



Degree Program in Corporate Finance

Course of International Financial Economics

**The Economic and Monetary Union (EMU) and
Montenegrin Economy model**

Prof. Guido Traficante

SUPERVISOR

Prof. Giuseppe De Arcangelis

CO-SUPERVISOR

Masa Jovovic ID: 759171

CANDIDATE

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1. INTRODUCTION

Exchange rates have been a concern ever since the existence of money¹. In recent decades, the global economy has been characterized by tumultuous fluctuations in currency values due to different geopolitical events, external shocks, changes in economic indicators, monetary policies, and others. Since such fluctuations exert profound impacts on international trade, investment, and overall economic stability, authorities around the world grapple with the challenge of selecting an appropriate exchange rate regime to manage their currencies effectively. Historically, different European countries have tried, adopted, and abandoned all degrees of exchange rate arrangements, ranging from fixed exchange rates, to fully flexible, semi-flexible, and fixed but adjustable rates.

To underscore the widespread adoption and significance of exchange rate targeting, it is noteworthy that 41.75% of International Monetary Fund (IMF) member countries have chosen it as their monetary policy's nominal anchor. Furthermore, out of 194 IMF countries, 66 implement floating regimes, with 102 adopting intermediate regimes and 26 employing pegged regimes, confirming the trend towards more flexible exchange rate regimes over the past decade.²

Although the concept of exchange rate targeting, together with different exchange rate regimes, is well-established in the literature, the academic discourse surrounding the optimal exchange rate regime has always been multifaced, as there is a constant debate whether a specific exchange rate regime promotes economic growth more effectively than others. Different economic studies answer this question both ways. For instance, Bailliu, Lafrance, and Perrault's research³ shows strong evidence that a floating exchange regime positively influences economic growth. Another study conducted by Levy-Yevati and Sturzenegger⁴ finds that less flexible exchange rate regimes impede growth in developing countries, while the exchange rate regime does not seem to matter in developed countries. Conversely, advocates of fixed exchange rates, typified by Mundell⁵, champion fixed exchange rate's stability and predictability as drivers of economic growth. However, more recent studies underscore the contextual dependency of exchange rate regime effectiveness, highlighting the need for nuanced analyses that account for specific economic contexts, institutional frameworks, and developmental stages.

Despite extensive scholarly inquiry, a consensus on the superiority of one regime over the other remains elusive. Moreover, there is a discernible need for comprehensive investigations that delve into the dynamic and context-specific nature of exchange rate regimes. This thesis endeavors to bridge this gap by examining

¹ Colonescu, (2017), "Macroeconomic Effects of the European Monetary Union: A counterfactual Analysis"

² IMF, (2023), "Annual Report on Exchange Arrangements and Exchange Restrictions 2022"

³ Bailliu, Lafrance, and Perrault, (2002), "Does Exchange Rate Policy Matter for Growth?"

⁴ Levy-Yevati and Sturzenegger, (2003), "To Float or To Fix: Evidence on the Impact of Exchange Rate Regimes on Growth"

⁵ Mundell, (1961), "A Theory of Optimum Currency Area"

the conditions under which fixed or floating exchange rate regimes are most appropriate for a small, open economy. Focusing on the unique case of Montenegro, where euroization catalyzed substantial economic recovery, this research delves into the macroeconomic implications of adopting a currency/monetary union regime, given Montenegro's aspirations to join the European Union (EU) and, subsequently, the Economic and Monetary Union (EMU). Accordingly, certain research questions can be asked:

- I. What are the macroeconomic implications of a fixed exchange rate regime, such as a currency union?
- II. How do key macroeconomic variables respond to domestic and foreign shocks under this regime?
- III. Does the EMU, as a strong fixed exchange rate regime, yield more benefits for a small, open economy like Montenegro, in comparison to other monetary policy regimes?

To address these questions, this thesis commences with a literature review encompassing exchange rate targeting, various exchange rate regimes, and the optimal choice of the exchange rate regime. Furthermore, Montenegro emerges as a compelling case study due to its size and degree of openness, alongside its distinctive experience with euroization and subsequent economic resurgence. Using the Gali and Monacelli (2005) model calibrated to Montenegro's specifics, this research thesis simulates the pegged exchange rate regime, to analyze its benefits and costs, while also examining the responses of some variables to domestic productivity shock and foreign output shock under this regime.

By undertaking such quantitative analysis, this research aims to equip policymakers with actionable insights for optimizing exchange rate policies, thereby bolstering economic stability and promoting growth. Additionally, this thesis not only enriches academic dialogue but also presents practical solutions to real-world economic dilemmas.

Regarding the structure of the thesis, there are six chapters, each building upon the previous one, to provide a comprehensive analysis of exchange rate regimes, particularly focusing on Montenegro's euroization and its potential membership in the Economic and Monetary Union (EMU). The second chapter delves into central banking fundamentals and monetary policy, covering various regimes and the concept of exchange rate targeting, while also examining different exchange rate regimes with a focus on the optimal choice. The third chapter focuses on Montenegro, introducing the concept of euroization, discussing the benefits and costs of adopting the euro, and exploring the implications of Montenegro joining the EMU. The fourth chapter presents the Dynamic Stochastic General Equilibrium (DSGE) models used for analysis, detailing the Gali and Monacelli (2005) model of a small, open economy, including households, firms, equilibrium, and monetary policy. It also discusses the model, parametrization and calibration of data, and the impulse responses to selected shocks under different scenarios (PEG and DITR), along with cyclical properties and a robustness check. The concluding chapter synthesizes the findings, discusses policy implications, and suggests areas for future research.

2. LITERATURE REVIEW

2.1. Central Banking

In the past two decades, central banking has developed significantly and experienced major dramatic changes that had a global scope and influenced central banks to evolve and become dominant forces in the creation of national and international policies. Because of those changes, instead of fiscal policy, which before the 1980s was considered the main instrument of economic policy, today economists and politicians emphasize the more significant role of monetary policy. Although the coordination of monetary and fiscal policy is necessary for creating economic growth and achieving a high level of employment, central banks have taken the role of important economic and political institutions, which as creators of monetary policy provide a healthy and stable macroeconomic environment, favorable for long-term sustainable growth of the economy.

After many different experiences and lessons learned throughout history, some of the key changes that influenced the development of central banking include the greater importance of the independence of central banks, maintaining low and stable inflation, but also creating stability that deeply affects the everyday life of all people. Although modern central banks have many common characteristics, there is still considerable diversity in how central banks operate and create their monetary policy. The reasons for this are their different historical contexts, leading philosophies, and specific national conditions, which can properly explain why certain frameworks of central banking and monetary policy work better in some countries than in others.

Despite the mentioned differences, certain characteristics can be seen as variables that are key to national economic growth and development, and represent the basic functions of modern central banks, namely 1) preservation of monetary stability and 2) preservation of financial stability. Although these are two different concepts, they are deeply connected and interdependent, given that both concepts have stood out over the last decades as preventive measures for numerous economic problems.

Monetary stability is often defined as an environment in which inflation is low and stable, which positively affects the ability of households and firms to optimize their consumption and investments and enables price changes not to be considered when making daily decisions.⁶ On the other hand, financial stability suggests the provision of a state in which financial instability and crises are very rare and the formation of a system in which capital and other resources are efficiently distributed. Naturally, this concept includes not only prevention but also reaction to crises, all to maintain stability, which is vital for long-term, sustainable economic growth. Additionally, there is another essential concept in modern monetary theory and politics.

⁶ Alan Greenspan, (2001), "Transparency in monetary policy"

That is the central bank independence (CBI). This concept particularly stood out after the collapse of the Bretton-Woodson system because it encouraged a re-examination of the role and independence of central banks as a possible solution to price instability in the world of floating exchange rates. “Moral corollary” of CBI certainly represents both a high degree of responsibility and transparency, thereby increasing confidence in the decision-making processes within the bank.⁷

2.2. Monetary policy

Nowadays, it is inconceivable to imagine a modern economy without a quality monetary policy and a functional central bank characterized by the previously mentioned concepts. What contributed to their evolution are a series of events and experiments during the last fifty years that led economists and policymakers to question but also agree on what constitutes a good monetary policy. Today, through a set of rules, measures, regulations, and monetary policy instruments, central banks can regulate the amount, structure, and dynamics of the money supply to achieve its long-term goals such as price stability and economic growth. It is clear that to constantly keep up with the changes that are present in the world and to avoid chaos in monetary relations, central banks are forced to persistently change or improve old instruments to adequately respond to given problems and complexity. Finally, it can be concluded that in conducting monetary policy, central banks should follow an explicit rule, rather than use pure discretion.

Following the explicit rule concerns the choice of monetary policy regime, which may be defined as “constraints or limits imposed by custom, institutions, and nature on the ability of the monetary authorities to influence the evolution of macroeconomic aggregates”⁸. Given that the choice of a monetary policy regime has never been a result of some rule, it exclusively depends on the prevailing understanding of monetary theory, the phase of the economic cycle, the nature of economic relations with foreign countries as well as inflation targeting policies. Therefore, all conditions and circumstances should be carefully considered before choosing a so-called nominal anchor. The broad use of the term “nominal anchor” is sometimes equated with a policy discretionary constraint that alleviates time-inconsistency problems, allowing central banks to focus on long-term goals, rather than short-term gains that may lead to poor long-term outcomes. In practice, there are 4 key monetary policy regimes, which central banks can be assumed to choose among:

- exchange rate targeting,
- money growth rate targeting,

⁷ Blinder, (1998), “Central Banking in Theory and Practice”

⁸ Bordo and Schwartz, (1999), “Chapter 3 Monetary policy regimes and economic performance: The historical record” – Handbook of Macroeconomics

- inflation targeting,
- unconventional monetary policy.

Given that the topic of this thesis is related to the concept of euroization and currency union as fixed exchange rate regimes, the focus in the continuation of this paper will be on exchange rate targeting as one of the 4 possible nominal anchors.

2.3. Exchange rate targeting

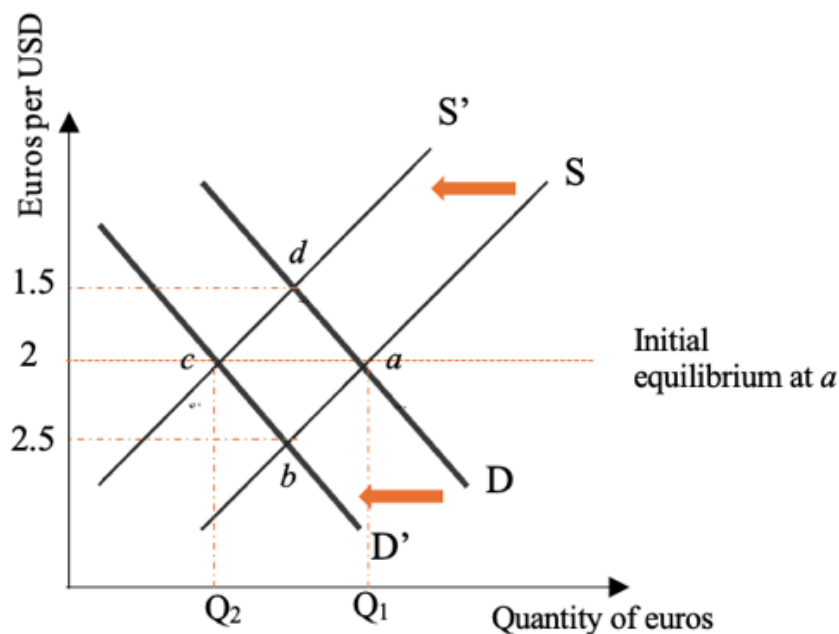
As previously mentioned, exchange rate targeting is one of the key monetary policy regimes⁹, which concerns maintaining the stability of a national currency by fixing it to a commodity, such as gold, or to another country's currency or a basket of currencies. It represents one of the most common strategies for controlling inflation in industrialized countries and promptly reducing inflation in underdeveloped countries, to provide greater predictability and stability in the economy. Thus, the implementation of exchange rate targeting implies that the central bank cannot freely manipulate the money supply, as this could lead to a shift of the exchange rate outside the intended target range, which could potentially destabilize the economy. Moreover, it is worth noting that while exchange rate targeting may provide short-term advantages in terms of stability and predictability, in the long-term it may limit the central bank's monetary independence and adaptability to domestic economic conditions. Therefore, the choice of this regime requires careful consideration of both global and local economic factors.

In history, there have been several popular attempts to peg currency to some commodity or another currency, especially after major global events that contributed to a better understanding of how this mechanism maintains monetary and financial stability. A notable example is a monetary system in the 1870s in which the money in circulation had a fixed cover in gold. This system, known as the gold standard, had many positive aspects including the natural rarity of this metal, and constant maintenance of its value, which ensured long-term price stability and public trust, but also reduced the risk of arbitrary monetary policy. Despite all its advantages, such a system was not able to catch until today, particularly due to its rigidity. Economic problems which arose during the Great Depression led to a sudden increase in unemployment and poverty. Fearing for their money, people began to withdraw it from banks, demanding payment in gold, which explains why leading world powers in the 19th century decided to leave the gold standard, that is to avoid the mass outflow of gold and its potential disappearance. All subsequent attempts were mainly based on fixing the value of the currency to the value of another country's currency, so after the collapse of the Bretton Woods system and until the late

⁹ p.1

1990s, many central banks, especially in developing economies, decided to peg their currency to the US dollar, while developed economies in Europe often chose the German mark, until the creation of the euro. Whether a central bank targets the value of its currency against another currency or a basket of currencies, or in terms of a specific exchange rate level, target zone, or gradual rate slide, the essential mechanics can be illustrated by the following simple model of exchange rate targeting.

