 2012.

Fourth, interest group theory postulates the importance of macroeconomic factors on the development of the financial sector, i.e. openness to trade and capital flows to the country. In providing their significance for encouraging financial development, man researchers highlighted that only a combination of both of them promotes banking activities development. Studies that especially emphasised the role of trade and capital flows for banking activities development are Mahawiya, Andrianaivo and Yartey. For emerging countries, the openness to capital and trade flows already at a high level to most countries. Trade and financial openness indexes measure the degree on which country is exposed to foreign trade and capital. These indexes developed by the IMF are presented in Table 4 for emerging economies in 2017.

Fifth, inflation and finance theory is the only theory that proposes the factor which has a strong negative impact on the development of the financial sector. Inflation can be described as a persistent rise in the price and defines the overall macroeconomic stability. Kim and Lin (2013, pp. 343–345) in their work stated that high inflation rates discourage banks from providing long-term credit and causes a reduction in the allocation of resources. But Huybens and Smith, in their empirical work, highlighted the point that when the inflation rate reaches 15 per cent, the negative effect of inflation in banking development reduces. In this context, the point of view of Ayadi is essential, i.e. he discovered the lesser negative effect of inflation in emerging countries with capital flows openness (Ayadi & Naceur, 2015). Figure 1 shows the relationship between economic growth of emerging economies and inflation rates, which apparently represents reverse dependence, assuming in high eco-

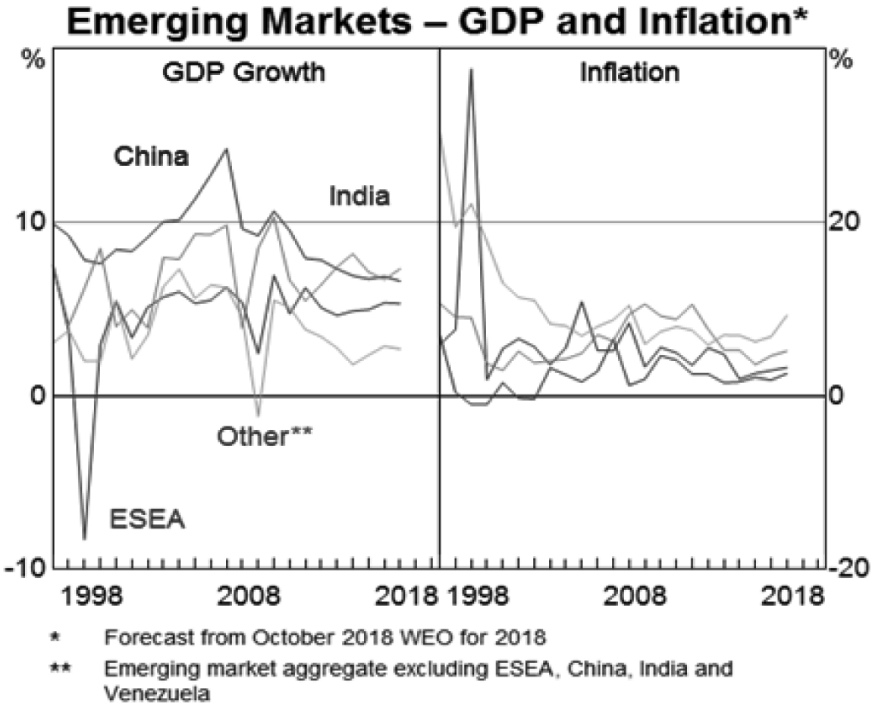

Figure 1. Emerging economies growth and the inflation rate

Source: IMF, RBA.

nomic growth corresponds to the development of banking activities.

There are many other determinants, including income level, government, culture, democracy, and human capital which would affect the banking development. Theoretically, all these determinants regarded to have a favourable influence on the development of the financial sector. The effects of each determinant can be summarised as represented in Table 5. Not all determinants have a direct positive impact on banking development, i.e. some determinants which have a positive effect on developed countries' banking have a negative impact on emerging market banking activities.

Table 5

The effects of the main determinants of banking activities development for emerging market countries

Main determinants	Effect on banking development
Institutional quality	Positive
Legal system and regulation	Negative/Positive
Liberalisation	Positive
Trade and financial openness	Positive/Negative
Economic growth	Positive
Inflation	Negative

Source: The author.

The Banking Activities Performance in Emerging Market Economies

The banking performance is a measure of profitability, stability and efficiency, the importance of which increased after the global financial crisis of 2008. Even though banking profitability has shrunk after the global financial crisis in both developed and emerging countries, it is still the best measure of bank performance. The empirical studies on bank profitability can be divided into two directions: analysis of banking profitability in multiple countries and analysis on the example of a single country. In other words, there are a few studies on emerging market countries. But the studies of the individual emerging country provide evidence that risk and competition affect profitability as in Table 6.

The banking profitability is measured either by return on asset or return on equity. Return on asset (ROA) is the simplest measure of profitability, which reflects the ability of the bank to generate profit from asset management. It is calculated as the ratio of net income before

Table 6
The empirical studies on bank profitability of emerging market economies

Study references	Banking sector investigated	Main findings
Mirzaei A., Moore T., Liu G. (2013)	Emerging countries banking sector (Czech Republic, Poland, Turkey)	Market share and concentration have an insignificant and negative correlation with bank profitability.
Sufian F. (2011)	South Korean banking sector	Risk has a negative impact on bank profitability.
Liu H., Wilson J. (2010)	Japanese banking sector	Higher profitability tends to have banks with lower risks, greater capital, and higher efficiency.
Sufian F., Chong R. (2012)	Philippine banking sector	Risk and bank profitability have a negative correlation.
Tan Y., Floros C. (2012)	Chinese banking sector	Taxation and GDP growth rate have a negative impact on bank profitability.

Source: The author.

Table 7
Bank profitability in selected emerging market countries for 2015–2017

Country	ROA (%)			ROE (%)		
	2015	2016	2017	2015	2016	2017
Argentina	3.59	3.22	3.38	30.82	26.50	28.54
Brazil	1.06	0.92	1.43	13.89	11.16	15.47
Czech Republic	1.26	1.32	1.42	12.04	12.25	13.78
China	1.09	1.54	0.96	16.99	22.44	13.83
Turkey	1.34	1.10	1.39	12.38	10.02	12.77
India	0.75	0.31	0.47	10.61	4.24	6.17
Indonesia	2.16	1.75	1.72	17.35	13.35	11.93
Malaysia	1.36	0.93	1.04	12.67	9.09	10.56
Nigeria	2.09	1.47	1.53	14.88	10.14	10.69
Republic of Korea	0.41	0.32	0.48	5.16	4.24	6.73
Poland	1.07	0.85	0.96	9.59	7.56	8.6
Russian Federation	1.00	1.00	0.49	8.68	8.68	5.93
Thailand	1.39	1.13	1.16	12.14	9.53	9.28
Philippines	1.27	1.14	1.19	12.22	10.62	10.89
South Africa	0.90	0.91	1.19	12.34	15.42	15.46
World average	1.19	1.02	1.02	12.21	10.23	10.23

Source: World bank's Global Financial Development Database (GFDD), 2018. https://data.worldbank.org/indicator/FB.AST.NPER.ZS?view=chart.

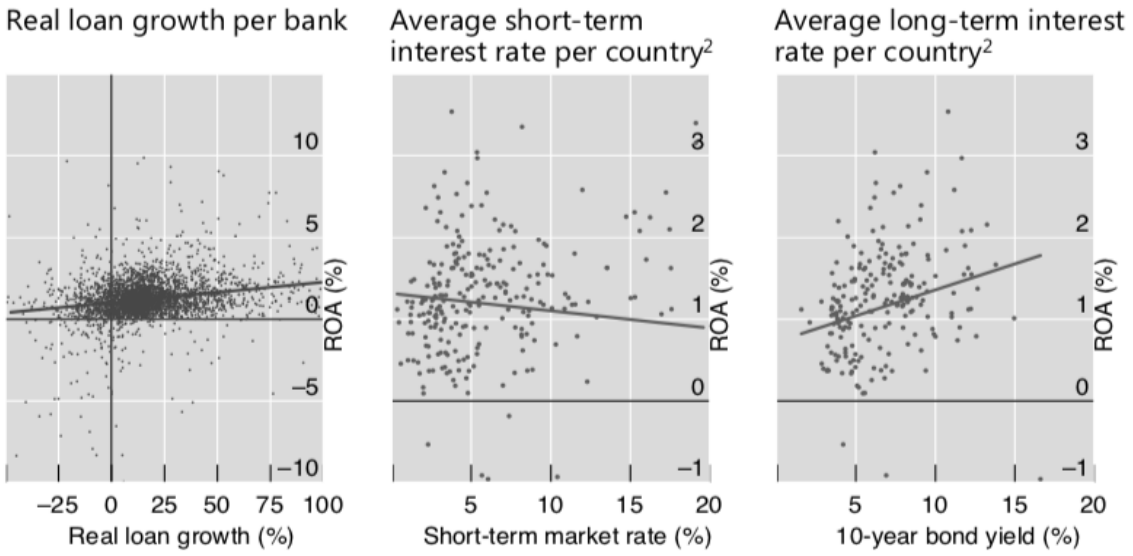

Figure 2. The correlation of ROA with different factors

Source: Kohlscheen & Murcia, 2018, pp. 6–9.

extraordinary items and taxes to an average asset for the period. Bank profitability in emerging economies was an upward trend until 2007, but it extremely high in comparison with developed countries. The current average of banking industry ROA is 1.12 per cent and 1.02 per cent for banks with an asset less than $1 billion[3]. Thus, in our analysis, the measure of 1.02 per cent is more appropriate taking into account that most of the banks in the emerging market, excluding Chinese largest banks with assets of $4 trillion individually[4]. Return on equity (ROE) in its turn is a measure of net income generated by invested capital of shareholders. It is calculated by dividing net income before extraordinary things and taxes to average capital. The average ROE for the banking industry is 10.34 per cent for large institutions and 10.23 per cent for smaller, which is suitable for emerging market banks (Table 7).

By comparison with average ROA and ROE, the measure of ROE is more favourable than ROA in emerging market banks. Despite this fact, ROA and ROE of emerging market banks are very promising. Mostly, bank performance in emerging markets is affected by credit growth, long-term interest rate, and by short-term interest rate and GDP growth to less extent. In other words, bank profitability in emerging markets is influenced more by credit growth. Figure 2 illustrates the correlation of real loan growth, short-term and long-term rate with ROA growth in selected emerging countries. Bank loan growth per bank and long-term interest have a strong positive relationship with ROA, while short-term interest rate causes a decrease in ROA due to funding cost.

The GDP growth effect on profitability is less than credit growth but influences both ROA and ROE. The relationship between GDP growth with ROA and ROE using the quadratic and linear model is represented in Figure 3. The concave curve describing the relationship between ROE and ROA with GDP growth (yellow and blue lines) is similar to the linear curve (red line) indicating a positive correlation of both ROA and ROE with GDP growth. The exception is strong negative GDP growth, where ROE is significantly sensitive to negative GDP growth indicating high relevance.

It is possible to measure the bank stability in terms of net interest margin, non-performing loans to gross loans and liquid assets to deposits and short-term funding (Baum, Pundit & Ramayandi, 2018, pp. 4–7). The factors influencing banking stability is discussed in many academic and regulatory circles in different countries. These works highlight competition, concentration, market structure and derivatives role

[3] Average ROA and ROE for banking industry. Weiss Rating, 2018. https://greyhouse.weissratings.com/ROA-ROE-and-What-These-Key-Measures-Mean-for-YOUR-Bank.

[4] Biggest emerging market banks 2018. Global finance, 2018. https://www.gfmag.com/magazine/november-2018/biggest-banks-emerging-markets.

Table 8
The empirical studies on bank stability of emerging market economies

Study references	Banking sector investigated	Main findings
Fu X., Lin Y., Monyleux P. (2013)	Asian banking sector (China, Indonesia, South Korea, Malaysia, Singapore, Thailand, Taiwan, Philippines)	Bank concentration is no sufficient measure of competitiveness. Also, competition-stability and competition-fragility relationships are both true
Bermpei T., Kalyvas A., Nguyen T. (2018)	Emerging countries banking sector (Argentina, Brazil, India, Indonesia, Malaysia, Russian Federation, South Africa, Thailand)	Bank regulation and institutional quality together effectively promote bank stability by influencing profitability rather than bank capital
Mohammed A., Wolfe S. (2013)	Emerging countries banking sector (Nigeria, South Africa, China, Philippines, Thailand, South Korea, India)	Greater competition in the banking sector and revenue diversification enhance bank stability
Mirzaei A., Moore T., Liu G. (2013)	Emerging countries banking sector (Czech Republic, Poland, Turkey)	Market share is positively correlated with bank stability in emerging market countries
Mohamed R. (2015)	Emerging countries (Brazil, Mexico, China, India)	The use of option and future instruments affect negatively on banking stability

Source: The author.

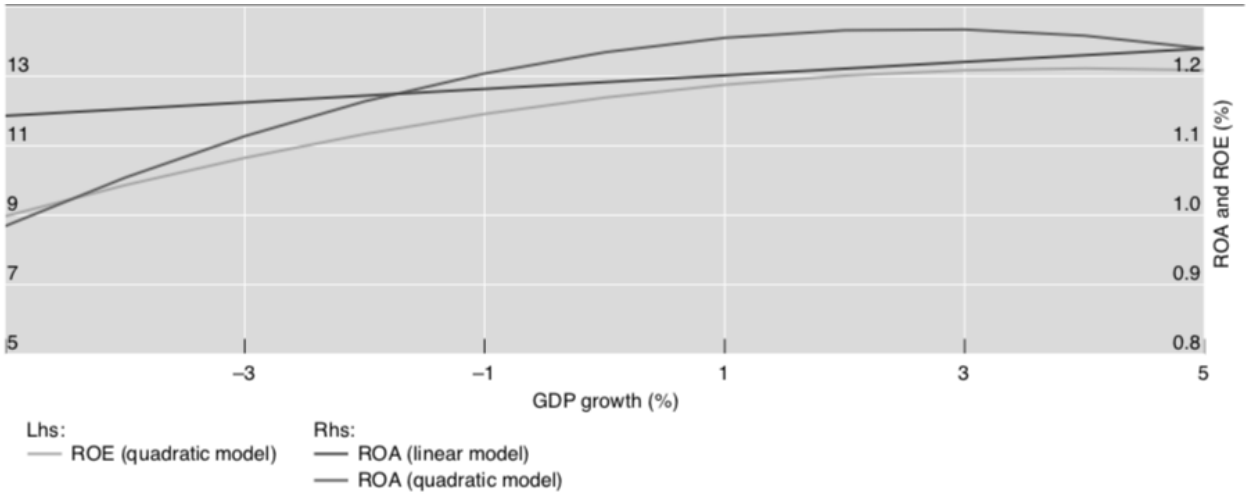

Figure 3. ROE and ROA's correlation with GDP growth in selected emerging economies

Source: Kohlscheen & Murcia, 2018, pp. 12–15.

on banking stability in emerging economies (Table 8).

Net interest margin (NIM) is a measure of banking stability which expressed as the difference of interest income and interest expense in ratio with interest-earning assets. In other literature, it is also referred to as bank's mark-up — the difference between weighted average yields of assets and liabilities. A very high or low NIM can create distrust between bank shareholders and cause bank management problems. NIM in emerging market banks volatile, but stable in comparison with world average NIM. Non-performing loan (NPL) is a loan that is close or in the position of default, thus the measure of the non-performing loan to gross loan measures the of asset quality and problems with stability in financial operations. It is calculated as the ratio of non-performing loan to total loan on the balance sheet, including

Table 1.9
Bank stability in selected emerging market countries for 2015–2017

Country	NIM (%)			NPL to gross loans (%)			Liquid assets to deposits and short-term funding (%)		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Argentina	5.91	9.20	10.35	1.99	1.74	1.84	42.92	56.23	61.27
Brazil	3.65	3.18	8.33	2.85	3.31	3.92	54.67	47.54	62.37
Czech Republic	2.41	2.31	2.25	5.61	5.48	4.59	19.02	28.27	33.74
China	2.84	4.07	2.29	4.01	3.92	3.44	16.99	15.75	13.83
Turkey	4.15	3.80	4.00	2.99	3.11	2.84	9.85	24.38	21.97
India	2.85	2.89	2.84	5.88	9.19	9.98	6.75	13.26	15.13
Indonesia	5.68	5.70	6.39	2.43	2.89	2.56	21.94	20.62	19.41
Malaysia	2.45	1.80	1.93	1.60	1.61	1.55	20.10	18.19	17.00
Nigeria	7.12	6.84	5.60	4.86	12.82	14.81	20.73	18.88	17.32
Republic of Korea	2.06	1.52	1.86	0.49	0.46	0.47	8.19	11.57	10.74
Poland	2.61	2.39	2.59	4.34	4.05	3.94	13.44	11.96	9.33
Russian Federation	4.25	1.45	4.11	8.35	9.45	10.00	44.33	40.76	34.34
Thailand	2.95	2.72	2.94	2.68	2.99	3.07	18.27	17.84	18.07
Philippines	3.44	3.31	3.31	1.86	1.72	1.58	31.71	11.96	12.64
South Africa	3.33	2.98	3.45	3.12	2.86	2.84	22.09	24.06	23.12
World average	3.77	3.56	3.56	4.01	3.92	3.45	28.32	27.96	21.34

Source: World bank's Global Financial Development Database (GFDD), 2018. https://data.worldbank.org/indicator/FB.AST.NPER.ZS?view=chart.

the non-performing loan. NPL to gross loan in emerging economies is characterised by a positive trend, i.e. decreasing in 9 of 15 represented countries. It means that emerging market banks are increasing their ability to enhance asset quality and conduct operation effectively not causing default problems. A liquid asset to deposits and short-term funding is a measure of bank stability that is calculated as easily converting assets divided by the sum of short-term funding and deposits. This indicator is highly volatile in individual emerging market banks, but higher than world average indicating that they are managing assets and liabilities effectively (Table 9)[5].

Bank efficiency is also one of the bank performance measures, which establishes bank health

[5] World bank's Global Financial Development Database (GFDD), 2018. https://data.worldbank.org/indicator/FB.AST.NPER.ZS?view=chart.

Table 10
The empirical studies on bank efficiency of emerging market economies

Study references	Banking sector investigated	Main findings
Du K., Sim N. (2016)	Emerging countries banking sector (China, India, Indonesia, Russia, Malaysia, Thailand)	Bank M&A has a positive effect on bank efficiency and mainly benefit directed to the target bank.
Phan H., Daly K., Akhter S. (2016)	Emerging Asian countries banking sector (Indonesia, India, Malaysia, Philippines)	For banks in Indonesia, market concentration is negatively associated with bank efficiency. For banks in Malaysia, India and the Philippines, market competition is negatively affecting banks efficiency.
Partovi E., Matousek R. (2018)	Turkey banking sector	The presence of NPLs and riskier portfolio diminish Turkey banking sector efficiency.
Hou X., Wang Q., Zhang Q. (2014)	Chinese banking sector	There is a positive relationship between bank efficiency and risk-taking.
Peng J., Jeng V., Wang J., Chen Y. (2017)	Taiwan banking sector	Both bank efficiency and profitability are increased with shareholder value maximisation.

