# Asymmetric and non-linear real effects of monetary policy shocks

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# ASYMMETRIC AND NON-LINEAR REAL EFFECTS OF MONETARY POLICY SHOCKS

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# List of abbreviations / Glossary

- ADF test: Augmented Dickey-Fuller test
- AS-AD model: an aggregate demand-aggregate supply model used in macroeconomics to represent the relationship between these two curves, which leads to equilibrium and the fluctuation of output and price on the market.
- Consumer durables, also known as durable goods, are a category of consumer goods that do not wear out quickly and therefore do not have to be purchased frequently. (Investopedia 08-09-2024)
- FinTech/fintech : Financial Technology
- FRED: Federal Reserve Economic Data
- Great Depression: It was a period of global economic downturn present in many countries around the world from the period of 1929 to 1939. One of the first shocks was felt by the Wall Street stock market.
- LP : Local Projection
- NKPC :New Keynesian Phillips Curve
- Trend inflation refers to the long-term movement in the inflation rate, excluding short-term fluctuations.
- The term "Keynesian" is used because the explanation is rooted in price and wage rigidity, a topic which is generally emphasised in the works of Keynes.
- VAR: Vector Autoregression

# Contents

# Introduction

For decades, institutions responsible for managing monetary policy have developed a variety of strategies to interact with economic agents and influence their behaviour in order to steer the economy toward the desired direction. Their key objective is to reach stability across a set of fundamental macroeconomic variables that will guarantee sustainable growth, low inflation, reliable currency value, and a consistent environment promoting international trade. Central banks that are in charge of the monetary policy decisions have in their arsenal conventional and unconventional measures that they can adopt depending on market conditions. Interest rate manipulation is the major tool used for attaining the predetermined goals; it is a procedure that is among normal banking operations, known as a conventional measure. Unconventional measures, on the other hand, are complementary instruments that the banks can use if traditional ones fail. Unconventional policies include reserve requirements, quantitative easing, open market operations, and many more. Both of those categories of tools have been massively adopted for a while, and theoretically, it was supposed that they would affect the economy in predictable proportion and direction. Nevertheless, real-world experience has shown that this statement was not always true.

The recent literature suggests that the real effect of monetary policy on the economy can vary depending on a number of factors. The first is the direction of the actions: both positive and negative policies will have asymmetric consequences. A second factor with a similar conclusion about unequal responses can come from the size of the shock. It states that the proportions of the impacts can be larger if the initial actions are relatively smaller. Finally, the third element is the business cycle. Whether the economy is in recession or expansion, the outcome of the policy intervention will be different. Many specialists have conducted studies to explain this phenomenon. Ravn and Sola described distinct categories of asymmetries and the main factors that could explain these distortions. Morgan based his analysis mainly on the business cycle. Agenor proposed additional conditions, not systematically related to the business cycle, that could potentially explain those disparities. These are only a very few examples of works that have been made about this topic.

The combination of recent disruptions and the rapid loss of power of the tools employed by the central banks has stressed the importance of understanding the full set of factors that could impact the intervention of the financial authorities. The fast shift in the structure of the markets and the emergence of new types of instruments have convinced economic actors that the current models and strategies are no longer consistent with the environment. The problem of the uneven and non-proportional effects seems to be much more complex than it is believed to be. For that reason, it is crucial to be well-equipped to reduce the deviations in the outcome of policy shocks. To do so, it is essential to determine where these movements can come from.

The aim of this work is to do a literature review that could regroup and summarise some of the results that have been revealed in the literature related to the concepts of asymmetries and nonlinearities in the effects of the monetary policy shocks. To do it, the review will start with a short explanation of what these concepts are and why it is so important to consider them deeply before a policy measure is taken. Then, the script will continue with a chapter that will be devoted to the analysis of different types of disproportionalities and deviations present in the effects, followed by the presentation of various factors that could directly impact the results of the intervention of the national banks. A particular focus will be on the distinction between elements related to the business cycle and those that are not connected to the state of the economy. Then, before moving to the conclusion, there will be a section concentrated on an empirical analysis of an alternative proposition regarding the potential effect of the development of financial technologies on the transmission mechanism of monetary policy decisions.

# Chapter 1

# Effects of monetary policy shocks

The Great Depression marked a period of one of the earliest and most massive uses of monetary policy actions. Central banks started the manipulation of interest rates and made adjustments to the money supply in order to bring the collapsing economy back to stability. However, the results were not very impressive. Many decisions proved to be ineffective, particularly as economies slipped into a liquidity trap where interest rate reductions no longer stimulated investment or demand. All this has raised doubts about whether the measures themselves were appropriate to use in extreme conditions.

Several historical examples have shown that tight monetary policy tends to be more effective and has a more immediate and decisive impact than easy policy, especially during periods of inflation or economic overheating. Evidence in favour of this proposition has been given in the document written by Donald P. Morgan[1] in 1993, which notes that during the Great Depression, even when the interest rate was below 1%, the economy did not respond positively, and the recession persisted until 1934. Another relevant example comes from Japan in the 1990s. Where the financial authorities used easy monetary policy while trying to fix the long stagnation following its asset bubble; however, this strategy was ineffective, and even when the interest rates were near zero, it was still being accompanied with weak demand. In contrast, there is the United States experience during the Volcker era in the early 1980s, where tight monetary policy proved to be highly effective to fight long-lasting inflation. Nevertheless, it is worthy to mention that the cost for this improvement was the creation of a sharp recession. More recently, the U.S. Federal Reserve's aggressive rate hikes in 2022–2023 successfully slowed down inflation.

The idea that the consequences of monetary policy will affect the economy consistently and proportionately was challenged by these historical observations. These "failures" have prompted a lot of research that has been carried out to study this phenomenon of asymmetric and non-linear monetary policy effects. Exploring the sources and consequences of these distortions is crucial for improving the design and implementation of future policy actions.

The asymmetric effects of the monetary policy shocks refer to the opposing implications of the actions taken by the central bank. The outcome of the interventions can be different from the expectations and what is theoretically predicted. It can be due to several factors or may depend on the state of the economy. For instance, actions designed to improve the situation by increasing the overall level of output have the inverse effect and push the economy down,

[1]Donald P. Morgan is an economist and financial research advisor working at the Federal Reserve Bank of New York.

leading to further complications of the current problems.
Parallel to this, there is the concept of nonlinearity to consider, which focuses on the magnitude of the effects. Experts define nonlinearity as disproportions in the repercussions of monetary shocks so that small manipulations can result in large changes.
In summary, nonlinearity refers to the size and proportionality of the economic response, whereas asymmetry concentrates on the direction.

The observed patterns cause broad-range implications for economic fluctuations in both ways, directly and indirectly.

Firstly, they would impact the overall structure of the monetary institution and the role they play. As Agénor[2] mentioned in its work of 2001, if this problem persists, monetary policy will lose its role as the main tool to employ in the case of unexpected economic fluctuations. Until now, it has been the determinant instrument; however, in the presence of its ineffectiveness, the usage of these measures can be questionable.

Secondly, the presence of uneven responses can lead to mistaking conclusions and to analytical errors made by the monetary authorities themselves. Thus, further measures can be underestimated or overestimated. The parameters used to determine optimal policy tools would no longer be effective and adapted to the current situation. This complexity in dealing with unstable effects can push the monetary authority to use several policy measures simultaneously. This superposition might install a panic into the economy, as was the case during the Great Depression. As a consequence, there will be a loss of confidence in monetary policy, as the outcome of the shocks would no longer be considered as foreseeable. Therefore, the presence of unpredictability of the results can lead to a more general volatility in the economy, which is synonymous with risk.

Financial markets are particularly vulnerable in this context. Investors base their decisions on the riskiness of their purchasing; consequently, when the uncertainty in the monetary market increases due to the monetary policy unpredictability and/or volatility, the riskiness increases in parallel; as a result, investment strategies shift, often leading to reduced market activity or increased speculation.

Gribalidi [3] (1997) pointed out the effect of monetary policy on the labour market. The paper argues that tight policy increases job destruction and reduces net employment, whereas the reverse effect does not hold, as an easy policy is less effective in stimulating the creation of working positions. The mechanism is the following: When interest rates are increased, the cost that the firm should bear to maintain the working positions is higher; therefore, the threshold of worker productivity is rising; consequently, employees who no longer attain this threshold are considered unproductive, and they lose their post. Although when interest rates are decreased, job creation does not seem to be proportional to the change because the creation of a working position requires more time and investments than the destruction. Aside from the creation of a position, even the hiring is not linear because it is highly dependent on the uncertainty of future economic and production conditions. In summary, the impact of the policy on employment is more effective at preventing the job loss than the creation of new positions.
These findings highlight the important relationship that the decisions on the money market have with the labour market; therefore, when the actions of the monetary authorities are no longer consistent, this would significantly affect the mechanism in the workforce market, which will significantly destabilise the employment structure in a country.

[2]Pierre-Richard Agénor is a professor of international macroeconomics and development economics.
[3]Pietro Garibaldi is a professor of economics at the University of Turin.

The global marketplace can also be impacted by the instabilities of the monetary policy, especially if the imbalance is present in countries which are key players in international trade, like China or the United States. In 2023, China, which is the world's leading exporter, accounted for approximately 11.76% of global exports, while the United States, the second biggest trader, contributed about 10.4%. These figures underscore the critical impact that monetary policy decisions in these nations can have on the dynamics of global trade. This relies mainly on the exchange rate channel. By the help of this transmission mechanism, the monetary policy decision impacts the national economy. Even when the central banks do not directly aim to influence their exchange rate, it may be affected by modifications in the domestic financial market. A higher interest rate in a country causes the appreciation of its currency, while the lower rate generally pushes the depreciation of it. When the domestic rate is lower, foreigners avoid saving or investing in that monetary unit, as it offers lower returns on financial assets denominated in that currency. As a result, the demand for the national money declines, which lowers, in turn, its value. This situation increases net exports by driving down imports and rising exports. The contrary happens when the currency is stronger due to the higher interest rates. Given the small description of the mechanism above, any monetary instability in China or the United States can lead to substantial spillover effects across international markets, mainly due to their significant shares in worldwide trade as well as the influence that the national monetary situation has on the exchange rate.

These are only a few of the implications that can arise because of the problem related to the asymmetries of the effects of the monetary policy shock. To have a clear understanding of this issue and its potential causes can be very helpful when trying to find a solution. It is crucial not just for crafting smarter policies but also for maintaining the credibility and trust in central banks.

# Chapter 2

# Asymmetries and nonlinearities of the effects of monetary policy shocks

## 2.1 Type of shock

### 2.1.1 Positive and negative shocks

The first area of interest will be the direction of the shock: whether it is positive, for instance, a diminution of the interest rates, or negative, indicating that the policy tends to cut down money supply, the results will be different. Much empirical evidence has shown that negative money-supply movements have real effects while the positive ones are less impactful. Even though the literature tends to emphasise the stronger and more persistent impact of negative shocks, this review will also illustrate factors and conditions under which positive shocks can influence the economy significantly.

Many theories about this phenomenon have been given over time. Initially those explanations had more to do with the expectation of the policy acts rather than they did with the direction of the shock. Mishkin[4] (1982) and Barro[5] (1977-1978) gave the justification of the asymmetric effects based on how better the future policy decision can be foreseen by the economic agents. The authors have suggested that when the policy shock is anticipated and predictable, the output level will remain the same because economic agents will have the opportunity to adapt their behaviour to the coming variation, but when the shock is not foreseen, any modification in the attitude can occur beforehand.
However, more recent analysis stated to focus more on the direction of the policy. For instance, Cover[6], in its work of 1992, provided a mechanism for distinguishing between positive and negative disturbance based on the specificities of the supply curve, more precisely the particularity of the slope of the aggregate supply (AS). This curve is thought to be upward sloping as long as the price level can be considered as expected, but then it becomes vertical when the price level passes to its unexpected stage. Meanwhile, the aggregate demand (AD) conserves its usual form; it is downwards sloping. Therefore, only a negative shock that could cause the demand curve to shift down can affect the real output level.

[4]Frederic Mishkin is an American economist born in 1951. He is a professor of banking and financial institutions at Columbia University. He was a member of the Federal Reserve Board of Governors from 2006 to 2008.

[5]Robert Barro is an American macroeconomist born in 1944. He is a professor of economics at Harvard University. He has contributed a lot to the foundation of the new classical macroeconomics.

[6]James Peery Cover is working in the department of economics at the University of Alabama.