Figure 1: A Simple Model of Exchange Rate Targeting



Source: Thammarak Moenjok, (2014), “Central Banking: Theory and Practice in Sustaining Monetary and Financial Stability”

Accordingly, Figure 1 represents an equilibrium model on the foreign exchange market in a country where the central bank sets exchange rate targeting as a monetary regime. For the sake of simplicity, I set up a hypothetical situation in which the central bank of country A decides to peg the value of its currency, the euro, to an exchange rate of 2 euros for 1 US dollar. An initial equilibrium is shown in the figure at point *a*, where the supply and demand for domestic currency are balanced. However, if demand for the domestic currency falls, for example through increased demand by importers for foreign currency, the demand curve shifts to the left, leading to a potential fall in the value of the domestic currency below the target level, thus point *b*. To counter this trend, the central bank intervenes in the market by selling foreign currency from its reserves and buying domestic currency, thereby reducing its supply, and supporting its exchange rate. On the other hand, if there is an increase in demand for the domestic currency, for example through an increased need for exporters to exchange their foreign currency earnings for domestic currency, the demand curve shifts to the

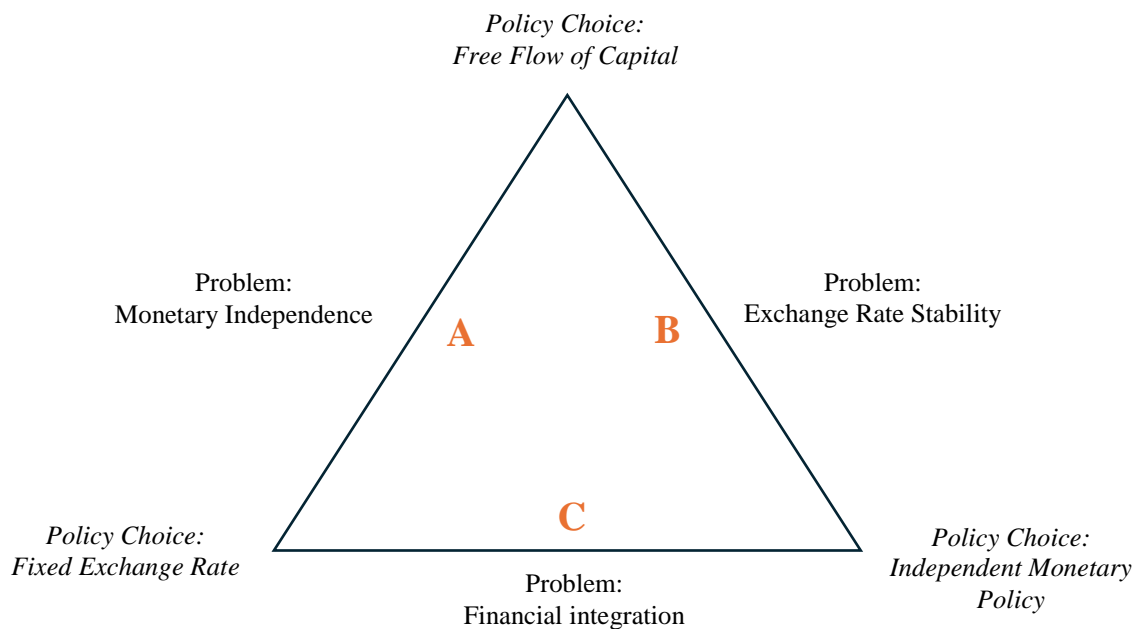
right. To prevent the domestic currency from appreciating above the target level, the central bank buys foreign currency from exporters and sells domestic currency, thereby increasing its supply in the market.

However, the effects of capital inflows and outflows also play a significant role in the dynamics of exchange rate targeting. Capital inflows increase the demand for the domestic currency and can lead to its appreciation, while capital outflows can cause its depreciation. In both cases, the central bank must intervene to maintain the exchange rate within desired limits, buying or selling foreign currencies as needed.

In the real world, maintaining a fixed exchange rate can be very challenging, especially in small, open economies that are subject to large and volatile international capital flows. Furthermore, exchange rate targeting can limit the independence of the central bank in conducting monetary policy, as it must continuously adjust the money supply not only according to internal economic needs but also to maintain a fixed exchange rate.

These challenges are further complicated by the "Impossible Trinity", also known as the Trilemma, which claims that a country cannot simultaneously have a fixed exchange rate, free flow of capital, and an independent monetary policy due to their mutual exclusion, as depicted in the figure below. Hence, many central banks have therefore abandoned exchange rate targeting as their monetary policy regime, especially in the context of globalization and diverging economic cycles.

Figure 2: The Trilemma



Source: Author

Figure 2 shows three sides of the trilemma triangle, where each side offers benefits and constraints, forcing countries to prioritize based on their economic goals and conditions.

Side A of the trilemma involves fixing the country's exchange rate while allowing the free flow of capital. This setting makes independent monetary policy unattainable. In such a scenario, any attempt to independently manipulate interest rates would undermine the fixed exchange rate due to potential opportunities for currency arbitrage.

Secondly, Side B allows the country to maintain both an independent monetary policy and a free flow of capital but excludes the possibility of maintaining fixed exchange rates. If the free flow of capital is allowed, maintaining a fixed exchange rate becomes unsustainable because capital movements would lead to pressures on the exchange rate that the central bank cannot control if it is to maintain an independent monetary policy.

Finally, Side C includes the choice of fixed exchange rates along with independent monetary policy, but at the cost of capital flow restrictions. In this regime, maintaining fixed exchange rates while pursuing an independent monetary policy requires controlling capital movements to prevent market forces from distorting the exchange rate regime.

2.4. Exchange rate regimes

Given that countries are often faced with numerous macroeconomic changes and challenges that can cause a weakening of trust in leading institutions and the national currency, they are forced to adhere to the operational rules and institutional mechanisms that the central bank uses to manage the exchange rate. To be more precise, various currency and financial crises, and the integration of world trade and capital markets, encouraged the search for an exchange rate regime that would be appropriate for a given economy. Although no regime is always favorable and ideal¹⁰, the choice of regime often depends on the conditions within a country, such as credibility of domestic monetary policy, current economic conditions, openness and size of the economy, history of hyperinflation, and so on.

Over the last decades, both in theory and practice, many exchange rate regimes have been tried, adopted, and abandoned. Certainly, the beginning of the debate was based on a simple division into a fixed and a floating regime¹¹. Yet, as time passed, in addition to the traditional division into fixed and floating regimes, a whole spectrum of different regimes emerged, suggesting that many countries could benefit from regimes that combine the benefits and costs of both poles. Although there are different classifications of the exchange rate regimes, such as the IMF classification, the Dornbusch and Kuenzler (1993) classification, the classification

¹⁰ Jeffrey A. Frankel, (1999), “No single currency regime is right for all countries or at all times“

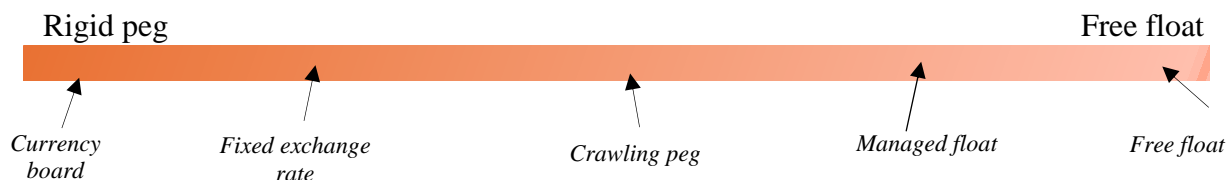
¹¹ Friedman, (1953), “The Case for Flexible Exchange Rates”

into fixed or flexible regimes in nominal or real terms, and many others, in this paper I categorize regimes into rigid peg regimes, free float regimes, and middle or intermediate regimes. Accordingly, classification can be presented as a continuum¹², where at one end there is a fixed, and at the other a free-floating system, based on 3 variables¹³:

- *The volatility of the exchange rate*, which is measured on average by the absolute percentage monthly change of the nominal exchange rate during the year.
- *The volatility of exchange rate changes*, which is the standard deviation of the percentage of monthly exchange rate changes.
- *The volatility of reserves*, which is measured on average by the absolute monthly change of international reserves relative to the monetary base in the previous month to assess the monetary effects of these changes.

Furthermore, the regimes that are classified as neither fixed nor flexible according to their characteristics are called middle or intermediate regimes and imply high volatility of all three variables. Some authors consider them particularly negative due to their small impact on economic growth, in comparison to the hard peg and free float. Other experts believe that transitional regimes are acceptable for countries that have not yet opened to capital flows, in most cases developing countries. Therefore, in the absence of institutional stability, transitional regimes can strengthen the credibility of the policy and the effect of disciplining the monetary policy, which is a prerequisite for future exchange rate fluctuations. Apart from these regimes, some others exhibit little variability in all three variables and cannot be classified under any group. Such exchange rate regimes do not have any impact on the economy. Given that intermediate regimes experienced numerous speculative attacks in the 1990s, many economists label them as inherently vulnerable, with some economists favoring complete flexibility and others favoring hard pegs, the so-called bipolar view. While fixed exchange rate regimes imply low volatility of the exchange rate and high volatility of reserves, flexible regimes are known for high volatility of the exchange rate and low volatility of reserves.¹⁴

Figure 3: A Spectrum of Exchange Rate Regimes



Source: Tobias Straumann, (2010), “Fixed Ideas of Money-Small States and Exchange Rate Regimes in Twentieth-Century Europe”

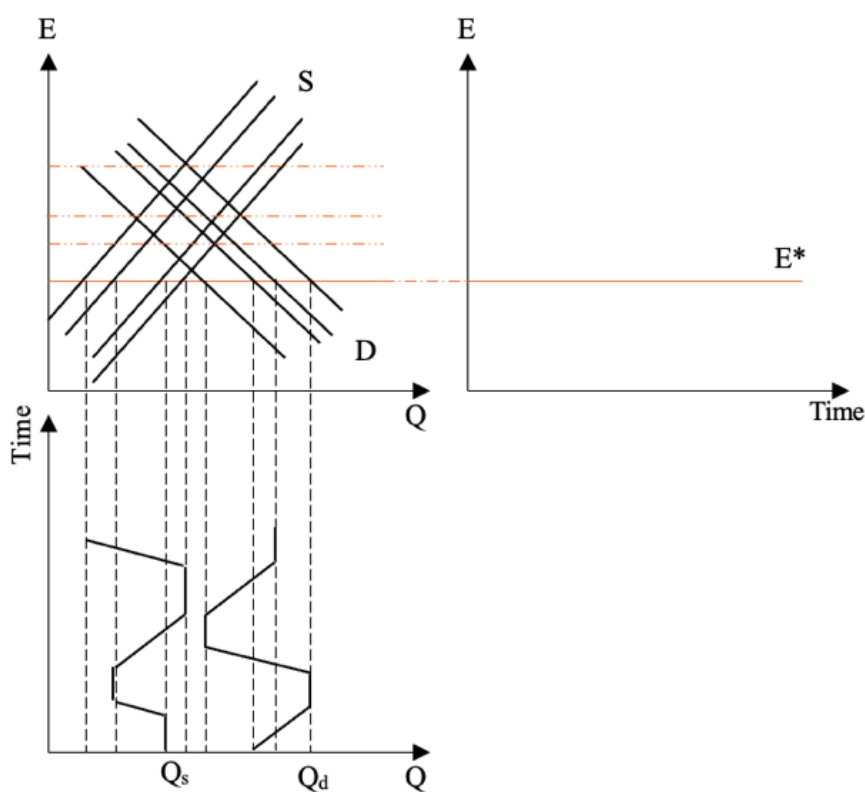
¹² Tobias Straumann, (2010), “Fixed Ideas of Money-Small States and Exchange Rate Regimes in Twentieth-Century Europe”

¹³ Levy-Yeyati and Sturzenegger, (2002), “A de facto Classification of Exchange Rate Regimes”

¹⁴ Levy-Yeyati, F. Sturzenegger, (2002), “Classifying Exchange Rate Regimes: Deeds vs. Words”

On the left side of the continuum are fixed regimes, through which monetary authorities keep the exchange rate at a certain level or within a certain range of allowed fluctuations. In the figure below, it can be seen how the demand and supply curves shift, while the exchange rate is maintained at a certain level E^* . If the exchange rate exceeds the permissible level, the central bank intervenes to prevent further growth of the exchange rate. It does this by selling its currency and buying an equivalent amount of foreign currency. On the other hand, if the exchange rate falls below the allowed level or range, the central bank reacts by buying its currency and selling foreign currency. Therefore, the central bank naturally intervenes and prevents the free movement of the exchange rate, by using its international reserves, which is represented as the difference between Q_d and Q_s in the figure. If such an intervention is not carried out, the alternative may include the introduction of capital controls or the rationalization of resources.

Figure 4: The Foreign Exchange Market under Fixed Exchange Rates



Source: Imad A. Moosa, (2005), "Exchange Rate Regimes-Fixed, Flexible or Something in Between?"

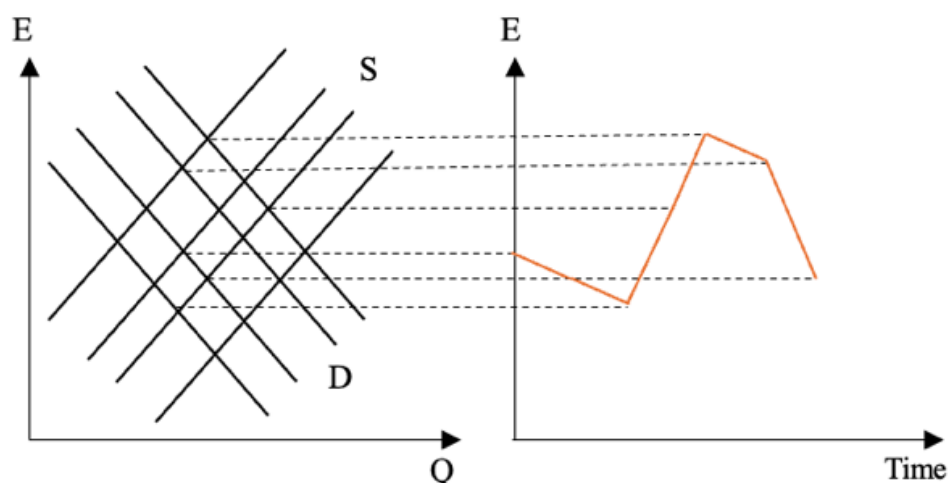
The advantages of such a regime mainly include reduced exchange rate volatility, which can contribute to a more stable economic environment by lowering inflation in the future¹⁵ and encouraging cross-border

¹⁵ J. A. Frankel, (2003), "Experience of and Lessons from Exchange Rate Regimes in Emerging Economies"

trade and investment. They also include the reduction of transaction costs and the risk of fluctuations, making trade and investment safer. Furthermore, when the domestic currency is pegged to the currency of an economically strong country, it can help eliminate foreign exchange risk and strengthen international exchange, which prevents competitive appreciation and depreciation. However, there are also several challenges associated with a fixed regime. One of the key problems is the reduction of the central bank's foreign exchange reserves due to the constant need for intervention to maintain exchange rate stability. Additionally, if there is a sharp and sustained decline in demand for a country's exports, a fixed exchange rate makes it difficult to adjust prices, which can lead to a decline in employment and economic activity.¹⁶

Conversely, on the right end of the continuum, one can find flexible regimes known as free-floating regimes, through which the central bank allows the exchange rate to be completely determined by market forces. In this system, unlike a fixed exchange rate, monetary authorities do not intervene to control exchange rate movements. Over time, the exchange rate adjusts to changes in supply and demand. This behavior is illustrated in the figure below. Starting from the initial equilibrium point, the exchange rate moves following the movement of supply and demand, while different equilibrium points corresponding to changes in the exchange rate can be recognized also. A simple assumption in this figure is that at a given point in time, changes occur in either the supply curve or the demand curve, although changes can occur on both sides simultaneously in the real world. This flexibility allows exchange rates to respond to market forces, providing the flexibility needed to maintain balance in a dynamic economic environment.