Source: The author.

and drives the economic growth of the country. The growing studies are concentrating on negative and positive relations of bank efficiency with bank and market characteristics on single and group of countries. For emerging market banks, bank efficiency is studied on the relation of it with bank M&A, market concentration, banks size, NPLs and risk-taking (Table 10).

Currently, literature highlighted the phenomenon of so-called financial inclusion which is more appropriate for defining bank efficiency (Goel & Sharma, 2017, pp. 952–954). A financial inclusion system is a system that determines bank efficiency in terms of its accessibility or penetration, availability, and usage. Accessibility dimension of banks for emerging countries is measured in this study by means of several bank branches per 100,000 adults to define the depth of the baking services access. In this case, the number of accounts per capita also can be used, but if the single person holds two and more accounts, the result of the indicator would be improper (Ahamed, 2016, pp. 208–212). Availability dimension of banks is measured by the outreach pervasiveness of financial services in terms of physical banks. It can be expressed by geographical outreach of automated teller machines (ATMs) per 1000 km^2, the number of ATMs per 100,000 adults also can be used, but km^2 defines geographic availability more precisely (Allen & Carletti, 2014, pp. 113–117). Usage dimension shows ease and affordability of banking activities, and for measurement transaction cost, ease of transaction and credit plus deposit to GDP can be used (Jiang & Yao, 2013, pp. 3365–3367). But as banking transactions costs and ease of transaction is different for individual banking institutions, it is more appropriate to use credit plus deposit to GDP as a representative indicator. It represents the extent to which people use credit and deposits for banks, i.e. more efficient banks more credit and deposits in circulation (Table 11). Bank efficiency in emerging market banks is always in a positive trend, i.e. most of the countries are increasing their position. The indicators of accessibility, availability and usage dimensions are not only comparable with average world figures but also characterised with substantial growth.

Bank performance based on bank profitability and stability indicators represent a stable trend for selected 15 countries between 2013 to 2017 (Figure 4). Figure 4 presents the average of each indicator aggregated by comparison with world

Table 11
Bank efficiency in selected emerging market countries for 2016–2018

Country	Accessibility			Availability			Usage		
	Number of bank branches per 100,000 adults			ATMs per 1000 km2			Credit plus deposit to GDP (%)		
	2016	2017	2018	2016	2017	2018	2016	2017	2018
Argentina	13.17	13.37	13.42	7.19	7.22	7.22	16.53	17.79	18.77
Brazil	20.72	20.40	19.22	21.82	21.55	20.92	51.79	55.34	59.26
Czech Republic	23.69	22.36	21.29	58.96	61.08	64.60	65.43	65.86	67.56
China	37.81	37.47	38.70	65.49	92.32	98.44	44.75	43.91	44.95
Turkey	19.19	18.14	17.39	60.05	60.25	61.51	45.07	44.47	46.33
India	13.54	14.06	14.72	61.88	67.91	71.77	64.26	64.49	65.96
Indonesia	17.75	17.39	16.89	54.81	57.09	58.87	32.82	33.71	34.39
Malaysia	10.51	10.26	10.06	35.39	34.42	34.06	124.45	123.83	119.54
Nigeria	4.98	4.74	4.44	18.01	19.10	19.16	17.91	17.69	17.27
Republic of Korea	16.76	16.26	15.45	125.45	124.48	123.42	124.02	127.44	130.29
Poland	31.14	31.02	29.29	61.64	67.05	72.32	51.94	53.59	55.83
Russian Federation	32.91	30.14	29.22	12.63	12.29	11.92	41.34	48.66	50.41
Thailand	12.54	12.38	11.88	124.29	125.49	131.03	114.64	115.01	114.45
Philippines	8.79	8.87	9.05	58.08	64.00	68.01	60.46	62.79	64.15
South Africa	10.86	10.16	10.43	22.21	22.62	22.55	58.32	59.52	59.54
World average	20.63	20.72	20.74	63.12	65.70	66.14	59.45	61.35	62.16

Source: IMF's International financial statistics, 2018 https://www.imf.org/external/pubs/ft/fsa/eng/pdf/ch02.pdf.

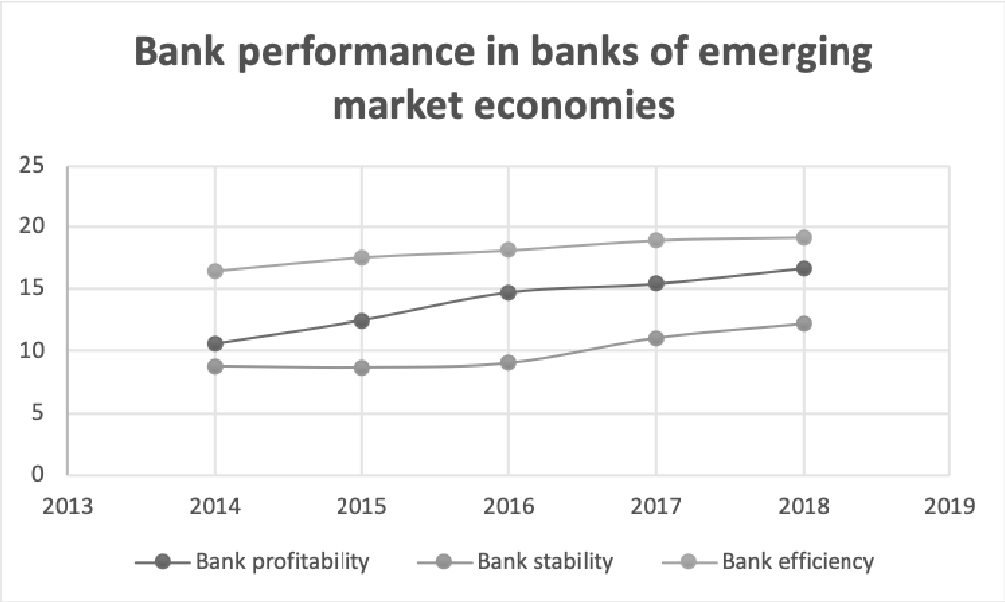

Figure 4. Bank performance in emerging market countries for 2013–2017

Source: The author.

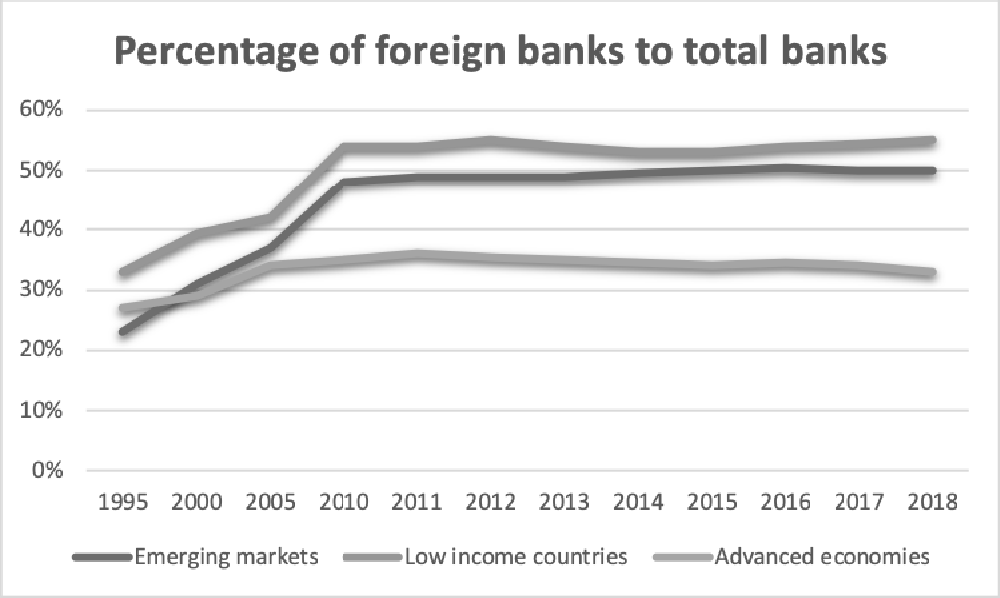

Figure 5. Percentage of foreign banks to total banks

Source: Global Financial Development Report 2017/2018. World Bank, 2018. https://openknowledge.worldbank.org/bitstream/handle/10986/28482/9781464811487.pdf#page=41.

average into one measure of bank profitability, stability, and efficiency. As apparently the figure represents, bank efficiency in emerging market banks is high surpassing both bank profitability and stability. As emerging market banking activities highly depend on developed countries financial situation, stability is not guaranteed. Banking activities profitability in the era of fintech revolution and high regulation is considerably presentable with constant growth.

Internationalisation of Emerging Market Banking

A dramatic shift in wealth distribution is a phenomenon that drives the global economy in modern times. The emerging economies of wealth is increasingly growing during the last years and mainly driven by wealth distribution. The total number of so-called high net worth individuals in emerging economies, mostly in Asian region drives the wealth attraction to emerging economies. In other words, the growth of high net worth individuals is comparative to GDP rate (Marques & Schneider, 2017, pp. 720–725). Many of these individuals in emerging countries require the same banking services with the same qualities as in developed countries. Despite growth banks of the potential emerging market, a large portion of a population is still not banked at a sufficient level or not banked at all. Thus, the result is a massive expansion of the internationalisation of banks.

In the process of banking internationalisation, financial integration and globalisation are driving force. In emerging market countries, it is characterised by two directions: going abroad and arrival. From 1995 to 2009, the number of foreign banks entering emerging market economies increased by 74 per cent, but from 2010 the trend is considerably slowing (Ghosh, 2017, pp. 84–87). The reasons behind such massive movements of banks are as follows:

To accelerate asset under management to attain a comparable size

To diversify current customers' assets composition

To gather access to new products and technology

To gain more knowledge, more significant presence, and further visibility

To encourage brand recognition.

In other words, foreign banks in host nations are mostly driven by higher profits, diversification of opportunities and accessibility for more expanding services. Also, two main methods of foreign banks entrance to the host country are distinguished as entering through branches and subsidiaries or merger and acquisition of existing banks.

Historically, foreign banks in low-income countries surpass by amount size those in

Table 12
The empirical studies on foreign banks penetration on emerging market economies

Study references	Banking sector investigated	Main findings
Chen J., Zhu L. (2018)	Emerging countries banking sector (Asia, Latin America, Eastern and Central American region countries)	Foreign banks penetration using competition encourages banking activities development in Latin America more than in Asia and Europe
Lee Ch., Chou P. (2018)	Emerging countries banking sector (China, Czech Republic, Egypt, Indonesia, Philippines, Taiwan)	Financial market openness improves financial market mobility and liquidity in emerging markets more than in developed markets
Wu J., Chen M., Jeon B. (2017)	Emerging countries banking sector (Poland, Czech Republic, Argentina, Brazil, China, India, Indonesia, Thailand, Korea)	An increased presence of foreign banks in emerging market pressures financial stability and implies higher risk than domestic banks
Ghosh A. (2016)	Emerging countries banking sector (Argentina, Brazil, China, Czech Republic, Hungary, India, Indonesia, Poland, Qatar)	The greater presence of foreign banks and share of loan causes reduction of both profits and costs for domestic banks
Hryckiewicz A., Kowalewski O. (2011)	Emerging countries banking sector (Czech Republic, South Korea, Poland)	Foreign banks' choice of entrance depends on economic characteristics and risk of country, and emerging countries are more attractive in these respects

Source: The author.

advanced and emerging countries. The distinguishing characteristic of foreign banks in emerging market countries in comparison with low-income countries is its persistent and sustainable growth. This massive penetration of foreign banks in emerging and low-income countries can be described by their old banking activities, the inefficiency of information and the exemption from credit allocation regulations which gives foreign banks possibility to gain more profits. Some of the foreign banks in advanced economies in continuous decline, mostly because advanced countries already undergone liberalisation and relation of regulations. Thus, the entrance of new banks to the market will have a marginal effect, i.e. there is an insignificant influence. Therefore, due to the lack of possibilities for development for new participants even through increasing banking sector openness, there is shallow penetration to advanced economies (Figure 5).

Many emerging market banks were slow in internationalisation due to the vast size, attractiveness, and comparative advantages of their domestic market. Currently, this phenomenon is under change by becoming the world's lending force. But few of them are experiencing into neighbouring countries following their large multinationals (MNCs). Their attractiveness is defined by competitive technologies and banking networks that will shape the banking future. But before examining international strategies of emerging market banks, it is essential to understand the environment that develops foreign banks interest to the emerging market.

There is an increasing volume of the literature concentrated on the influence of foreign banks on the emerging market. A presence of

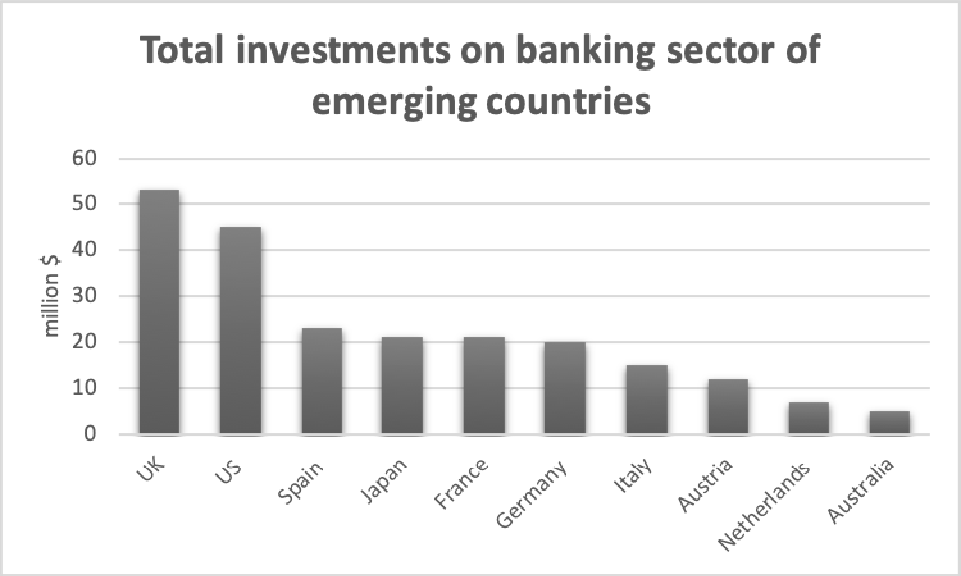

Figure 6. Total investments in the banking sector of emerging market countries for 2018

Source: International banking statistics, 2018. BIS, 2018. https://www.bis.org/statistics/rppb1810.htm.

foreign banks traditionally consider as a positive development for the financial market, but in recent studies, the adverse effects of foreign banks have been revealed. The principal arguments supporting the positive impact of foreign banks are their ability to bring capital, technical improvements and skills, innovation and fostering competition. But current studies highlighted the destabilising role of foreign banks mostly due to increased competition, the transmission of foreign shocks and imposed different risks to the domestic financial system (Table 12).

There are many pieces of evidence that across developed, developing, and emerging countries share of banks owned by foreigners increased. For emerging countries like Brazil, India and China, the state-owned banks play an essential role in the banking sector. Still, after the crisis of 2008–2009, mainly the foreign banks helped to recover from financial distress. A foreign bank is a bank where 50 per cent of overall shares are owned by foreigners. In this respect, Table 13 represents the percentage of foreign bank assets to total bank assets, where the Czech Republic and Poland are substantially owned by foreigners.

Most countries have a share of foreign bank assets to total bank assets of less than the world average. These small shares also can be described by the fact that the number of total as-

Table 13

Percentage of foreign banks assets to total bank assets for 2016–2018

Country	Foreign bank assets to total banks assets (%)		
	2016	2017	2018
Argentina	27	26	25
Brazil	16	15	15
Czech Republic	85	86	87
China	1	1.32	1.45
Turkey	15	16	17
India	3	3	3
Indonesia	27	28	29
Malaysia	17	17	17
Nigeria	17.42	16.82	15.54
Republic of Korea	7	7	8
Poland	56.6	45.5	44.3
Russian Federation	7	6	4
Thailand	7	8	9
Philippines	1	1	1
South Africa	24	25.5	26
World average	26	24.3	22.1

Source: Percentage of foreign bank assets to total bank assets. World Bank, 2018. https://databank.worldbank.org/data/reports.aspx?source=1250&series=GFDD.OI.16.

sets of local banks of emerging market countries is considerably increasing over several years.

Several developed countries dominate the amount of total investment made to the banking sector of emerging market countries. Among them, the UK and US are distinguished by colossal investment and increasing interest in emerging market banking activities. Despite numerous obstacles to enter and operate in the new market, especially the banking sector in which high regulation and competition, they adapt to it successfully. Investments in the form of establishment of new banks, including branches and subsidiaries, increased substantially from the US and Japan. The UK, the US, Germany, Australia, and Japan invest in emerging Asia more than in emerging Latin America and Europe. While Spain, Austria, Italy, and the Netherlands more often contribute to emerging Europe and Latin America (Figure 6).

Branches, subsidiaries, and representative offices of foreign banks in emerging countries are mostly established in capital cities and then in less extent in other places. The superiority of different countries foreign banks employing branches, subsidiaries and representative offices can be represented as follows:[6]

Argentina banking sector — HSBC, Deutsche Bank, Santander Bank, BNP Paribas (European banks)

Brazilian banking sector — Barclays, Santander Bank, HSBC, Credit Suisse, BNP Paribas (European banks)

Czech Republic banking sector — BNP Paribas, Deutsche Bank, HSBC, UniCredit Bank, Raiffeisen Bank International (European banks)

Chinese banking sector — Citibank, J.P. Morgan, Morgan Stanley, East-West bank (American banks)

Turkish banking sector — Merrill Lynch Bank, J.P. Morgan Chase, Citibank (American banks) and Deutsche Bank, HSBC, Societe Generale (European banks)

Indian banking sector — Standard Chartered Bank, Barclays Bank, The Royal Bank of Scotland, Deutsche Bank, Societe Generale (European banks) and Shinhan Bank, Woori Bank, KEB Hana Bank, Industrial Bank of Korea (South Korean bank)

Indonesian banking sector — Bank of America, Citibank, J.P. Morgan Chase (American banks)

Malaysian banking sector — Standard Chartered Bank, HSBC, Deutsche Bank, BNP Paribas, Royal Bank of Scotland (European banks)

Nigerian banking sector — Citibank and J.P. Morgan Chase (American banks)

South Korean banking sector — Bank of America, Bank of New York Mellon, Citibank, J.P. Morgan Chase (American banks)

Poland banking sector — BNP Paribas, Credit Agricole Bank, Credit Suisse, DZ Bank, HSBC, Societe Generale (European banks)

Russian banking sector — Raiffeisen Bank International, Societe Generale, Home Credit & Finance Bank, Credit Europe Bank (European banks)

Thailand banking sector — The Bank of Tokyo-Mitsubishi, Sumitomo Mitsui and Mizuho (Japanese foreign banks)

Philippines banking sector — J.P. Morgan Chase Bank, Citibank, Bank of America, Wells Fargo Bank (American banks)

South African banking sector — Standard Chartered Bank, Societe Generale, Deutsche Bank (European banks).

These list of foreign banks in selected emerging market countries prove the results of Figure 6, which highlights the increasing role of American and European banks in the internationalisation process.

[6] Banks around the World, 2018. https://www.relbanks.com/best-banks.