In addition to his first explanation, where the slope was changing into two states, a second framework is given where he represented the aggregate supply as being completely inelastic. Here he also conserved the normal direction of the aggregate demand. According to this proposition, the overall output level (Y) will be equal to the aggregate supply if the demand exceeds the supply of the market, but it will be equal to the demand if the situation is the opposite, so the demand is lower than the level of the supply. Because of this, only negative shocks that affect the overall demand and make it move downward will alter output levels and have a significant impact.

$$Y = \begin{cases} AS & \text{if } AD \geq AS, \\ AD & \text{if } AD < AS. \end{cases}$$

In addition to the structural characteristics of demand and supply presented previously, another significant explanation for the asymmetrical impact of the policy shocks lies in the rigidity of prices and wages. When their flexibility is limited, so it can be more pronounced in one direction rather than the other, the effects of monetary policy become uneven.

Agenor (2001) focused on wage rigidity. According to this mechanism, wages are said to be more flexible to upward movement rather than downward. This is founded on two perspectives: from the workers' point of view and the employer's one. Workers are not willing to see their salary cut down in both nominal and real terms. This was meant to ensure their purchasing power first, then due to the long-term contracts, social norms, or psychological factors. While the upward movement is happily accepted. Meanwhile, firms are not willing to decrease wages either, as this can cause the reduction of the productivity of workers, make them lose motivation and insist on quitting, which can be very costly if expenses have been incurred for the hiring and the training. Therefore, a positive monetary shock will have more impact on the economy, as it will push the general consumption up and consequently ensure salary raising due to higher production. Similar conclusions were drawn by Akerlof[7] and Yellen[8] in 1985 and Ball[9] and Romer[10] in 1990 after their analysis of the labour market and wage stickiness.

The perspective of the price rigidity, meanwhile, is central to what Ravn[11] and Sola[12] termed "The traditional Keynesian asymmetry" in the article published in 1997. The same concept was mentioned by Cover (1992), Agenor (2001) and Senda[13] (2001). The evidence of this asymmetry has also been pointed out by the analysis carried out by Karras[14] in his work of 1996, which concentrated specifically on European countries. DeLong[15] and Summers[16] in their work of 1988 also conducted studies to demonstrate the existence of this type of anomaly and had the

[7]George Arthur Akerlof, born in 1940, is an American economist and professor of economics in the school of public policy and at the University of California.

[8]Janet Yellen is an American economist born in 1946. She has been United States Secretary of the Treasury since 2021.

[9]Laurence Ball is an American economist born in 1959 and a professor at the University of Baltimore. He is a specialist in the field of macroeconomics.

[10]David Romer, born in 1958, is an American economist and professor of political economy at the University of California. He is more specialised in the field of macroeconomics and has written economic papers in the area of New Keynesian economics.

[11]Morten O. Ravn is a professor at University College London.

[12]Martin Sola is specialised in the field of macroeconomics and finance. He is a professor at the University of Torcuato Di Tella in Buenos Aires.

[13]Takashi Senda has a PhD in economics at Hiroshima University.

[14]Georgios Karras is a professor of economics at the University of Illinois at Chicago.

[15]James Bradford DeLong is an American economist and historian born in 1960. He has been a professor of economics at the University of California.

[16]Lawrence Summers is an American economist born in 1954. From 1999 to 2001, he was the United States Secretary of the Treasury and was the director of the National Economic Council from 2009 to 2010. From 2001 to 2006, he was the director of Harvard University.

conclusion that negative shocks have bigger effects on the output than positive ones due to the price rigidity reason.

The effects of the monetary shocks depend highly on the decision of firms to adapt their prices. If they are not changed, the policy will have more impact because the unique external variable that will be affected is the output level and consequently the economic activity, while when prices are modified, the activity of the economy will be touched slightly. The Keynesian asymmetry is mainly based on this concept; it is suggesting that prices are flexible upwards but sticky in the opposite direction. That is why negative policy measures that should push prices down are more effective because firms are not willing to change prices, so their nominal level stays the same (while the real price is reduced); therefore, only the output position is changed globally.

In the article written by Levy[17] in 2007, the author studied the role of price rigidity on the market based on the time factor, and he suggested that this inflexibility can only explain the effects of the monetary policy in the short run. Because in the long run, prices are adaptable and can be adjusted to the new market conditions; therefore, as time goes on, the effects of the policy will disappear and become neutral.

D. Levy studied how firms decide if they will do an indexation of prices in the current period or not, and to do so, he studied the implication of the price rigidity on the policy effects by illustrating the simple price adjustment model proposed by Calvo [18] in 1983:

$$p_t = (1 - \alpha)p_{it}^* + \alpha p_{t-1} \tag{2.1}$$

In this model, $(1-\alpha)$ gives the probability that a firm adjusts its price in the current period. The probability that a firm does not update it is equal to $\alpha$. Thus, the current price level $p_t^*$ in the economy is a weighted average of its past value $p_{t-1}$ and newly set prices $p_{it}^*$.

From this, several important implications emerge for understanding nonlinear policy transmission. The first one is that if the probability of the price indexation is high for many firms, the overall level will be changed, and the effects of the monetary policy will be neutralised. The second element that could be pointed out is that the decision to index prices is independent across firms and depends only on the individual optimisation decisions of the company itself. This introduces heterogeneity into how firms respond to the same shock. The third fact is that the prices of the current period are partially based on the past values, so there is an influence of a rolling effect, which can slow down the indexation, thus allowing the policy to influence the economy.

Senda (2001) also empathised with similar ideas and said that if many firms do adjust their prices, the global price level on the market will also follow the trend, even if there are many organisations that would prefer to maintain the old situation. Hence, this heterogeneity of firms impacts their decision about the indexation and, therefore, the magnitude of the impact that the policy can have.

[17] Daniel Levy is a professor of economics at Bar-Ilan University.

[18] Guillermo Calvo is an Argentine economist known for his influential work in macroeconomics, particularly on price stickiness and emerging market crises. He introduced the Calvo pricing model in 1983, which became a cornerstone of New Keynesian economics.

### 2.1.2 Large and small shocks

The second characteristic of the shock which creates inequity in the impacts is the size of the policy change. Large money-supply changes are believed to be neutral or less influential, whereas small shocks have real effects or lead to bigger impacts. As a result, the policy changes have disproportionate effects; in other words, they are nonlinear. This concept has been developed in the work carried out by Agenor (2001); Ball and Romer (1990); Akerlof and Yellen (1995); Ball and Mankiw[19] (1994); and others. In the literature, the asymmetry related to the magnitude of the shock is called "menu-cost asymmetry".

This concept is built on the idea that companies should bear additional costs in order to regularly change prices of their products and/or services, which impact the profit maximisation problem of the firms present on the market. According to the paper of Ravn and Sola (1997), large monetary shocks are neutral because they imply a large difference in prices; therefore, businesses decide to adjust them to the new trading environment, while small shocks are considered unworthy enough to make changes (as the price difference is not very important); consequently, the small variations of monetary policy do have real effects (as prices are not adapted). This type of asymmetry, while very similar to the Keynesian asymmetry, still has some differences. First of all, the second model is built on the idea of the indexation of prices resulting from the optimisation problem of the firms individually and is based on the prices and costs rather than price rigidity responding to the market movements and the behaviour of the competitors.

### 2.1.3 Hybrid shock

The third source of asymmetry illustrated by Ravn and Sola (1997) is considered to be the hybrid one. It combines the Keynesian and the menu-cost asymmetry because it focuses on both the direction and the size of the shock. This states that small negative shocks are more effective than large positive changes.

The core argument justifying the hybrid asymmetry is the periodicity of the price changes. The idea is that they can be changed every second period without expense, but if they are modified between periods, firms should pay a menu cost.
Ball and Mankiw (1994) have found that the inaction and non-indexation of prices are more optimal for negative policy shocks than positive policy measures. They concentrated their analysis on the frequency of the indexation and concluded that the periods of inaction allow the policy to have some effects on the economy, whereas the periods where prices are adjusted eliminate these influences and become neutral. Since this period of the price adjustment lasts two years, the hybrid asymmetry can be considered to have short-run effects.

[19]Greg Mankiw, born in 1958, is an American macroeconomist and professor of economics at Harvard University.

## 2.2 Price indexation

The point of connection between all these three types of shock which create asymmetric effects is the importance of the price indexation. In the previous section, some potential causes of the price changes have already been presented. It was shown that the decision of the companies to adapt their prices can significantly affect how the economy will react to the decision of financial authorities. Nevertheless, the decision of the price indexation can be stimulated by other factors. In the following section some additional elements related to the price indexation will be presented.

### 2.2.1 Variability of the policy

In line with the document written by Ravn and Sola, the decision about the indexation of prices depends also on the variability of the monetary shock. The empirical evidence of this proposition was found by Ball and Romer (1990). If the variance is high, prices will be indexed because the probability of a big shock is greater, and if the variance is low, prices will stay the same. Therefore, with high variability of policy, the real effects of the monetary policy shocks will be neutral, as prices will be aligned with the state of the economy constantly. The same conclusion is reached after the econometric analyses carried out by Ravn and Sola.

Another factor influencing the indexation is the stability and predictability of the monetary policy, as it is described in the document of Ravn and Sola. If firms can predict the policy shock, they will choose to index their prices. In the other case, they would prefer to maintain them at the current level, thus causing the non-neutrality of the effects. So now the variance of the policy shock has two dimensions: the first related to the size of the variance (high and low) and the second related to the predictability of the shock. Hence, the decision depends on the "big" variance of unanticipated shocks and the "small" variance of unanticipated shocks.

### 2.2.2 Trend inflation

The decision to index or not is mainly shaped by the changes in the general price level. The factor of the trend of inflation is mentioned in the works of many authors, such as Agenor (2001), Weise [20] (1999), Senda (2001), Morgan (1993), and others. They all highlight the influence that inflation has on the decision of price indexation, and consequently on the asymmetry and nonlinearity of the effects of monetary shocks. Agenor suggests that in the presence of trend inflation, prices will be more willing to adjust upward than downward; for that reason, the rigidity causes these asymmetric effects discussed previously. The development of the mechanism is the following: in the presence of inflation, firms will be willing to increase their prices to ensure the maximisation of the profit from their activity, while in the case where prices should be decreased, firms will be reluctant to adjust downwards as the real prices are already falling because of the inflation effects; therefore, the nominal price will remain constant. A similar conclusion was obtained by Tsiddon [21] in 1993. Caballero [22] and Engel[23] conducted a comparable analysis in 1992 and concluded that prices are pushed to their upper limit by the inflation, which facilitates the upward movement rather than the reduction due to the policy changes.

[20] Chales L. Weise is a professor of economics specialising in the fields of monetary policy and fiscal policy.
[21] Daniel Tsiddon is a professor of economics.
[22] Ricardo Jorge Caballero was born in 1959. He is a Chilean macroeconomist and professor of economics.
[23] Eduardo M. Engel is a professor of economics at the University of Chile.

Morgan also argued about the impact of the trend of inflation on the effects of the policy. He suggested that the inflation, together with the monetary policy shock, pushes the prices up to an even higher level than they would be if the prices were influenced only by the market equilibrium set after the policy changes impacting the demand. So rather than the output being adjusted to the demand, as in the AS-AD model, it is prices that are increased.

Ball and Mankiw (1994) that the degree of asymmetry is positively related to the inflation rate, indicating that higher inflation amplifies these distortions. Nevertheless, in 2001, Senda studied the link between inflation and the magnitude of asymmetric effects as well and stated that the relation is not completely regular as Ball and Mankiw predicted, but it is concave. Signifying that after a certain point, 5% in the inflation level, more precisely, the size of the asymmetric outcome starts to decrease. The representation of this relation can be the following: if the asymmetry of the effects is believed to be a function of the inflation ($\pi$): $A = f(\pi)$, so the proposition of Senda is that the first derivative of the function is positive as long as the rate of inflation is below the threshold (5%) then when the rate starts to become bigger, the derivative changes the sign.

$$f'(\pi) > 0 \quad \text{if} \quad \pi < 5\%, \quad \text{and} \quad f'(\pi) < 0 \quad \text{if} \quad \pi > 5\%.$$

This concave relationship suggests that extremely high inflation rates may reduce the asymmetrical impact of monetary shocks. This is because of the presence of the menu cost, which incentivises firms to adapt prices only when the difference is very important due to the hyper-inflation.

### 2.2.3 Expected and unexpected demand

The decision about the indexation can also occur depending on the predictability of the aggregate demand of the market. Ravn and Sola said that when the demand is believed to be expected, the firms can anticipate it and change their prices, so if any action is taken in this situation, the effects will be marginal. On the contrary, when the demand cannot be foreseen, prices cannot be adapted, and the result is that only the real activity can be changed because the output level will be affected.