Figure 5: The Behavior of Flexible Exchange Rates



Source: Imad A. Moosa, (2005), "Exchange Rate Regimes-Fixed, Flexible or Something in Between?"

¹⁶ M. Obstfeld and K. Rogoff., (1995), "The Mirage of Fixed Exchange Rates"

The benefits of a flexible regime, include greater opportunities for the central bank to use monetary policy to address domestic economic problems. Without the need to maintain a fixed exchange rate, the central bank is free to manage interest rates and use other instruments to stimulate the domestic economy. For example, in the event of a recession, the central bank may lower interest rates to stimulate demand, even if this means a depreciation of the exchange rate. This flexibility provides the central bank with the tools to stimulate demand for domestic products and maintain the desired level of output and employment, without excessive worries about the exchange rate.¹⁷ However, the expectations of market participants can be unstable, leading to significant fluctuations in the exchange rate, which potentially discourages international exchange and investment.¹⁸ In a world with higher capital flows, it is difficult for the central bank to keep the exchange rate stable, as capital inflows and outflows affect the exchange rate. In extreme cases, the need to maintain the exchange rate may require large amounts of foreign currency, which is not always sustainable. Thus, although a flexible exchange rate regime provides greater flexibility and the possibility of adjustment, it may also lead to greater economic risks due to unpredictable changes in the market.

To see the presence of different regimes in the real world, it is most appropriate to rely on IMF's Annual Report on Exchange Arrangements and Exchange Restrictions 2022, more precisely Exchange Rate Arrangements presented as a percentage of IMF members.

Table 1: IMF's Annual Report on Exchange Arrangements and Exchange Restrictions 2022

Exchange Rate Arrangement	2016	2017	2018	2019	2020	2021	2022¹⁹
Hard peg	13.0	12.5	12.5	12.5	12.5	13.0	13.4
No separate legal tender	7.3	6.8	6.8	6.8	6.8	7.3	7.2
Currency board	5.7	5.7	5.7	5.7	5.7	5.7	6.2
Soft peg	39.6	42.2	46.4	46.4	46.9	47.7	46.9
Conventional peg	22.9	22.4	22.4	21.9	21.4	20.7	20.6
Stabilized arrangement	9.4	12.5	14.1	13.0	12.0	12.4	11.9
Crawling peg	1.6	1.6	1.6	1.6	1.6	1.6	1.5
Crawl-like arrangement	5.2	5.2	7.8	9.4	12.0	12.4	12.4
Pegged exchange rate within horizontal bands	0.5	0.5	0.5	0.5	0.0	0.5	0.5
Floating	37.0	35.9	34.4	34.4	32.8	33.2	34.0
Floating	20.8	19.8	18.2	18.2	16.7	16.6	18.0
Free floating	16.1	16.1	16.1	16.1	16.1	16.6	16.0
Residual							
Other managed arrangements	10.4	9.4	6.8	6.8	7.8	6.2	5.7²⁰

Source: AREAER database and IMF calculations.

¹⁷ Duška Gajić, (2004), "Režimi deviznih kurseva"

¹⁸ Jeffrey A. Frankel, (1999), "No single currency regime is right for all countries or at all times."

¹⁹ These numbers indicate years, time period 2016-2022

²⁰ Percentage of countries and territories using different regimes out of 190 IMF member states plus some territories

Finally, it should be taken into account that the classification of countries according to the exchange rate regime becomes complex due to the difference between what the country officially claims to apply and what it applies, i.e. de facto (also known as the behavioral classification) and de jure classification of the exchange rate regime. This involves countries that report their regime as flexible but attempt in practice to hold their exchange rates within a relatively narrow range or to peg it formally, and vice versa. In literature, the previously mentioned problems are described as the “fear of floating” and the “fear of fixing”. Such ‘pegs that float’ and ‘floats that peg’ tend to be the result of countries with relatively poor political institutions, described by more corruption, less protection of property rights, and so on.²¹

2.4.1. The optimal choice of an exchange rate regime

Despite all the previously mentioned theories about the exchange rate regimes and different classifications²², the choice of the optimal exchange rate regime is still one of the most important, at the same time very difficult decisions that every country faces when entering international economic relations. Such a question may seem vague or too technical to outside observers, but for economists and economic historians, debates about exchange rate regimes have always been interesting, henceforth many studies continue to explore the relationship between exchange rate regimes and economic growth. However, the context-specific nature of this relationship makes it particularly challenging to draw universal conclusions, consequently studies often involve opposing views. For example, Milton Friedman, known for his advocacy of monetarism, supports flexible exchange rates, while Robert Mundell, prefers optimum currency areas defined by fixed exchange rates and common currencies. Overall, there is no one-size-fits-all solution, that is a single best or most efficient regime that can be singled out for its outstanding features, as each regime brings with it many benefits and costs, so the choice is purely down to the country.

However, finding the “perfect” regime is a critical factor for maintaining macroeconomic stability and economic growth, so countries that fall between fixed and flexible regimes must carefully consider their specific conditions to make the best decisions, as ignoring relevant factors can destabilize the economy. Some of the approaches that may help navigate when choosing an adequate exchange rate regime include the study of the theory of Optimal Currency Area, different political and financial aspects, as well as the analysis of the advantages and costs of certain regimes. Furthermore, the previously mentioned factors are very often used as variables in empirical regime choice models, which explain how the underlying exchange rate regime is related to the economic, financial, and political characteristics of the country. Given their significance, I will showcase

²¹ Alesina, Alberto F., and Wagner, Alexander F., (2003), “Choosing (and Reneging on) Exchange Rate Regimes”

²² p. 4-11

them in the table provided below.

Table 2: Factors Affecting the Choice of the Optimal Exchange Rate Regime

OCA factors	Fear of floating factors	Political economy factors	Other factors
Openness	Foreign currency debt	Political instability	Growth
Economic development	Degree of dollarization	Central bank credibility	Inflation
Size of economy	Degree of exchange rate pass-through	Central bank independence	Terms of trade volatility
Inflationary differential	Elasticity of supply of external funds	Majority of party in office	Real exchange rate variability
Capital mobility	Lack of credibility	Number of parties in coalition	Growth of domestic credit
Labor mobility		Political integration (similarity of policy preferences)	Symmetric or asymmetric preponderance of shocks
Trade integration			Real or nominal type of shocks
Diversification of production and exports			Reserves
			Per capita GDP

Source: Imad A. Moosa, (2005), "Exchange Rate Regimes-Fixed, Flexible or Something in Between?"

As shown in the table, the choice of the optimal exchange rate regime typically aligns with three main theoretical frameworks: the optimum currency area theory, political economy considerations, and the fear of floating theory, while an additional macroeconomic and monetary factors may also play a role. Also, it is important to note that the classification of these factors is not rigid, as some factors overlap and can imply more or less flexibility depending on their classification. Traditionally, the choice of exchange rate regime is guided by the principles of the optimum currency area²³, emphasizing factor mobility and price adjustment flexibility. Additionally, countries with significant trade volumes, close economic ties to major partners and synchronized economic shocks often favor fixed rates, particularly if they are small, open economies that

²³ Mundell, (1961), "A Theory of Optimum Currency Area"

struggle with monetary commitment.²⁴ Furthermore, the choice of an exchange rate regime is significantly influenced by the nature of the economic shocks the economy faces. While fixed regimes are adept at managing nominal (or monetary) shocks that affect the money supply and the price level, thereby mitigating the impacts of these shocks, conversely, flexible regimes show greater adaptability to real shocks, such as changes in productivity or terms of trade, facilitating rapid economic adjustments through shifts in the nominal exchange rate. Moreover, the origins of shocks, whether domestic or foreign—further delineate the appropriateness of adopting fixed versus flexible exchange rates.

Secondly, the “fear of floating”²⁵ term, highlighting the risk-averse nature of monetary authorities, has emerged to explain why countries are reluctant to adopt a flexible exchange rate despite its theoretical benefits. This type of factors generally includes foreign currency debt, the degree of exchange rate pass-through, elasticity of supply of external funds, lack of credibility, etc.

Furthermore, political economy factors show how the choice of an exchange rate regime is not solely a technical economic decision but is also deeply influenced by the broader socio-political context within which economic policies are formulated and implemented. Factors such as political instability, central bank credibility and independence, and other, often demonstrate the intersection of economics with political and institutional dynamics, which influence policymaking and economic strategy, including the choice of a proper regime.

²⁴ Williamson, (1991) paper

²⁵ Calvo and Reinhart, (2002), “Fear of floating”

3. EUROIZATION

3.1. Concept of dollarization

Traditionally, own currency has been an important part of the sovereignty of any country as it reflects the state of the real economy. In situations when the national currency becomes particularly unstable, weak, and difficult to change due to various problems such as unstable prices, bad exchange rates, and lack of investors, citizens lose trust in the domestic currency and the monetary authorities. Such an example in the literature are mostly countries that have gone through war, or various riots and conflicts in history, due to which trust is often lost. Rebuilding trust through economic stability is very challenging in these situations, especially due to weak institutional capacities, which makes it difficult to implement good economic policies. Under such conditions, countries choose among different exchange rate regimes to solve problems and meet their monetary policy objectives, but the choice of exchange rate regimes is limited. Since they do not have the technical capabilities or data needed to implement an independent monetary policy and establish the credibility of the domestic currency, they usually opt for a strict exchange rate regime. Doubtlessly, the most rigid of them all is the substitution of the domestic currency for a foreign one, i.e. dollarization, which can be seen as the solution of last resort, that is the ultimate way to achieve credibility, growth, and prosperity²⁶, once all other solutions have been considered.

Dollarization, as a concept, is not new, but in the last 25 years, it has attracted considerable attention, both among economists, political decision-makers, and experts of various kinds, as well as in business circles²⁷, who began to look at it as a reform of the international financial architecture. This interest stems from the insufficiently researched history of dollarization and very limited empirical data, which led to doubts about the role of such an exchange rate regime as an effective long-term choice for achieving monetary and financial stability, especially in challenging economic times. But over time, with the support of an influential group of economists, dollarization, as an initially impractical idea, becomes a realistic political option. This change in perception suggests that political actors may seriously consider dollarization as a solution for economic challenges, although it has been present in a limited number of countries until now.

For a long time, there was a debate in the literature about the very definition of dollarization, and no consensus could be reached on the differences between currency exchange and dollarization, because of the numerous functions that money has in the economy. Although these terms are often used as synonyms, each of them can denote different phenomena, which further complicates the research of this phenomenon.

²⁶ Sebastian Edwards, (2001), "Dollarization: Myths and Realities"

²⁷ Wall Street Journal, (1999a, 1999b), Financial Times, (1999)

Nowadays, the term dollarization is used to refer to the instrument of monetary policy and the process that a country's monetary system goes through when a new currency is accepted essentially as a means of payment and a unit of account. Additionally, there are different classifications of dollarization, mostly concerning whether it is complete or partial, official, or unofficial. While official dollarization is a formal legal process that demonetizes the domestic currency and replaces it with a foreign currency that becomes legal tender, in case of unofficial dollarization, in addition to the domestic currency, a hard currency usually circulates (currency dollarization, i.e. anchor) which is not legal tender, but which can perform basic monetary functions. Therefore, this form of dollarization implies a situation in which both foreign currency and domestic currency are used as means of payment. Officially adopting full, de jure dollarization represents the strictest form of dollarization, and is often applied in countries facing severe problems.

Although the process is named dollarization, this term does not necessarily imply that the dollar is the new accepted currency, but it can be any other widely used currency. Regardless of the currency, it is implemented with the idea of solving currency instability and establishing economic stability. Choosing the best currency for the process is not as simple as it seems, as dollarization is a complex issue that leaves no room for possible mistakes. Historically, the dollar has been considered one of the strongest currencies in the world, due to its excellent performance in every corner of the global economy, especially in the real and financial sectors of the USA. Its growing importance was a result of its great stability and America's success in becoming a superpower. As the United States came to dominate the international monetary system, "the dollar forced out gold as the principal asset of the system"²⁸. However, currency power configurations are never static. They evolve along predictable lines with the growth and decline of nations. With this in mind, the creation of the European Economic and Monetary Union (EMU) and the euro as a currency, in 1992 and 1999 respectively, has gradually shaken the position of the dollar. Thus, the dollar finally got a worthy competitor on the international market for the first time. This event is seen as one of the most important developments in international monetary arrangements, which confirms the eternal rivalry between these two currencies when it comes to the question of the strongest one.²⁹ As a recommendation for choosing the most suitable currency, countries have usually imposed those currencies that were the most widespread among the citizens, reflecting their confidence in it. Being in some country's geographical vicinity or sharing a common border may also affect the choice of reserve currency. Hence, for these countries, dollarization has a regional dimension.³⁰

However, there is an eternal debate about whether and when to implement dollarization, that is, the division between the approach "just do it" and "coronation".³¹ Accordingly, the previously mentioned

²⁸ Robert Mundell, (2003), "Currency Areas, Exchange Rate Systems and International Monetary Reform"

²⁹ Courchene and Harris, (1999), "From fixing to monetary union: options for North American currency integration"

³⁰ Winkler, A., Mazzafero, F., Nerkich, H. and Thimann C., (2004), "Official dollarisation/euroisation: Motives, features and policy implications of current cases"

³¹ Gruben, Wynne and Zarazaga, (2002), "Implementation Guidelines for Dollarization and Monetary Unions"

discussion is largely focused on the conditions whereby it is possible to judge whether a country is ready to adopt dollarization or not

since this regime does not make sense everywhere³². In literature, these conditions are mostly depicted by an extensive list of factors, which can be divided into 3 main groups:

- monetary, financial, and fiscal factors,
- real trade and related factors,
- other factors.³³

Table 3: Criteria for Dollarization/Euroization

Characteristics of the economy	Implications of the dollarization
Size of the economy	The smaller the economy, the greater the demand for dollarization
Openness	Greater openness to trade may strengthen the case for dollarization
Geographical concentration of trade	Dollarization is suitable when the anchor country is a major trading partner
Domestic inflation deviation from world inflation	The greater such deviation from the main trading partner's inflation, the more frequent the adjustment of the exchange rate is necessary
Degree of economic/financial openness	The greater the degree of financial development, the less acceptable the dollarization
Labor mobility	The greater the degree of labor mobility, the easier and cheaper it is to adjust to external shocks in dollarization
Foreign nominal shocks	The more frequent domestic nominal shocks, the less desirable the dollarization
Real shocks	The more sensitive the economy is to domestic and foreign real shocks, the less attractive the dollarization
Credibility of the bearer of an economic policy	Countries that lack credibility benefit from dollarization

Source: R. Kovačević, (2002), "Devizni kursevi-režimi i politika"

³² Williamson, J., (2000), "Dollarization does not Make Sense Everywhere",

³³ Roubini, (2001), "Factors to be Considered in Assessing a Country's Readiness for Dollarization"

According to the table 3, different characteristics of the economy influence the suitability and effectiveness of dollarization. Many may wonder why the size of an economy plays a critical role in assessing whether dollarization represents an appropriate policy choice. What supports this statement is much greater institutional flexibility in small countries than in large ones³⁴. Due to high economic openness and sensitivity to global economic changes, small states established a special model of "democratic corporatism" to protect themselves from negative external influences. Other important factors are certain aspects of international integration, which usually involve the following: a high level of reserves, capital controls, labor mobility, a high degree of production and export diversification, as well as close economic relations with partner countries (high degree of trade openness). Regarding the preponderance of shocks and type of shocks, they better be symmetric and nominal shocks, respectively, as a dollarized economy can better cope with economic disruptions through fiscal policy, pricing adjustments, or other non-monetary mechanisms, thereby maintaining stability and reducing the risk of economic imbalances.