References

Ahamed, M. (2016). Bank profitability, stability, and efficiency. *School of business and management*, 208–212.

Ahmed, A. (2013). Effects of financial liberalisation on financial market development and economic performance: empirical assessment on emerging countries. *Economic Modeling*, 261–265.

Allen, F., Carletti, E. (2014). The African financial development and financial inclusion gaps. *Journal of African Economies*, 113–117.

Asiama, J., Mobolaji H. (2015). Institutional quality and financial development. ICITI.

Atiq, Z., Haque, M. (2013). Financial development and economic growth: the role of financial liberalisation.

Ayadi, R., Naceur, S. (2015). Determinants of financial development across countries.

Baum, Ch., Pundit, M., Ramayandi, A. (2018). Capital flows and financial stability in emerging economies. Asian Development Bank, pp. 4–7.

Coyle, C., Turner, J. (2013). Law, politics, and financial development. *The Journal of Economic History*, 810–813.

Eswar, S. (2017). Financial regulation and reforms in emerging markets.

Feyen, E., Levine R. (2013). Financial development in 205 countries. Journal of Financial Perspectives, 17–21.

Filippidis, I., Katrakilidis, C. (2014). Institutions, policy, and banking sector development. *Journal of Economics and Finance*, 501–507.

Ghosh, A. (2017). How does banking sector globalisation affect economic growth? Illinois Wesleyan University, 84–87.

Goel, S., Sharma, R. (2017). Developing a financial inclusion index for India. *Information technology and quantitative management*, 952–954.

Jiang, C., Yao, S. (2013). Bank ownership, privatisation, and performance: Evidence from transition country. *Journal of Banking and Finance*, 3365–3367.

Kim, D., Lin, S. (2013). Dynamic relationship between inflation and financial development. *Macroeconomic Dynamics*, 343–345.

Kohlscheen, E., Murcia, A. (2018). Determinants of bank profitability in emerging markets. BIS Working Papers, 6–9.

Law, S., Azman-Saini, W. (2012). Institutional quality, governance, and financial development. *Economics of Governance*, 217–220.

Marques, J., Schneider, S. (2017). Internationalisation strategies of emerging market banks. Indiana University, 720–725.

Развитие банковской деятельности в странах с формирующейся рыночной экономикой

Отгонтугс Нарангуа

Бакалавр экономики факультета международных финансов, Департамент мировой экономики и международных финансов, Финансовый университет, Москва, Россия

Аннотация. Цель статьи — анализ специфики развития банковской деятельности в странах с формирующейся рыночной экономикой. Это важно не только для оценки ее влияния на стимулирование роста развивающихся экономик, но и для установления общего влияния этих процессов на мировой финансовый рынок. Объектом исследования является банковская деятельность, а его предметом — влияние развития банковской деятельности на экономический рост данных стран. Обоснован тезис о том, что для этих стран финансовое развитие должно рассматриваться с точки зрения банковской стабильности, конкуренции и экономического роста. Выявлены специфические характеристики, отличающие банковскую деятельность стран с формирующейся рыночной экономикой от развитых стран, путем оценки деятельности банков с использованием критериев стабильности, прибыльности и эффективности.

Ключевые слова: банковская деятельность; формирующаяся рыночная экономика; банковские кризисы; финансовый кризис 2008 г.

Review of Business and Economics Studies
2020, Vol. 8, No. 2, 43-76
DOI: 10.26794/2308-944X-2020-8-2-43-76

The Appraisal of Assets' Fair Value Using the Real Options Technique

Alexander Gulabyan

BA in Economics, International Finance Faculty, Department of World Economy and World Finance, Financial University. Scientific advisor: Tsvirko Svetlana Eduardovna, Associate Professor, PhD in Economics

Abstract

The goal of this paper is to analyse and systematise the possible approaches to real options valuation, especially when considering the practical aspects of their application in real-life valuation problems. Therefore, the paper sets the following tasks:

To outline the concept of fair value and analyse the traditional approaches to its calculation in the context of asset valuation

To define the real-option approach to fair value estimation and analyse its theoretical background

To determine the role of the real options approach in the traditional system of valuation techniques

To analyse the practical aspects of their application in valuation problems considering the corresponding examples

To provide the real-life example of this technique applied in current market conditions using the recent data.

The object of this research is the option pricing models, and the subject is their application in estimation of real options embedded in corporate valuations, particularly considering the side.

Keywords: real option valuation; asset valuation; fair value estimation; real options approach

JEL Classification: G11

Introduction

The relevance of the topic can be explained by the fact that asset valuation has always been one of the key pillars in finance playing a significant role in various economic relationships, is an essential element of any investment decision-making process and corporate valuations in general. Therefore, it is crucial for assets or investment projects to be fairly valued to prompt the right decisions and strategies to be adopted by the economic agents.

There are several traditional approaches to fair value valuation each of which has several methods with its relative advantages and drawbacks and thus may appear to be the best valuation tool given the corresponding conditions and the scope of available data. However, despite the variety of classical valuation techniques, there are still situations when their application is not effective or even useless.

In business practice, it often turns out that companies can react to changes in the market situation, which makes it possible to adjust the incurred investment outlays. The additional value added to investment projects is, therefore, a premium received for the company's adjustment to changing market conditions.

In the traditional approaches, the value of such flexibility is neglected, because of which the evaluation of investment projects is often underestimated.

This value-adding flexibility is known as a real option that can be defined as a right (but not an obligation) to change a decision regarding an investment project when new information appears.

The *real-option approach* to valuation thus aims to capture the effect of these omitted value-drivers to assess the investment projects more fairly. Therefore, it may lead to the situation when the bad project, initially estimated by traditional methods, will appear to be profitable after accounting for the lurking investment opportunities measured by the real-option approach.

Although being widely-used in investment project appraisal the real-option approach may be also applied in the valuation of assets that do not generate any cash flows, but instead provide its holder with a right to earn income under a certain course of action — those generally include the intangibles such as licenses or exclusive patent rights to produce a particular product that will provide their holder with some cash flows in future; another good illustration is the unexplored reserves of natural resources. Valuation of such assets using the classical techniques will generally yield inaccurate results or maybe impossible at all, thus making the real-option technique even more essential in this case.

All these factors make the subject of the real options approach to valuation to be of practical worth in the field of corporate finance.

The real option valuation technique is not new. However, most papers on this topic consider the specifics of its application in business valuation and investment projects' appraisal. Typical examples include the research papers by Donald and DePamphilis, Mun J, Limitovskiy M.A., Pirogov N.K., Krukovskiy A.A., Huchzermeier A., Loch C., Bruslanova N., and others.

At the same time, there is a relatively small number of works concerning the aspects of real options approach application in the valuation of assets of special option-type such as patents and undeveloped reserves of natural resources. The methodology of real options approach application in the valuation of such assets was mainly developed by Aswath Damodaran in his books on valuation (2006, 2012) which I used as a key theoretical background of this paper.

The practical part of this research is based on the information mainly obtained from the Bloomberg Terminal, official company's financial statements and press releases.

This paper includes the following sections: introduction, three parts, and conclusions. In the introduction, I substantiated the relevance of the chosen topic, its theoretical and practical significance, defines the degree of its elaboration, and the scope of relevant literature and information base. It highlights this paper's goals and tasks, formulates the object and the subject of the undertaken research.

Part 1 outlines the notion of fair value and the theoretical basics of traditional valuation techniques. Part 2 focuses on option pricing models, provides insights to the real options approach to valuation and analyses practical aspects of its application, considering the corresponding examples. Part 3 provides the real-life example of this real options valuation technique application in current market conditions using the recent data. The conclusion of this thesis summarises the key theoretical results of the undertaken research and provides practical recommendations on the application of the real options approach.

Theoretical Basics of Asset Valuation

Meaning of Asset Valuation and Concept of Fair Value

Asset valuation merely accounts to the value assigned to a particular property, such as stocks, options, bonds, buildings, machinery, or land, which is estimated usually when a firm or asset is to be disposed of, insured, or taken over.

There are many reasons for companies to undertake this procedure, including the following:

It allows to determine the right price for an asset, especially in cases of its acquisition or disposal and is beneficial for both parties of such a transaction, since neither the buyer nor the seller will pay more or receive less than the asset value

Every person or legal entity owning property or other assets has to pay taxes on them, hence asset valuation provides with an accurate estimation of the tax base for this purpose and so of the corresponding amounts of tax expenses incurred

It facilitates the business valuation process particularly in cases of merges between two or more companies or take-overs

Asset valuation procedure can also be undertaken for the lender needs when estimating the possible loan amount that can be paid back by the company offering its assets as collateral to be transferred to a lender in cases of the company's insolvency

Companies, especially public ones, are regulated, and hence are required, which means they need to present financial audits and reports for transparency. Part of the audit process involves verifying the value of assets.

According to IFRS13, the fair value is defined as the price that should be paid for an asset at its disposal or the price of transferring liability in the context of the simple transaction between independent of each other and knowledgeable

market participants acting in accordance with their financial interests at the measurement date under current market conditions, although in some cases observable market transactions or some other information might not be available for analysis. Thus, such a definition of fair value has the following key implications:

Fair value is the sale price of an asset — not the purchase one since sometimes these two prices are different (particularly for financial instruments)

Fair value is a market quotation. When measuring fair value, it is necessary to match it with the perceptions of market participants and thus exclude any uniqueness associated with the specific conditions in which the seller is placed

Market participants are independent, knowledgeable, willing to make a transaction and have access to the market

The intended sale transaction must be "normal" and not forced

Fair value should be tied to the measurement date.

Fair value measurement also implies that the transaction of asset disposal or liability transferring takes place in the principal market for the asset or liability or, in the absence of the former, in the most advantageous market for that asset or liability.

The principal market is the one with the greatest volume and level of activity for the asset or liability to be accessed.

The most advantageous market is the one, maximising the value to be received for the asset or paid to settle the liability after transportation and transaction costs. However, these two terms often coincide.

In spite of the assumption that the corresponding transaction is to be made in a principal or the most advantageous market conditions, the fair value itself is calculated before any adjustments for transaction costs that merely characterise only the transaction but not the involved asset or liability. However, in cases when location matters, the market price is adjusted for the expenses incurred to transfer the asset to that concrete marketplace.

All the data used by companies to measure fair value fall into three categories defined as corresponding levels comprising the hierarchy of fair value:

First level: observable data on identical valuation objects

Second level: observable data on similar valuation objects

Third level: unobservable data.

First level data include quoted prices in active markets for identical assets or liabilities that a company can receive at the measurement date. Such prices are the most reliable evidence of fair value and should be used without adjustments to estimate fair value whenever possible. This type of data is generally available in the currency, stock, brokerage (intermediary), dealer markets, and "from principal to principal" markets as well (where operations are carried out without intermediaries).

Second level incorporates the following data:

Quoted prices for similar (but not identical) assets or liabilities in an active market

Quoted prices for identical or similar assets or liabilities in markets that are not active.

Last level unobservable data is based on assessment and professional judgment. Such categorisation allows users of financial statements to objectively assess the quality of fair value estimates, since the higher the level of data used in measuring fair value, the higher is the quality of such estimates.

Thus, valuation methods used to measure fair value should maximise the use of observable data and minimise the use of unobservable data.

When measuring fair value based on unobservable data, a company can start with its own estimates, but must make adjustments if there is strong evidence that market participants will use different data or if the company has a piece of specific information used in its fair value estimations that is not available to other market participants. There is no need to spend a lot of effort to obtain information about the perceptions of market participants. However, one should consider any available information when making a fair value assessment.

Companies are obliged to provide detailed information on the fair value measurement process. Therefore, it is important to know which valuation methods and data have been used, as well as the basic information about the assessed assets or liabilities, considered significant.

Fair value aims to increase the degree of objectivity, transparency, and relevance of the information in the company's financial statements. Being a business valuation measure, it does not

make any sense to businesses in the context of its taxation. Its major advantage lies in its immediacy, which provides an updated valuation of assets and liabilities. Historical data, such as acquisition and production costs, does not provide its users with accurate and valid valuation estimates. Therefore, fair value assessment is known to be the best way to ensure the success of any investment and is also used as a basis for future cash flows prioritisation.

One of the advantages of fair value measurement from the point of its objectivity is the consideration of such factors as risks inherent to business activities. Since fair value is a market valuation, it is determined by the perceptions of market participants would use in relation to the value of an asset or a liability, including risk assumptions.

This remark is particularly relevant for the income approach to valuation when a fair estimate is calculated at the present value that will be discussed further in this chapter. In many cases, the amount and timing of cash flows are uncertain. Even the fixed amount stipulated by the contract, such as loan payments, is uncertain if there is a risk of default. For these market participants generally demand compensation (that is, risk premium) for accepting the risk inherent to cash flows associated with a particular asset or liability. Therefore, the fair value estimate should include a risk premium; otherwise, it will not represent the fair value.

Traditional Assets' Valuation Techniques

IFRS13 divides classical methods of asset valuation into 3 main groups, depending on the approach they are based on:

Methods of income approach, including discounting cash-flow (DCF) and direct capitalisation techniques

Market or sale comparison methods

Methods of valuing assets at their liquidation value or replacement cost, that constitute the cost approach.

The fair value hierarchy assigns priority to data rather than the corresponding valuation method; thus the fair value estimated on the basis of any of the methods may be attributed to each of its three levels, depending on which type of data is used.

Therefore, there is no universal valuation technique that will always yield the best result in any case, since each of them might be more appropriate than others, depending on the particular circumstances, usually including the following factors to be considered by the investor or another party undertaking asset valuation when choosing the optimal technique:

The reasonably available information about the valuation object

The market conditions (for ex. the optimal valuation technique may vary, depending on whether the market is of a bullish or bearish type)

Investment horizon (for ex. some technique may perform better when measuring the fair value of long-term investments as compared to other methods and vice versa)

The life cycle of the investment object

The nature of business, where the examined asset is employed, as well as the type of the industry where this business is undertaken (for ex. some methods may perform better at capturing the volatile or in contrast cyclical nature of business).

Let us briefly discuss each approach in a bit more depth. The key notion of the *income approach* is that the asset fair value is estimated based on the present value of the expected future cash flows it will generate. However, each of its methods has some specific aspects which we must take into account.

Direct capitalisation model implies that asset will generate the same cash flows for each year of its holding or assumes that their growth rate is moderate and predictable. Hence the fair value (price) of the corresponding asset is found by capitalising its expected future cash flow for the one year or its average expected future cash flow to be received for the whole holding period (in case if the cash flows are not the same for each year) given the appropriate capitalisation rate which is the required rate of return on the asset being assessed that is generally equivalent to cost of equity or the WACC, depending on the capital structure of the business, where this asset is employed. (see formula 1.1 for direct capitalisation model[1])

$$P = \frac{CF}{r}, \qquad (1.1)$$

where

CF — cash flow for one year or average cash flow

[1] The formula is a special case of general DCF model, given constant cash flows received forever, derived using formula of the sum of the infinite geometric progression.

r — capitalisation rate (required rate of return on asset).

However, the assumptions underlying the direct capitalisation technique seem to be rather unrealistic, making DCF model more flexible in this sense and yielding more accurate results, given the availability of all the necessary information, since it takes into account each individual expected cash flow that will be received in future and is assumed to arise evenly at the end of the each year during the whole asset holding period, including the expected cash flow from the asset's possible resale at the end of this period or the asset's scrap value (in cases if it is held till the end of its useful life). Hence the fair value of an asset under DCF model is defined as the sum of the present values of all the expected future cash flows received from the asset during its holding period, which formally is equivalent to discounting each future expected cash flow given the capitalisation (discounting) rate, which is generally assumed to stay constant during the asset holding period for simplicity, and finding their sum. (see formula 1.2)

$$P = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^i} + \frac{R}{(1+r)^n}, \qquad (1.2)$$

where

CF — cash flow for i-th year (n = last year of holding an asset)

R — cash flow from asset disposal at year n or asset's scrap value

r — capitalization (discounting) rate.

Since the DCF approach accounts for each individual potential future cash flow to be received from the asset also considering the time value of money, it is generally accepted as a primary asset valuation technique.

However, in real-world, any business usually operates under a certain degree of uncertainty. In this case, the timing of expected cash flows and their amount even for the first year in future usually cannot be forecasted for sure, as well as the level of appropriate capitalisation rate, making the methods of income approach absolutely useless in the assessment of asset fair value due to the lack of necessary information on the inputs required to estimate the corresponding amounts.

The other two asset valuation approaches — the market and the cost-based, are not sufficiently influenced by business uncertainties since they don't generally require forecasting, but instead, use present data in fair value assessment, hence are preferable in this sense.

The market or sales comparison approach defines the asset fair value based on the price and other relevant information of market transactions involving similar or comparable assets. The market approach methods are mostly used in valuing unquoted equity instruments are generally related to the data sources used (for instance, quoted prices of public companies or prices from merger and acquisition transactions). Such relevant information used in fair value estimation under this approach usually includes the following:

Transaction price paid for an identical or a similar instrument of an investee

Comparable company valuation multiples derived from quoted prices (i.e. trading multiples) or from prices paid in transactions such as mergers and acquisitions.

Cost approach determines the asset's value based on the amount of expenses required to be incurred for its acquisition or production and, also incorporates several valuation methods, including the following:

Historical cost method

Replacement cost method

Replacement cost method.

The historical cost technique lies in identifying the actual costs incurred in the production of assets at prices effective on the day these costs have been incurred.

According to the other two methods, the asset fair value is estimated as the amount required to reproduce or replace it with a similar asset of the same production capacity. Hence the asset price under cost approach is equalised either to its reproduction or replacement cost, depending on the method applied. However, one should distinguish between these two terms.

Reproduction cost is the one required to reconstruct the analogous asset given the materials and technology available at the date of the assessment object creation.

Replacement cost, in contrast, is the amount required to build a similar asset of the same production capacity using the resources and technology available at the date of the asset assessment.

The asset fair value can also be measured based on its liquidation value. However, the asset value

based on this method does not correspond to the its liquidation value, that reflects the most likely price at which the asset may be alienated during its exposure time, which is less than the one under market conditions, given the seller is forced to make a transaction of this asset's disposal.

Thus, determination of the asset's liquidation value, as opposed to the market one, requires accounting for the effect of extraordinary circumstances, forcing the asset to be disposed under conditions that do not correspond to market ones.

Asset valuation plays a significant role in various economic relationships, being a crucial element of any investment decision-making process and corporate valuations in general.

Traditional asset valuation techniques include several methods concerning different aspects of this process, each of which has its own strengths and weaknesses.

However, given the availability and predictability of data on the corresponding variables such as future cash flows and discount rates the DCF approach is generally considered as the most accurate and superior asset valuation technique since it takes into account the potential income the asset is expected to generate each future period of its remaining useful life with regard to the time value of money.

Real Options Approach to Asset Valuation

Definition and Types of Real Options

An option is a right, but not the obligation, to buy, sell, or use an asset for a period in exchange for a specific fixed amount of money, defined as option strike or exercise price. Options providing its holder with the right to buy an asset are generally referred to as call options, while those granting the right to sell are known as put-options. Those traded on financial exchanges are called financial options.