# Chapter 3

# Business cycle factor

Whether the economy is in a recession or in expansion has a huge impact on how monetary policy will be implemented. During a recession, the central banks apply expansionary measures; loose policy measures are decided to increase the output level. On the contrary, when the economy is expanding, the authorities may choose contractionary actions to slow down the activity by using tight measures. However, as mentioned in the article written by Morgan, according to the goal of the monetary changes, there can be asymmetric effects; therefore, the outcome of the intervention can vary. Many authors, such as Ravn and Sola (1997), Morgan (1993), Agenor (2001), Garcia[24] and Schaller[25] (1995), Weise, and others have investigated the impact of the business cycle on the policy outcome.

Agenor pointed out that the effectiveness of the policy depends mainly on the balance between the liquidity effect and expectation effects related to the growth-orientated measure. The liquidity effects suggest that the decrease of the interest rate in the case of expansionary strategies will stimulate consumption and spending, while the expectation effects are mainly based on the idea that the interest rate decline may increase the risk of the future possible inflation; therefore, the results become the opposite as agents wait for an increase in the general price level and reduce their spending in the current time period. Kaufmann [26] (2001) has analysed the effects of the monetary policy over time and has made the same conclusion that the variation of the effects can be interconnected with the economic fluctuation. To have a deeper view into these processes, the chapter will go over some factors related to the business cycle which influence the outcome of the shocks.

## 3.1 Credit conditions

Garcia and Schaller (2002), Cover (1992), Morgan (1993), and others stressed the role that the financial markets have for the implementation of monetary policies depending on the economic fluctuations. Ravn and Sola debated about liquidity availability during recession and expansion. They said that at the time of economic booms the credit and the liquidity will be abundantly available to the agents, so the monetary policy will not be very effective and it can even be

[24]René Garcia is a professor of economics at the University of Montréal, specialising in the field of econometrics and finance.

[25]Hunley Schaller is a professor of economics at Carleton University.

[26]Daniel Kaufmann is a researcher and lecturer specialising in monetary economics, monetary history, and forecasting.

neutral, whereas during economic difficulties, firms and consumers may struggle in obtaining loans and have less cash in their hands. That is why measures of the central bank are more effective and show clear results.

Jackman[27] and Sutton[28] (1982) have brought another argument in favour of the importance of the credit on the effects of the policy: the modification of the consumption behaviour of the economic agents. In their model, when the interest rate increases, consumers reduce their spending because loans that they had contracted previously now constitute a bigger part of their payments. But the inverse is not visible, as when the interest rate decreases, individuals will not proportionally increase their spending but will rather prefer to postpone their consumption or save the money for future consumption.

The third source of the distortion is mainly created because of the attitude of the bank in front of the market fluctuation and the policy. When credit conditions are tightened during expansion and the interest rate is increased, banks may not be willing or unable to offer more loans. In addition to this, businesses and consumers might be hesitant to borrow. First of all, financial institutions start to do more precise selection of their clients to prevent themselves from potential losses because, as the market interest rate increases, it also pushes up the cost of funding for themselves. That is why they try to minimise any risk of bankruptcy among borrowers and become more cautious about the quality of their clients to ensure the continuity of their activity and that they can get back their money. A similar suggestion was made by Agenor (2001). As a result, the preventive behaviour of banks, which leads to credit rationing, creates a new source of asymmetry.

The creditworthiness of clients matters so much because of the net worth of the firms. Gertler[29] in 1988 argued about it and said that during an economic downturn, the net worth of the companies present in the markets decreases because the asset side of their balance sheet loses value. As a result, firms cannot offer worthy collateral to get loans; thus, this creates another barrier to funds. This credit-constrained situation pushes them to dramatically reduce their investments, but when the economy is expanding back, the effects of the change in credit demands are not changed drastically. That is the reason that creates the disproportionately related business cycle.

All these processes are mainly possible due to the interest rate channel; this is another type of transmission mechanism used by national banks. The primary way this operates is through the effect of interest rate changes on borrowing and lending behaviour. The relationship between the interest rate movements and the amount of money in circulation can be demonstrated using the elasticity of money demand. It is believed to be negative and very similar to the rule of the demand of many normal and ordinary goods or services. As the cost of borrowing increases because of the rise in the interest rate, the amount of loans asked for on the market decreases. On the other hand, when the rate decreases, it makes the loans less costly; therefore, there will be more requirements for money addressed to commercial banks. The negative elasticity is an illustration of the hypothesis that the increase of the interest rate will push down the amount of money in circulation.

The second route is related to the opportunity cost of consumption based on the interest rate of the market. By calculating the opportunity cost of consumption, people determine whether it makes more sense to spend their money immediately or to postpone their spending and save

[27]Richard Jackman is a professor of economics at the London School of Economics and Political Science.

[28]John Sutton, born 1948, is a professor of economics at the London School of Economics.

[29]Mark Gertler is an American economist born in 1951. He is a professor of economics at the University of New York and is a specialist in business cycles and monetary policy.

money in order to earn a higher return. Therefore, the changes in the deposit rate are viewed as an additional point of pressure on the amount of liquidity in the markets. Agents may find it more advantageous to save money during periods of high interest rates because they will receive a higher return on their investment. The opposite happens, though, when interest rates decline; saving becomes unprofitable, and savers decide to spend their income right away rather than put it off. When expressed in terms of elasticity, the savings fluctuate positively in response to changes in the interest rate.

## 3.2 Liquidity trap

Morgan, in his work of 1993, has mentioned a situation where a substantial decrease of the interest rate during a high recession period is revealed to be ineffective because of the phenomenon of the liquidity trap. It is a situation where the rates on the markets are at their lowest level, and any additional reductions do not stimulate the demand for money on the market. In this way he pointed out the nonlinear implication of the easy policy, where the size of the shock and the response are not proportional anymore and there is no real effect.

This term was first used by Keynes, who described the variation of the behaviour of individuals who prefer to keep their money rather than invest it because the return on their investments will be marginal. This change is based on the expectations made by investors who believe that the rate on the market will rise soon and prefer not to buy bonds; therefore, the prices of these obligations fall and they are not attractive anymore. All this together pushes the economy even more to the declining side and does not solve the current problems. The extreme consequence of this could be the apparition of the deflationary infinite cycle. However, to characterise a situation as a liquidity trap, a low level of interest rate is not sufficient; there should also be a massive saving of money instead of consumption or investment. The mechanism used by Keynes was primarily focused on the financial market, but it can be expanded globally to explain the influence of the liquidity trap in the framework of the effects of monetary policy shocks.

## 3.3 Asymmetric information on financial market

In their work written in 1995, Garcia and Schaller have also studied the implications of the business cycle on the monetary policy effects. They suggested that the impact is stronger when the economy is in recession because of the asymmetry of information that constrains the decisions of agents on the financial markets. Thus, the policy measure to increase the interest rate will have two outcomes: the standard effects of the reduction of investment and borrowing, and the second is the restricted demand for investment coming from agents on the financial market because of the higher asset prices. The sum of these two amplifies the effects of the policy, creating disproportionality.

The mechanism related to this can be presented in more detail by policy transmission channels called the asset price channel. It is characterised by two different aspects. The first one comes from quantitative easing, which occurs when the central bank purchases a large number of financial assets. This practice pushes the asset prices up, hence lowering their return. The additional money that the seller gets from the transaction allows him to spend more (as its purchasing power became bigger) and to increase the overall demand on the market. The second one occurs when the central bank lowers their interest rate; money borrowing becomes easier, so investors will tend to purchase riskier forms of financial assets instead of safer ones, for instance,

government bonds. While borrowing costs increase, investors become more risk-averse, as they can lose a lot of money without being able to borrow in order to cover their losses. Therefore, when interest rates decrease, investors are more likely to seek out riskier investments, such as stocks or real estate, which increases demand and drives up the price of these assets.

The other relation between the financial assets and the central bank's interest rate is based on the fact that when the bank increases its policy rate, the new bonds issued on the market become more attractive as their future return increases; therefore, they become more demanded, which makes the price of existing bonds on the financial market to fall. Whereas, when the rate is decreased, the existing bonds are more attractive because the rate of return fixed on bonds is higher than the actual.

While the asset price channel implies generally smooth financial functioning, the inclusion of asymmetric information, as highlighted by Garcia and Schaller, can amplify these impacts, especially during recessions when uncertainty is high and agents are more risk-averse. In such circumstances, monetary policy may not only affect asset prices but also intensify investment hesitancy, so exacerbating the economic response.

## 3.4 Changing outlook

Monetary policy's effectiveness is significantly influenced by consumer and business behaviour, particularly in terms of confidence levels. According to Morgan, if economic agents are more pessimistic during market downturns than they are optimistic during expansion, the effects of policy can be different. Agenor (2001) also stressed the importance of the confidence factor for the implementation of the regulations. His arguments are very similar to what Morgan had said: if end-users and companies are not certain about the future of the economy, the modifications, such as the decrease of the interest rate, will not stimulate the spending or the investment. As it was experienced during the Great Depression, the pessimism discouraged borrowing and lending; thus, it affected the policy implementation. However, the optimism contributes to the creation of asymmetric impact as well, but in this case it weakens the negative policy. To summarise, for efficient assimilation, the optimism and the pessimism among economic agents should be in balance. If the first is greater than the second, the implementation of a tight measure will be complicated, and if the situation is the inverse, the changes intended to push the economy up will have weaker effects.

Another perspective is related to the uncertainty about the evolution of the market, regardless of the fact that the policy is expansionary or not. If individuals are not certain about the future, they would restrict their consumption spending. In this case, any change of the monetary instrument may have unexpected consequences. Many works, including Agenor's (2001), have discussed the importance of expectation.

As it was mentioned several times all around this work, the expectation channel is considered one of the important ways through which monetary policy can reach the economy and can modify its current and future state. Central bank actions and communications affect a lot the vision of agents about future inflation, interest rates, and economic conditions. Their confidence level is influenced by the policy actions and remarks made by the authority. All this together can impact decisions about investments and spending on the market.
The New Keynesian Phillips Curve (NKPC) illustrates the relationship between market expectation and current behaviour.

The model takes the following form:

$$\pi_t = \beta E_t[\pi_{t+1}] + \kappa y_t + \mu_t \tag{3.1}$$

Where:

- $\pi_t$ is the inflation rate at time $t$
- $E_t[\pi_{t+1}]$ is the expected inflation rate at time $t+1$
- $\beta$ is the discount factor
- $\kappa$ is a parameter that reflects the sensitivity of inflation to the output gap
- $y_t$ is the output gap at time $t$
- $\mu_t$ is a cost-push shock term

The NKPC is widely used to assess the magnitude of the influence that the monetary authority's communications regarding the economic evolution have on investors' and consumers' current behaviour. Predictions about the future price level are incorporated into the NKPC economic model, which provides insight into current economic activity. This model illustrates how businesses and individuals use the remarks and announcements coming from the authorities related to their actions to make their own projections of the future.

For instance, changes in interest rates and other policy instruments affect current inflation and output based on the modification of expectations about future inflation. Consequently, the NKPC captures how forward-looking behaviour can either amplify or dampen the effects of policy, depending on agents' expectations. This highlights the importance of the expectation channel and illustrates how expectations can shape the behaviour of economic agents.

The policymaker should not neglect the inflation psychology before undertaking any action, which stands for the idea that if everybody expects the inflation to persist, their behaviours will be such that the general price level increase will stay for longer.

## 3.5 Capacity constraint

Another asymmetric effect related to the business cycle comes from the capacity constraint of firms. It is developed by Agenor, who constructed its proposition on the fact that companies are limited in their physical capital (K) or labour (L), or both in the short run. The production function of firms can be expressed to be the following: $Q = f[\bar{L}, \bar{K}]$. This limitation does not allow companies to increase infinitely their production in the case of expansionary measures, which operate through a decrease in the interest rate that could push up the aggregate demand. So the effects of the positive measures may not be proportional to the monetary shocks, and when the limit of the production capacity is reached, there will be no effects on the output but only on the prices; they will tend to rise. However, this limitation is considered to be only present in the short run, but in the longer time period, production factors can be changed. That is why the effects of the monetary actions can have differences.

# Chapter 4

# Factors independent of the business cycle

## 4.1 Sectoral and regional factor

Theoretically, the impact of the monetary policy is believed to affect uniformly the whole country; however, many empirical findings suggested that this is not the case. Because the presence of companies active in specific sectors as well as their presence in some regions is also crucial for the response of the economy to the policy manipulations.