3.2. Euroization in Montenegro

This year is twenty-two years since the euro was introduced as the official currency in Montenegro, a country in Southeast Europe, that is not a member of the European Union and the Eurozone, nor does it have any formal monetary agreement with the European Central Bank. However, it is a country where the government and citizens use the euro as the only domestic currency. To this day, euroization is considered a historically significant decision that paved the way for Montenegro's independence and rescued its economy from financial instability. To fully understand the impact of euroization on Montenegro's macroeconomic situation, it's essential to explore the history and primary reasons for adopting this rigid exchange rate regime at a critical juncture.

Montenegro's monetary history is marked by numerous attempts to establish its currency as a symbol of independence, often influenced by the dominant country or empire at the time. When Montenegro became a member of the Republic of Yugoslavia and adopted the Yugoslav dinar, it initially fostered trust and confidence, which are crucial for maintaining economic credibility and stability. However, this centralized monetary system and poor financial discipline led to the third-highest recorded hyperinflation in the world, devastating the Balkan economy. In response to the economic crisis, Montenegro experimented with various unofficial monetary policies to stabilize the economy, protect public finances, and preserve living standards. These attempts included introducing new currencies and replacing the dinar, which was often deemed one of

³⁴ Katzenstein, P., (1985), "Small States in World Markets"

the worst currencies globally.³⁵ One notable effort was the dual currency system where the dinar and the German mark were used simultaneously, as a form of unofficial dollarization. Eventually, Montenegro abandoned the dinar in favor of the German mark, avoiding the pitfalls of printing its currency due to concerns about financial discipline. Persistent hyperinflation and monetary instability necessitated a new solution, leading to the adoption of the euro. In early 2002, Montenegro officially and unilaterally adopted the euro, initially as a parallel legal tender with the German mark and later as the sole legal tender due to quickly gained confidence in the European currency. Although discussions with the European Central Bank and the Bundesbank occurred in 2001, Montenegro, not being part of the European Monetary System, implemented euroization solely with the help of German commercial banks. The Central Bank of Montenegro managed the entire process, depositing cash in German banks and securing euro banknotes and coins in advance. The conversion was cost-free for citizens and the economy, financed through interest on deposits.

Equally important, Montenegro satisfied all theoretical requirements that were mentioned before through the analysis of the optimal exchange rate regime and dollarization. This involves Montenegro being a small, open postwar economy, with significant hyperinflationary experience from the past and considerable labor mobility. Furthermore, it experienced major economic disturbances, which were reflected in the financial system crises and slow or declining economic growth. Additionally, the high dependence on foreign trade with the European Union, negligible revenues from issuing currency, and foreign exchange reserves were present.^{36,37}

3.2.1. Benefits and costs of adopting euro

As mentioned in the beginning of the 3rd chapter, the growing concern about dollarization as a serious policy issue emerged at the end of the 20th century. Evidence for that is the numerous literature that offers an overview of the process itself and its effects on the country's economy. To conclude, whether dollarization leads to “better policies” in the real world, it is necessary to focus on the individual independent-country experiences and therefore, derive numerous theoretical benefits and costs, as the effects of dollarization depend exclusively on the state in which the economy is. Furthermore, dollarization also has an impact on the country that emits that currency, in this case it is the Eurozone. In addition to the seigniorage that European Central Bank receives for printing the euro, it also enjoys the reduced costs of foreign trade transactions, but also the elimination or at least the reduction of the currency risk. Moreover, the possibility of dumping is reduced,

³⁵ S. Hanke, (2000), “The beauty of a Parallel Currency”

³⁶ Fabris, Vukajlović-Grba, Radunović, Janković, (2004), “Ekonomika politika u dolarizovanim ekonomijama sa posebnim osvrtom na Crnu Goru”

³⁷ Jovović Maša, Bachelor Thesis, (2022), “Euroization as a path of Montenegro to the EMU”

while possible mistakes in monetary policy have less consequences considering that they spread to a larger number of countries.³⁸ Besides these advantages, dollarization may be a problem for the currency-issuing "country" since it makes it difficult to conduct a monetary policy. What is particularly aggravating is the pressure on the European central bank and the difficulty of controlling so much money in circulation. When it comes to the benefits and costs of euroization in the case of Montenegro, I present them in the table below.

Table 4: Benefits and Costs of Euroization in Montenegro

Benefits	Costs
Lower inflation rate, closer to the one in Eurozone	Loss of foreign exchange reserves
Lower interest rates because of lower inflation and elimination of devaluation risk	No possibility of adjusting the level of the exchange rate
Reduced transaction costs	No realization of emission profit
Inflow of foreign direct investments (FDI)	Limited possibilities of the central bank to use "the lender of last resort" policy
Increased foreign trade	Increased outflow of currency in case of balance of payments problems
Enhanced budget discipline	Almost no possibility of an exit strategy
Elimination of currency risk	One-time costs

Source: Jovović Maša, Bachelo Thesis, (2022), "Euroization as a path of Montenegro to the EMU"

Suppression of inflation is very often mentioned in the literature as a major advantage of dollarization, which was also one of the main reasons why the authorities in Montenegro decided to take this step. During the 1990s, Montenegro faced persistent inflation and macroeconomic instability. The introduction of the euro significantly reduced inflation, which dropped from 28% in 2002 to a single-digit 9.4%, for the first time in 26 years. Structural reforms implemented between 2001 and 2006 contributed to a further decline in inflation, which fell below 2% at the end of 2005. That was an impressive result, given that inflation in the Eurozone was slightly higher than 2%. Since then, inflation in Montenegro has been gradually approaching the rate of inflation in the European Monetary Union, which continues to this day.

Although it was realistic to expect that euroization in Montenegro could reduce interest rates due to lower inflation and less risk of devaluation, bringing them closer to the rates in the Eurozone, interest rates did

³⁸ Fabris, Vukajlović-Grba, Radunović, Janković, (2004), "Ekonomika politika u dolarizovanim ekonomijama sa posebnim osvrtom na Crnu Goru"

not fall as much, which is still a phenomenon very present in literature.³⁹ The causes of high interest rates included higher inflation than in EMU, high sovereign risk, the poor credit rating of debtors, high operating costs of banks, and the absence of some systemic laws. What indicated that there was room for an additional reduction in interest rates was the large difference between active and passive interest rates. So, over time, interest rates experienced some kind of decline because of improving macroeconomic indicators, increasing number of banks, greater participation of foreign credit lines, greater competition among banks, the efficiency of the legal system, and the growth of bank credit activities.

Additionally, this process has reduced transaction costs, which are often present in trade between countries with different currencies. Such reduction influenced the increase in trade with EU countries, which is in line with the "Rose effect", suggesting that trade grows between countries with the same currency.⁴⁰ Confirmation of this came already in 2004, when foreign trade increased, accounting for 81% of GDP.

Also, the special importance of euroization is reflected in the volume of foreign direct investments (FDI), which are crucial for the development of the economy, especially for countries such as Montenegro, due to the lack of their sources of accumulation. After the introduction of the euro in 2002, FDI began to grow gradually, and already in 2004, thanks to macroeconomic stability and a liberal economic approach, FDI reached a record level of 375 million euros. Apart from the volume of FDI, their structure is also particularly important, which changed in 2008 with the decline in real estate investments and the growth of intercompany debt, which amounted to 245.9 million, 112.6% than in 2007.

Finally, many studies have shown that full dollarization encourages greater budgetary discipline compared to a flexible exchange rate regime⁴¹, given that fiscal policy is the most important tool for macroeconomic management in dollarized countries such as Montenegro, as it has no other mechanisms to ensure financial stability and long-term economic growth. Since 2002, Montenegro has recorded an improvement in fiscal discipline. There were positive trends in public finances, and the budget deficit and public debt stabilized. The public debt of Montenegro was reduced from over one billion euros in 2002 to 644.4 million euros, of which the domestic debt is 26% of that amount, and the external debt is 74%. This was certainly contributed by the favorable macroeconomic conditions in Montenegro, which cannot be said during the financial crisis of 2008. Since Montenegro does not have a central bank that could provide support in such situations, there is an increased risk of economic problems, high interest rates, and a reduced perspective for development.

³⁹ Mann C., (1999), "Dollarization as Diet",

⁴⁰ Rose, A. K., (2000), "One Money, One Market: the Effects of Common Currencies on Trade",

⁴¹ Tornell, A. and Velasco, A., (1995), "Fiscal Discipline and Choice of Exchange Rate Regime",

However, as literature implies, there is no such thing as a free lunch. This same statement is also used in describing dollarization, which indicates that in addition to the many benefits that this process can bring, every benefit comes with a certain cost. The first in the series is certainly the absence of monetary policy, which is particularly important for stimulating the economy in cases such as rising inflation, decreasing employment, and recession, which makes it difficult for them to stabilize and reduce domestic business cycles. Additionally, the moment Montenegro started using the euro, it experienced the loss of seigniorage, as this cost dollarization largely depends on whether the country has been able to agree on revenue sharing with the country whose currency it uses. In the case of Montenegro, since no such official agreement existed, seigniorage is in the hands of the ECB.

The next source of costs is the lack of lender in the last resort. Central banks usually fulfill this role, helping banks when they urgently need funds and have no other options. In the event of euroization, the Central Bank of Montenegro lost the ability to add liquidity to the financial system, which could help in the event of a potential "banking panic." However, banks can find liquidity from other sources, not only from the central bank. Thus, dollarization does not mean the loss of lenders as a last resort, but the loss of one specific source of liquidity—the central bank.⁴²

Last, but not the least challenge of euroization concerns the problem of its duration. Although inflation and hyperinflation have often been the motivations for introducing dollarization, economic actors often remain in this regime even after inflation stabilizes. This irreversibility, known as hysteresis, suggests that a reduction in inflation does not guarantee an end to dollarization, as leaving dollarization is more difficult than leaving any other regime. Even though an exit from dollarization is possible, many economists do not think it would be favorable in this case, as it would require a return to the old currency or the introduction of a new one, and significant changes in the system, which might not be ideal for Montenegro.⁴³

3.3. Montenegro in the European Economic and Monetary Union

After the introduction of the euro, it was natural to think of the European Union as a future economic goal, given its ideals of freedom, stability, and improved living standards, which is especially important for small countries that do not have a stable economic and financial environment and are constantly subject to fluctuations. For these reasons, the EU is deemed highly important for Montenegro and its citizens, which explains why it requested membership in 2008. Two years later, the Commission gave a positive answer, and the Council granted it candidate status. Certainly, this is just the beginning and the whole process requires a

⁴² Calvo, (2000), "Testimony on Full Dollarization"

⁴³ Author's Bachelor Thesis, (2022), "Euroization as a path of Montenegro to the EMU"; Financial data from CBCG's annual reports

careful preparation to maximize the benefits of membership. Some of these benefits include greater economic cooperation with EU companies, easier exports, economic reforms, market opening, greater opportunities for GDP growth, increased foreign direct investment from the EU, but also potential membership in the European Economic and Monetary Union (EMU).

However, the process of joining the EMU is not simple, as it requires the fulfillment of various criteria. The first condition for a country to become a member of the European Economic and Monetary Union is to be a member of the European Union. Other criteria, based on economic indicators, aim to ensure the success of the Stability and Growth Pact of 1997 and to guide the introduction of a common currency in line with the principle "One Market, One Currency". These criteria are known as the Maastricht criteria, or Convergence criteria, which represent the set of monetary and fiscal stability rules that are based on the rationale of the optimum currency area and should not be exceeded when entering the euro area.⁴⁴

Table 5: The Maastricht Criteria

What is measured:	Price stability	Sound and sustainable public finance	Exchange rate stability	Durability of convergence
How it is measured:	Harmonized consumer price inflation	Government deficit and debt	Exchange rate developments in ERM II	Long-term interest rate
Convergence criteria:	The average inflation rate observed during a one-year period before a country is examined for admission to the single currency must not be more than 1.5% higher than the average of the three best performing member states in terms of price stability	The annual government deficit must not exceed 3% of gross domestic product and the public debt must not exceed 60% of GDP, unless the ratio is sufficiently diminishing and approaching the reference value at a satisfactory pace	Candidate countries must observe the normal fluctuations margins provided by the exchange rate mechanism of the European Monetary System for at least two years, without devaluing their currency against that of any other member stat	During the year preceding the examination, the average long- term interest rate must not be more than 2% higher than those of the three best performing member states in terms of price stability

Source: EU's official website

⁴⁴ Author's Bachelor Thesis, (2022) "Euroization as a path of Montenegro to the EMU"

As for Montenegro, since the opening of Chapter 17, which deals with the concept of the Economic and Monetary Union, it has been working hard to meet all the criteria, but with the limited instruments available, due to the introduction of euroization. As already mentioned in the chapter describing the effects of such a process on the Montenegrin economy⁴⁵, the fiscal policy is the only available instrument that may be used to ensure economic discipline and stability. Thanks to the benefits that euroization as a regime carries, Montenegro has already achieved or was close to achieving the Maastricht Criteria several times after the introduction of the euro into its monetary system. But what makes this process particularly challenging is the use of the euro, which was not the result of any agreement with the ECB, but the result of a tacit permission in a particular political moment. This creates a problem in fulfilling the third criterion, shown in the table 5, related to the exchange rate stability. Given that there is no similar situation in the history of the EU, it is still unknown how this problem will be solved, but it will certainly be a political decision whether Montenegro should introduce its own currency to meet all requirements. However, such a solution would be very risky and expensive, and difficult to carry out in terms of logistics and it would imply very negative consequences on the Montenegrin economy.