Options that involve real assets, such as licenses, copyrights, trademarks, and patents, are referred to as real options. Other examples of real options include the right to buy land, commercial property, and equipment. Such assets can be valued as call options if their current value exceeds the difference between the asset's current value and some pre-set level. For example, if a business has an option to lease office space at a predetermined price, the value of that option increases as lease rates for this type of office space increase. The asset can be valued as a put option if its value increases as the value of the underlying asset fall below a predetermined level. To illustrate, if a business has an option to sell an office building at a pre-set price, its value increases as the value of the office building declines.

The concept of real options was proposed in 1977 by Stewart Myers. Originally, the term "real option" meant the undefined benefits of the investment project (Myers, 1977, p. 150). It was not until the early 1990s that the concept of real options was used in practice to evaluate investment projects.

Real options valuation techniques are widely applied in investment projects characterised by a high level of risk and flexibility, allowing the decision-makers to actively respond to market changes during the project.

Real options reflect management's ability to adapt and later revise corporate investment decisions. They can impact substantially the value of an investment in a single project, which is generally underestimated when assessed using the standard DCF model since they account for the larking options that may be embedded in investment project and add up to its value and hence should be considered when appraising such investments. These options include actions that may be applied by the management in the course of realisation of the investment project to increase its value. However, as highlighted by Aswath Damodaran in his book on valuation (2006, p. 51), these actions must satisfy the following option recognition criteria to be qualified as real options:

An option should provide the holder with the right to buy or sell a specified quantity of an underlying asset at a fixed price at or before the expiration date of the option

There must be a clearly defined underlying asset whose value changes over time in unpredictable ways

The payoffs on this asset (real option) must be contingent on a specified event occurring within a finite period.

The similarity of real options to financial options results from the following factors:

The real option is the right to take a specific action

The option is exercised when it is beneficial to the buyer

They can be both call (call) and sale (put) options

The value of the option is the higher the uncertainty

The payoff function is asymmetric: potential losses are limited, and potential profits can be high.

Although being widely-applied in investment project appraisal the real-option approach may also be used in the valuation of assets that do not generate any cash flows, but instead provide its holder with a right to earn income under a certain course of action — those generally include the intangibles such as licenses or exclusive patent rights to produce a particular product that will yield some cash flows in future; another good illustration is the undeveloped reserves of natural resources. Valuation of such assets using the standard DCF approach will generally provide erratic estimates or maybe impossible at all, thus making the real-option technique highly valued in this case.

Despite the advantages of the extended flexibility in asset and investment project valuation, real options can be costly to obtain (e.g., the right to extend a lease or purchase a property), complex to value, and dependent on problematic assumptions — these are the main drawbacks of this approach. In this case, they should not be pursued unless the firm has the resources to exploit the option, and they add significantly to the value of the firm.

As also noted by Damodaran, there has to be a restriction on competition in the event of the contingency for an option to have significant economic value, since in a perfectly competitive product market, no contingency, no matter how positive, will generate positive net present value. He also mentioned another real options value driver — the degree of their possible exclusivity, depending on whether only their holder may take advantage of the contingency or somebody else also has such an opportunity, and if there is no exclusivity at all, then there is no option value as well. In this sense, real options become less valuable as the barriers to competition become less steep.

According to a recent survey (Horn et al., 2015, p.17), real options are used relatively infrequently by corporate chief financial officers (CFOs) but tend to be more common in the energy and biotech industries. In these industries, investments tend to be large, long-lived, and subject to a wide range of outcomes.

Thus, the real options valuation technique is mainly used in the following areas:

Research and development projects

Projects in the mining industry

Investment projects related to modern technologies (high-tech)

Projects in universally understood human and intellectual capital.

However, in recent years, because of the growing interest in the subject of real options, the field of this method's application has extended and includes the following spheres:

e-business

venture capital projects

start-up projects

IT infrastructure

e-commerce, m-commerce

FMCG

production industry.

There are several types of real options that generally may be embedded in the investment, depending on the possible course of actions adopted by the company management, such as:

Option to delay (management may decide to delay or defer the investment project)

Option to expand (the company may expand by entering new markets and developing new products at later stages of the investment project, based on the realised favourable outcomes at its early stages)

Option to abandon (management may stop the production or abandon the investment project if the outcomes are unfavourable at its early stages).

Real Options Valuation Models

Option Pricing Models: Theory with Examples

The techniques of real options valuation are like those used in case of financial options value estimation and include the application of the generally known option-pricing models:

The binomial model (usually accompanied with decision tree construction)

The modified version of the Black-Scholes model.

As highlighted by Damodaran, both these methods incorporate the approach of a replicat-

ing portfolio and hence are mostly applicable for real option valuation when the following conditions are satisfied:

The underlying asset is traded — this particularly allows for the possibility of building replicating portfolios, except the observable prices and volatility being the model inputs

There is an active market for the option itself

The cost of exercising the option is known with some degree of certainty.

However, when using these models to value real assets, we must take the risk that the obtained value estimates may be biased as compared to the market price due to the difficulty of arbitrage. The key notion of this approach is to replicate the same cash flows generated by the option being valued, using a combination of risk-free borrowing/lending and the underlying asset. For instance, the call-option can be replicated by borrowing some amount of money at a risk-free borrowing rate and then buying some number of the underlying assets (e.g. shares). In contrast, put-options instead are replicated by the initial sale of some number of the underlying assets and then lending at a risk-free lending rate. The risk-free rate of borrowing is assumed to be equal to the one of lending, and the number of underlying assets bought or sold in this case is referred to as option delta (Δ).

The option value cannot be negative as in case of the worst outcome, it is not exercised so that its holder does not incur any losses. Thus, call and put option may yield the following payoffs as graphically represented in Figures 1 and 2 correspondingly:

Thus, given the corresponding risk-free rate (r) the European call's and put's price (denoted as c and p) with time to maturity of t years may take the following values:

$$\max[0; S - Xe^{-rt}] \leqslant c \leqslant S$$
$$\max[0; Xe^{-rt} - S] \leqslant p \leqslant Xe^{-rt}$$

As also noted by Damodaran in his book (2006, p. 832.), since the time interval at which the option can be exercised (t) is shortened, the limiting distribution, as $t \to 0$, can take one of two forms:

If price changes become smaller as t tends to 0, the limiting distribution is the normal distribution and the price process is a continuous one

If price changes remain large as t tends to 0, the limiting distribution is the Poisson distribution, i.e., the one that allows for price jumps.

The Binomial Model of Option Pricing

The binomial model reflects the classical mechanism of option pricing and incorporates the idea of the replicating portfolio. This model provides with more accurate estimations in cases of several sources of uncertainty as compared to Black-Scholes model and usually includes the construction of decision trees with each of its nodes being the best estimate for the option value at the corresponding future time-period. There are some key assumptions underlying this model:

There only two possible scenarios at each future period — the best and the worst, so that the value of the option or the underlying asset may either increase or decrease as compared to the previous period

The underlying asset does not pay any dividends

No arbitrage is possible

The risk-free rate of borrowing/lending (r) is constant throughout the life of the option

Markets are frictionless, i.e. there are no taxes and no transaction cost

Investors are risk-neutral.

The mechanism of the option-pricing under binomial model could be illustrated by the following simple example of pricing a call-option on the stock using this approach.

Example 1. Suppose that some stock A today (t = 0) is priced at S_0 = \$150 and the next year (t = 1) the price is expected either to rise up to S_u = \$170 or drop till S_d = \$130.

Given the payoff structure on the call depicted in Figure If the exercise price of the call option on stock A is X = \$160, then its corresponding payoffs at t=1, given good or bad scenarios, can be written as:

Max [S_u — X; 0] = \$10 or Max [S_d — X; 0] = \$0 correspondingly. (see Figure 3)

The question is what the current price of the call-option is?

Solution. To replicate the call-option payoff we must borrow money (or sell a bond with face value of B) and buy N shares of stock A, so we have to find such N and B that will equalise our portfolio payoffs with the option payoffs given

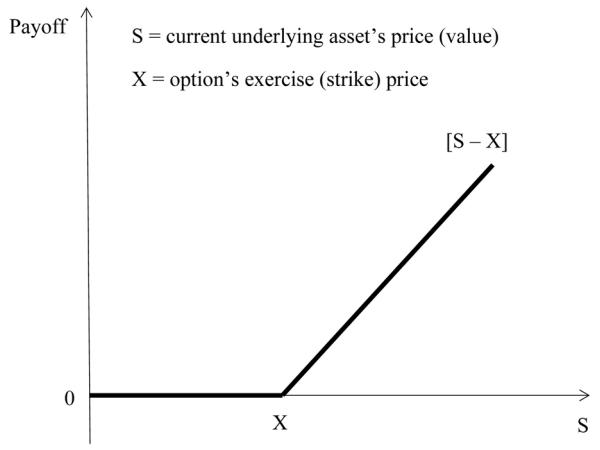

Figure 1. The payoff on call option

Source: The author.

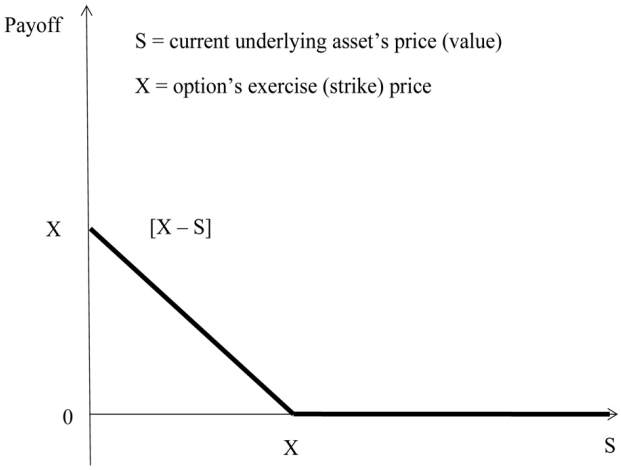

Figure 2. The payoff on a put option

Source: The author.

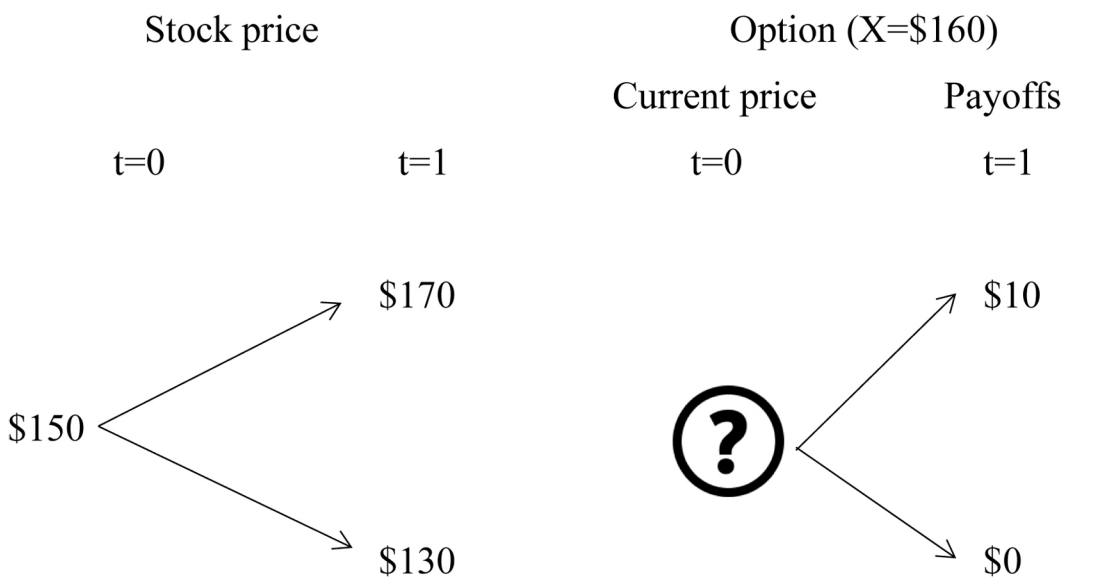

Figure 3. 1-step decision tree for a 1-period binomial option pricing model

Source: The author.

any scenario — good or bad. Formally, we should solve the following system of equation with respect to N and B:

$$\begin{cases} 10 = -B + N * S_u \\ 0 = -B + N * S_d \end{cases} \Rightarrow\Rightarrow \begin{cases} 170 * N - B = 10 \\ 130 * N - B = 0 \end{cases} \Rightarrow\Rightarrow$$

$$\Rightarrow\Rightarrow \begin{cases} N^* = 0.25 \\ B^* = 32.5 \end{cases}$$

Since our stock/bond portfolio has the same payoffs as the option, the option and the portfolio must have the same value today, or else there will be the arbitrage opportunity that contradicts the model assumptions. Hence the current value of the call-option equals to the today (discounted) value of our portfolio. Assuming risk-free rate (r) equal 5 per cent we have:

$$\frac{-B^*}{1+r} + N^* * S_0 = \frac{-32.5}{1.05} + 0.25 * 150 = 6.55.$$

So, the current value of the call-option equals to $6.55. It was a simple example to illustrate how the replicating portfolio approach is embedded in the binomial model. In reality, the exact future stock (or another underlying asset) price is unknown. However, one can predict the level of its

increase (u) or decrease (d) at each time interval, using the following formulas:

$$u = e^{\sigma\sqrt{h}} \qquad (2.1)$$

$$d = \frac{1}{u}$$

where

σ = standard deviation of stock price

h = time interval after which the price will change (as part of the year)

u > 1, 0 ⩽ d < 1.

If current stock price (S_0) will either increase by y_u per cent or fall by y_d per cent in each succeeding time interval, then the stock price in the next period will take one of these two possible values:

$S_u = S_0*(1+ y_u\%) = S_0*u$ — in case of stock price increase

$S_d = S_0*(1 — y_d\%) = S_0*d$ — in case of stock price drop.

E.g.:

if u = 1.35, then y_u = 1.35–1 = 0.35 = 35%

if d = 0.7, then y_d = 1–0.7 = 0.3 = 30%.

Given there are only 2 possible future scenarios of a stock price change and that we will anticipate the increase in stock price with some probability π, the stock price will fall with the probability of (1 — π).

Assuming risk-neutrality one can calculate π by the following formula:

$$\pi = \frac{e^{-rh} - d}{u - d}, \qquad (2.2)$$

where r = annual risk-free rate.

In cases of one-period models (t = 1) when the call/put option expires in one period time its price (c or p) is equalised with the discounted (present) expected value of its future payoffs in case of the current stock price (S_0) increase/fall up to S_u and S_d correspondingly (P_u and P_d).

$$c \text{ or } p = e^{-rh}\left(\pi P_u + (1-\pi) P_d\right)$$

for call-option: for put-option: X = option exercise price

P_u = Max [S_u — X; 0] P_u = Max [0; X — S_u]

P_d = Max [S_d — X; 0] P_d = Max [0; X — S_u]

The similar approach is used when dealing with two or more period option pricing binomial models (t > 1). First one should define the possible option payoffs in the last period and then calculate their expected value in the preceding period, using the same technique, and so on, moving back to the present period to determine the current price of the option.

Let us consider the following example to get a general idea. Assume a call option expiring in 6 months with a strike price (X) of $15 and a current underlying stock price (S_0) is $12. Risk-free rate (r) = 5 per cent. Every three months, the underlying stock price may either increase or drop by 30 per cent. In this case, we have:

u = 1.3 d = 0.7 h = 0.25 (for 3 months = 3/12 (= 1/4) of a year)

$$\pi = \frac{e^{-rh} - d}{u - d} \approx 0.48 \ (1 — \pi) = 0.52$$

What is the current price of the call option (= c)? We'll construct a 2-step decision tree to deal with this problem, with each of its nodes indicating the underlying stock's price (S) in a particular period (t) in case of both possible scenarios: price going up or down (S_u and S_d) with the corresponding option payoffs (P_u and P_d) (see Figure 4).

Option payoffs at t = 1:

$$P_u = e^{-rh}\left(\pi P_{uu} + (1-\pi) P_{ud}\right) \approx$$

$$\approx 0.99*\left(0.48*5.28 + 0.52*0\right) \approx \$2.51$$

$$P_d = e^{-rh}\left(\pi P_{du} + (1-\pi) P_{dd}\right) \approx$$

$$\approx 0.99*\left(0.48*0 + 0.52*0\right) \approx \$0.$$

Now we can calculate the current price of our call-option:

$$c = e^{-rh}\left(\pi P_u + (1-\pi) P_d\right) \approx$$

$$\approx 0.99*\left(0.48*2.51 + 0.52*0\right) \approx \$1.19.$$

However, it was a relatively simple example. In reality, the underlying stock price may change each minute and the period of options expiration may be much longer, turning its price estimation into a rather tedious and complicated process.

It is probably the main drawback of the Binomial option pricing model that usually exceeds its relative advantage in the accuracy of the obtained estimation results in case of several sources of uncertainties as compared to Black-Scholes model, making the latter more effective in practice. Also, as highlighted by A.A. Krukovskiy (2008, p. 129) in his paper on real options, with the increas-

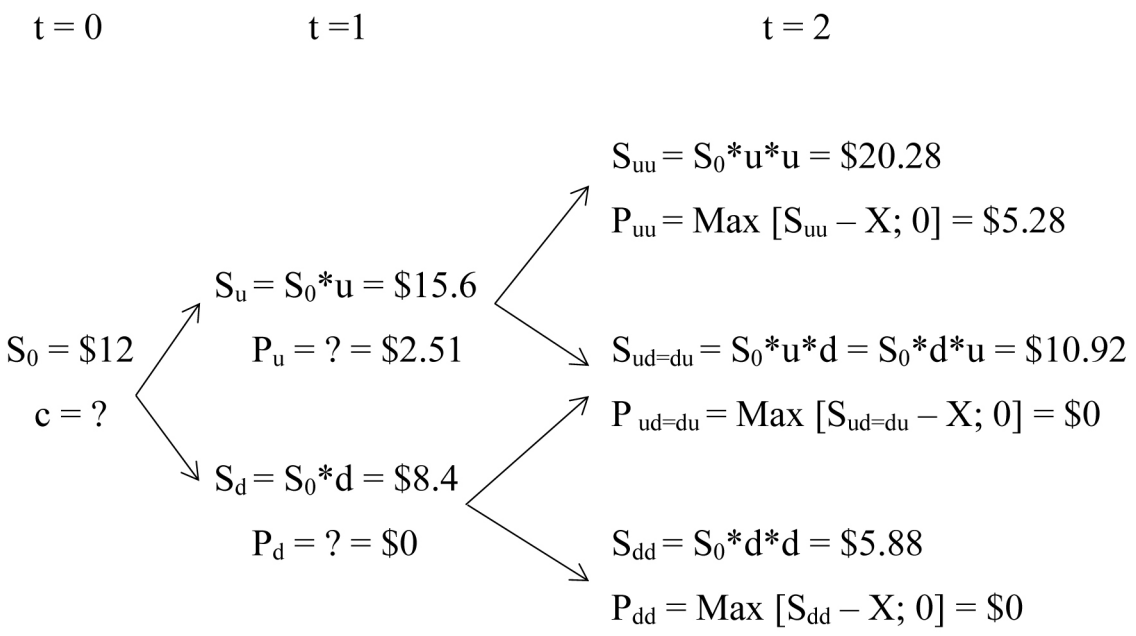

Figure 4. 2-step decision tree for a 2-period binomial option pricing model

Source: The author.

ing frequency of stock price change (i.e. with h tending to 0) both these models yield almost the same results.