The sectoral factor highly impacts the monetary policy implementation and can cause asymmetries and non-linearities. In the document written in 2013 by Jensen[30], Kishan[31] and Vacaflores[32] it is said that the sectoral sensitivity to the interest rate and money supply can amplify or decrease the effects of the policy.
The unequal effects can be seen across different fields of activity of companies as well as over different phases of the business cycle. Peersman[33] and Smets[34] in 2005 have also suggested that the effects of the policy on the industries can vary based on the durability of the goods that they produce. "*The impact of monetary policy on industries producing durable goods is almost three times as high than the impact on non-durable goods.*" (Pressman and Smets, 2005) This heightened dependence is attributed to the fact that durable goods purchases are often financed through credit, making them more susceptible to interest rate fluctuations. The capital intensity of the production process and the degree of international openness also have an impact on the sensitivity of the industry to the policy. Capital-intensive industries may be more affected due to their reliance on funding for investment. Whereas open businesses may face diverse effects from changes in exchange rates and foreign demand fluctuations. The importance of the business cycle phase is related to a company's financial structure. The way different industries respond to monetary policy changes is influenced by a variety of factors. For instance, it could

[30]Dennis W. Jansen is an economist and professor at Texas A&M University. He is specialised in macroeconomics, monetary economics, financial economics, and the economics of education.

[31]Ruby P. Kishan is a professor of economics at Texas State University.

[32]Diego E. Vacaflores is a professor at McCoy College of Business, specialising in macroeconomics, Latin American economics, and emerging market economies.

[33]Gert Peersman is a professor of economics at the department of economics at Ghent University. He is specialised in the fields of empirical macroeconomics, monetary economics, monetary policy, fiscal policy, business cycle analysis, crude oil, and food commodity market dynamics.

[34]Frank Smets is an adviser to the Counsel to the Executive Board at the European Central Bank and professor of economics at Ghent University.

be the maturity of the firm, its debt structure, coverage ratios, financial leverage, and size. For example, industries with more leverage or shorter loan maturities may be more exposed to interest rate increases.

The repercussions of the policy, which impact the rate of sales, are strongly felt in the industries of construction, retail, services, and wholesaling of durables. While the effects are weaker in the manufacturing industry. Big sectors, such as construction and retail, can decrease the impacts of the policy thanks to their size and the fact that they are not very dependent on the credit from banks. However, small firms working in the same industries are highly impacted by the new rules. The analysis carried out by Jensen, Kishan, and Vacaflores discovers that tight monetary policy affects negatively and significantly publicly traded companies in the manufacturing, retail, wholesale durables, and service sectors. The retail industry has the biggest impact, followed by services, manufacturing non-durables, manufacturing durables, and wholesaling durables. They have also found out that organisations impacted in the construction sector are generally smaller firms and not large ones.

Carlino[35] and Defin[36] published an article in 1998 arguing about the diversified response to the central bank's intervention across regions. The industrial composition of the territories and the size of firms present in that area determine the reactivity of the provinces to the policy changes.
First, the regional response to the policy is highly variable because of interest rate elasticity, which is very different across industries present in the area. That is why the abundance of industries, which are very interest rate sensitive, intensifies the effects of the financial interventions. Regions with mainly interest-sensitive sectors, such as housing, construction, and durable goods, are particularly responsive to movement due to their dependence on borrowing.

The second source of the distortion is the size of the firms present in the region. Indirectly, this implies the credit availability. Banks are more reliant on offering loans to large and financially stable companies rather than to small firms, which are more likely to fail. Bernanke[37] and Blinder[38] discussed the indirect effects of the credit availability in 1988, when they suggested that regions where small firms are more present could experience proportionally larger effects of the monetary policy because of the sensitivity of the credit demand to the variation of the interest rate. Large firms are not very dependent on loans, as they have a relatively larger range of sources of funding, such as the private placements, the convertible debts or the bond issuings. Gertler and Gilchrist[39] in 1993 suggested that according to the size of the company, the availability of the information also can affect differently the sensitivity to the monetary policy. Access to the information for small firms is more costly than for large firms; therefore, they do not have the possibility to analyse the whole credit span of the market. That is why the credit becomes more costly for them.

Kashyap[40] and Stein[41] in 1995 argued about the third factor that can cause a regional

[35]Gerald Carlino is an economist who specialises in regional business cycles and regional growth at the Federal Reserve Bank of Philadelphia.

[36]Robert Defina is an economist who has worked at the Federal Reserve Bank of Philadelphia and Villanova University.

[37]Ben Shalom Bernanke is an American economist born in 1953. He was chairman of the Federal Reserve from 2006 to 2014.

[38]Alan Stuart Blinder is an American economist born in 1945 and a professor at Princeton University.

[39]Simon Gilchrist is a professor of economics at New York University.

[40]Anil K. Kashyap is an economist born in 1960 and professor of economics and finance at the University of Chicago. Kashyap is specialised in price setting, the Japanese economy, monetary policy, financial intermediation, and regulation.

[41]Jeremy Chaim Stein (born in 1960) is an American economist and professor of economics at Harvard University; he chaired Harvard's economics department.

asymmetric effect of the monetary policy. It concerns mainly the ability of central banks to modify the balance sheet of commercial banks through the policy. By the manipulation of the balance sheet, they mean the ability of banks to give loans to their consumers. They give the example of a tight policy: when banks are forced to raise their reserves, some of these financial institutions can have the possibility to turn to other sources of funding, while others do not have such a chance. Small banks do not have many alternative sources of financial means and are forced to conduct their activity with less money. Therefore, regions where a lot of loans are made by small banks can respond more largely to policy shock than regions where the majority of credit is given by large banks.

## 4.2 Policy factor

Monetary policy is a complex tool with effects that can vary significantly depending on the instruments that are used and their interaction with other policies. As it is mentioned in the article written by Benigno[42] and Rossi[43] disproportionalities can be due to the varying impact of the instruments. Even if the final goal of the regulation is similar, the outcome that they would have will be different.

The reason why the policy will affect the economy differently is highly influenced by the credibility of the national bank. If agents believe that the central bank will react to any negative change in the market and will employ adequate measures, they will be more resilient and will not artificially amplify their demand or heavily decrease it. The policymaker should try to avoid the panic among actors. As the experience of the last decade has shown, the main factor impacting how the policy will act on the economy is varying with the level of panic present in different markets.
To foster this credibility, the bank should also be able to choose the right instrument at the moment of need. Its primary goal is to use the tool that would create as little distortion as possible, so as to affect directly the variable targeted by the bank without touching any other parameter. For instance, the magnitude of the effect of the interest rate change will be different from the direct manipulation of the money supply because it affects the whole economy by many channels. Therefore, the effect is nearly always much stronger.

Cover carried out empirical studies in 1992 related to the importance that the expectation about the policy has on the output level. He found out that the unexpected increases of the money supply are considered to be neutral, while the unexpected decreases of money lead to the decline of the output. He suggested that the factor that is leading here is the expectation of the policy rather than its direction, so if the policymaker manages to decrease the variability of its actions, thus making it more predictable, it can help to stabilise the effects and reduce distortions.

The interaction between the monetary policy and the fiscal policy affects differently the overall outcome of the manipulations. For instance, if A and B are two different measures, then their combined impact can be greater than the sum of their individual implications $E(A+B) \geq E(A) + E(B)$. It is called the synergetic effect. For example, during an economic downturn, lowering interest rates while increasing government spending can result in being more effective for economic recovery than either policy could achieve alone. "Kirsanova[44], Leith[45] and Wren-

[42]Pierpaolo Benigno is a professor of monetary macroeconomics at the University of Bern.
[43]Lorenza Rossi is a professor in economics and specialised in macroeconomics at Lancaster University.
[44]Tatiana Kirsanova is a professor of economics at the University of Glasgow.
[45]Campbell Leith is a professor of macroeconomics at the University of Glasgow.

Lewis[46] (2009) also suggest that fiscal policy can also be useful when the monetary policy is no longer effective for the stabilisation of the economy, emphasising the crucial role that the fiscal policy plays in the interactions with the monetary directives.
In 1968, the monetary measures taken by the Fed chair, William McChesney Martin, aiming to slow down the inflationary pressure, were revealed to be ineffective because the fiscal policy actions were not supportive and consistent with the tightening rules made by the Fed. The fiscal modifications aiming to increase the income tax were only temporary and not permanent as they were supposed to be, which resulted in being insufficient to foster the decrease of the money in circulation. Here is only a little illustration of the importance of the collaboration between these aspects of economic policy.

The time difference between the policy implementation and the moment when the effects of regulations can be visible is called policy lags. It is another time factor that should be considered. Because of this, the effects can be felt nonlinearly as markets take time to react; due to this, the magnitude of the shock and the response can vary. Milton Friedman[47] has discussed this topic in his article "The Lag in Effect of Monetary Policy", written in 1961. In this document, he states that the delay between the shock and the effects is related to many factors, but the main one among them is the fact that businesses need time for the adjustment of their behaviours and expectations to the new realm of the economy.

## 4.3 Global economic environment

The global economic environment also implies that the policy implementation will be different from what is expected theoretically. The increasing interconnection between counties can amplify or, on the contrary, diminish the effects of the monetary policy. Depending on the size of the country, the policy can have repercussions on other nations. The effects of the monetary action can vary depending on what is decided in other countries at the same time. It can be illustrated as the waves on the water; if they go in the same direction, their forces will be summarised, while if they go in the opposite direction, they could create contradictions and change the magnitude.

Depending on whether the policy is implemented by "big" countries or not, the effect will be different. Let's imagine a situation where a large country changes something in their monetary structure. Thanks to the larger economic size of this country, the effects will also affect other smaller ones, so the outcome of the policies in those small counties will be different. Therefore, it can change the proportions as well as the direction of the economic implications. In another way, it can be explained by the number of transactions a country has with others. The strength of the trade relationship can modify the way that the policy affects the economy at the country level. For example, the decision to decrease the interest rate might lead to benefits in the country by increasing exports and investment, therefore affecting the exchange rate, but these effects can be amplified much more if this country has a lot of commercial relations with others; otherwise, these effects will be lower.

[46]Simon Wren-Lewis is a British economist and professor of economic policy at the Blavatnik School of Government at Oxford University.

[47]Milton Friedman (born in 1912 and died in 2006) was an American economist and statistician. He received the Nobel Memorial Prize in Economic Sciences for his research on consumption analysis, monetary history and theory, and the complexity of stabilisation policy in 1976.

# Chapter 5

# Alternative proposition

Among the factors that could contribute to the transmission mechanism of monetary policy shocks, less importance is given to the new technologies that are massively entering our everyday life. Thanks to the development of revolutionary technologies and the emergence of up-to-date platforms and algorithms, new business models are created. This gives the opportunity for the formation of innovative financial services, alternative banking systems or novel communication possibilities for consumers and firms. Over the last 10 years, the financial technologies' sector (also called fintech) has been massively developed, and it is estimated to continue to grow[48]. For instance, since 2017 the industry's revenue has been doubled, passing from $90.5 billion to $197.8 billion in 2023. According to the estimations, the growth will reach $917.17 billion by 2032. The sectoral statistics reveal that 30,000 start-ups, led by Visa, are operating in the sector on the day of 2023. The investments in that field have been accelerated during the COVID-19 period, passing from 49.9 billion to 122.9 billion; however, in the years after that, the asset allocation has decreased. The USA is the largest contributor in the sector since its development[49] .

According to the statistics, over 90% of Chinese citizens are using fintech for digital banking, payments and financial management solutions. China is the leader of fintech adoption in the world, followed by the US. 65.3% of North Americans were using digital banking on the day of 2022. Moreover, the personal loan agreement contracted via fintech has increased by 33% in the US.

Fintech has rapidly evolved from a niche sector into a cornerstone of global financial systems. Its influence on traditional banking reshapes how individuals and businesses access financial services. Recent research has revealed that fintech adoption will alter the traditional financial business model[50], more specifically: According to survey results made in 2018, 66.7% of senior banking executives believed that fintech firms were having a substantial impact on wallets and mobile payments, while 62.5% noted a similar effect on cards and other traditional payment methods. Around one-third (33.3%) observed a strong fintech influence on savings and checking accounts. Additionally, 29.2% identified value-added services as being notably affected. The 12.5% think that the impact would be in areas such as loans and mortgages and, lastly, wealth and asset management services (8.3%).

The apparition of alternative sources of funding due to the emergence of fintech could po-

[48]See Statista, Fintech - statistics & facts, accessed May 28, 2025.
[49]FinancesOnline, *81 Key Fintech Statistics 2024: Market Share & Data Analysis*, accessed May 28, 2025.
[50]Capgemini, *Retail Banking Report 2018*

tentially contribute to how the monetary policy would affect the economic variables. It can have two opposite effects; it can amplify as well as dampen the impact of the monetary policy.

First, financial technologies can decrease the effectiveness of the monetary policy because of the reduced role of the central banks in the credit market. The old-fashioned financing possibilities are giving their place to new emerging ones. The money demand will tend to be more decentralised and less regulated. The financial authorities can lose their control over aggregate demand and other institutions and actors. This financial disintermediation due to peer-to-peer lending, neobanks, crypto platforms or crowdfunding might also decrease the credit responsiveness to the interest rate changes. The communication among the demanders and the suppliers of funds is now becoming more direct, so the investment and borrowing process is no longer impacted by the interest rate of the markets. That is why any manipulation of the rate will be less impactful on the financial structure.
The alternative to finding money for small and large companies excludes the factor that the size of the firms will affect the implementation of the policy, as it was suggested previously.