However, Montenegro must constantly work on solving the problems that affect the stability of its financial and economic system, and the issues that the European Commission highlights in its annual reports. Therefore, solely continuous work on economic reforms will help Montenegro achieve the necessary macroeconomic parameters and enjoy the benefits of EMU, which will be explained in more detail in the next chapter.⁴⁶

3.3.1. Concept of currency union

Even though, Montenegro opted for unilateral euroization as a fixed exchange rate regime in 2002, entering the EMU would imply switching to another regime, that is monetary union, known as an absolute fixed regime.⁴⁷ Monetary union or currency union, represents a currency zone, where member countries share the same currency, and have a common monetary and exchange rate policy. Although euroization and currency union are both fixed regimes, there are certainly differences between them. Namely, in the case of dollarization, the dollarized country loses the monetary policy option, while in the currency union, monetary authorities have some kind of rights, therefore, they can participate in the creation of a common monetary policy. This difference has a further impact on another concept, the seigniorage, that is completely lost in the case of dollarization, but is still an option in currency unions. Additionally, the benefits that countries achieve by fixing

⁴⁵ p. 20-23

⁴⁶ Author's Bachelor Thesis, (2022), "Euroization as a path of Montenegro to the EMU"

⁴⁷ Corden, (2002), "Too Sensational: On the Choice of Exchange Rate Regimes"

the exchange rate in the form of a currency union are monetary efficiency and the use of the exchange rate as an anchor for monetary policy. Monetary efficiency refers to the benefits of stimulating international trade investment through stability of exchange rates and reduction of exchange rate risk, which comes to the fore in conditions of stronger economic integration in the currency zone.⁴⁸ However, in literature some criteria are considered when deciding whether a specific currency zone is optimal and whether it is optimal for a specific country to join a particular currency zone. This mainly implies a level of economic integration, similarity of economic structure, and fiscal federalism.

Considering the mentioned benefits that euroization had on the economy of Montenegro⁴⁹, one can conclude that the introduction of the euro was a favorable decision, leaving little room for doubt that EMU membership will not be as beneficial. Naturally, this does not give a clear answer as to what the effects joining the currency union would have on the Montenegrin economy. In practice, many modern central banks rely on a range of macroeconomic models to predict prospects for the economy and thus decide on appropriate monetary policy action today. Given that even the most advanced macroeconomic models cannot fully capture all the complexities of the economy, as their forecasts can be inaccurate to a certain degree, the decision of whether the central bank will change its monetary policy will depend on the judgment of those in charge. In the continuation of the paper, I will rely on the so-called dynamic stochastic general equilibrium model (DSGE), and thereby try to analyze the macroeconomic implications of this fixed exchange rate regime, i.e. European monetary union.

⁴⁸ Frankel and Rose, (2002), “An Estimate of the Effect of Common Currencies on Trade and Income”

⁴⁹ p. 20-23

4. METHODOLOGY

4.1. DSGE Models

This chapter, which also represents the quantitative investigation of my thesis, deals with the understanding and implementation of Dynamic Stochastic General Equilibrium models or the so-called DSGE models. Such models today symbolize a cornerstone in modern macroeconomics and have been widely used in academia, research institutes, and monetary authorities since the 1980s, to study the dynamics of economies over time. Rooted in the New Consensus Macroeconomics framework, DSGE models have evolved from the earlier Real Business Cycle (RBC) models, which in turn were developments of the Solow growth model from the 1950s, which provided a foundational platform for subsequent, more sophisticated models. The ongoing development and refinement of these models continue to push the frontier of macroeconomic research, ensuring their relevance and utility in an ever-evolving economic landscape. The versatility and comprehensive structure of DSGE models are mainly the result of two desirable features: microeconomic foundations and dynamic macroeconomic analysis, meaning their combination of micro-foundations and optimizing economic behavior of rational agents allows for a comprehensive analysis of macro effects. As the name suggests, the main characteristics of the model are: dynamic, stochastic, general, and equilibrium.

- DSGE models are dynamic because they consider how current decisions impact future uncertainties, highlighting the importance of agents' expectations in shaping macroeconomic outcomes;
- They are stochastic, as they account for random shocks and their transmission through the economy, which leads to fluctuations in economic variables;
- These models are general, encompassing the entire economy by determining both price and output levels simultaneously, unlike partial equilibrium models that assume either fixed price levels or only determine output;
- Moreover, they achieve equilibrium, reflecting the interactions between policy measures and agents' behaviors.⁵⁰

As DSGE models have revolutionized the formulation and analysis of monetary policy, fiscal policy, and other structural reforms, they are deemed highly appropriate for policymakers and researchers to use them to simulate the effects of different policy interventions on key macroeconomic variables. Despite various criticisms regarding their assumptions and simplifications, DSGE models remain a valuable tool for

⁵⁰ Kocherlakota, (2010), “Modern Macroeconomic Models as Tools for Economic Policy”

understanding and analyzing macroeconomic dynamics, and they continue to be actively used. Given their benefit of providing a detailed and dynamic understanding of the economy, I have decided to focus on the Gali and Monacelli (2005) model, i.e. the DSGE model of a small open economy, and use it as a framework for analyzing the properties and macroeconomic implications of alternative monetary policy regimes, using Montenegro as a small, open economy and Eurozone as a world economy.

4.2. Gali and Monacelli (2005) model

The Gali and Monacelli (2005) model is a suitable Dynamic Stochastic General Equilibrium (DSGE) framework for analyzing the macroeconomic dynamics of a small, open economy. It was developed by Jordi Gali and Tommaso Monacelli in 2005 and has been influential in the field of international economics ever since. The model captures the characteristics of a small economy within a continuum of infinitesimally small economies comprising the global economy. According to this assumption, each country's economy is so small that its domestic policy decisions have no significant impact on other economies, while they all share the same preferences, market structure, and technology. Additionally, given that the focus of the model is on the behavior of a single economy and its interactions with the world economy, it is particularly appropriate for explaining the theoretical microeconomic principles and interactions among key agents within the Montenegrin economy, and for studying the properties of alternative monetary policy regimes, especially when emphasizing the PEG or fixed exchange rate regime. In this work, the fixed exchange rate regime implies that Montenegro is officially part of the European Monetary Union, and thus CBCG⁵¹ cannot independently set its domestic interest rate. In addition, the research explores the implications of the Domestic Inflation Targeting Rule (DITR), also known as the domestic inflation-based Taylor rule, as an alternative monetary policy regime. By comparing the responses of different variables under these regimes to a domestic productivity shock and foreign output shock, the study aims to provide comprehensive insights. Furthermore, for easier interpretation of the results, the analysis employs MATLAB and Dynare, using Impulse Response Functions (IRFs) to simulate the responses to selected structural shocks.

To enable understanding of the model, its implications, and results, the 4th chapter is organized into three parts. The first part discusses the theoretical assumptions and microeconomic principles, focusing on key agents such as households and firms. It also simplifies the model's equilibrium to domestic inflation and the output gap while briefly describing the alternative monetary policy regimes. The second part includes the summary of the model, offering a clearer perspective on its dynamics and relationships. The third and fourth part delve into the practical aspects of the model, addressing the calibration and parameterization of data and

⁵¹ Central bank of Montenegro

providing insights into the model's responses to a domestic productivity shock and foreign output shock, respectively.

4.2.1. Households

Under this subchapter, the theoretical foundation for modeling the behavior of households in a small, open economy is laid out, to understand the economic behavior of households, that is how they make a consumption, labor, and saving decisions in response to prices, wages, and interest rates.

In a small, open economy there is a continuum of households, where each household seeks to *maximize its lifetime utility*, which is given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, N_t) \quad (1)$$

where:

- E_0 is the rational expectation operator,
- β^t is the subjective discount factor,
- U denotes the utility function,
- C_t is the composite consumption index,
- N_t represents hours of labor (hours worked).

Further, I could go into detail about analyzing the *composite consumption index* C_t , which is defined as:

$$C_t = \left[(1 - \alpha)^{\frac{1}{\eta}} (C_{H,t})^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} (C_{F,t})^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta-1}{\eta}} \quad (2)$$

where:

- $C_{H,t}$ is a domestic goods consumption index $C_{H,t} = \left(\int_0^1 C_{H,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon-1}{\varepsilon}}$
- $C_{F,t}$ is an imported goods index $C_{F,t} = \left(\int_0^1 (C_{i,t})^{\frac{\gamma-1}{\gamma}} di \right)^{\frac{\gamma-1}{\gamma}}$. Further, $C_{i,t}$ represents an index of goods that are imported by country i and consumed by domestic households.
- Similarly to the function describing domestic goods consumption index $C_{H,t}$, the index of imports $C_{i,t}$ is

given by $C_{i,t} = \left(\int_0^1 C_{i,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)$

From the above functions, 4 parameters can be explained:

- ε , describing elasticity of substitution between goods produced within Montenegro, $\varepsilon > 1$
- α , measuring a degree of openness which is usually calculated as imports/GDP, $\alpha \in [0, 1]$
- η , the substitutability between domestic and foreign goods, $\eta > 0$
- γ , the substitutability between goods produced in different foreign countries.

To optimize its utility, defined in (1), household faces the following *budget constraint*:

$$\int_0^1 P_{H,t}(j) C_{H,t}(j) dj + \int_0^1 \int_0^1 P_{i,t}(j) C_{i,t}(j) dj di + E_t\{Q_{t,t+1} D_{t+1}\} \leq D_t + W_t N_t + T_t \quad (3)$$

where:

- $P_{H,t}$ is the differentiated domestic good j 's price,
- $P_{i,t}$ stands for the price of differentiated imported good j from country i ,
- $Q_{t,t+1}$ represents the stochastic discount factor for one-period ahead nominal pay-offs relevant to the domestic household,
- D_{t+1} is the nominal pay-off in period $t + 1$ of the portfolio held at the end of period t ,
- W_t is the nominal wage,
- while T_t denotes taxes (lump-sum transfers),
- for $t = 0, 1, 2, \dots$

Another key concept is *the optimal allocation of expenditure*, which refers to how households allocate their spending across different types of goods to maximize their utility (1) given their budget constraint (3). This specifically involves how households allocate their expenditure between domestic goods and imported goods, and within these categories, across various varieties of goods. Firstly, the expenditures will be explained:

- The household's expenditure on a specific variety j of domestic goods $C_{H,t}(j)$ is determined by the relative price of that variety, so the consumption within domestic goods is defined as:

$$C_{H,t}(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}} \right)^{-\varepsilon} C_{H,t} \quad (4)$$

where $P_{H,t}(j)$ is the price of variety j , $P_{H,t}$ is the aggregate price index of domestic goods, ε is the elasticity of substitution between varieties of domestic goods, and $C_{H,t}$ is the total consumption of domestic goods.

- Similarly, the household's expenditure on a specific variety j of imported goods from country i $C_{i,t}(j)$ is:

$$C_{i,t}(j) = \left(\frac{P_{i,t}(j)}{P_{i,t}} \right)^{-\varepsilon} C_{i,t} \quad (5)$$

where $P_{i,t}(j)$ is the price of variety j from country i , $P_{i,t}$ is the price index for goods imported from country i , and $C_{i,t}$ is the total consumption of goods from country i .

- Furthermore, the household's expenditure on goods from different foreign countries is determined by the relative prices of those goods:

$$C_{i,t} = \left(\frac{P_{i,t}}{P_{F,t}} \right)^{-\gamma} C_{F,t} \quad (6)$$

where $P_{F,t}$ is the aggregate price index for all imported goods, γ is the elasticity of substitution between goods produced in different foreign countries, and $C_{F,t}$ stands for the total consumption of imported goods. Taking into account the mentioned functions (4), (5), and (6), the optimal allocation of expenditures between domestic and imported goods is given by:

$$C_{H,t} = (1 - \alpha) \left(\frac{P_{H,t}}{P_t} \right)^{-\eta} C_t; \quad C_{F,t} = \alpha \left(\frac{P_{F,t}}{P_t} \right)^{-\eta} C_t \quad (7)$$

where P_t is the overall consumer price index (CPI), η is the elasticity of substitution between domestic and foreign goods, and α reflects the degree of openness of the economy, that is the share of imported goods in the consumption basket.

In summary, the optimal allocation of expenditure implies that households will:

- spend more on a variety of goods if the relative price is lower,
- allocate more expenditure to domestic or imported goods, depending on their relative prices, but also on the elasticity of substitution η ,
- and allocate their consumption depending on the overall price levels of the goods P_t (CPI) and their

preferences.

Further, to describe the economic environment for households in a small, open economy, other key identities such as terms of trade, inflation dynamics, and international risk-taking, should be explained. Since the model is focused on a small, open economy (Montenegro) that interacts with the global economy i (Euro area), *the bilateral terms of trade* are crucial for understanding trade dynamics and economic relationships between these two economies: $S_{i,t} = \frac{P_{i,t}}{P_{H,t}}$, that is the price of the country i 's goods in terms of domestic goods. Using this formula, it is possible to find *the effective terms of trade* as aggregated bilateral terms of trade across all trading partners:

$$S_t = \frac{P_{F,t}}{P_{H,t}} = \left(\int_0^1 S_{i,t}^{1-\gamma} di \right)^{\frac{1}{1-\gamma}} \xrightarrow{\text{Log-linearization}} s_t = \int_0^1 s_{i,t} di \quad (8)$$

where $P_{H,t}$ is nothing but the price of domestic goods and $P_{F,t}$ is the price of the country i 's goods.

Assuming that the purchasing power parity (PPP) holds, that is $P_{H,t} = P_{F,t}$, the formula for log-linearized CPI inflation can be written as:

$$p_t = (1 - \alpha) p_{H,t} + \alpha p_{F,t} = p_{H,t} + \alpha s_t \quad (9)$$

where $s_t \equiv p_{F,t} - p_{H,t}$ explains log effective terms of trade and $\pi_{H,t} \equiv p_{H,t} - p_{H,t-1}$ defines domestic inflation. Accordingly, CPI inflation and domestic inflation are linked through the following formula:

$$\pi_t = \pi_{H,t} + \alpha \Delta s_t \quad (10)$$

which explains how the inflation difference is proportional to the percentage change in terms of trade, with the proportionality coefficient captured by α , the degree of openness.