The Black-Scholes Model of Option Pricing

The pricing analysis in the binomial model is based on the assumption that the underlying asset's prices are well-represented by a discrete time. However, in 1974, Fischer Black and Myron Scholes presented an option pricing model, allowing the time process for the underlying asset to be continuous. This analysis gave exact prices for puts and calls using a continuous time version of the replication strategy followed in the binomial methodology.

The Black-Scholes model included the same parameters as the Binomial one and was initially designed to value the options of the European type that may be exercised only at their expiration in contrast to Binomial model that may also be applied to the ones of the American type that may be exercised any time before their maturity date. The model assumes no sharp fluctuations in price and the returns on the underlying asset are expected to be normally distributed. Other underlying assumptions are like the ones of the Binomial model and include the following:

The underlying asset does not pay any dividends

No arbitrage is possible

The risk-free rate of borrowing/lending (r) and the volatility of the underlying asset price is known and constant throughout the life of the option

Markets are frictionless and efficient, i.e. there are no taxes or transaction costs, and the prices incorporate all the available information, so one cannot predict any of its possible movements.

Given these assumptions, the value of the call option (c) is calculated using the following formulas:

$$c = SN(d_1) - Xe^{-rt}N(d_2)$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \qquad (2.3)$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

where

S — current underlying asset price

X — option strike (exercise) price

σ — volatility of the underlying asset price

t — life of the option (time till its expiration)

*values of N(d1) and N(d2) are taken from the cumulative distribution function (c.d.f.) of standard normal distribution

Despite being initially designed to value European call-options, the standard Black-Scholes model may be also applied to price an American calls that can be exercised at any time during their maturity period (t), since they were proved to have the same price as those of the European type, assuming that underlying asset does not pay any dividends.

From the formula (2.3) it is clear there are several factors influencing the price of a call-option that are summarised below:

The effect of the current underlying asset price (S): the Black-Scholes equation tells us that call option prices increase as the current spot asset price increases; This is pretty unsurprising as a higher underlying price implies that the option gives one a claim on a more valuable asset.

The effect of the exercise price (X): again, as you would expect, higher exercise prices imply lower option prices. The reason for this is clear: a higher exercise price implies lower payoffs from the option at all underlying prices at maturity.

The effect of volatility (σ): although outstanding outcomes (underlying price becoming very high) are rewarded highly, extremely bad outcomes are not penalised due to the kink in the option payoff function. This would imply that an increase in the likelihood of extreme outcomes should increase option prices, as large payoffs are increased in likelihood. The Black–Scholes formula verifies this intuition, as it shows that call prices increase with volatility, and increased volatility implies a more diverse spread of future underlying price outcomes.

The effect of time to maturity (t): call option prices increase with time to maturity for similar reasons that they grow with volatility. As the horizon over which the option is written increases, the relevant future underlying price distribution becomes more spread-out, implying increased option prices. Furthermore, as the time to maturity increases, the present value of the exercise that one must pay falls, reinforcing the first effect.

The effect of risk-free interest rates (r): when the risk-free rate rises — call option prices to grow. It is due to the same effect as above, in that the discounted value of the exercise price to be paid falls when rates rise.

Put-call parity

The Black–Scholes formula gives us a closed-form solution for the price of a European call option under certain assumptions on the underlying asset price process. However, until now, we have said nothing about the pricing of put options. Fortunately, a simple arbitrage relationship involving put and call options allow us to do this. This relationship is known as put-call parity. In what follows, we assume the options have the same strike price (X), time to maturity (t) and are written on the same underlying asset.

Consider an investment consisting of a long position in the underlying asset with current value S and a put option with its price denoted as p, called portfolio A. The cost of this position is S + p.

Another portfolio denoted as B, comprises a long position in a call-option with its price denoted as c and lending Xe^{-rt}. Hence the cost of this position is $c + Xe^{-rt}$.

What are the possible payoffs of these positions at maturity?

Given the payoff structure on the put-option, depicted in Figure 2, the payoff on portfolio A can be written as follows:

max [X — S; 0] + S = max[X; S]

Similarly, the payoff on portfolio B can be written as:

max[0; S — X] + X = max[X; S]

Comparison of the above two equations implies that the two portfolios always pay identical amounts. Hence, using no-arbitrage arguments, portfolios A and B must cost the same amount. Equating their costs, we obtain:

$$S + p = c + Xe^{-rt} \qquad (2.4)$$

Equation 2.4 is the put-call parity relationship. Given the price of a call (c), the current value of the underlying asset (S) and knowledge of the riskless rate (r), we can deduce the price of a put (p) using the following expression:

$$p = c + Xe^{-rT} — S$$

Substituting for c from the Black-Sholes formula (2.3) and rearranging the terms we get the formula for pricing a put-option:

$$p = Xe^{-rt}\left(1 - N\left(d_2\right)\right) - S\left(1 - N\left(d_1\right)\right) \qquad (2.5)$$

Similarly, given the put price, we can deduce the price of a call with similar features.

The equation allows to deduce the effect of the Black-Scholes model's parameters on put prices:

The effect of the underlying price (S): for the opposite reason to that given for the call, put prices drop as underlying prices increase

The effect of the exercise price (X): similarly, put prices rise as exercise prices rise

The effect of volatility (σ): put options and call options are affected in identical ways by volatility. Hence, as volatility increases, put prices rise

The effects of time to maturity (t) — increased time to maturity will lead to a greater dispersion in underlying prices at maturity, and hence put prices should be pushed higher. However, as the holder of a put receives the exercise price, discounting at higher rates makes puts less valuable. The combined effect is ambiguous

The effect of the risk-free rate (r): puts are less valuable as interest rates rise, due to a higher degree of discounting of the cash received.

The Black-Scholes approach also incorporates the concept of replicating portfolio in its framework: to replicate the call option one should buy $N(d_1)$ of the underlying asset (i.e. $N(d_1)$ is the option delta(Δ)) and borrow $Xe^{-rt}N(d_2)$.

It'll be reasonable to add that this model can be adjusted to take dividends into account by adding dividend yield (y) as its new component and assuming it constantly throughout the options life, so the modified version of the Black-Scholes model takes the following form:

$$c = Se^{-yt}N(d_1) - Xe^{-rt}N(d_2)$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \qquad (2.6)$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

The price of the put-option (p) may be also derived from the put-call parity:

$$p = Xe^{-rt}\left(1 - N(d_2)\right) - Se^{-yt}\left(1 - N(d_1)\right) \quad (2.7)$$

Moving back to the case of pricing the American call options that can be exercised any time before the settlement date it should be noted that call-estimates yielded by a modified version of Black-Scholes model are rather close to the price of American call on the asset that pays dividends since. Generally, there are no clear benefits, and thus no solid reasons for early option exercise and so the ability to do so does not make any sense.

Early exercise is generally prompted by weird mispricing resulted from the technical or market-based reason causing a mess in the theoretical option's prices.

However, there are certain circumstances under which the early exercise will add up some value, thus resulting in a higher American calls' prices as compared to the European ones. Such circumstances imply the following favourable conditions to be satisfied:

The option is deep-in-the-money and has Δ (i.e. $N(d_1)$) equal or close to 1

The option has little time value

The dividend payment is relatively high, and its ex-date precedes the option expiration period (t).

Despite the limitations considering its underlying unrealistic assumptions particularly the Black-Scholes model is generally known to be the most optimal approach to option valuation mostly due to its relative simplicity and generality enabling to undertake rather complicated valuations without turning them into a time-consuming, exhausting process, just like in case of binomial decision tree construction, since all you need is to obtain the data on the model inputs and then substitute it into the corresponding formula to obtain the immediate result.

For this reason, the modified version of the Black-Scholes model is also frequently applied in real options valuation and hence will be used in our analysis.

Application of Black and Scholes Model in Real Option Valuation

Real Options on the Asset Side

Valuing product patent as a real option to delay

Application of Black and Scholes model in real options valuation we based on the book by Damodaran (2012). A firm with exclusive rights to a project or product for a specific period may decide to postpone the investment in a project or product development which is also known as exercising of the option to delay.

A product patent provides a firm with an exclusive right to develop and market a specific product and hence can be defined as a real call option to delay.

The underlying asset, in this case, is the project or product on which development a firm has a patent, and so the present value (PV) of the expected cash flows from developing the product today may be treated as its current value (S) while the option's exercise price (X) is equivalent to the cost of the product development. The volatility of cash flows or revenues received from current products can be used as a proxy to estimate the volatility of the underlying asset value (σ).

The patent expires when the exclusive rights to the product end. When the patent rights expire, excess cash flows associated with the holding of these rights vanish as other competitors will also be empowered to manufacture this product and reap the possible gains.

As highlighted by Donald DePamphilis in his book (2017, p. 299) on mergers and acquisitions, the opportunity cost of product development delay is equivalent to an adjustment of the initial Black-Scholes model that made it possible to expand its application in situations considering underlying assets with regular dividend payments. The payment of a dividend is referred to as a reduction in the stock value since such funds are not reinvested in the company to provide future growth. Hence, if the projected cash flows from the product arise evenly throughout the patent life (t) then with each year of the product development delay, the firm will sacrifice the potential cash flow for this year that could have been received. So, the annual cost of delay(y) in this case may be calculated as $\frac{1}{t}$.

If cash flows are not anticipated to rise evenly, the cost of delay may be approximated as the ratio of the expected cash flow for the next period to the current value of the underlying asset(S).

The firm will exercise its patent rights only if the present value of the potential cash flows from the product development exceeds the present value of the associated costs. (i.e. if S > X) or else it can set the patent aside, thus escaping any associated future costs. Thus, the patent-holding may yield the following payoffs:

$P_1 = S - X$ if $S > X$

$P_2 = 0$ if $S \leqslant X$

Given all these remarks, one can apply the Modified Black-Scholes option pricing model to value the product patent (see formula 2.6).

Let us consider the following example. Suppose a company A holds a patent on product B for the next 25 years (i.e. t = 25) and plans to manufacture and realise it by itself. PV of cash flows from introducing product B now (S) = $5m and cash flows are assumed to arise evenly throughout the patent life; PV of development costs (X) = $3m. Risk-free rate (r) = 6 per cent and the volatility in S (σ) = 0.5. What is the value of the patent? Finding the value of the patent is equivalent to the valuation of a real call option to delay.

$$\text{The annual cost of delay}\left(y\right) = \frac{1}{t} = \frac{1}{25} = 0.04$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} =$$

$$= \frac{\ln\left(\frac{\$5m}{\$3m}\right) + \left(0.06 - 0.04 + \frac{0.5^2}{2}\right)25}{0.5\sqrt{25}} \approx 1.65$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx 1.65 - 0.5\sqrt{25} \approx -0.85$$

$N(d_1) = \Delta$ = Probability (Pr) ($Z \leqslant d_1$), $Z \sim N(0;1)$ = $= \Pr(Z \leqslant 1.65) \approx 0.9505$

$N(d_2) = \Pr(Z \leqslant d_2) = \Pr(Z \leqslant -0.85) = 1 - \Pr(Z \leqslant 0.85) \approx 1 - 0.8023 \approx 0.1977$.

Having obtained all the necessary inputs, we can apply the Modified Black-Scholes model to get the answer:

$$c = Se^{-yt}N\left(d_1\right) - Xe^{-rt}N\left(d_2\right) \approx \$1.62m$$

Hence the patent on product B is approximately worth $1.62m.

It should be noted that NPV of product B if introduced now equals S — X = $2m > c = $1.62m (estimated value of a patent on product B), thus for company A it is better to introduce B now than wait till later times holding patent rights on it unexercised.

The real-option approach to patent valuation is best suited for firms of the following types:

New firms or start-ups having only one or two promising products in the corresponding niche, and at the same time earning little or no revenue or cash flow

Firms where product patents comprise the substantial part of their value and thus cannot be assessed using the traditional DCF technique.

Table 1
Black-Scholes model inputs for resources' undeveloped reserves valuation

Notation	Model input characteristics	Estimation hints and possible proxies
S	the current value of underlying asset = PV of estimated reserves of natural resources	sum of the projected future cash flows from the same or similar resources' exploitation discounted back at the development lag length. *could be approximated using the past average data on growth rates of cash flows from the analogous resources' reserves if the general trend is expected to remain relatively stable
X	PV of development costs	past data on the development costs of the same or similar resources
t	option life = expiration period of firm's right to exploit the resources' reserves	
r	risk-free rate	Treasury bond rate corresponding to t
y	the annual cost of delay	could be approximated as the ratio of average annual cash flow (or net sales) from the reserve to its current value (S)
σ	volatility in S	could be approximated by volatility in the same or similar resource prices

Source: The author.

The described model may also be extended to estimate the value of the firm, particularly of these types that could be obtained by summing its following three components:

PV of net cash flows from the firm's commercial products, discounted at the firm's corresponding WACC (estimated with DCF model)

Value of the firm's existing patents, obtained via application of the real-option approach

The expected value of commercial products that the company plans to generate in future from new patents that may be obtained because of its research and development (R&D) activities. (i.e. Value of new patents that will be obtained in future — R&D cost to be incurred to obtain these patents).

As argued by Damodaran (2006, p. 790), the value of the third element will depend on the expectations of a firm's R&D capabilities. Thus, given a firm earning its cost of capital from R&D, this component will turn to zero.

Valuing natural resources as real options

The same technique may also be applied in the valuation of the undeveloped reserves of natural resources. However, the notion of the modified Black-Scholes model inputs will be slightly different in this case (see table 2.1 for details).

In this case, the examined resource takes the role of the underlying asset which value is determined by two factors — the resource amount available for development and the price of the resource. A firm owning some undeveloped reserves is consequently provided with a right either to develop them and yield cash flows from generated resources (i.e. the value of the underlying asset (S)) or not if costs are equal or exceed the potential benefits. If we define resource development costs as X then the undeveloped reserves of resources may be presented as a real call-option with the following payoffs:

$P_1 = S - X$ if $S > X$

$P_2 = 0$ if $S \leqslant X$

Once developed, the reserve may provide its owner with resources for sale only after some time which is defined as development lag. The cost of such delay is the lost potential cash flows that could have been received during the lag period. Hence the value of the reserves is discounted back at the development lag length using an annual cost of delay as a discounting rate.

Let us consider the following example. Suppose company A owns a natural gas reserve of 30m m^3, and the PV of its development costs is estimated at \$10 per m^3 of gas with the development lag (dlag) of 3 years. Assume each m^3 of gas sold currently

yields a marginal profit of $10 on average. The firm's rights to exploit the reserve will expire in 25 years. (i.e. t = 25). Once developed, the reserve is expected to provide about 6 per cent of its current value each year from sales of the generated resources. (i.e. y = 0.06). The volatility in prices for gas (σ) is 0.2, and the risk-free rate (r) is 8 per cent. What is the current value of the undeveloped reserves of gas?

Firstly, we calculate the current value of estimated gas reserves (S) and PV of total development costs (X):

$$S = \frac{\$10 * 30m}{(1+y)^{dlag}} = \frac{\$300m}{1.06^3} \approx \$251.88m$$

$$X = \$10*30m = \$300m$$

Now we can estimate d_1 and d_2:

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 0.82$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx -0.17$$

$N(d_1) = \Delta = Pr\ (Z \leqslant d_1)$, $Z \sim N\ (0;1) \approx 0.7954$
$N(d_2) = Pr\ (Z \leqslant d_2) \approx 0.4306$

Having obtained all the necessary inputs, we can apply the Modified Black-Scholes model to get the answer.

$$c = Se^{-yt}N(d_1) - Xe^{-rt}N(d_2) \approx \$27.22m$$

Hence the undeveloped natural gas reserves are approximately worth $27.22m.

The real-option approach to undeveloped resources reserves valuation is best suited for firms of the following types:

Firms where rights on natural resources reserves comprise the substantial part of their value

Firms which natural resources reserves are rather homogeneous so that the Black-Scholes model's corresponding inputs may be estimated with adequate accuracy.

The described model may also be extended to estimate the value of the firm, particularly of these types that could be obtained by summing its following two components:

PV of net cash flows from developed reserves of natural resources, discounted at the firm's corresponding WACC (estimated with DCF model)

We obtained the value of existing undeveloped firm's reserves via application of the real-option approach.

Thus, moving back to our example and, if PV of company's A net cash flows from the already developed reserves equals $70m, its firm's value may be calculated using the following formula:

$$Value\ of\ firm\ A = \$70m + c \approx$$
$$\approx \$70m + \$27.22m \approx \$97.22m$$

In the event when firm's every single undeveloped reserve cannot be valued by real-option technique due to lack of data on the model's corresponding inputs the firm itself can be estimated as one call-option on its assets. However, as highlighted by Damodaran (2006, p. 797), the firm's value, in this case, is likely to be underestimated since the option on a portfolio on assets (i.e. a firm estimated as one call-option) generally worthies less than a portfolio of call-options on each firm's single asset (each firm's undeveloped reserves' resources).

Valuing Other Options Embedded in Investment Projects

Option to engage in other projects (expand)

As noted above the real options approach is also widely applied in investment project appraisal since it allows us to consider the possible options embedded in the project, that are neglected in the classical approaches. These lurking options add-up to the project's value, so there could be the case that a project initially assessed with traditional techniques yields negative NPV and hence is considered as bad one that shouldn't be worth taking but in fact, the true NPV adjusted to the effects of the corresponding options may be positive turning the bad investment into a good one increasing the investor's wealth.

One of the options adding-up to the project's value is the option to expand, since engaging in a project today may enable a firm to undertake other additional projects, so the resulting total NPV may be improved as compared to one of the initial projects.

Let us consider the following example. Suppose company A plans to introduce new product

Table 2
Black-Scholes model inputs for expansion option valuation

Notation	Model input characteristics	Estimation hints and possible proxies
S	the current value of underlying asset = PV of expected cash flows from expansion if undertaken now	*could be approximated using the past average data on growth rates of cash flows from the analogous products being introduced to the regional market (or the one of the relatively same size) if the general trend is expected to remain relatively stable
X	PV of expansion costs (additional investment)	past data on the expansion costs of the same or similar projects
t	the expiration period of expansion possibility	
r	risk-free rate	Treasury bond rate corresponding to t
y	the annual cost of expansion delay	assuming that cash flows will arise evenly throughout the expansion period this cost may be calculated as $\frac{1}{t}$
σ	volatility in S	could be approximated by volatility in the same or similar products' prices or using the volatility in the free cash flows or an enterprise value of the firm, its analogues or the whole industry on average

Source: The author.

B. A believes that its competitors won't be able to copy the product B due to the patent protection for at least 7 years, so A will enjoy a monopolistic position in B production and expects to receive cash flows from this product's realisation during the patent life period (i.e. t = 7 years).

Company A may introduce its product B only for local (city) market by spending $300m. It has been estimated that the PV of potential cash flows from the local introduction will amount only $200m and hence the project will yield negative NPV $\left(NPV_B^1\right)$ of $100m and thus should be rejected.

However, if the local introduction goes well the company A will be provided with an option to enter a regional market with its new product B by investing additional $700m anytime during the next 7 years (until the expiration of the patent rights on product B) that is expected to generate the total PV of $1,050m from the cash flows received.