On the other hand, the impact of monetary policy can be amplified thanks to the development of the fintech sector. With the help of digital platforms, mobile payments, and online banking, the efficiency and the speed of the financial transactions become more prominent. Consequently, this reduces the lags in the transmission of monetary policy and allows interest rate changes to impact consumption and investment decisions more quickly. Those technologies also contribute to the financial inclusion of populations which were not active in that market before.
Digital platforms enable easier access to credit, savings, and investment products for the population which was not served previously. As more households and firms participate in the system, monetary policy actions have a broader base of influence, amplifying their macroeconomic effects.
Fintech can also be used as an easy data source because it generates vast amounts of real-time data related to the financial activity. Central banks can use this information to better monitor economic life and tailor policy decisions more precisely. In turn, policy adjustments would be better targeted and more effective.

Based on all that is presented above, an alternative factor which could affect how the monetary policy will influence the fundamental economic variables could be drawn from the emergence of the financial technologies. The question now is to find out whether the fintech indeed changes the outcome of the authorities' decision or not, and the second question is to know if it amplifies or the contrary, decreases the effectiveness of the policy transmission. In order to test if this alternative proposition could be confirmed or rejected, an econometric analysis will be conducted. The investigation will be conducted over the period from June 2015 to January 2025. It is important to note that the widespread emergence and influence of fintech began approximately around 2015; therefore, the study will consider the period since then. Concerning the geographical focus, the study will be concentrated exclusively on the United States. This choice is motivated by two main factors: first, the fintech sector has initially expanded in the US. It is one of the first countries that implemented new financial technologies in the economy and started to democratise it; second, due to data availability constraints, a comprehensive and reliable fintech development index could only be obtained for the US.

## 5.1 Data

This study uses a set of monthly macroeconomic and financial indicators: First, the Industrial Production Index (PROD), serves as a proxy for the gross domestic product (GDP). It reflects the overall production activity within the U.S. economy and is widely used as a high-frequency indicator of real economic performance. In the context of this study, the production index will serve as the dependent variable through which the effects of monetary policy shocks (and their potential alteration due to fintech development) will be evaluated. The variable is indexed to 2017=100, and is seasonally adjusted.
The Interest Rate (IR) is the three-month interbank rate. This short-term interest rate serves as a standard proxy for the monetary policy adjustments. In this study, it will act as the main independent variable, and will allow to assess how the economy (particularly the industrial production) is affected when a shock hits the variable of the monetary policy. The indicator is expressed in percent and is not seasonally adjusted.

There is an important element to consider related to the monetary policy variable. This study uses conventional interest rate changes to measure policy shocks. However, these variables may suffer from endogeneity, as policy rates often respond to prevailing macroeconomic conditions. That is why an alternative would be to employ external monetary policy shock measures, such as the series developed by Romer and Romer (2004) or high-frequency identification strategies using financial market data around central bank announcements (e.g., Gertler and Karadi, 2015).
Nevertheless, the implementation of such approaches presents practical limitations in this context. The Romer and Romer shock series is only available up to 1996, while the analysis of the alternative proposition is concentrated on the period after 2015. Furthermore, high-frequency identification strategies rely on daily frequency, which is not compatible with the monthly frequency of other key variables in the analysis, such as macroeconomic controls or the production index.

The Consumer Price Index (CPI) measures the average change over time in the prices paid by urban consumers for a basket of goods and services. The CPI used in this study is indexed to 1982–1984 = 100 and is seasonally adjusted. It serves as a primary indicator of inflationary trends in the economy. The Volatility Index (VIX) measures market expectation of near-term volatility conveyed by stock index option prices. The VIX is commonly interpreted as a barometer of investor uncertainty and financial market risk. The indicator is not seasonally adjusted.
The Unemployment Rate (UNRATE) reflects the number of unemployed as a percentage of the labour force. It provides insights into labour market dynamics. The indicator is expressed in percentage and is seasonally adjusted.

The Consumer Price Index, Volatility Index, and Unemployment Rate are included in the analysis as control variables. These indicators are selected due to their potential influence on industrial production, which is the dependent variable of the study. Including them helps to avoid model misspecification; the goal is to account for key macroeconomic and financial factors that may independently affect output. Furthermore, these variables are likely to be correlated with both the main independent variable (interest rate shocks) and the production variable. That is why their inclusion is essential for isolating the true effect of monetary policy shocks and the moderating role of fintech on the production index.

The FINTECH variable is represented by the S&P Kensho Alternative Finance Index created in 2017. The first value is set at 100 in 2015, which is considered the base year (which corresponds to the recognised period of rapid fintech expansion). This is a sub-index of the

Kensho Global Alternative Finance Index, which measures the performance of the US listed companies which are specialised in providing alternative finance services. The index is designed to assess the performance of publicly traded companies that are fundamentally engaged in financial innovation and the digital transformation of financial services, such as peer-to-peer lending (or direct lending), crowdfunding, blockchain-based payment systems, robo-advisory platforms, software and hardware enabling the usage of digital currencies and other non-traditional financial services. The index serves as a proxy for the development of the fintech sector in the United States. Overall, the index captures the market performance of the companies active in the fintech sector. While the index is originally available at a daily frequency, for the purposes of this study (and to ensure consistency with the other macroeconomic variables), the monthly average of the index was computed and used in the analysis.

All data used in this study, with the exception of the S&P Kensho Alternative Finance Index, are sourced from the Federal Reserve Economic Data (FRED) database. The S&P Kensho Alternative Finance Index is obtained from S&P Global. For reference, Appendix 1 provides the plots of the raw data series, while some basic descriptive statistics are included in Appendix 2.

Before proceeding with the model estimation, all variables were tested for stationarity using the Augmented Dickey-Fuller (ADF) test. Ensuring stationarity is crucial to avoid specious regressions and to validate the assumptions of the used econometric models. Given that some of the variables were already seasonally adjusted while others were not, and based on the outcomes of the stationarity tests, all variables were standardised through a logarithmic first-difference transformation. This is made to ensure stationarity across all the dataset, which will allow for more meaningful interpretation of the results. Thus, the coefficients that are estimated can be interpreted as elasticities. It provides insight into how a 1% increase of the independent variables impacts the dependent variable in percentage.

## 5.2 Model: Local projection

The study employs the local projection (LP) method, which was originally proposed by Jordà (2005). This model is used to estimate the dynamic effects of monetary policy shocks on output and to assess how these implications evolve in the presence of financial technology. Local projections offer a flexible econometric framework for directly estimating impulse response functions (IRFs) without requiring the specification of a full-system model, as in traditional vector autoregression (VAR). While LP and VAR have a conceptual link, as both aim to trace the effect of shocks over time and account for inter-variable correlations, local projections do so by estimating a series of separate regressions for each forecast horizon, rather than relying on recursive structure or the inversion of large matrices.

In the frame of this analysis, the main advantage of using local projections lies in their robustness to model misspecification. Unlike VARs, which are sensitive to the correct identification and ordering of variables, LPs remain valid even when the underlying data-generating process is complex or partially unknown. This feature is especially valuable in the context of this research because it incorporates structural breaks and interaction terms. Another particularity is that the post-Fitech period is relatively short, and that could challenge the stability assumptions required by VAR models. Employing a local projection method makes it easier to include nonlinearities and time-varying interactions in the model. For instance, elements standing for the relation between interest rate shocks and fintech development can be included without adding excessive complexity to the model. These strengths make this approach par-

ticularly interesting to assess whether the transmission of monetary policy has changed in the fintech era.

As it was already stated before, the alternative proposition is based on two major questions: The first one is to test whether the development of the fintech has a significant influence on the transmission mechanism of the monetary policy shocks. While the second is to assess in which direction and magnitude the alternative finance affects the production: does it amplify the effect or reduce it? For that reason, two specifications of models will be used. The first one will be employed to respond primarily to the first question; the second one (while being very similar to Model 1) will include distinctive features designed to give a response to the second question of the research.

**Model 1 (without fintech regime dummy):**

$$\begin{aligned}\Delta \ln(\text{PROD})_{t+h} = \alpha_h &+ \beta_{1,h}\Delta \ln(\text{IR})_t \\ &+ \beta_{2,h} \cdot \Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t \\ &+ \gamma_h' X_t + \phi_h \Delta \ln(\text{PROD})_{t-1} + \varepsilon_{t+h}\end{aligned} \tag{5.1}$$

**Model 2 (with fintech regime dummy interaction):**

$$\begin{aligned}\Delta \ln(\text{PROD})_{t+h} = \alpha_h &+ \beta_{1,h}\Delta \ln(\text{IR})_t \\ &+ \beta_{2,h} \cdot \text{Highfintech}_t \cdot \Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t \\ &+ \gamma_h' X_t + \phi_h \Delta \ln(\text{PROD})_{t-1} + \varepsilon_{t+h}\end{aligned} \tag{5.2}$$

**Where:**

- $\Delta \ln(\text{PROD})_{t+h}$: Log difference in the production index at horizon $h$, representing the percentage growth rate in production between $t+h$ and $t+h-1$.
- $\alpha_h$: Horizon-specific intercept capturing average productivity growth at horizon $h$, unrelated to explanatory variables.
- $\beta_{1,h}$: Baseline effect of a 1% change in interest rates on productivity at horizon $h$.
- $\Delta \ln(\text{IR})_t$: Change in the interest rate growth rate at time $t$.
- $\beta_{2,h}$: Captures the interaction between interest rate shocks and fintech developments.
  - **Model 1:** $\beta_{2,h} \cdot \Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t$ measures the continuous marginal effect of the interaction between fintech and interest rate changes on the production index.
  - **Model 2:** $\beta_{2,h} \cdot \text{Highfintech}_t \cdot \Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t$ allows the fintech-monetary policy interaction to differ in high vs. low fintech development regimes.
  - $\text{Highfintech}_t$: Dummy variable equal to 1 if $\Delta \ln(\text{FINTECH})_t$ is above its historical mean (indicating a high-fintech regime), and 0 otherwise.
- $\Delta \ln(\text{FINTECH})_t$: Log difference in the fintech indicator, representing the growth raet of fintech at time $t$.
- $\gamma_h'$: Vector of coefficients associated with control variables at horizon $h$.
- $X_t = [\Delta \ln(\text{VIX})_t, \Delta \ln(\text{UNRATE})_t, \Delta \ln(\text{CPI})_t]'$: Control variables including financial volatility (VIX), unemployment rate, and inflation measure (CPI).
- $\phi_h$: Coefficient of the lagged productivity growth rate, used to control for autocorrelation or persistence in productivity.
- $\varepsilon_{t+h}$: Error term capturing shocks to productivity not explained by the included regressors.

## 5.3 Model interpretation

The second term of Model 1 and Model 2 is the same, $\beta_{1,h}\Delta \ln(\text{IR})_t$; it captures the baseline effect of a monetary policy shock on output growth at horizon $h$. It reflects how production typically responds to a change in the interest rate, holding other factors constant.

The third term varies across the two model specifications. In Model 1, which is without the fintech regime dummy, the term $\beta_{2,h} \cdot \Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t$ represents whether the effect of interest rate shocks on output is different with fintech development. This interaction captures whether fintech growth has significant influence on the response of production to monetary policy shocks in a continuous manner, regardless of the level or regime of fintech. It is useful for testing gradual or marginal changes in sensitivity due to fintech development.

The Model 2 contains a fintech-regime dummy factor: The term $[\beta_{2,h} \cdot \text{Highfintech}_t \cdot \Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t]$ introduces a regime-based nonlinear interaction. Here, the fintech variable only modifies the monetary transmission effect when its activity is relatively high (above its historical average). This allows testing whether the influence of those technologies on the transmission of interest rate shocks differs between low- and high-financial-technology environments. Model 2 introduces a structural change perspective by allowing fintech's influence to differ between low- and high-fintech periods. It is crucial to note that this methodology has some drawbacks because the interaction term between fintech and monetary policy is activated only when the dummy variable for high fintech development is equal to one. In the low fintech regime, this dummy is zero, so the interaction term is inactive. Consequently, the response is governed solely by the direct effect of monetary policy ( $\beta_{2,h} \cdot \Delta \ln(\text{IR})_t$), without any moderating influence from fintech dynamics. This might be challenging from the interpretation perspective; however, that is the unique regime-switching methodology that has been applicable in the frame of this work.
In summary, the regime-switching interaction term helps to determine whether the fintech sector is a dampening, amplifying, or neutral force in the evolving structure of monetary policy transmission.