Additionally, under this model, it is assumed that the Law of One Price (LOOP) holds at all times as well, thus the price of an imported good in domestic currency is:

$$P_{i,t}(j) = \varepsilon_{i,t} P_{i,t}^i(j) \quad (11)$$

where $P_{i,t}^i(j)$ price of country i 's good j expressed in the producer's currency, and $\varepsilon_{i,t}$ the bilateral nominal exchange rate. In order to define *the nominal exchange rate* e_t , the CPI inflation equation is necessary under

the assumption that PPP holds. To express this relationship, $p_{F,t}$ from $s_t = p_{F,t} - p_{H,t}$ is taken and plugged into $p_{F,t} = e_t + p_t^*$:

$$s_t = e_t + p_t^* - p_{H,t} \quad (12)$$

Furthermore, the real exchange rate q_t , which measures the relative price of foreign goods in terms of domestic goods, may be defined as:

$$q_t = e_t + p_t^* - p_t \quad (13)$$

Alternatively, q_t can be expressed in terms of the terms of trade as well:

$$q_t = (1 - \alpha) s_t \quad (14)$$

What enables households in different countries to share and mitigate consumption risks arising from country-specific economic shock (such as productivity shock) is the mechanism called *international risk sharing*. The primary idea behind international risk sharing is that households in different countries can adjust their consumption when there are idiosyncratic shocks, under the assumption of complete financial markets. By allowing households to trade state-contingent claims, the model shows how consumption can be smoothed across borders, leading to more stable economic outcomes. This may be explained using the first-order condition for optimal consumption for the representative household in the domestic economy and any other country i :

$$\beta \left(\frac{C_{t+1}^i}{C_t^i} \right)^{-\sigma} \left(\frac{P_t^i}{P_{t+1}^i} \right) \left(\frac{\mathcal{E}_t^i}{\mathcal{E}_{t+1}^i} \right) = Q_{t,t+1} \quad (15)$$

By combining these conditions and using the definition of the real exchange rate (13) but in level terms, we get the international risk-sharing condition (log-linearized):

$$c_t = c_t^* + \frac{1}{\sigma} q_t = c_t^* + \left(\frac{1 - \alpha}{\sigma} \right) s_t \quad (16)$$

where:

- c_t is the log of domestic consumption,
- c_t^* is the log of world consumption,
- q_t is the log of the real exchange rate,
- s_t being the effective terms of trade.

Thus we see that the assumption of complete markets at the international level leads to a simple relationship linking domestic consumption with world consumption and the relative price of domestic goods to foreign goods or the terms of trade.

Finally, another key concept to be addressed when describing households is the concept of uncovered interest parity, known as UIP. This condition asserts that the difference in interest rates between two countries should equal the expected change in the exchange rate between their currencies, and it can be denoted as:

$$E_t\{Q_{t,t+1} [R_t - R_t^i (\varepsilon_{i,t+1}/\varepsilon_{i,t})]\} \xrightarrow{\text{Log-linearization}} r_t - r_t^* = E_t\{\Delta e_{t+1}\} \quad (17)$$

where r_t is the domestic interest rate, r_t^* is the foreign domestic rate, while $E_t\{\Delta e_{t+1}\}$ explains the expected change in the nominal exchange rate e_t .

Combining the UIP condition with the terms of trade dynamics, a stochastic difference equation for the terms of trade is obtainable:

$$s_t = (r_t^* - E_t\{\pi_{t+1}^*\}) - (r_t - E_t\{\pi_{H,t+1}\}) + E_t\{s_{t+1}\} \quad (18)$$

↓
solving forward
↓

$$s_t = E_t \left\{ \sum_{k=0}^{\infty} [(r_{t+k}^* - \pi_{t+k+1}^*) - (r_{t+k} - \pi_{H,t+k+1})] \right\} \quad (19)$$

The function (19) provides a comprehensive framework for analyzing the interactions between interest rates, exchange rates, and international trade, and explains how economic shocks and policy changes impact the domestic economy in an open economy context.

In summary, this chapter provides a comprehensive examination of household behavior in a small open economy, integrating various economic forces and market dynamics. The interplay between domestic economic conditions, international prices, and financial markets is complex yet crucial for understanding household consumption patterns. By grasping these key concepts, policymakers and economists can better design strategies to stabilize the economy, enhance household welfare, and navigate the challenges of an interconnected global marketplace.⁵²

⁵²Gali and Monacelli, (2005), “Monetary Policy and Exchange Rate Volatility in a Small Open Economy”

4.2.2. Firms

Similarly to the households, there is a whole continuum of firms in the economy as well, where each firm produces a differentiated good using the same linear technology, which is described as:

$$Y_t(j) = A_t N_t(j) \quad (20)$$

where $Y_t(j)$ is the output of firm j , A_t represents the level of technology, and $N_t(j)$ is labor input.

Further, the productivity level A_t from function (20) follows an AR(1) process⁵³: $a_t = \rho_a a_{t-1} + \varepsilon_t$, indicating that current productivity depends on past productivity and a random shock ε_t .

Another important concept in understanding the pricing and production decisions of firms in an economy is the concept of *the real marginal cost*, which refers to the additional cost incurred by a firm to produce one more unit of output, taking into account the prices of inputs and the level of technology:

$$mc_t = -\nu + w_t - p_{H,t} - a_t \quad (21)$$

where

- w_t is the nominal wage rate,
- $p_{H,t}$ is the price level of domestically produced goods,
- a_t is the technology level, $a_t \equiv \log A_t$
- and ν is a constant term related to an employment subsidy.

Furthermore, the aggregate production function shows that aggregate output is a function of technology and employment:

$$y_t = a_t + n_t \quad (22)$$

Since Galí and Monacelli (2005) model uses Calvo price settings, each firm may change its price each period with probability $1 - \theta$ being independent of the last time it reset its price. Such a forward-looking price-setting strategy may be defined as:

$$\bar{p}_{H,t} = \mu + (1 - \beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E_t \{mc_{t+k} + p_{H,t}\} \quad (23)$$

⁵³ Autoregressive process, in which the current value is based on the immediately preceding value

According to this price-setting strategy, firms are forward-looking in their price-setting behavior. They do not set prices based only on current conditions but also consider expected future economic conditions. Due to the fraction θ of firms that do not adjust their prices, there is an inherent stickiness in the overall price level. This stickiness means that prices do not adjust immediately to changes in economic conditions, leading to short-term non-neutrality of monetary policy.⁵⁴

4.2.3. Equilibrium

This subchapter will explain the equilibrium conditions in a small open economy, focusing on aggregate demand and output determination, the trade balance, and the supply side, including marginal cost and inflation dynamics. On the demand side, the goods market clearing condition ensures that the output produced by the domestic economy is equal to the total demand for domestic goods, both from domestic consumers and foreign buyers:

$$Y_t = (1 - \alpha) \left(\frac{P_{H,t}}{P_t} \right)^{-\eta} C_t + \alpha \int_0^1 \left(\frac{P_{H,t}}{\mathcal{E}_{i,t} P_{F,t}^i} \right)^{-\gamma} \left(\frac{P_{F,t}^i}{P_t^i} \right)^{-\eta} C_t^i di \quad (24)$$

This equation accounts for the total demand for domestic goods and ensures that all produced goods are either consumed domestically or exported. While the first term represents the demand from domestic consumers, adjusted for the price level and substitution elasticity, the second term integrates the demand from foreign consumers, adjusted for exchange rates and foreign price levels.

To describe the difference between the value of domestic goods produced and consumed domestically versus those exported, it is necessary to refer to the concept of trade balance, which is critical in understanding how a small open economy interacts with the rest of the world. In the model, net exports (NX) are defined as the difference between domestic output and domestic consumption, adjusted for the terms of trade, and can be represented by:

$$nx_t = y_t - c_t - \alpha s_t \quad (25)$$

where:

- nx_t stands for net exports as a fraction of steady-state output,
- y_t is the domestic output,
- c_t is the domestic consumption,
- α refers to the degree of openness,
- and s_t are the terms of trade, that is the relative price of foreign goods in terms of domestic goods.

⁵⁴ Gali and Monacelli, (2005), “Monetary Policy and Exchange Rate Volatility in a Small Open Economy”

Conversely, on the supply side, one can find marginal cost as it directly pertains to the production costs and decisions of firms. It influences how much firms are willing to supply at different price levels, thereby shaping the supply curve. Marginal cost represents the cost of producing one more unit of output. Under this model, the marginal cost in a small, open economy incorporates several factors, including labor costs, productivity, and terms of trade.

$$mc_t = -v + \sigma y_t^* + \varphi y_t + s_t - (1 + \varphi) a_t \quad (26)$$

where:

- v - constant related to the employment subsidy,
- σ - intertemporal elasticity of substitution,
- y_t - domestic output,
- y_t^* - world output,
- φ - inverse of the labor supply elasticity,
- s_t - terms of trade,
- a_t - productivity.

Using the concept of marginal cost in a small, open economy (26), it is possible to describe the dynamics of domestic inflation in terms of real marginal cost using the following formula:

$$\pi_{H,t} = \beta E_t \{ \pi_{H,t+1} \} + \lambda \widehat{mc}_t \quad (27)$$

where $\lambda = \frac{(1 - \beta\theta)(1 - \theta)}{\theta}$, and it reflects the degree of price stickiness.

4.2.4. Monetary policy

In comparison to other models, where monetary policy is introduced by assuming that some monetary aggregate follows an exogenous stochastic process, this model is different as the monetary policy is endogenous, with a short-term interest rate being the instrument of that policy. This implication allows setting different monetary regimes, such as the DITR and PEG case. As mentioned in the beginning of this chapter, the focus of the work is to analyze the macroeconomic implications of the exchange rate peg, that is the fixed exchange rate regime, simulating the membership of Montenegro in the Eurozone. Such strategy implies the following:

$$e_t = 0 \quad (28)$$

Additionally, so as to provide a comparison between alternative policy regimes, I will also provide macroeconomic implications of the DITR regime, that is the regime where the domestic interest rate responds systematically to domestic inflation, and implies flexible nominal exchange rate e_t . Such domestic inflation-based Taylor rule (DITR) specifies the following⁵⁵

$$r_t = \rho + \varphi_\pi \pi_{H,t} \quad (29)$$

4.3. The summary of the model

To make the analysis more accessible and focused, I use the summary of the model. This streamlined approach preserves the essential mechanisms driving economic fluctuations. By concentrating on the core components, one can gain clear insights into the fundamental relationships and dynamics within the economy. The summary of the model encompasses a set of key equations that describe the behavior of aggregate demand, the trade balance, and inflation dynamics, such as the IS equation and the Philips curve. Further, there are equations that capture the interactions between domestic and foreign variables, highlighting the open nature of the economy. The model also incorporates important parameters that influence economic decisions, such as risk aversion, substitution elasticities, and price stickiness. Using MATLAB, it is possible to simulate the model to investigate how the economy responds to different types of shocks, enhancing the understanding of the transmission mechanisms in an open economy. In the following section, the set of equations that constitute the simplified version of the model are presented. These equations form the foundation of MATLAB simulations, enabling to analyze the dynamic responses of key economic variables. By calibrating the model to realistic parameter values, it is ensured that simulations reflect plausible economic scenarios, offering a robust tool for policy analysis and economic forecasting.

The following table is divided into 3 categories:

- equations describing the economy,
- equations depicting monetary policy regimes,
- equations related to the shocks.

⁵⁵ Gali and Monacelli, (2005), “Monetary Policy and Exchange Rate Volatility in a Small Open Economy”

Table 7: The summary of the Model

Equation	Description
	Economy:
$x_t = E_t\{x_{t+1}\} - \frac{1}{\sigma_\alpha} (r_t - E_t\{\pi_{H,t+1}\} - \bar{r}r_t)$	IS curve
$\pi_{H,t} = \beta E_t\{\pi_{H,t+1}\} + \kappa_\alpha x_t$	Philips curve
$\bar{r}r_t = \rho - \sigma_\alpha \Gamma(1 - \rho_a)a_t + \alpha \sigma_\alpha (\Theta + \psi) E_t\{\Delta y_{t+1}^*\}$	Natural rate of interest
$\bar{y}_t = \Omega + \Gamma a_t + \alpha \Psi y_t^*$	Natural level of output
$x_t = y_t - \bar{y}_t$	Output gap
$s_t = e_t + p_t^* - p_{H,t}$	Terms of trade
$y_t = a_t + n_t$	Employment
$nx_t = \alpha ((\varphi/\sigma) - 1) s_t$	Net exports
$y_t = c_t + (\alpha\omega/\sigma) s_t$	Consumption
$w_t - p_t = \sigma c_t + \varphi n_t$	Real wage
$\pi_{H,t} = p_{H,t} - p_{H,t-1}$	Domestic inflation
$\pi_t = p_t - p_{t-1}$	CPI inflation
$\Delta e_t = e_t - e_{t-1}$	Depreciation rate
	Monetary policy regimes:
$r_t = \varphi_\pi \pi_{H,t}$	DITR case
$e_t = 0$	PEG case
	Stochastic processes for shocks:
$a_t = \rho_a a_{t-1} + \varepsilon_a$	Domestic productivity shock
$y^* = \rho_y y_{t-1}^* + \varepsilon_{y^*}$	Foreign output shock

However, it is important to notice that Table 7 does not include the final list of equations that describe the model, and which are to be used for the model simulation, it is just a brief overview of the key equations. Other equations that can be found in the MATLAB file of the model⁵⁶, concern the relationship between

⁵⁶ File: Gali_Monacelli_2005.mod

different parameters such as sigma, eta, gamma, and other, and were not included in the Table 7 in order to avoid further complexity.

The first equation in the table depicts the so-called open economy dynamic IS curve, describing the output gap as a function of the nominal interest rate, the natural rate of interest, the expected future output gap, and expected future inflation, which implies its forward-looking character. Just after it comes the Philips curve, in particular the new Keynesian Phillips curve (NKPC), which relates domestic inflation to expected future inflation and the output gap, highlighting the trade-off between inflation and economic activity. One of the mechanisms of this equation is the expectation channel, where future expectations of inflation play a crucial role in determining current inflation, which again implies a forward-looking aspect that is a hallmark of NKPC. Another key mechanism involves the economic slack, implying that a positive output gap typically generates inflationary pressures due to higher demand for goods and services, leading to increased prices. Conversely, a negative output gap exerts deflationary pressures. The model also includes other equations that play a role in the economic model, by representing various relationships and dynamics within the economy, including output, inflation (both domestic and CPI), terms of trade, employment, net exports, etc. Secondly, there are two equations describing alternative monetary policy rules, DITR and PEG case, which have to be separately simulated⁵⁷ in MATLAB to analyze the implications of each of them. Finally, in order to demonstrate the impulse responses to a domestic productivity shock and foreign output shock, it is necessary to include the stochastic processes of the shocks in the model, where ρ is the persistence of the shock, and ε is the stochastic component.