The risk-free rate (r) is assumed to be 8 per cent, and the volatility in the similar product's prices (σ) is estimated as 0.3. This expansion option will add some value to the project that can be estimated using the modified version of the Black-Scholes model with the following inputs, as presented in Table 2.

From the information given we have:
S = $1050m
X = $700m.
Now we can estimate d_1 and d_2:

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 0.35$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx -0.44$$

$N(d_1) = \Delta = \Pr(Z \leqslant d_1), Z \sim N(0;1) \approx 0.6381$
$N(d_2) = \Pr(Z \leqslant d_2) \approx 0.3298.$
Finally, we can obtain the following call-option value:

$$c = Se^{-yt}N\left(d_1\right) - Xe^{-rt}N\left(d_2\right) \approx \$114.59m.$$

Hence the expansion option adds-up approximately $114.59m to the projects value making its total NPV $\left(NPV_B^T\right)$ positive:

$$\left(NPV_B^T\right) = \left(NPV_B^1\right) + c \approx$$
$$\approx \$-100m + \$114.59m \approx \$14.59m > 0.$$

Table 3
Black-Scholes model inputs for project abandonment option valuation

Notation	Model input characteristics	Estimation hints and possible proxies
S	the current value of underlying asset = PV of expected cash flows from the project	*could be approximated using the past average data on growth rates of cash flows from the analogous projects being if the general trend is expected to remain relatively stable
X	the residual value of the project abandonment (value of Alpha's share at its disposal to Beta)	past data on the same or similar projects
t	the expiration period of the project abandonment possibility	
r	risk-free rate	Treasury bond rate corresponding to t
y	the annual cost of abandonment delay	assuming, that cash flows will arise evenly throughout the project life this cost may be calculated as $\frac{1}{n}$
σ	volatility in S	could be approximated by volatility in the cash flow from similar projects

Source: The author.

Given the expansion option, the project increases the company's wealth by approximately $14.59m, and hence it should be definitely undertaken.

Option to abandon a project

The value of continuing a project given the remaining n years of its life should be compared to the value at its liquidation or disposal. If the former exceeds the latter, then the project should be continued — otherwise, it is better to be abandoned to save on its costs. It is the key notion of firm's another possible option that may be embedded in a concrete project and affect the decision on making the corresponding project's investment. A company can choose to shut down a project if its generated cash flows are far away from the expected amounts in order not to incur further losses which may consequently add value to the project.

Let us consider the following situation to get the idea. Suppose company Alpha considers undertaking a co-project with company Beta to produce product A. The project will last 20 years (i.e. n = 10). Alpha shares 40 per cent of the project's costs and potential gains and hence is required to invest $300m with the PV of anticipated cash flows estimated as $270m which yields a negative project's NPV of S30m $\left(NPV_A^1\right)$ thus turning the project in a total loss for Alpha.

However, Alpha is also given an option to sell its share of the investment to Beta anytime during the next 7 years for $200m if it decides to exit the project.

This option adds some value to the initially unprofitable project that is equivalent to the price of the corresponding put-option and hence can be estimated using the modified Black-Scholes approach. The model inputs for this case are shown in Table 3.

The Alpha's cash flows from the project are assumed to arise evenly throughout its life, and the volatility in their PV-s (σ) was estimated as 0.4. The corresponding 7-year risk-free rate (r) is 7 per cent.

Obtaining the inputs for the model:

S = $270m

X = $200m

$$y = \frac{1}{n} = 0.05$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 0.94$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx -0.11$$

$N(d_1) = \Delta = \Pr(Z \leqslant d_1), Z \sim N(0;1) \approx 0.8277$

$N(d_2) = \Pr(Z \leqslant d_2) \approx 0.4549.$

Table 4
Black-Scholes model inputs for equity valuation

Notation	Model input characteristics
S	the current value of underlying asset = current firm's value
X	the nominal value of outstanding financial claims (zero-coupon bonds)
t	life of the option = maturity period of zero-coupon debt
r	risk-free rate = Treasury bond rate corresponding to t
σ	volatility in S

Source: The author.

Finally, we can obtain the corresponding put-option value:

$$p = Xe^{-rt}\left(1 - N\left(d_2\right)\right) - Se^{-yt}\left(1 - N\left(d_1\right)\right) \approx \$34m.$$

Hence the abandonment option adds-up approximately \$34m to the projects value making its total NPV $\left(NPV_A^T\right)$ positive:

$$\left(NPV_A^T\right) = \left(NPV_A^1\right) + p \approx$$
$$\approx \$-30m + \$34m \approx \$4m > 0.$$

Given the abandonment option, the project increases the Alpha's wealth by approximately \$4m and hence should be undertaken.

Valuing equity at firm liquidation as a real option
Equity may be referred to as a residual claim on the firm's value left after all other financial claims have been satisfied.

Hence in case of firm liquidation, equity-holders receive the entire firm's residual value left after discharging of debts and settlement of other liabilities. At the same time, the principle of corporate veil protects the equity holders by limiting their liability to the amount of their equity investments in case of the company's total financial claims' amount exceeding the firm value, so they risk to lose no more than the total nominal value of shares they hold.

Thus equity may be presented as a call option on the current value of the firm (i.e. the PV of firm's future free cash flows) being in the role of the underlying asset in this case (i.e. S) that may be exercised only at firm's liquidation after redemption of the nominal value of its outstanding debt being the option's exercise price (X). This option thus may yield the following payoffs:

$$P_1 = S - X \text{ if } S > X$$
$$P_2 = 0 \text{ if } S \leqslant X$$

Assuming a firm has only outstanding zero-coupon bonds with a fixed maturity date in its debt structure and can be liquidated any time before this date then the option's life will coincide with the bonds' time to maturity and thus the value of firm's equity may be calculated using the classical Black-Scholes model with the following parameters as depicted in Table 4.

Let us consider the following example. Suppose, Company A is currently worth \$150m with the volatility in its value (σ) estimated as 0.3 and has only outstanding zero-coupon bonds on its debit account with a nominal value of \$130m and maturing in 12 years. Assuming the corresponding risk-free rate (r) equal to 12 per cent —what is the value of the company's equity and debt outstanding? From the information given we have:

S = \$150m
X = \$130m

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 2.04$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx 1$$

$N(d_1) = \Delta = \Pr(Z \leqslant d_1), Z \sim N(0;1) \approx 0.9795$
$N(d_2) = \Pr(Z \leqslant d_2) \approx 0.8422.$

Substituting the obtained results in the Black-Scholes formula we get:

$$c = SN\left(d_1\right) - Xe^{-rt}N\left(d_2\right) \approx \$120.979m.$$

Hence the value of the company's A equity approximately equals to \$120.979m and thus the value of debt outstanding amounts to \$29.021m (i.e. S — c).

Now we assume that part of the company's assets was destroyed by a natural disaster so that its value plummeted to \$100m ceteris paribus. In this case, given the debt face value of \$130m exceeding the new firm's value, the

Table 5

Firm's A debt structure

Debt type (i)	Debt maturity	Face Value (FVi) (including expected interest/coupon payments)	Duration (Di) (in years)
1	Short-term	$10m	0.3
2	10 years	$50m	7
3	20 years	$70m	15
4	Long-term	$100m	19
	$\sum FV_i$	$230m	

Source: The author.

company is considered a troubled firm since it is likely to go bankrupt due to insolvency. What will be the new value of A's equity? Since all other factors except the firm's value stayed unaltered, our model parameters will take the following values:

S = $100m

X = $130m

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 1.65$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx 0.61$$

$N(d_1) = \Delta = Pr\ (Z \leqslant d_1), Z \sim N\ (0;1) \approx 0.9508$

$N(d_2) = Pr\ (Z \leqslant d_2) \approx 0.7302.$

Hence the new value of equity will be:

$$c = SN(d_1) - Xe^{-rt}N(d_2) \approx \$72.589m.$$

The result indicates the fact that stock of troubled firms which is generally treated as worthless when accessed by traditional DCF technique, since the discounted nominal amount of firm's financial obligations exceeds its current value, still has some value due to the time premium on the option (i.e. firm's equity), suggesting that the underlying asset's value (i.e. the firm's value) may exceed the option's strike price (i.e. the face value (FV) of firm's debt) at some point in time until the end of the option's life, thus making real-option approach particularly worth applying in equity valuation of essentially bankrupt firms. Although the model assumes that a firm has only one debt-issue of a zero-coupon bond, it could also be adjusted to value equity in firms with relatively complex debt structure by converting them into one equivalent zero-coupon bond.

The best way to do it is to estimate a face-value-weighted average of the durations corresponding to each of debt types and use it as a maturity period of zero-coupon debt (i.e. a life of the option considered (t)) in the Black-Scholes model.

Let us consider the following example. Suppose firm A has a complex debt-structure that is described in the table below.

What will be the corresponding face value of the zero-coupon bond equivalent to firm's aggregate debt (i.e. X parameter in the Black-Scholes option pricing model) and what will be this bond's maturity period (t)? The first part of the question requires to sum the interest and coupon adjusted face values corresponding to each of debt types (FV_i) to get the answer. Thus, the face value of the simulated equivalent zero-coupon bond (X) will be equal to $\sum FV_i = \$230m.$

As noted above, this bond's maturity period (t) may be approximated by a face-value-weighted average of these bonds' durations given the following formula:

$$t \approx \frac{\sum_{i=1}^{n} FV_i D_i}{\sum_{i=1}^{n} FV_i}, \qquad (2.8)$$

where n = number of debt types in the firm's debt structure.

Hence, in this case, we have:

$$t \approx \frac{\sum_{i=1}^{n} FV_i D_i}{\sum_{i=1}^{n} FV_i} \approx \frac{\begin{array}{c}\$10m*0.3+\$50m*7+\\ +\$70m*15+\$100m*19\end{array}}{\$230m},$$

where $t \approx$ 14,36 years.

At the same time, we can note that the Black-Scholes model may overestimate the equity value when applied for companies financed by various debt instruments with different coupon/interest payments and terms to maturity (e.g. like firm A in the above given an example).

Since the option pricing model allows for only one input for the time to expiration, we must convert these multiple bonds issues and coupon payments into one equivalent zero-coupon bond. However, it is reasonable to add that results on firm's equity values provided by real options valuation technique will be more precise in cases when the variance in the firm's value may be estimated with adequate accuracy since the model is rather sensitive to this parameter.

When considering equity to be an option one may provide insights to the potential reason underlying the conflicts of interest between equity holders and bondholders. As suggested by Damodaran (2012, p. 1169) in his book on valuation since equity being treated as an option increases in value with volatility in firms value, then it may be the case that stockholders may prompt the company to invest in risky negative NPV projects to increase their wealth at the expense of the bondholders.

Let us consider the following situation. Suppose company A (from the previous example) is in the state before the disaster. Hence the firm's current value (S) is \$150m with the following capital structure, as calculated before:

Value of equity: \$120.979m
Value of outstanding debt: \$29.021m
} S = \$150m

Now imagine that shareholders invest in the project with negative NPV of \$-10m that is rather risky thrusting the volatility in A's value (σ) to 0.6. What will be the firm's new capital structure? Using the initial information on the task from the previous example we have:

S = \$150m — \$10m = S140m (since the initial firm's value will be reduced by the project's negative NPV amount)

X = nominal value of zero-coupon debt outstanding = \$130m

t = time to maturity of zero-coupon bonds = 12 years

r = 0.12

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 1.77$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx -0.31$$

$N(d_1) = \Delta = \Pr(Z \leqslant d_1), Z \sim N(0;1) \approx 0.9614$

$N(d_2) = \Pr(Z \leqslant d_2) \approx 0.378.$

Thus, the post-project value of A's equity will be:

$$c = SN(d_1) - Xe^{-rt}N(d_2) \approx \$122.96.$$

And the value of the firm's outstanding debt after its unprofitable investment will amount to \$17.04m (i.e. S — c). Hence the firm's resulting capital structure will be (initial amounts are placed in brackets for ease of comparison):

Value of equity:
\$122.96m
(\$120.979m)
Value of outstanding debt:
\$17.04m
(\$29.021m)
} S = \$140m (\$150m)

The obtained results indicate that the company's equity value has improved by approximately \$2m at the expense of bondholders' wealth that has dropped by a substantial amount of nearly \$12m.

As also argued by Damodaran such conflict of company's primary stakeholders' interests given the option nature of equity may also be illustrated when concerning the situation of conglomerate mergers of firms with volatilities in their free cash flows (and thus in their value) being negatively or at least not highly positively correlated that generally is the case when merging firms operate in different economic sectors. As a result of such merger given the relatively small correlation between merging

firms the resulting volatility in a merged firm will be reduced as compared to an initial state before the merger — this could be derived from the variance property. Hence the equity holders will realize the substantial post-merger drop in their wealth while the bondholders will, in contrast, be better off. However, the adverse effect on shareholders' wealth may be partly offset by an additional bond issue.

Let us consider the following example. Suppose company A and company B operating in different industries and thus having the correlation coefficient between their free cash flows (ρ_{AB}) estimated as –0.3 (i.e. firms' values are negatively correlated) decide to merge.

The information on A and B is given below.

	A	B
Value of the firm (S)	$200m	$250m
FV of debt (zero-coupon bonds) (X)	$130m	$70m
Debt maturity period (t)	12 years	12 years
Volatility in S (σ)	0.3	0.4

The corresponding risk-free rate (r) is 12 per cent. What will be the value of equity and outstanding debt in the merged firm? First, let us calculate the equity and outstanding debt value of each firm before the merger. From the information given we have:

S_A = $200m

X_A = $130m

$$d_1^A = \frac{\ln\left(\frac{S_A}{X_A}\right) + \left(r + \frac{\sigma_A^2}{2}\right)t}{\sigma_A\sqrt{t}} \approx 2.32$$

$$d_2^A = d_1^A - \sigma_A\sqrt{t} \approx 1{,}28$$

$N(d_1^A) = \Delta = \Pr(Z \leqslant d_1^A)$, $Z \sim N(0;1) \approx 0.9898$

$N(d_2^A) = \Pr(Z \leqslant d_2^A) \approx 0.8998.$

Substituting the obtained results in the Black-Scholes formula we get:

$$c_A = S_A N\left(d_1^A\right) - X_A e^{-rt} N\left(d_2^A\right) \approx \$170.249m.$$

Hence company A initially has about $170.249m of equity and thus the value of its debt outstanding amounts to $29.751m (i.e. $S_A - c_A$). The same steps will be taken to estimate equity and outstanding debt levels of company B:

S_B = $250m

X_B = $70m

$$d_1^B = \frac{\ln\left(\frac{S_B}{X_B}\right) + \left(r + \frac{\sigma_B^2}{2}\right)t}{\sigma_B\sqrt{t}} \approx 2.65$$

$$d_2^B = d_1^B - \sigma_B\sqrt{t} \approx 1.26$$

$N(d_1^B) = \Delta = \Pr(Z \leqslant d_1^B)$, $Z \sim N(0;1) \approx 0.996$

$N(d_2^B) = \Pr(Z \leqslant d_2^B) \approx 0.8971.$

Substituting the obtained results in the Black-Scholes formula we get:

$$c_B = S_B N\left(d_1^B\right) - X_B e^{-rt} N\left(d_2^B\right) \approx \$234.118m.$$

Thus, company B initially has approximately $234.118m of equity and $15.882m of debt outstanding in its capital structure.

Assume that A's share in the combined firm's value is w_A = 30 per cent = 0.3 and the remaining part comes to B so $w_B = 1 - w_A = 0.7$. Thus the value of merged firm C (S_C) = $w_A S_A + w_B S_B = w_A S_A + (1 - w_A) S_B$:

S_C = 0.3*$200m + 0.7*$250m = $235m.

Given no additional debt-issues prior to the merger the FV value of the C's debt (X_C) = $X_A + X_B$ = $130m +$70m = $200m in zero-coupon bond that will mature in 12 years (i.e. t in case of firm C = 12).

At our next step, we should estimate the volatility in the value of firm C (σ_C). The variance in the merged firm's value equals σ_C^2:

$$\sigma_C^2 = \mathrm{Var}[S_C] = \mathrm{Var}[w_A S_A + w_B S_B]. \qquad (2.9)$$

Given the variance property we get:

$$\mathrm{Var}[S_C] = \mathrm{Var}[w_A S_A] + \mathrm{Var}[w_B S_B] + 2\mathrm{Cov}[w_A S_A; w_B S_B],$$

where:

$$Var\left[w_A S_A\right] = w_A^2 Var\left[S_A\right] = w_A^2 \sigma_A^2$$

$$Var\left[w_B S_B\right] = w_B^2 Var\left[S_B\right] = w_B^2 \sigma_B^2$$

$Cov[w_A S_A; w_B S_B] = w_A w_B Cov[S_A; S_B]$.

Substituting for $Cov[S_A; S_B]$ (or σ_{AB}) = $\rho_{AB}{}^{*}\sigma_A\sigma_B$ we obtain the following expression for $Var[S_C]$ (see formula 2.10 for the variance of merged firm's value):

$$Var\left[S_C\right] = w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + 2w_A w_B \rho_{AB}\sigma_A\sigma_B. \quad (2.10)$$

Estimation results yield $\mathrm{Var}\left[S_C\right] = \sigma_C^2 = 0.07$ and thus the volatility in the value of the combined firm C (σ_C) = $\sqrt{\sigma_C^2} \approx 0.26 = 26$ per cent, which is even lower than volatility in the firm's A value (σ_A) of 0.3. The reason for such a low value is the negative correlation coefficient (ρ_{AB}) of –0.3, although relatively small in absolute value.

We can note that in Damodaran's example, substantiating his suggestion of mergers' adverse effect of on equity, the value of the combined firm C (S_C) was calculated as an aggregate of the ones of firms A and B, thus $S_C = S_A + S_B$ so the value of merged firm incorporates 100 per cent of both S_A and S_B. (i.e. w_A and w_B parameters are equal to 1 and thus can't be treated as corresponding weights of firms' A and B values in one of the combined firms that by definition should be greater than zero but smaller than one and sum into unity. In this case, the formulas (2.9) and (2.10) for the variance and the volatility in the combined firm's value $\left(i.e.\ \sigma_C^2\ and\ \sigma_C\ correspondingly\right)$ should be reduced to the following form:

$$\sigma_C^2 = Var[S_C] = Var[S_A + S_B] = Var[S_A] + Var[S_B] + 2Cov[S_A; S_B] \quad (2.11)$$

$$\sigma_C^2 = \sigma_A^2 + \sigma_B^2 + 2\rho_{AB}\sigma_A\sigma_B$$

$$\sigma_c = \sqrt{\sigma_C^2} = \sqrt{\sigma_A^2 + \sigma_B^2 + 2\rho_{AB}\sigma_A\sigma_B}\ .$$

However, Damodaran used formula (2.9) for σ_C^2 thus assuming:

$S_C = w_A S_A + w_B S_B$, where $w_B = 1 - w_A$ that itself contradicts the fact that merged firm's value was initially calculated as $S_C = S_A + S_B$.