Together, these models allow us to assess whether the digitalisation of financial services has reshaped how interest rate changes impact real economic activity. If it turns out that the fintech alters the strength or timing of monetary transmission, it would have direct implications for how central banks would design and implement policy in increasingly digital economies.

## 5.4 Results

As already mentioned, the analysis will primarily focus on the first question and will tend to find whether the presence and the development of the financial technologies have impacted the transmission mechanism of the monetary policy shock in general. In order to do it, the study will start with the assessment of the statistical results of Model 1. To interpret its outcome, specific attention will be directed to the variables of interest, which are the monetary policy indicator and the fintech index.

At horizon 0, the results of the local projection model show that the variable of the interest rate ($\Delta \ln(\text{IR})$) is statistically significant and positive. Its coefficient is estimated to be 0.0135 with a p-value of 0.042. This suggests that the immediate response of the production to a monetary policy shock is positive. This means that, in the very short term, an increase in interest rates is associated with a slight increase in production. While this may seem not to

be in line with traditional perspective (where higher interest rates typically reduce the output level), it could just reflect a delayed adjustment in real activity. Some other factors can lead to the same phenomenon, such as confidence effects or a non-linear relation of the policy changes and the economic reaction. However, for the further horizons, the coefficient starts to decrease and passes to the negative stage, which is consistent with the theoretical predictions.

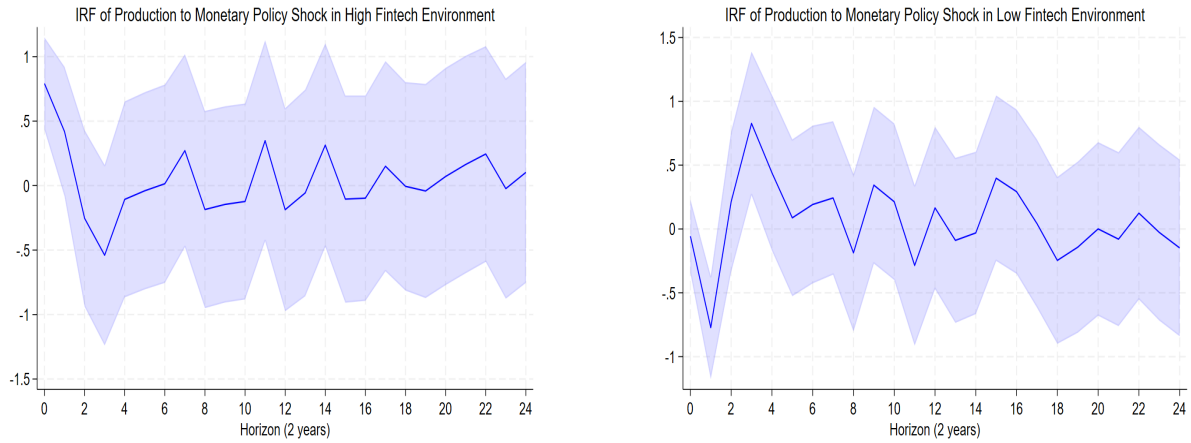
The interaction term between the monetary policy shock and fintech development ($\Delta \ln(\text{IR})_t \cdot \Delta \ln(\text{FINTECH})_t$) is positive (0.2884) and highly statistically significant (p = 0.001). This indicates that fintech expansion has an impact on the transmission mechanism of the monetary policy shocks and might amplify the immediate effect of policy on production. In other words, the short-run response of output is stronger in economies or periods with higher fintech activity. This supports the argument that financial digitalisation enhances the speed and possibly the effectiveness of monetary transmission, as it enables the economy to react faster and more directly to the changes.

Changes in VIX, represented by $\Delta \ln(\text{VIX})_t$, a measure of financial market volatility, do not show an immediate and significant effect on the dependent variable at horizon zero, but it has a significantly negative impact at horizon one and, for instance, at horizons 3 and 7 if looking at a 1-year period. This could suggest that in the short term, financial uncertainty affects the variable; nevertheless, this effect dissipates in later periods, likely due to risk aversion or delayed investments. The unemployment rate $\Delta \ln(\text{UNRATE})_t$ exhibits a strong, significant negative effect at horizons zero and one, which indicates that rising unemployment quickly reduces the production, but its influence fades and becomes insignificant afterwards. Inflation, measured by the consumer price index $\Delta \ln(\text{CPI})_t$, has a positive and significant effect initially at horizon zero, which diminishes and becomes less consistent over time. This may imply that the real effect of the inflation pressure goes far beyond the two-year horizon and is less prominent and short-term.

To respond to the second question of this analysis and to find out whether the presence of the fintech has amplified or, the inverse, decreased the impact of the monetary policy, another methodology was employed. It consisted of splitting the fintech variable into two environments. One representing a high fintech development environment and the other low. The detailed information about this process has been already given previously. Figure 5.1 illustrates the impulse response function of the production index responding to the shock of the short-term interest rates and its interaction with the financial technologies. However, the graph (a) represents the response of the production to the monetary policy changes in the high-fintech development, while the graph (b) considers the low-fintech development (in other words, its absence).

In the high fintech environment, the impulse response function shows that the growth rate of the production index has a positive immediate effect in response to a monetary policy shock. The magnitude of the instant reaction is equal to nearly 0.8 per cent. Then there is a contraction as the production growth rate starts to decrease and passes to -0.5%. This is in line with the theoretical production, which states that an increase in the interest rate in the short term will push the production down.
Over the medium to long run, the response gradually returns toward zero, indicating that the economy absorbs the shock smoothly without persistent disruptions. However, it can be noticed that in the very short term (at a 3-month horizon), the confidence interval is relatively narrow; then it starts to be larger, which stands for the increasing uncertainty and volatility of the effects of the shock.

In the low fintech environment, which is also similar to the absence of the interaction of the monetary policy with the fintech, the impulse response function displays a sharply negative




(a) High fintech environment

(b) Low fintech environment

Figure 5.1: Model 2: IRF in different fintech environments
*Source: Stata.*

initial reaction of the production growth rate to a monetary policy shock, with the response falling by nearly 1 percentage point in the first month. This indicates that monetary tightening results in a significant contraction in economic activity when fintech development is limited. Additionally, the magnitude of the decline is bigger compared to high fintech settings, and it exceeds the -0.5% limit, showing a more severe contraction in response to policy tightening. The timing of the reaction is also different between those two regimes, as the maximum of the production decline in the high-fintech environment is felt around the third month, while in the low-fintech environment it is at the first month. This means that the presence of the fintech postpones the overall production contraction. Although there is a rebound in subsequent quarters, the response remains highly volatile and unstable. It is fluctuating around zero throughout the 24-month horizon.

Appendix 3 presents detailed results of Model 1, which offers insight into the estimation's details, such as the standard errors, p-value and confidence interval. Appendix 4 also provides a robust version of the same model. This was estimated to verify whether the impulse response functions maintain the same patterns when accounting for potential deviations from standard assumptions, such as heteroskedasticity or outliers. Incorporating robustness helps to ensure that the model's dynamic behaviour is not driven by atypical observations or model specification issues. Thus, this is useful in increasing confidence in the validity and reliability of the results. Similarly, Appendices 5 and 6 contain impulse response functions for Model 2, allowing for a comprehensive evaluation of its performance under the two specifications.

# Conclusion

This literature review regroups different factors that could explain why the effects of monetary policy can differ by the magnitude and the direction from the initial shock. One of the important causes is the price rigidity, which makes it such that the positive effects are less visible than the negative ones; this is often called "Keynesian asymmetry". This type is more focused on the direction of the shock, whether it is positive or negative. Prices are believed to be sticky downwards, so any positive shock, which makes prices go downward, has fewer real effects than the negative shock. The second is related to the presence of the menu cost, which is considered to be very decisive when the shocks are not big enough to index prices. There is also a third type of distortion when both of these causes interact and lead to the hybrid asymmetry. In this case, small negative shocks are more effective, while big positive shocks are neutral because of the menu cost effects and the rigidity of prices.

The review turned to the analysis of the business cycle factors, which states that whether the economy is in recession or expansion, the result of the policy intervention will be different. That is mainly explained by the presence of asymmetric information in the market during a recession when some agents have additional data and can respond in a better way to the changes. There is also the importance of the outlook that economic agents have. The pessimism or optimism during the business cycle modifies the expectations that individuals have about the future and therefore their current behaviour. The financial market also plays a crucial role; the credit constraint during the recession modifies investment and consumption decisions. The positive shock can have limited effects during expansion because of the capacity constraints of the producers, who cannot increase their output infinitely.

Moreover, it has been shown that there are a lot of additional factors that could explain the existence of asymmetries, such as the regional factor and the sectoral dependence, where the high number of interest rate-sensitive sectors leads to amplified effects of the policy. But there is also the size of firms present in a region or a sector that needs to be considered. Big firms are less likely to be affected by the policy manipulation because they are less dependent on the public funding sources.

Finally, the time and policy factors should not be neglected. Because the effects of the policy changes need some time before being visible, this lag effect could explain why the implication of the policy change can be seen as asymmetric because the repercussions on the economy increase marginally and need time to be fully present. The policy needs to be consistent with the problem that they are used for. If the response is not adequate, the effects will be asymmetric and disproportionate to the shock.

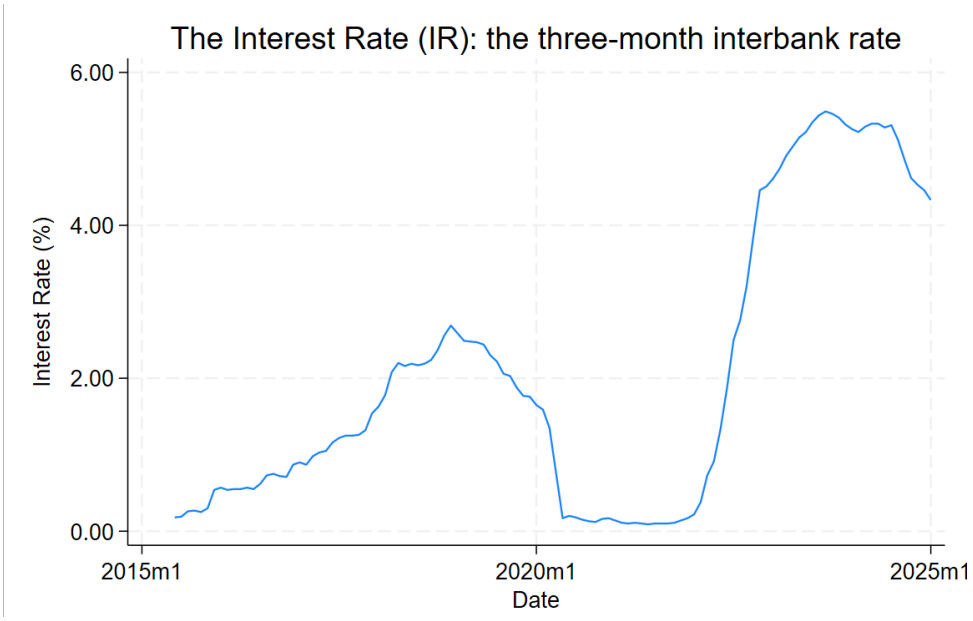
The empirical analysis of the alternative proposition, which was designed to test if the transmission mechanism of the policy has been affected by the development of fintech, has revealed that indeed the interaction of the policy changes with the financial technology development has a significant impact. Moreover, depending on the level of the financial technology development,

the outcome of the policy change is slightly different. Because the reaction of the production to the policy tightening can be interpreted to be decreased and delayed. Without the financial technologies interaction, the response is quicker and larger in magnitude.