4.4. Parameter calibration

In this section, the focus is on calibration, which is the process of determining the values of parameters within the model to ensure that it accurately reflects real data and economic relationships. This process is particularly important as it helps bridge the gap between theoretical models and actual economic data, which allows the model to make more reliable predictions and provide useful policy insights. The first step in calibration is the selection of the key parameters in the model that need to be calibrated, while the second step involves gathering relevant empirical data. Finally, it is necessary to align values to the parameters based on empirical data and economic theory. Additionally, it can be beneficial to simulate the model and analyze its output. If the model accurately replicates observed economic behavior, the calibration is validated. Therefore, once the parameters are obtained, the model is ready to be simulated so as to determine how the economy responds to various shocks and policy interventions. The following parameters are crucial for the model used

⁵⁷ Different cases have to be run separately in Dynare in order to see the results

in this research.

Table 6: Parameter Calibration

Parameter	Description	Typical value	Value used in the model
σ	intertemporal elasticity of substitution	[1, 2]	1
η	the elasticity of substitution between domestically produced goods and foreign goods	[1, 2]	1
γ	the elasticity of substitution between goods produced in different foreign countries	[1, 2]	1
φ	the inverse of the Frisch elasticity of labor supply	[2, 3]	3
ε	the elasticity of substitution between different varieties of goods produced within the economy	6	6
θ	the fraction of firms that do not adjust their prices in any given period, reflecting price stickiness	0.75	0.75
β	discount factor	0.99 ⁵⁸	0.99
α	the degree of openness of the economy	0.4	0.6
φ_π	the responsiveness of the nominal interest rate to deviations of inflation from its target in the Taylor rule	1.5	1.5
ρ_a	the persistence of productivity shocks over time	0.9	0.2288
ρ_{y^*}	the persistence of foreign output shocks over time	(0.8,0.9)	0.4983

In order to calibrate the stochastic properties of the domestic productivity shock and foreign output shock, I use the autoregression function in MATLAB to analyze selected time series data. Accordingly, I fit AR(1) processes to (log) labour productivity in Montenegro, and (log) Eurozone GDP, using quarterly, HP-filtered data over the sample period 2008:1–2023:4. As no official institution reports data on labour productivity in Montenegro, I obtained the necessary data by dividing the GDP with the number of employees⁵⁹. After performing the autoregression on the Montenegrin labour productivity data and on the Eurozone GDP⁶⁰ (seasonally and calendar adjusted), I obtained the following estimates:

⁵⁸ Implies a 4% annual discount rate

⁵⁹ Data on Montenegrin GDP and number of employees were taken from Monstat

⁶⁰ Data on Eurozone GDP was taken from Eurostat

$$\begin{aligned}
a_t &= 0.2288 a_{t-1} + \varepsilon_a & \sigma_a &= 0.0448 \\
y^* &= 0.4983 y_{t-1}^* + \varepsilon_{y^*} & \sigma_{y^*} &= 0.0193 & \text{with corr}(\varepsilon_a, \varepsilon_{y^*}) &= 0.1201
\end{aligned}$$

The autoregressive analysis of labor productivity in Montenegro and Eurozone GDP reveals valuable insights into the dynamics of these economic indicators over time. For labor productivity in Montenegro, the autoregressive coefficient $\rho_{y^*} = 0.2288$ indicates that each unit increase in the previous period's productivity leads to a 0.2288 unit increase in the current period's productivity. This suggests a relatively modest dependence on past productivity levels. In contrast, Eurozone GDP exhibits a stronger dependence on past values, with an autoregressive coefficient $\rho_{y^*} = 0.4983$ suggesting that changes in GDP are significantly influenced by previous GDP levels. Furthermore, the standard deviation of the error term provides insight into the variability of predictions. For labor productivity in Montenegro, the standard deviation $\sigma_a = 0.0448$ represents a relatively small magnitude of the differences between observed and predicted values, while Eurozone GDP has an even smaller standard deviation $\sigma_{y^*} = 0.0193$, indicating less variability in prediction errors. Finally, the correlation between the error terms $\text{corr}(\varepsilon_a, \varepsilon_{y^*}) = 0.1201$ suggests a slightly positive relationship between the errors in predicting labor productivity in Montenegro and Eurozone GDP. This implies some level of commonality or interdependence in the factors affecting both series.

4.5. Impulse responses

Within this section, one can find the impulse response analysis, a fundamental tool in macroeconomic modeling, providing valuable insights into the dynamic behavior of economic variables in response to shocks. In the context of the Gali and Monacelli (2005) model, which is designed for small open economies, impulse responses help elucidate the transmission mechanisms and the temporal effects of various shocks on key economic indicators such as output gap, inflation, interest rate, etc. Additionally, as this model extends the standard New Keynesian framework by incorporating features specific to open economies, such as exchange rate dynamics and international trade, it is possible to obtain a more nuanced understanding of how external shocks, like changes in foreign output, propagate through the domestic economy. By analyzing the impulse responses, we can observe the immediate impact, persistence, and eventual stabilization of the economy following such shocks. Specifically, impulse response functions in this research trace the effects of a one-time shock to the system over time, holding other factors constant.

Through the following analysis, it is possible to gain a deeper understanding of the dynamic adjustments that occur within a small open economy like Montenegro. For instance, how does a domestic productivity shock influence inflation and output? What are the repercussions of a foreign output shock on domestic inflation and exchange rate? Further help in addressing these inquiries is provided by a visual and quantitative depiction of the

impulse responses, by generating the IRFs⁶¹ in Dynare. This approach not only enhances the accuracy of my analysis but also makes the complex interactions within the model more accessible and interpretable.

So as to systematically explore dynamics under different scenarios, there are two IRF plots, depicting the impulse responses or the reactions of 6 macroeconomic variables to selected shocks. Each graph represents a different variable's response over time, measured in periods.

- *PEG case and Domestic Productivity Shock*: examining the impulse responses when the exchange rate is fixed and the economy experiences a domestic productivity shock;
- *PEG case and Foreign Output Shock*: investigating the impact of a foreign output shock under PEG case;
- *DITR case and Domestic Productivity Shock*: analyzing the effects when the central bank follows a Domestic Inflation Targeting Rule in the presence of a domestic productivity shock;
- *DITR case and Foreign Output Shock*: exploring the responses when a foreign output shock occurs and the central bank adheres to a Domestic Inflation Targeting Rule.

⁶¹ Impulse Response Functions

4.5.1. Impulse responses to a domestic productivity shock

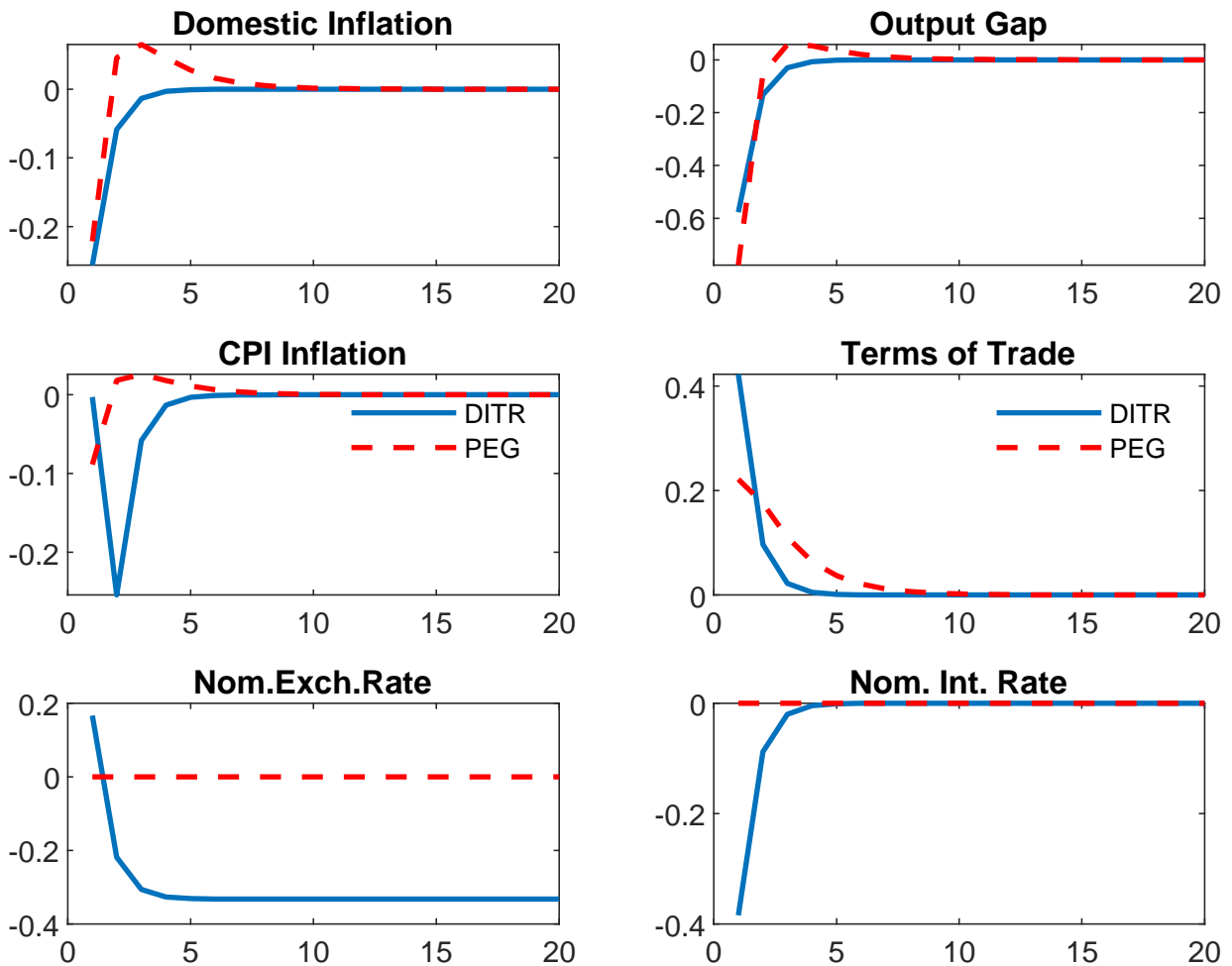


Figure 6: Impulse responses to a domestic productivity shock under PEG and DITR regime

Firstly, the output gap, which is defined as the difference between actual output and potential output, exhibits a negative response under PEG regime. This phenomenon can be attributed to the immediate impact of a positive productivity shock, which augments the economy's potential output. In the short run, actual output might not adjust instantaneously to the elevated potential output, which can result in a negative output gap. Over time, the economy undergoes adjustments, consistent with classical economic theory and the New Keynesian framework. Such a negative output gap typically exerts deflationary pressure, observable in the impulse response function (IRF) plot.

Additionally, a positive productivity shock typically leads to a reduction in production costs, as increased productivity means more output can be produced with the same input, thereby reducing the marginal cost of production. According to the New Keynesian Phillips curve, lower marginal costs result in lower prices set by

firms, culminating in diminished inflation rates. The initial drop in the plot aligns with this theory. Notably, inflation initially falls and then rises persistently above the steady-state level (noted as 0 in this model) due to the stationarity in the terms of trade, prior to stabilization. A comparable pattern is evident in CPI inflation. However, under a fixed exchange rate, the stability of imported goods' prices results in a less pronounced decrease in CPI inflations, as the CPI's inclusion of imported goods dampens the overall impact of the productivity shock on inflation, resulting in a smaller decline compared to the more substantial drop seen in domestic inflation.

Regarding the terms of trade, the initial positive response signifies an improvement in Montenegro's terms of trade. With a fixed exchange rate, the adjustment happens through relative price changes. The improved productivity lowers domestic prices without a corresponding depreciation, thus improving the terms of trade.

Further, as anticipated, the nominal exchange rate and nominal interest rate exhibit no significant changes under PEG case. Deviations in these plots would indicate challenges in maintaining the fixed exchange rate, which is atypical in a well-functioning currency union. In such a regime, the country is constrained from utilizing monetary policy to address domestic shocks. Consequently, the nominal interest rate's response to a domestic productivity shock is indirect and minimal. The European Central Bank (ECB) does not adjust rates based on the economic conditions of an individual member state. Therefore, a domestic productivity shock in Montenegro would have a negligible direct impact on the nominal interest rate, unless the shock were sufficiently substantial to influence the aggregate eurozone economy, which is improbable given Montenegro's relative economic size.

Alternatively, it is advantageous to conduct a comparative analysis of the fixed exchange rate framework against another, such as the DITR regime, to evaluate the differential responses of economic variables to a domestic productivity shock under varying monetary regimes.

One can notice that the responses of output gap and domestic inflation are qualitatively similar to those under PEG, as described in the New Keynesian Phillips curve. But the huge difference is the permanent fall in the both domestic and CPI price levels, which exhibits a similar behavior as the nominal exchange rate. Under this monetary policy, I assume a hypothetical scenario in which Montenegro uses a flexible exchange rate regime, allowing some flexibility in the nominal exchange rate. The observed behavior of the nominal exchange rate describes depreciation. However, the domestic inflation-based Taylor rule allows for an immediate reduction in interest rates in response to lower inflation. This monetary easing supports the economy by encouraging investment and consumption. As inflation starts to return to its baseline, the interest rate also adjusts upward, stabilizing around the new equilibrium. Additionally, the terms of trade tend to decline on impact due to an increase in CPI inflation.