The corresponding weights were also estimated inappropriately as:

$$w_A = \frac{S_A}{S_C}$$

$$w_B = \frac{S_B}{S_C} = 1 - w_A, \text{ since } S_C = S_A + S_B.$$

Given such weights' interpretation we have:

$$\left.\begin{aligned} S_A &= w_A S_C \\ S_B &= w_B S_C \end{aligned}\right\} \Rightarrow S_C = S_A + S_B = \quad (2.12)$$

$$= w_A S_C + \left(1 - w_A\right) S_C = S_C \text{ since } w_B = 1 - w_A.$$

Obviously, the expression (2.12) above is not equivalent to the following one:

$$S_C = w_A S_A + w_B S_B.$$

However, it was treated as such in Damodaran's example and so the obtained parameters w_A and w_B were used as corresponding weights in formula (2.9) for σ_C^2, thus leading to an erratic estimate of volatility in the value of the merged firm C $\left(\sigma_C\right)$.

Given this fact, all the further obtained results cannot be trusted, so I decided to design my example that at least would not be subject to such contradictions to either prove or instead reject Damodaran's suggested hypothesis. From (2.9) it is clear that $\mathrm{Var}\left[S_C\right]$ is positively related to ρ_{AB} and so is the σ_C being the square root of $\mathrm{Var}\left[S_C\right]$. Formally this can be shown, considering the derivative of $\mathrm{Var}\left[S_C\right]$ with respect to ρ_{AB}:

$$\frac{\partial \mathrm{Var}\left[S_C\right]}{\partial \rho_{AB}} = 2w_A w_B \sigma_A \sigma_B > 0,\ since\ w_A, w_B, \sigma_A, \sigma_B > 0$$

Hence both $\mathrm{Var}\left[S_C\right]$ and σ_C will increase with ρ_{AB}. Thus since $\rho_{AB} \in \left(-1;1\right)$ then if the value of firms A and B were highly or even perfectly positively correlated ($\rho_{AB} = 1$) the resulting volatility in combined firm's value (σ_C) would be much higher, and thus the value of its equity would also increase as compared to the case of $\rho_{AB} = -0.3$. Mathematically we have:

if $\rho_{AB} = 1$, then:

$$\sigma_C^2 = \mathrm{Var}\left[S_C\right] = w_A^2\sigma_A^2 + w_B^2\sigma_B^2 + 2w_A w_B \sigma_A \sigma_B = \left(w_A\sigma_A + w_B\sigma_B\right)^2$$

$$\sigma_C = \sqrt{\left(w_A\sigma_A + w_B\sigma_B\right)^2} = \left|w_A\sigma_A + w_B\sigma_B\right|$$

given $w_A, w_B, \sigma_A, \sigma_B > 0$:

Table 6
Information on firms' capital structure

	A	B	A + B	C (30% A + 70% B)
Equity	$170.249m	$234.118m	$404.367m	$188.942m
Debt outstanding	$29.751m	$15.882m	$45.633m	$46.058m
Total	$200m	$250m	$450m	$235m

Source: The author.

$\sigma_C = w_A\sigma_A + w_B\sigma_B \approx 0.37 > 0.26$ (i.e. σ_C given $\rho_{AB} = -0.3$).

Since the debt maturity period (t) stays the same, the corresponding risk-free rate(r) should not be changed as well. Having obtained all the necessary inputs, we can now substitute them into the Black-Scholes model to find the value of the merged firm's equity and outstanding debt.

S_C = $235m
X_C = $200m

$$d_1^C = \frac{\ln\left(\frac{S_C}{X_C}\right) + \left(r + \frac{\sigma_C^2}{2}\right)t}{\sigma_C\sqrt{t}} \approx 2.23$$

$$d_2^C = d_1^C - \sigma_C\sqrt{t} \approx 1.33$$

$N(d_1^C) = \Delta = \Pr(Z \leqslant d_1^C), Z \sim N(0;1) \approx 0.987$

$N(d_2^C) = \Pr(Z \leqslant d_2^C) \approx 0.908$

$$c_C = S_C N\left(d_1^C\right) - X_C e^{-rt} N\left(d_2^C\right) \approx \$188.942m.$$

Thus, the combined company C will have nearly $188.942m of equity and thus about $46.058m of debt outstanding. Let us summarize the obtained results on the firms' capital structure in the table for the ease of comparison (see Table 6).

Based on the information from the table above the aggregate value of equity before the merger (i.e. A + B) is $404.367m and it will substantially drop by more than a half (i.e. by $215,425m) up to $188.942m in merged firm C. At the same time, the level of outstanding debt, in contrast, will rise as a result of a merger by nearly $0.425m from the total aggregate amount of $45.633m to $46.058m. Hence the wealth of bondholders will improve at the expense of the stockholders if the merger takes place. This occurs partly to a negative correlation between merging firms' free cash flows that yields the relatively small volatility in combined firm's value and thus implies the lower value of equity and as a result the higher level of outstanding debt as compared to the ones of firms A and B when taken in aggregate. Thus, conglomerate mergers not followed by increases in leverage indeed may result in a wealth transfer from equity holders to debt holders.

As we have seen real options could be referred to as an asset (particularly intangible one that generally cannot be valued by traditional DCF approach) or extended investment opportunity providing its holder with the right to receive additional cash flows under certain circumstances, such as an option to delay, expand or abandon a particular project.

Real options may be valued using standard option pricing approaches, including the Binomial model and the Black-Scholes model. However, the latter is applied more frequently due to its relative simplicity and generality, enabling them to undertake rather complicated valuations without turning them into a time-consuming, exhausting process.

Despite some limitations mainly implied by its underlying assumptions, the real-option technique provides its user with the extended flexibility and thus has a broad scope of application in investment, asset or equity valuation and even may be extended to value the entire firm under the corresponding assumptions.

Given particular circumstances this approach may be either applied as a complement to traditional techniques so as to account for the potential value-adding factors generally neglected by standard DCF model or in contrast be the only possible valuation tool, thus turning it into a powerful practical instrument of value analyses that definitely should not be ignored.

Valuing Patent Rights of Amgen Inc. on "Parsabiv" and Determining the Optimal Time of its Exercise

Problem Overview

In this part, we will consider the application of the real-option approach in the determination of the optimal time of the patent. The object of our analysis will be the recent patent of Amgen Inc. on the production and sale of Etelcalcetide (trade name "Parsabiv"). Amgen Inc. is one of the leading companies in U.S. biotech-industry that develops manufactures and implements innovative drugs based on genetic engineering. Founded in 1980, Amgen is known as the leader in its industry sector, as it was among the first biotech-firms that managed to unleash the potential of a new generation of effective and safe drugs to provide patients with innovative methods of serious diseases treatment.

Etelcalcetide is a calcimimetic drug for the treatment of secondary hyperparathyroidism in patients undergoing hemodialysis. Initially, the drug's formula was developed by another company KAI Pharmaceuticals that consequently held the patent on it. However, based on the information from the company's official press release[2] Amgen Inc. acquired KAI in 2012. Thus, it could be assumed that in 2013 the acquisition process had been already finished and thus Amgen obtained the patent rights on Etelcalcetide, expiring at the end of 2030.

According to the information from the U.S. National Library of Medicine[3] the drug was synthesized in 2013, meaning that Amgen exercised the patent on Etelcalcetide in the year just immediately following its acquisition.

However, although having exercised the patent and thus having the drug developed, Amgen could not market its product Parsabiv (trade name for Etelcalcetide) until its approval by the US Food and Drug Administration (USFDA) for treatment of secondary hyperparathyroidism (HPT) in adult patients with chronic kidney disease (CKD) on hemodialysis in 2017. Thus, Amgen did not receive any cash flows from its product sales until that time.

Was it the right decision to exercise a patent immediately or it would have been better to wait till later times and if yes what would be the optimal time of converting a patent in a commercial product? These are the issues considered in this chapter.

Patent Value Estimation

We will begin our analysis from estimating the value of Amgen's patent on Parsabiv using the technique described in part 2 based on the application of the modified Black-Scholes model. According to this approach, the value of the patent will be equal to one of the corresponding options to delay the drug development project provided by the patent. Thus, we need to obtain the necessary data on modified Black-Sholes model's required inputs to get the answer.

It should be noted that we will estimate the patent's present value as at the year of 2013. Thus in 2013 the corresponding real option to delay had 17 years remained till its expiration since Amgen owns the patent rights on Parsabiv production and marketing till the end of 2030 (i.e. t = 17).

Given the information above Amgen exercised the patent on Parsabiv in 2013 and thus invested the amount X in its development. The estimation of this investment's amount is probably the toughest thing to do in this section since there is no publicly available information on this variable thus we used the average figure based on the information on research and development (R&D) spending statistics for pharmaceutical companies as at 2013 provided by Astra Zeneca company (Al-Huniti, 2013, p. 23) and therefore assumed X = $3,692.14m.

At our next step, we calculated the present value (as at 2013) of the corresponding cash flows to be received from the Parsabiv's sales using the historical data obtained from the official company's financial statements and from Bloomberg Terminal and also forecasting it for future periods till the end of 2030 mostly assuming stable average growth rates of Amgen's financial indicators and relevant ratios.

[2] FDA Approves Amgen's Parsabiv™ (Etelcalcetide), First New Treatment in More than a Decade for Secondary Hyperparathyroidism in Adult Patients on Hemodialysis. Available at: https://www.amgen.com/media/news-releases/2017/02/fda-approves-amgens-parsabiv-etelcalcetide-first-new-treatment-in-more-than-a-decade-for-secondary-hyperparathyroidism-in-adult-patients-on-hemodialysis.

[3] U.S. National Library of Medicine National Center for Biotechnology Information. Etelcalcetide. Available at: https://pubchem.ncbi.nlm.nih.gov/compound/Velcalcetide.

Each cash-flow from Parsabiv was estimated as the share of the corresponding year's net operating profit (i.e. EBIT(1 — tax)) from product sales — this share was assumed to be equal to one of Parsabiv's sales in a total amount of company's product sales. Since Parsabiv is a relatively new product, it will at first lack public trust at the primary stage of its introduction, which thus results in its initial share in total sales to be rather insignificant. This may also be explained by the company's intention no to produce large amounts of new product in order not to incur additional losses in case of low product demand. Thus, the initial quantity produced will be limited, and so will the primary product sales, undertaken at most to test the market conditions so as to determine the further sales development strategy.

However, given the innovativeness of Parsabiv and according to forecasted estimates provided by Bloomberg the first stage of introduction will take only several years and then it sales' share are assumed to grow relatively fast up until the year of 2023, so by that time this share will slightly exceed the one of Amgen's another drug — Sansipar which is a close substitute of Parsabiv being the less advanced predecessor of the latter. After that, Parsabiv's share in total product sales is expected to experience the normal average growth rate corresponding to the one of Sensipar. Obviously, this assumption makes our forecast rather conservative — however, given the prudence accounting concept, it is better to understate income rather than expenses.

Effective tax rates were also assumed to be subject to stable average growth, estimated without considering the abnormal fluctuations due to accounting adjustments to recent Tax Act enacted by the US on December 22, 2017. At the same time, we expect the tax rate to be no more than the US current corporate income tax of 21 per cent. It is likely that the Amgen's effective tax rate will be generally lower than the corporate one due to tax reliefs provided by US government to companies involved in R&D. However, we again chose the conservative approach on prudency grounds to be on the safe side.

The obtained cash flows were discounted at Amgen's WACC using its historic values obtained from Bloomberg Terminal and assuming it constant in future periods given its insignificant average growth rate.

As a result of our calculations, we have obtained the following discounted cash flows (DCF) for each period of Parsabiv's sales, as shown in the tables below.

Thus, the present value of cash flows from the Parsabiv's development (PV) amounts to approximately $7627.548m, assuming them to be received starting from the next year after the investment in the product's development was made and thus the patent was exercised. However, the fact that Amgen couldn't market its newly synthesized drug after its development in 2013 until the approval of US FDA was received in 2017 allowing for the first sales to take place creates the development lag (dlag) of 3 years, that should also be taken into account in the estimation of the present value of cash flows from the Parsabiv's sales. Given that the corresponding cash flows are received evenly throughout the patent expiration period (t) the annual cost of the product's development delay could be calculated as $y = \frac{1}{t} = \frac{1}{17} \approx 0.059$.

Therefore, PV of cash flows from Parsabiv's realisation adjusted to the development lag (S) was estimated as follows:

$$S = \frac{PV}{(1+y)^{dlag}} \approx \$6425.607m$$

Given the remaining patent life of 17 years, we take assumed the risk-free rate (r) to be equal to the one of the 20-year US Treasury bond in 2013 (i.e. r = 0.0312). Due to the lack of historical data on Parsabiv, being a relatively new product, the volatility in its cash flows (σ) was approximated by the one in cash flows received from the sales of its close substitute Sansipar (i.e. $\sigma \approx 0.226$). Having obtained the key inputs, we can now estimate the other parameters of the modified version of Black-Scholes model and then estimate the value of the patent, which coincides with the one of the corresponding real call option to delay:

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - y + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \approx 0.56$$

$$d_2 = d_1 - \sigma\sqrt{t} \approx -0.38$$

$N(d_1) = \Delta = Pr\ (Z \leqslant d_1)$, $Z \sim N\ (0;1) \approx 0.7113$
$N(d_2) = Pr\ (Z \leqslant d_2) \approx 0.3534$.

Table 7
Parsabiv's DCF calculation output

	31.12.2017	31.12.2018	31.12.2019
Year № (i)	1	2	3
	$	$	$
Product sales	21795000320	22532999168	21881339661
EBIT(adj.)/Sales, %	59	58	59
EBIT (adj.)	12858000640	13116999424	12967750935
Eff. Tax rate (tax)	0.794	0.121	0.206
EBIT (1-tax)	2648748132	11529842494	10302053293
Parsabiv's share in total sales, %	0.023	1.491	2.429
CF (Parsabiv)	607650,3999	171926828,2	250285019,8
WACC, %	10	8	8
DF	0.907	0.852	0.787
DCF	551406.8964	146556990.9	196983200.4

Source: The author.

Table 8
Parsabiv's DCF calculation output

	31.12.2020	31.12.2021	31.12.2022
Year № (i)	4	5	6
	$	$	$
Product sales	22005103514	22976624931	23991038847
EBIT(adj.)/Sales, %	60	61	63
EBIT (adj.)	13276678018	14113264999	15002566808
Eff. Tax rate (tax)	0.21	0.21	0.21
EBIT (1-tax)	10488575634	11149479350	11852027778
Parsabiv's share in total sales, %	3.094	4.490	6.517
CF (Parsabiv)	324498464	500640503.6	772394761.9
WACC, %	8	8	8
DF	0.727	0.671	0.619
DCF	235797079.7	335879272.2	478440554.3

Source: The author.

Therefore, the corresponding call value is:

$$c = Se^{-yt}N(d_1) - Xe^{-rt}N(d_2) \approx \$913.525m.$$

Hence the Amgen's patent on Parsabiv approximately worth $913.525m.

Determination of Optimal Time to Exercise the Patent Rights

Was it the right decision to exercise a patent immediately or Amgen should have waited till later times? Since the NPV from the Parsabiv's development in 2013 equals $S - X \approx \$2733.47m$, so that it exceeds the obtained value of the patent (c) then for Amgen it's definitely better to convert Parsabiv into the commercial product as soon as possible than to hold the patent on it that will become less valuable with each year of the development delay that will shrink the period of the patents expiration (t) and the same time will increase annual costs of delay (y) thus leading to a decrease in the corresponding call's value. Hence the Amgen's decision to develop the Parsabiv in 2013 was reasonable.

Table 9
Parsabiv's DCF calculation output

	31.12.2020	31.12.2021	31.12.2022
Year № (i)	4	5	6
	$	$	$
Product sales	22005103514	22976624931	23991038847
EBIT(adj.)/Sales, %	60	61	63
EBIT (adj.)	13276678018	14113264999	15002566808
Eff. Tax rate (tax)	0.21	0.21	0.21
EBIT (1-tax)	10488575634	11149479350	11852027778
Parsabiv's share in total sales, %	3.094	4.490	6.517
CF (Parsabiv)	324498464	500640503.6	772394761.9
WACC, %	8	8	8
DF	0.727	0.671	0.619
DCF	**235797079.7**	**335879272.2**	**478440554.3**

Source: The author.

Table 10
Parsabiv's DCF calculation output

	31.12.2023	31.12.2024	31.12.2025
Year № (i)	7	8	9
	$	$	$
Product sales	25050238956	26156202563	27310994267
EBIT(adj.)/Sales, %	64	65	66
EBIT (adj.)	15947905097	16952810825	18021037441
Eff. Tax rate (tax)	0.21	0.21	0.21
EBIT (1-tax)	12598845026	13392720552	14236619579
Parsabiv's share in total sales, %	9.458	10.003	10.578
CF (Parsabiv)	1191660810	1339636071	1505986257
WACC, %	8	8	8
DF	0.572	0.528	0.488
DCF	681510837.2	707356561.1	734182462.3

Source: The author.

However, given the conservative assumptions about the future growth in Parsabiv's sales share and tax rates underlying the calculation of the patent value it could have been the case that the obtained estimate (c) will instead exceed the corresponding project's NPV if the more optimistic course of action is considered instead. If it is true than holding Parsabiv as a patent would be preferable than converting it immediately into a commercial product. However, in this case, one will likely to be concerned with a question about the optimal period of holding it as a patent.

This issue was considered by Damodaran (2012, p. 1103) in his book on investment valuation on the example of a patent on drug Avonex owned by another the US biotech firm Biogen, which value (c) estimated by the similar real-option technique appeared to be higher than the NPV from its immediate conversion into the commercial product in 1997 (i.e. development of drug Avonex and thus the exercise of the patent rights on it) with the corresponding difference being the time premium for holding a patent on Avonex rather than investing in its development as a product.

Table 11
Parsabiv's DCF calculation output

	31.12.2026	31.12.2027	31.12.2028
Year № (i)	10	11	12
	$	$	$
Product sales	28516769819	29775780148	31090375561
EBIT(adj.)/Sales, %	67	68	70
EBIT (adj.)	19156574908	20363664600	21646815150
Eff. Tax rate (tax)	0.21	0.21	0.21
EBIT (1-tax)	15133694177	16087295034	17100983969
Parsabiv's share in total sales, %	11,187	11,831	12,511
CF (Parsabiv)	1692993086	1903221610	2139555398
WACC, %	8	8	8
DF	0.450	0.416	0.384
DCF	762025713.2	790924895.9	820920055.7

Source: The author.

Table 12
Parsabiv's DCF calculation output

	31.12.2029	31.12.2030
Year № (i)	13	14
	$	$
Product sales	32463010127	33896246266
EBIT(adj.)/Sales, %	71	72
EBIT (adj.)	23010819288	24460771741
Eff. Tax rate (tax)	0.21	0.21
EBIT (1-tax)	18178547238	19324009675
Parsabiv's share in total sales, %	13,231	13,992
CF (Parsabiv)	2405236090	2703907855
WACC, %	8	8
DF	0.354	0.327
DCF	852052756.7	884366139.1
	$	
$PV = \sum DCF_i$	7627547926	

Source: The author.

In this case, as argued by Damodaran the optimal time of patent exercise is the one at which this time premium will turn to zero (i.e. when c = S — X).