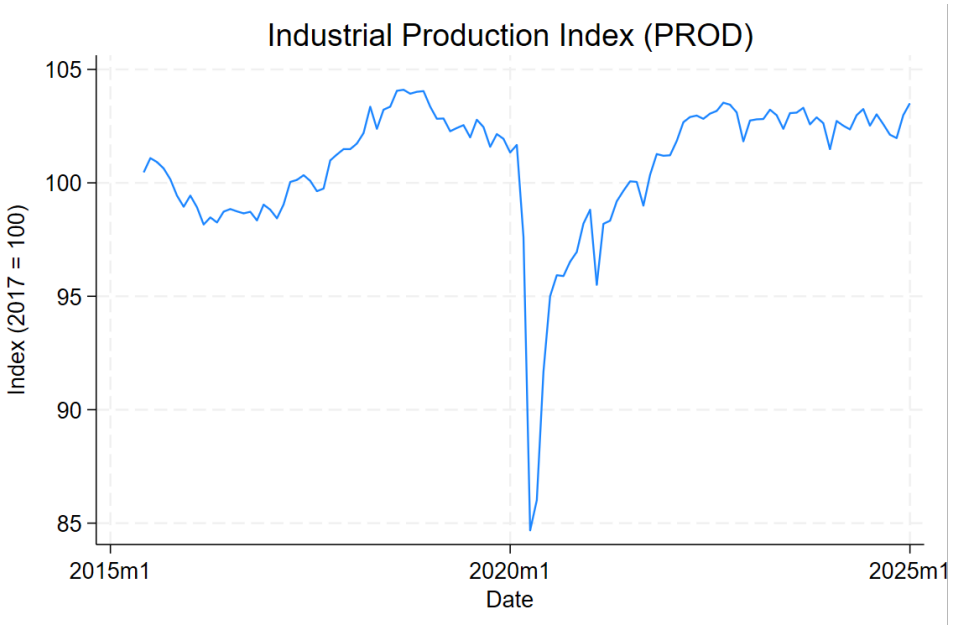
The existence of all these asymmetries can lead to detrimental consequences, such as the loss of confidence in the central bank's actions and the belief that the economy is under control. The central bank needs to deploy new instruments and methods to react in the moment of need because old-fashioned tools are no longer effective. The asymmetric changes present in the market can affect other markets as financial or labour; therefore, all the structures can be destabilised. Authorities must prevent the economy from the repetition of the Great Depression of the last decade, when the ineffectiveness of actions and the loss of confidence created a situation of panic and destruction. That is why it is very important to deeply understand all possible factors that could affect their decisions and decrease or amplify them, leading to situations with unexpected outcomes.

# Appendices

1. Plot data.

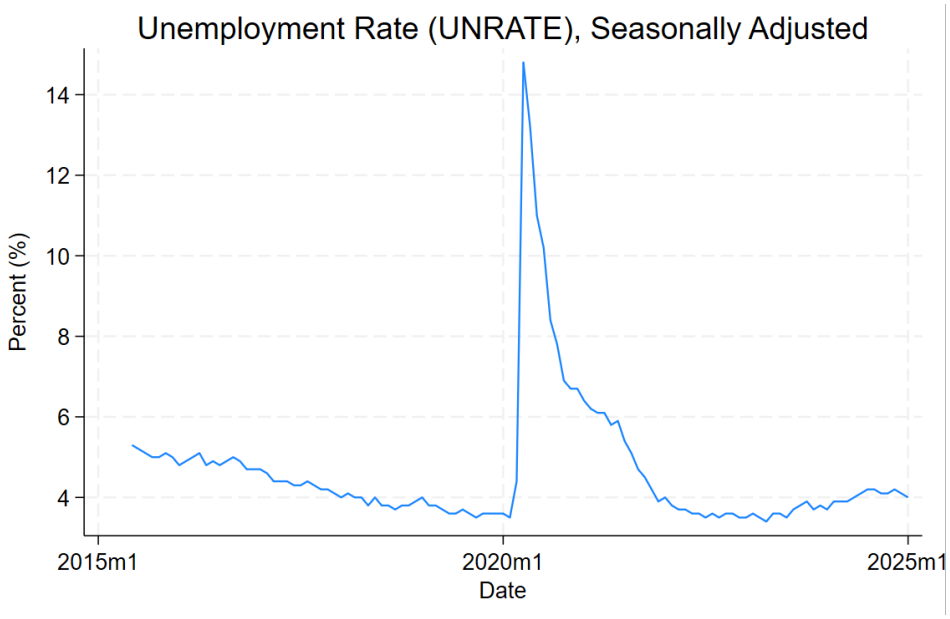



(a) Interest rate

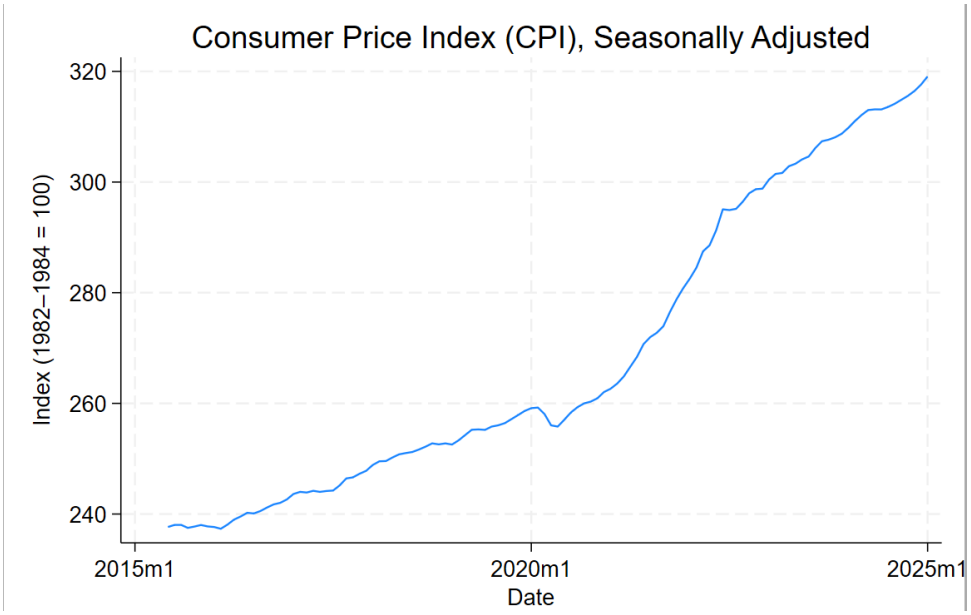



(b) Production index

Figure 5.2: Data: part 1
*Source: FRED. Graphs produced in Stata.*

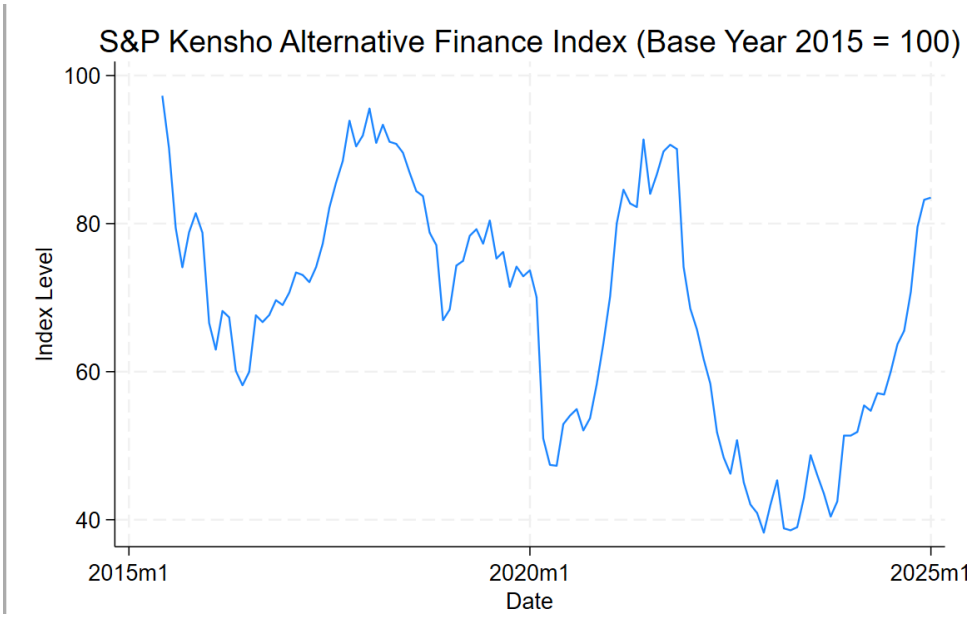



(a) Unemployment rate

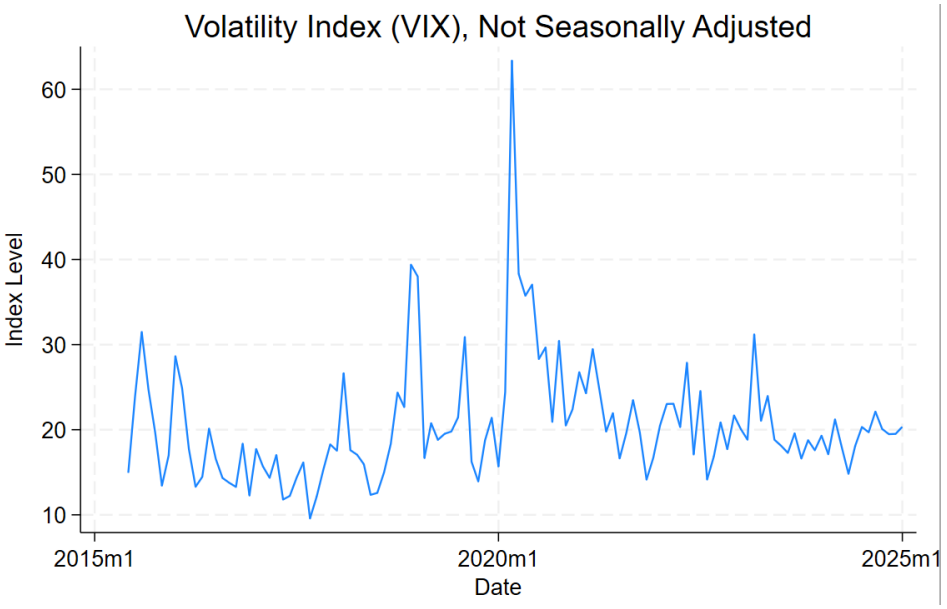



(b) Consumer price index

Figure 5.3: Data: part 2
*Source: FRED. Graphs produced in Stata.*




(a) S&P Kensho alternative finance index *Source: S&P Global.*




(b) Financial uncertainty index *Source: FRED.*

Figure 5.4: Data: part 3
*Graphs produced in Stata.*

2. Data : descriptive statistics

```
summarize IR PROD UNRATE CPI FINTECH VIX
```

| Variable | Obs | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| IR | 115 | 2.063826 | 1.855264 | .09 | 5.49 |
| PROD | 116 | 100.752 | 3.072882 | 84.6812 | 104.1038 |
| UNRATE | 116 | 4.642241 | 1.754257 | 3.4 | 14.8 |
| CPI | 118 | 269.6268 | 27.04949 | 237.336 | 319.775 |
| FINTECH | 116 | 68.32226 | 16.11586 | 38.26 | 97.27417 |
| VIX | 118 | 20.87482 | 7.555214 | 9.56958 | 63.36377 |

Figure 5.5: Descriptive statistics of the dataset
*Source: Stata.*

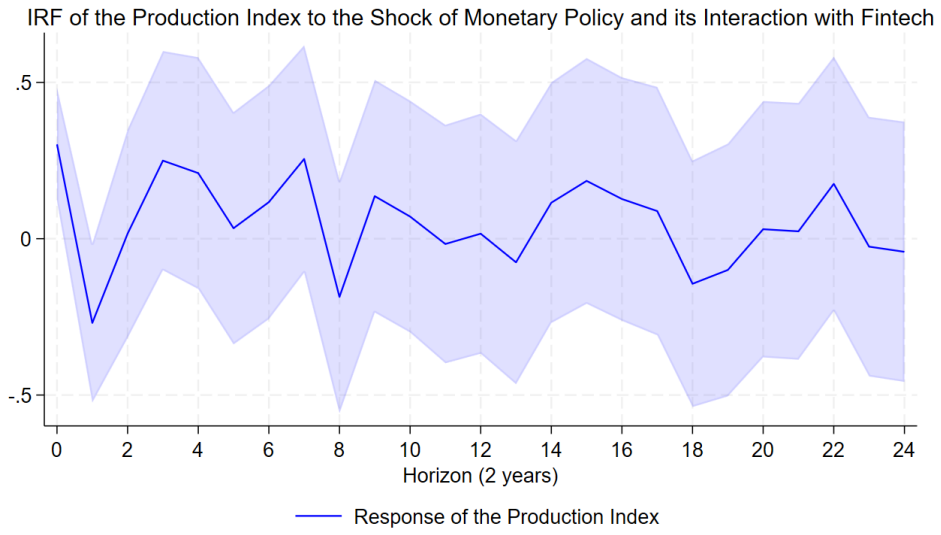
3. Model 1:

```
locproj D_ln_PROD (c.D_ln_IR c.ir_fintech)
D_ln_VIX D_ln_UNRATE D_ln_CPI,
ylags(1) lcs(c.D_ln_IR + c.ir_fintech) hor(0/24) noi
```

D_ln_PROD_h(0)

| | Coefficient | Std. err. | z | P>\|z\| | [95% conf. | interval] |
|---|---|---|---|---|---|---|
| D_ln_IR | .0134566 | .0066289 | 2.03 | 0.042 | .0004642 | .0264491 |
| D_ln_PROD L1. | .011367 | .0895487 | 0.13 | 0.899 | -.1641452 | .1868792 |
| ir_fintech | .288419 | .088773 | 3.25 | 0.001 | .1144272 | .4624109 |
| D_ln_VIX | .0025952 | .0031026 | 0.84 | 0.403 | -.0034858 | .0086763 |
| D_ln_UNRATE | -.1133195 | .0196874 | -5.76 | 0.000 | -.151906 | -.074733 |
| D_ln_CPI | 1.036989 | .3676298 | 2.82 | 0.005 | .316448 | 1.75753 |
| _cons | -.0027293 | .001223 | -2.23 | 0.026 | -.0051264 | -.0003321 |

(a) Model 1 - Table of statistics (horizon = 0)



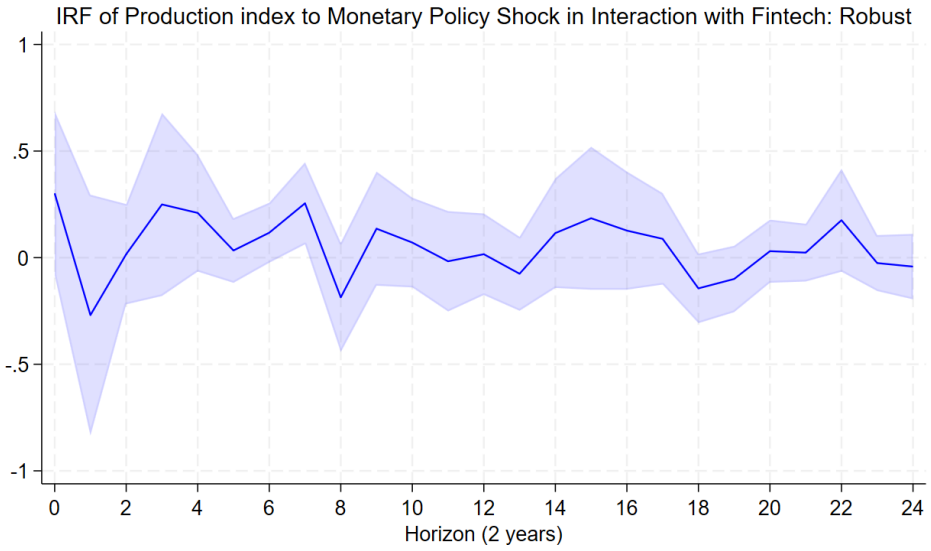

(b) Model 1 - IRF

Figure 5.6: Model 1 outputs
*Source: Stata.*

4. Model 1 : Robust

| | Coefficient | Std. err. | z | P>\|z\| | [95% conf. | interval] |
|---|---|---|---|---|---|---|
| D_ln_IR | .0134566 | .0100883 | 1.33 | 0.182 | -.0063161 | .0332294 |
| D_ln_PROD L1. | .011367 | .2068223 | 0.05 | 0.956 | -.3939972 | .4167312 |
| ir_fintech | .288419 | .1863141 | 1.55 | 0.122 | -.07675 | .653588 |
| D_ln_VIX | .0025952 | .0038165 | 0.68 | 0.497 | -.004885 | .0100755 |
| D_ln_UNRATE | -.1133195 | .0402831 | -2.81 | 0.005 | -.1922729 | -.0343661 |
| D_ln_CPI | 1.036989 | .3412598 | 3.04 | 0.002 | .3681321 | 1.705846 |
| _cons | -.0027293 | .0011276 | -2.42 | 0.015 | -.0049392 | -.0005193 |

(a) Model 1: Robust - Table of statistics (horizon = 0)

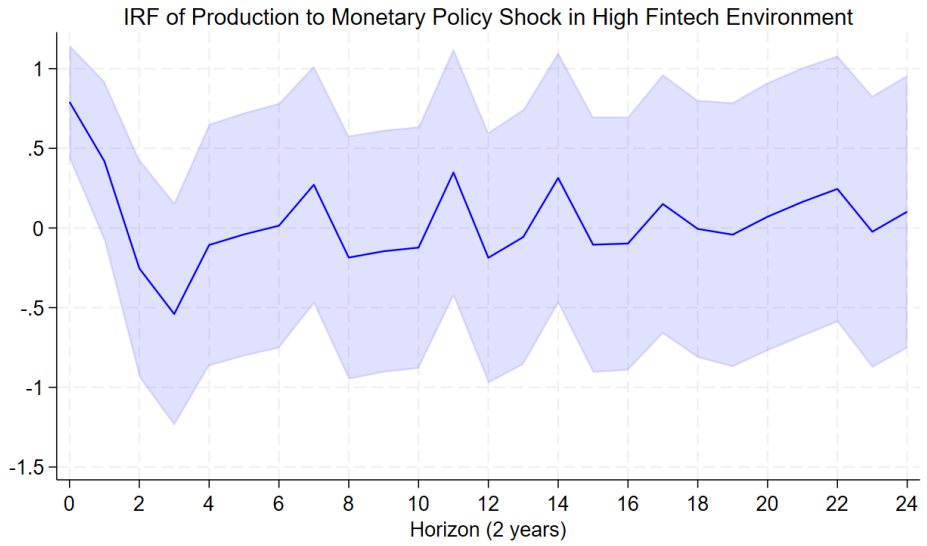



(b) Model 1 : Robust - IRF

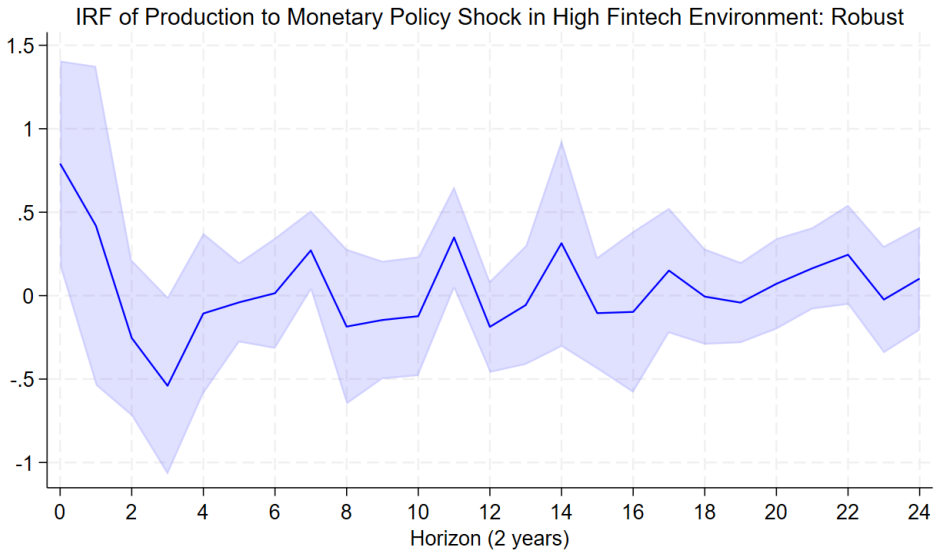
Figure 5.7: Model 1: Robust outputs
*Source: Stata.*

5. Model 2: High Fintech environment

```
locproj D_ln_PROD (c.D_ln_IR highfintech#c.ir_fintech)
D_ln_VIX D_ln_UNRATE D_ln_CPI,
ylags(1) lcs(c.D_ln_IR + 1.highfintech#c.ir_fintech) hor(0/24) noi
```




(a) Model 2: High fitech environment- IRF

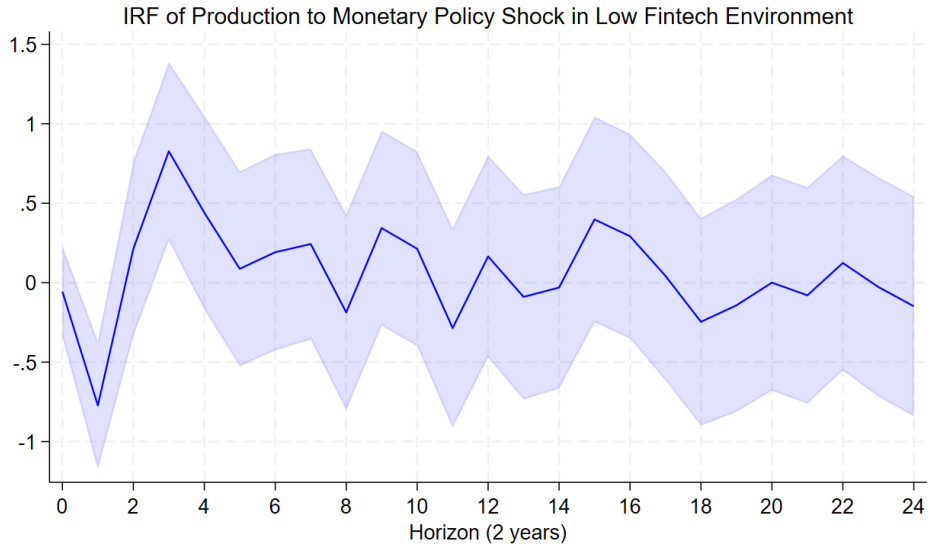



(b) Model 2 Robust: High fintech environment- IRF

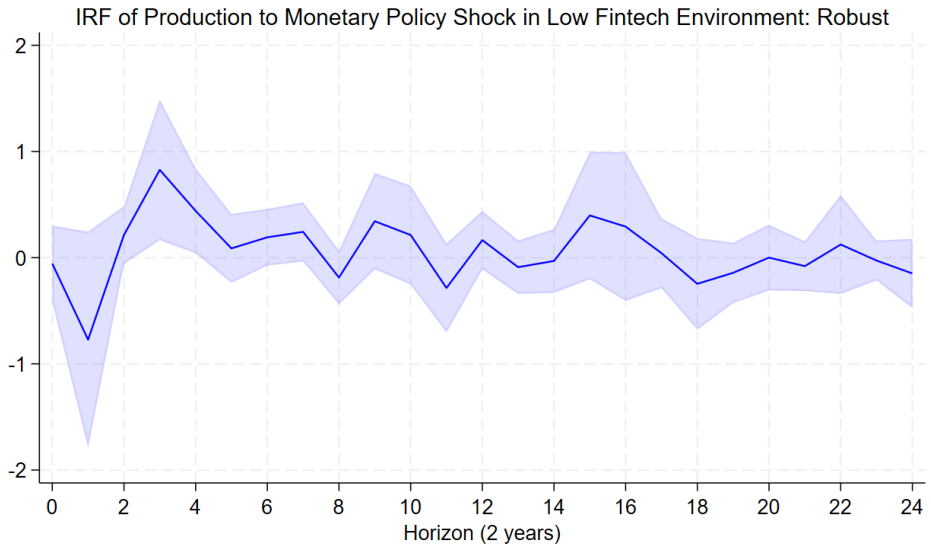
Figure 5.8: Model 2: High fintech environment outputs
*Source: Stata.*

6. Model 2: Low fintech environment

```
locproj D_ln_PROD (c.D_ln_IR highfintech#c.ir_fintech)
D_ln_VIX D_ln_UNRATE D_ln_CPI,
ylags(1) lcs(c.D_ln_IR + 0.highfintech#c.ir_fintech) hor(0/24) noi
```




(a) Model 2: Low fitech environment- IRF




(b) Model 2 Robust: Low fintech environment- IRF

Figure 5.9: Model 2: Low fintech environment outputs
*Source: Stata.*

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# EXECUTIVE SUMMARY

For decades, monetary authorities have relied on a mix of conventional and unconventional tools to influence economic agents and steer the economy toward sustainable growth and stability. Historically, it was assumed that these tools would produce consistent and proportional results. However, real-world experience has shown the inverse.

Recent literature highlights that the real effects of monetary policy are neither symmetric nor linear. This work will present that the direction, the magnitude, and the timing of interventions can yield varying outcomes depending on several factors, including the state of the business cycle, the size of the initial shock, and broader structural changes in financial markets. Rigidities in prices and wages, which make them more resistant to upward than downward adjustments, with the presence of menu costs, make small negative policy shocks more impactful than large positive ones. This inconsistency challenges the traditional understanding of monetary transmission mechanisms and weakens confidence in the effectiveness of policy actions. These asymmetries can impact the dynamics in the labour market, as well as the investment strategies and global trade.

Additionally, the review will explore an alternative proposition which will give the conclusion that the development of financial technologies may delay and reduce the responsiveness of production to monetary policy changes, further complicating the transmission mechanism. Understanding these dynamics is essential for designing adaptive, credible, and forward-looking policy strategies.

**KEYWORDS:** Asymmetric real effects, Nonlinear real effects, Positive/negative monetary policy shock, Policy transmission mechanisms, Price/wage rigidity, Menu costs, Business-cycle, FinTech and monetary policy

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