This point in time could thus found graphically by valuing the call assuming that all Black-Scholes model's key parameters other than patent life (t) stay constant and saving the obtained estimates for each t to plot them further on the graph together with the current product's NPV. This can be treated as a simulation of the patent's early exercise at different times till its expiration period (thus allowing it to be presented as an American call) with the obtained values being its values

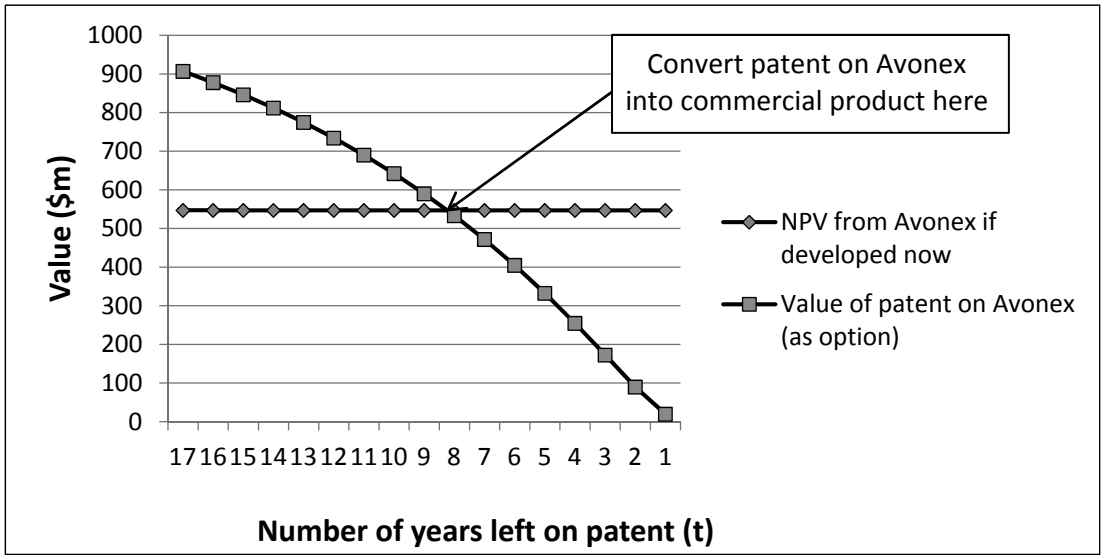

Figure 5. Patent value Vs. NPV (Avonex case)

Source: The author.

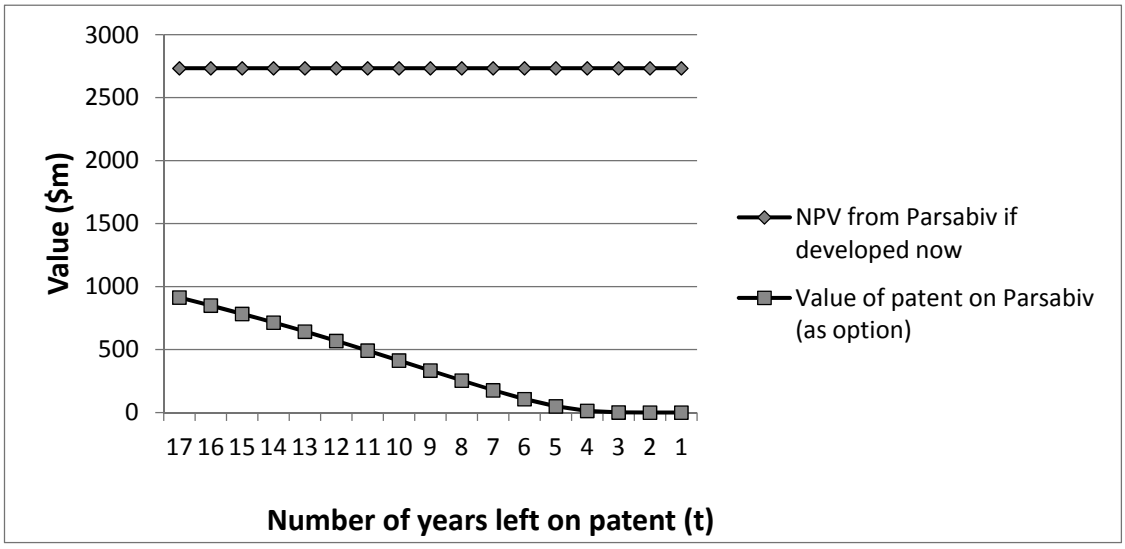

Figure 6. Patent value Vs. NPV (Parsabiv case)

Source: The author.

given the corresponding exercise time since the traditional Black-Scholes model doesn't allow for such flexibility to be taken into account and thus assumes that patent may be exercised only at the end of its life (i.e. a patent is assumed to be a real call option of European type). The optimal time to exercise is then determined as the one at which these two curves intersect.

Since with each year of product development delay, the patent life (t) will become shorter resulting in a higher cost of annual development delay that will yield lower call (i.e. a patent) values the curve illustrating the value of the patent as an option at different times will be therefore downward sloping.

Following this logic and using the initial data from the example in Damodaran's book we have obtained the graph of c (i.e. the value of the patent as an option) with respect to remaining patent life (t) plotted together with line fixed at the current level of NPV resulted from the immediate development of Avonex (the picture of the same graph was given in Damodaran's book — however, we decided to model it ourselves so as to ensure the understanding of the described methodology).

Moving back to our problem, we can plot the same graph for the case of Amgen's Parsabiv, illustrated in Figure 6.

Therefore given that the patent value increases with its remaining life, likely, the optimal time to

exercise the patent on Parsabiv (denoted as the point of intersection of two curves) had passed long before the time when Amgen Inc. acquired the KAI Pharmaceuticals and thus consequently became the owner of the corresponding patents rights.

Obviously, since the described technique of patent's optimal exercise time determination is based on simulation, it is not expected to yield precise results as compared to ones based on models applicable to American option valuation such as Binomial one or using the Black-Sholes equation with a non-linear function. However, these approaches are far more complicated and time-consuming. Thus, in a world when the time on decision-making is always limited the accuracy advantage is vanished, making such simulation the best tool providing with the general picture of overall value trends.

Conclusions

Asset valuation plays a significant role in various economic relationships, being a crucial element of any investment decision-making process and corporate valuations in general.

Classical approaches to asset valuation include several methods concerning different aspects of this process, each of which has its strengths and weaknesses.

However, given the availability and predictability of data on the corresponding variables such as future cash flows and discount rates the DCF approach is generally considered as the most accurate and superior traditional asset valuation technique since it takes into account the potential income the asset is expected to generate each future period of its remaining useful life with regard to the time value of money.

Real options are a response to the disadvantages and limitations of classical methods of asset valuation and assessment of investment projects that do not allow considering the decision elasticity inherent in them. Thus, the essence of real options is not to replace classical methods, but to supplement and enrich them with additional elements, often playing the ultimate role in the investment decision-making process.

Despite some limitations mainly implied by its underlying assumptions, the real-option technique provides its user with the extended flexibility and thus has a broad scope of application in investment, asset or equity valuation and even may be extended to value the entire firm under the corresponding assumptions.

Given particular circumstances this approach may be either applied as a complement to traditional techniques so as to account for the potential value-adding factors generally neglected by classical approaches or in contrast be the only possible valuation tool, thus turning it into a powerful practical instrument of value analyses that definitely should not be ignored but instead is to be adopted by the analysts and other expert dealing with valuation problems so as to ensure the adequacy and comprehensiveness of the obtained estimates and thus not to make wrong decisions.

However despite the advantages of the extended flexibility in asset and investment project valuation, real options can be costly to obtain (e.g., the right to extend a lease or purchase a property), complex to value, and dependent on problematic assumptions — these are the main drawbacks of this approach. In this case, they should not be pursued unless the firm has the resources to exploit the option, and they add significantly to the value of the firm.

This research may be further developed to analyse the application of American option pricing models in corporate valuations.

By analogy with equity valuation in troubled firms, the real-options approach may be extended to access the fair value of countries where the amount of internal and external debt obligations overhang the value of the countries assets since the traditional methods can't be used in this case.

Real-option valuation technique may also be applied in the measurement of megapolises' potential boundaries. The intuition is as follows. According to the statistical data, the population in megacities is growing at a faster rate in comparison with general population growth. The main reason for this paradox is the internal migration of people from provinces to megapolises in search of potentially available new opportunities and better living standards. However, the authorities of megacities are aware of the fact the endless extensive growth of cities creates an array of problems; therefore, the supply of new housing development intentionally lags the existing demand for it. The amount of supply deficit in the land market is even more significant. All these factors lead to an increase in numbers of flours in

the constructed buildings as well as raise the price level in the real estate market, given the growth in construction costs due to rising land prices and the need to balance demand with limited construction opportunities.

Given these facts, such migration to megacities may be defined as a real option of people from provinces to receive new potential opportunities, so to attain better living conditions. Hence the migration to megapolises will continue as long as its value (as an option) remains positive. From an economic point of view, this option value will be positive unless the excess of the price level in megalopolises over the price level in provinces will exceed the number of new potential opportunities, provided by megacities to people migrating from provinces. Given the option nature of migration, the government can thus not only predict by also regulate its flows by altering these parameters.

It should be noted that such migration to megacities a characteristic feature of all megacities all over the world. However, the time when it reaches its peak differs. Thus, the megacities in developed countries have already passed this stage, while the opposite is true for the ones in developing countries.

Therefore, this example reflects the extensive possibilities of real options approach applies not only in corporate valuations but also in the field of planning for the development of megapolises particularly in the context of forecasting the magnitude of internal migration providing room for estimation and control of the potential level of extension of city areas.

References

Al-Huniti, Nidal. (2013). Quantitative Decision–Making in Drug Development. AstraZeneca.

Angelis D.I. (2000). Capturing the options value of R&D. Research Technology Management.

Bauer, M. (2009). An analysis of the use of discounting cash flow methods and real options to value flexibility in real estate development projects, Lambert Academic Publishing, Berlin.

Black, F., Scholes, M. (1973). The pricing of Options and Corporate Liabilities. *Journal of Political Economy, 81*(3), 637–654.

Branch, Marion A. (2003). Real Options in Practice. New York: Wiley.

Brennan, J., Schwartz, E. (1985). Evaluating Natural Resource Investments. *The Journal of Business, 58*(2), 135–157.

Brennan, M. J., Trigeorgis, L. (2000). Project Flexibility, Agency, and Competition. Oxford: Oxford University Press.

Bruslanova, N. (2004). Evaluation of investment projects using real options technique. *Finansovyy director,* 4, 20–23. (in Russian)

Bulan, L., Mayer, C., Tsuriel, Somerville C. (2009). Irreversible investment, real options, and competition: evidence from real estate development. *Journal of Urban Economics, 65*, 237–251.

Capozza, D., Li, Y. (1994). The intensity and timing of investment: the case of land. *The American Economic Review, 84*(4), 889–904.

Childs, P. D., Riddiough, T. J., Triantis, A. J. (1996). Mixed uses and the redevelopment option. *Real Estate Economics, 24*, 317–339.

Cox, J., Ross, S., Rubinstein, M. (1979). Options Pricing: a simplified approach. *Journal of Financial Economics, 7*, 229–263.

Cox, Ross, Rubinstein. (1979). Option Pricing: A simplified approach. *Journal of Financial Economics, 7*, 229–263.

Damodaran, Aswath. (2006). Damodaran on Valuation: Security Analysis for Investment and Corporate Finance. John Wiley & Sons.

Damodaran Aswath. (2012). Investment Valuation: Tools and Techniques for Determining the Value of any Asset. University Edition. Wiley Finance Series.

DePamphilis, D. (2017). Mergers, Acquisitions, and Other Restructuring Activities: An Integrated Approach to Process, Tools, Cases, and Solutions. Academic Press.

Dixit, A. K., Pindyck, R. S. (1994). Investment under Uncertainty. Princeton, NJ: Princeton University Press.

Dixit, A. K. (1992). Investment and hysteresis. *Journal of Economic Perspectives, 6*, 107–132.

Folta, T. B., Miller, K. D. (2002). Real options in equity partnerships. *Strategic Management Journal, 23*, 77–88.

Geske, R. (1979). The valuation of compound options. *Journal of Financial Economics, 7*(1), 63–81.

Grenadier, S. R. (1995). Valuing lease contracts a real–option approach. *Journal of Financial Economics, 38*, 297–331.

Hertz, D. (1964). Risk Analysis in Capital Investment. *Harvard Business Review, 42*, 95–106.

Horn, A. et al. (2015). The Use of Real Options Theory in Scandinavia's Largest Companies. *International Review of Financial Analysis, 41*(C), 74–81.

Howell, S. et al. (2001). Real Options. Evaluating Corporate Investment Opportunities in a Dynamic World. London: Financial Times Prentice Hall.

Huchzermeier, A., Loch, C. (2003). Evaluating R&D Projects as Real Options: Why More Variability is not always better. Working Paper, WHU Koblenz and INSEAD.

Kalinin, D. (2003). How to determine the "real" value of the investment project? An example of using the method of real options. *Rynok tsennykh bumag* [Securities market], *24*, 62–65.

Karpova, N., Pocherin, N. (2000). Application of option theory in determination of value of R&D and license agreements. *Voprosy otsenki* [Assessment issues], *2*, 57–66.

Krukovskiy, A. A. (2008). The method of real options in investment management. *Trudy ISA RAN* [Proceedings of ISA RAS], *37*, 122–143.

Kulatilaka, N., Markus, A. J. (1992). Project valuation under uncertainty: where does DCF fail? *Journal of Applied Corporate Finance, 5*(3), 92–100.

Leslie, K. J., Michaels, M. P. (1998). Making real options real. *The McKinsey Quarterly, 3*, 128–141.

Leslie, K. J., Michaels, M. P. (2000). The real power of real options. *The McKinsey Quarterly, 3*, 4–22.

Leung, B.Y.P., Hui, E.C.M. (2002). Option pricing for real estate development: Hong Kong Disneyland. *Journal of Property Investment & Finance, 20*(6), 473–496.

Limitovskiy, M. A. (2017). *Investitsionnyye proyekty i real'nyye optsiony na razvivayushchikhsya rynkakh: ucheb. posobiye dlya bakalavriata i magistratury* [Investment projects and real options in emerging markets: study guide for undergraduate and graduate students], 5th edition. Moscow: Yurayt Publ.

Lucius, D. I. (2001). Real options in real estate development. *Journal of Property Investment & Finance, 19*(1), 73–78.

Majda, S., Pinduck, R. (1987). Time to build, Option Value and Investment Decisions. *Journal of Financial Economics, 18*, 7–27.

Mao, Y., Wu, W. (2011). Fuzzy Real Option Evaluation of Real Estate Project Based on Risk Analysis. *Systems Engineering Procedia, 1*, 228–235.

Mathews, S., Datar, V. (2007). A Practical Method for Valuing Real Options: The Boeing Approach. *Journal of Applied Corporate Finance, 19*(2), 95–104.

Milne, A., Whalley, A. E. (2000). Time to build, option value and investment decisions: a comment. *Journal of Financial Economics, 56*, 325–332.

Morano, P., Tajani, F. (2013). The transfer of development rights for the regeneration of brownfield sites. *Applied Mechanics and Materials, 409–410*, 971–978.

Mun, J. (2006). Real Options Analysis. Tools and techniques for valuing strategic investments and decisions. John Wiley & Sons.

Myers, Stewart C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics, 5*(2), 147–175.

Pacheco-de-Almeida, G., Zemsky, P. (2003). The effect of time–to–build on strategic investment under uncertainty. *Rand Journal of Economics, 34*, 166–182.

Pirogov, N. K., Salomykova, O. A. (2007). Analysis of companies' growth options in the emerging capital markets. *Korporativnyye finansy* [Corporate finance], *2*(2), 32–42.

Pirogov, N. K., Zubtsov, N. (2008). Interaction of real options on the example of development projects in Russia. *Korporativnyye finansy* [Corporate finance], *6*(2), 40–55.

Quigg, L. (1993). Empirical testing of real option–pricing models. *Journal of Finance, 48*(2), 621–39.

Rocha, K., Salles, L., Alcaraz, Garcia, F. A., Sardinha, J. A., Teixeira, J. P. (2007). Real estate and real options — a case study. *Emerging Markets Review, 8*, 67–79.

Schatzki, T. (2003). Options, uncertainty, and sunk costs: an empirical analysis of land use change. *Journal of Environmental Economics and Management, 46*, 86–105.

Shen, J., Pretorius, F. (2013). Binomial option pricing models for real estate development. *Journal of Property Investment & Finance, 31*(5), 418–440.

Shoup, D. (1970). The optimal timing of urban land development. *Regional Science Association Papers, 25*, 33–44.

Stewart, B. (2002). The quest for Value. Harper Collins.

Tan, Jackson J. (2018). Interfaces for enterprise valuation from a real options lens. *Strategic Change, 27*(1), 69–80.

Titman, S. (1985). Urban Land Prices Under Uncertainty. *The American Economic Review, 75*(3), 505–514.
Triantis, A. J., Hodder, J. E. (1990). Valuing flexibility as a complex option. *Journal of Finance, 45*, 549–565.
Trideorgis, L. (2003). Real options: Managerial flexibility and strategy in resource allocation. Cambridge, Mass: MIT Press.
Vonnegut, A. (2000). Real Options Theories and Investment in Emerging Economies. *Emerging Markets Review, 1*, 82–100.
Vygon, G. V. (2004). Estimation of the fundamental value of oil fields: the method of real options. *Ekonomika i matematicheskiye metody* [Economics and mathematical methods], *37*(2), 54–69. *Data-sources:* Bloomberg Terminal Drugbank. Etelcalcetide. Available at: https://www.drugbank.ca/drugs/DB12865 (Retrieved 3 May 2019)
FDA Approves Amgen's Parsabiv™ (Etelcalcetide), First New Treatment In More Than A Decade For Secondary Hyperparathyroidism In Adult Patients On Hemodialysis. Available at: https://www.amgen.com/media/news-releases/2017/02/fda-approves-amgens-parsabiv-etelcalcetide-first-new-treatment-in-more-than-a-decade-for-secondary-hyperparathyroidism-in-adult-patients-on-hemodialysis (Retrieved 3 May 2019)
Official annual financial statements of Amgen Inc.
U.S. National Library of Medicine National Center for Biotechnology Information. Etelcalcetide. Available at: https://pubchem.ncbi.nlm.nih.gov/compound/Velcalcetide (Retrieved 3 May 2019)

Оценка справедливой стоимости активов с использованием метода реальных опционов

Александр Гулабян
Бакалавр экономики факультета международных финансов, Департамент мировой экономики и международных финансов, Финансовый университет, Москва, Россия

Аннотация. Целью данной работы является анализ и систематизация возможных подходов к оценке реальных опционов, особенно при рассмотрении практических аспектов их применения в реальных оценочных задачах. Объектом исследования являются модели ценообразования опционов, а предметом — их применение при оценке реальных опционов, заложенных в корпоративные оценки, особенно с учетом побочных эффектов.

В статье делается попытка:

— сформулировать понятие справедливой стоимости и проанализировать традиционные подходы к ее расчету в контексте оценки активов;

— определить реальный опционный подход к оценке справедливой стоимости и проанализировать его теоретические предпосылки;

— определить роль подхода к реальным опционам в традиционной системе методов оценки стоимости.

Проанализированы практические аспекты их применения в задачах оценки с учетом соответствующих примеров и приведены реальные примеры применения этой методики в современных рыночных условиях с использованием последних данных.

Ключевые слова: оценка реальных опционов; оценка активов; оценка справедливой стоимости; подход к реальным опционам