4.5.2. Impulse responses to a foreign output shock

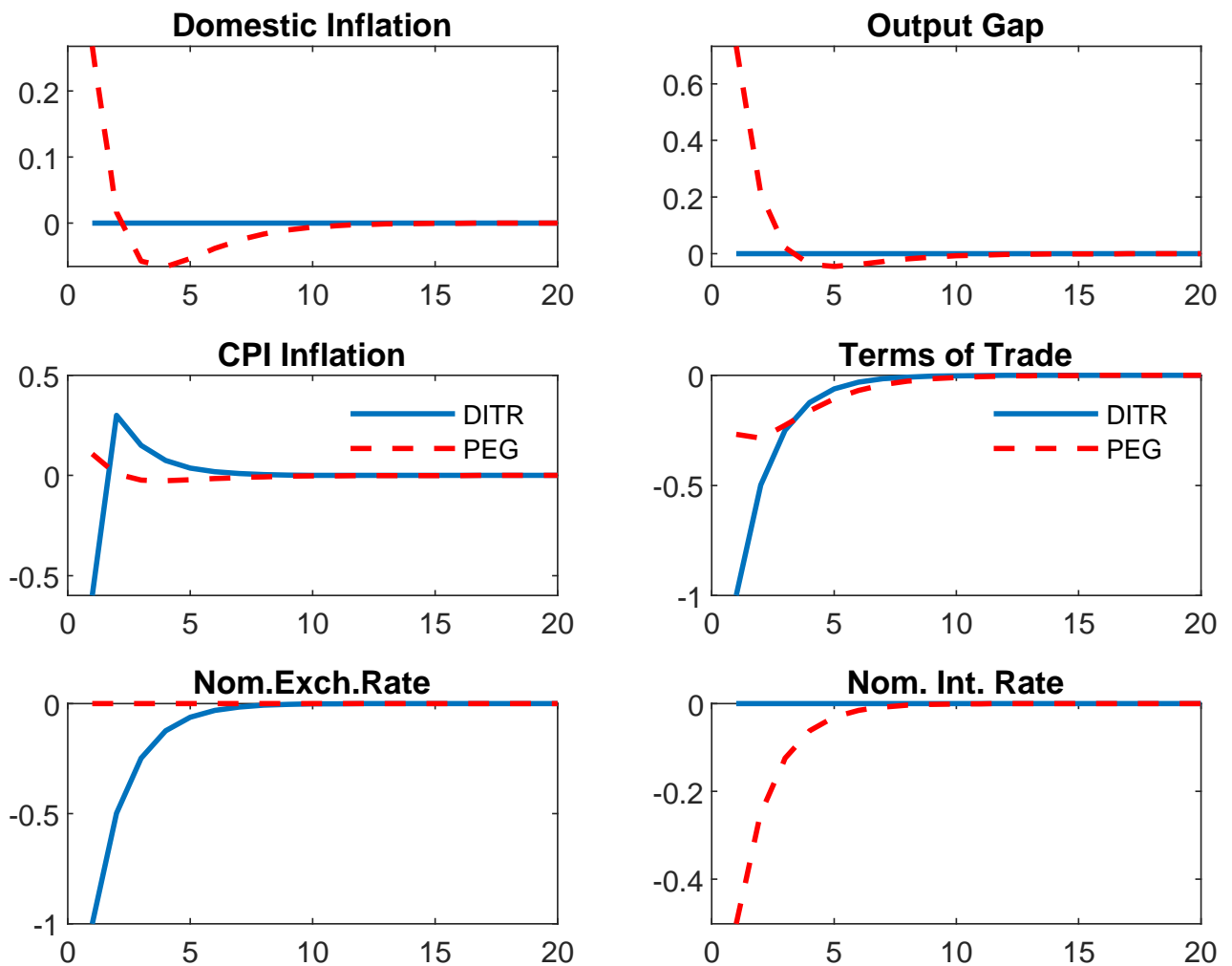


Figure 7: Impulse responses to a foreign output shock under PEG and DITR regime

In addition to the previous analysis, analyzing the impact of foreign shocks, particularly those originating from the Eurozone, on a domestic economy like Montenegro under a fixed exchange regime, may yield numerous advantages. Firstly, it enables policymakers to assess the effectiveness of the fixed exchange rate regime in shielding the domestic economy from external disruptions, offering insights into its capacity to uphold stability and resilience. Secondly, by understanding the ramifications of foreign shocks, policymakers can better discern the potential need for policy adjustments, guiding decisions on fiscal or monetary measures to counter adverse effects and uphold economic stability. Moreover, it facilitates an evaluation of trade flows, export competitiveness, and import prices, thereby informing the development of trade policies to bolster international competitiveness.

In summary, analyzing the responses of variables, such as inflation, output gap, terms of trade, and others, to foreign shocks under a fixed exchange rate regime, assists policymakers in understanding the transmission mechanisms of external shocks and informs policy decisions aimed at promoting macroeconomic stability and sustainable economic growth. Given the significance of such analysis, the forthcoming section of this paper presents empirical findings elucidating the impulse responses of key economic variables to foreign output shock.

In the event of a positive output shock in the Eurozone, were Montenegro to be integrated into the EMU, the repercussions on domestic inflation and CPI inflation in Montenegro would likely manifest through various interrelated mechanisms. Initially, heightened economic activity within the Eurozone could stimulate greater demand for Montenegro's exports, potentially increasing export prices and thereby contributing to domestic inflation. Furthermore, increased demand from the Eurozone for Montenegro's exports might induce a surge in domestic production and economic activity, potentially fostering upward pressure on domestic inflation as firms respond to heightened demand by adjusting prices—an observation that may be discerned within the IRF plot. Furthermore, increased domestic income and purchasing power might raise demand for imports, potentially increasing import prices and contributing to CPI inflation.

Additionally, a positive foreign output shock can increase the domestic output gap by stimulating demand for exports, leading to increased production and economic activity domestically, as well as through supply chain effects and improved confidence that spur additional investment and consumption. These factors collectively contribute to an expansionary effect on the domestic economy, leading to a widening of the output gap. In summary, due to Montenegro's integration into the broader European economy, positive developments in the Eurozone have had significant impacts on Montenegro's economy, including its output gap, through various channels such as trade, supply chains, and investor confidence.

Furthermore, the observed decline in Montenegro's terms of trade following a foreign output shock can be attributed to the intricate interactions among various economic factors. Specifically, the increase in domestic inflation, coupled with shifts in relative prices and competitiveness, serves as a primary driver of this decline. The rise in domestic inflation, stemming from the positive output shock in the Eurozone, contributes to a relative increase in production costs and prices within Montenegro compared to its trading partners. Consequently, Montenegro's exports become relatively less competitive in international markets, leading to a decrease in their value relative to imports. This adverse impact on the relative value of exports versus imports is consistent with the changes observed in both domestic inflation and the domestic output gap, underscoring the interconnectedness of these variables in shaping Montenegro's terms of trade dynamics in response to external shocks.

Overall, while the nominal exchange rate of Montenegro remains fixed as it is part of the EMU,

differential inflation rates between Montenegro and the Eurozone can still influence the real exchange rate and thus affect the competitiveness of Montenegro's exports and the attractiveness of its imports.

On the other side, the impulse responses to a foreign output shock differ under alternative monetary regimes. Under a Domestic Inflation Targeting Rule (DITR) regime, the central bank prioritizes stabilizing domestic inflation. This regime implies that the central bank's nominal interest rate response to foreign output shock is minimal. A foreign output shock impacts the domestic economy via trade and financial channels, potentially increasing domestic output and influencing inflation indirectly. However, the central bank's policy rule under DITR is primarily responsive to deviations in domestic inflation from the target and the domestic output gap. If the foreign output shock does not significantly alter domestic inflation—owing to factors such as domestic economic slack or the mitigating effects of exchange rate adjustments—the central bank finds little justification for altering the nominal interest rate. Even though Figure 7 shows no changes in domestic inflation, the decline is actually observable at the 10^{-16} dimension, as well as in the nominal interest rate as a proper response to the drop in domestic inflation. However, the shock does lead to a certain decrease in CPI inflation, driven mainly by the appreciation of the domestic currency in response to increased foreign demand. This appreciation also manifests as a decrease in the nominal exchange rate, signifying the relative strength of the domestic economy. Consequently, the terms of trade deteriorate as the price of imports decreases relative to exports, aligning with the economic mechanisms of the DITR regime.

4.6. Cyclical properties of alternative monetary policy regimes

In order to complement the quantitative analysis, table 7 reports the cyclical properties of several key macroeconomic variables under alternative monetary policy regimes. The results obtained highly confirm the findings that were already evident in the plots of the impulse response functions.

Table 7: Cyclical Properties

Variable	PEG case	DITR case
Nominal depreciation rate	0.00	2.80
Terms of trade	1.61	2.78
CPI inflation	0.47	1.73
Domestic inflation	1.16	1.18
Output	2.14	1.94 ⁶²

⁶² Values denote standard deviations in percentages

The analysis of the cyclical properties of alternative monetary policies reveals distinct differences between the Fixed Exchange Rate (PEG) regime and the Discretionary Inflation Targeting Regime (DITR). The PEG regime maintains a nominal depreciation rate of 0.00, confirming its fixed exchange rate nature, which reduces uncertainty in foreign exchange markets and stabilizes the terms of trade at 1.61. This stability extends to CPI inflation, which remains low and stable at 0.47, aligning with literature that suggests fixed exchange rates anchor inflation expectations effectively. However, domestic inflation at 1.16 under the PEG regime indicates that while import price stability is maintained, domestic factors can still cause inflationary pressures. Conversely, the DITR regime, with a nominal depreciation rate of 2.80, shows higher exchange rate volatility, reflecting a flexible exchange rate system that allows for market adjustments. This flexibility results in higher variability in the terms of trade (2.78) and CPI inflation (1.73), as the central bank targets inflation directly and responds to domestic economic conditions, albeit with increased short-term inflation fluctuations. Despite this, domestic inflation remains similar to the PEG regime at 1.18, suggesting effective inflation control by the central bank despite exchange rate movements. Output variability is higher under the PEG regime at 2.14, highlighting the limitations of a fixed exchange rate in responding to domestic economic fluctuations, leading to greater economic instability. In contrast, the DITR regime's ability to adjust interest rates and allow for a floating exchange rate results in slightly lower output variability at 1.94, indicating better stabilization of the economy. Overall, the PEG regime prioritizes stability at the expense of flexibility, leading to higher output volatility, while the DITR regime offers greater flexibility, better-managing output, and inflation variability despite higher exchange rate and terms of trade volatility.

4.7. Robustness check

In order to check the quality of my work, I have decided to perform some kind of robustness check, as such checks play a pivotal role in enhancing the credibility and reliability of macroeconomic models and their simulations. Since models are tasked with capturing complex interactions and predicting future outcomes, the necessity to ensure the robustness of model results is paramount. Moreover, they provide a mechanism for assessing the model's ability to capture real-world dynamics across diverse economic conditions and contexts.

Namely, I focus on parameter sensitivity analysis to assess the impact of variations in model parameters on the model's outcomes. The goal was to understand how sensitive the model's results are to changes in specific parameters and to identify which parameters have the most significant impact. Generally, conducting a parameter sensitivity analysis involves several steps. Firstly, key parameters in the model that could influence outcomes are identified.⁶³ Then, plausible ranges for each parameter are established based on theoretical

⁶³ In my work, these parameters are the ones for which calibration was done. p.40

considerations, empirical evidence, or expert judgment. Each parameter is systematically varied within its range while keeping other components constant, running the model multiple times with different values. The results are then analyzed to assess how changes in parameter values affect the model's predictions. Finally, the sensitivity of the model's outcomes to these variations is interpreted to identify which parameters significantly affect the results.

While there is not a definitive list of outcomes that would be considered "wrong," there are certain results or patterns that might indicate issues with the model or its implementation. Those typically include unrealistic responses, counterintuitive behavior, or violation of economic principles. In my analysis, whenever I change the values of the key parameters, the results do not change qualitatively. However, I observed that the parameters ρ_a and ρ_{y^*} caused some changes in the model's outcomes. Specifically, these parameters represent the degree to which domestic productivity and foreign output shocks, respectively, are persistent over time. Therefore, in order to understand and accurately estimate ρ_a and ρ_{y^*} , I have performed a data robustness check as well. This type of analysis implies using alternative datasets or time periods to estimate the model. If the results remain consistent across different datasets or timeframes, it adds credibility to the model's robustness. Initially, during the simulation of the model under different monetary policy regimes, a distinct zig-zag pattern emerged in the variables, which is consistent with the usage of the original raw data. To mitigate this pattern, I opted for seasonally and calendar-adjusted data, which eliminates predictable seasonal fluctuations and irregular calendar effects, ensuring a clearer depiction of underlying trends. Additionally, I employed the Hodrick-Prescott (HP) filter on the dataset, as this filter segregates the cyclical component of a time series from its long-term trend, facilitating a nuanced understanding of economic cycles, noise reduction, policy analysis, accurate data comparison, and enhanced forecasting capabilities.

5. SUMMARY AND CONCLUDING REMARKS

In conclusion, this thesis has provided a rigorous examination of macroeconomic dynamics in a small open economy framework, focusing on Montenegro as a small, open economy. By employing the model and utilizing MATLAB simulations, the analysis has elucidated the intricate interplay of economic variables and policy interventions in response to shocks.

The calibration process, meticulously aligning model parameters with empirical data and economic theory, has ensured the robustness of the model and its applicability to real-world scenarios. This calibration step is crucial, as it bridges the gap between theoretical constructs and observable economic phenomena, enhancing the model's predictive power and policy relevance. Furthermore, the robustness check, including parameter sensitivity analysis and data robustness verification, has bolstered the credibility and reliability of the model's outcomes. By scrutinizing the sensitivity of model results to changes in key parameters and ensuring consistency across different datasets, the thesis has enhanced confidence in the validity of its findings.

The impulse response analysis has been instrumental in uncovering the temporal effects and transmission channels of various shocks, shedding light on how the economy responds to both domestic and foreign disturbances. Through a systematic exploration of different scenarios under alternative monetary policy regimes, such as the PEG and DITR cases, the thesis reveals nuanced implications stemming from their distinct operational frameworks, as it points to the presence of a trade-off between the stabilization of both the nominal exchange rate and the terms of trade, as in the PEG case, and the stabilization of domestic inflation and the output gap on the other side. Under a fixed exchange rate regime, such as Montenegro's potential participation in the EMU, notable advantages include the maintenance of stable nominal exchange rates and the terms of trade, fostering price stability and external balance. However, the rigidity of this regime constrains the central bank's maneuverability in addressing domestic shocks effectively, potentially leading to prolonged economic imbalances. Conversely, the DITR monetary policy rule, depicting a hypothetical flexible exchange rate regime, offers greater flexibility in monetary policy, facilitating immediate adjustments in interest rates to mitigate the adverse effects of productivity shocks and support economic stabilization. While DITR accommodates nominal exchange rate flexibility, exchange rate fluctuations may introduce volatility, influencing price competitiveness and trade dynamics.

Taking into account everything previously mentioned, and the research questions posed in the very introduction of this paper, the following answer can be given. Analyzing the macroeconomic implications of a strong fixed exchange rate regime, such as monetary union, one can conclude that one of the primary benefits is exchange rate stability. By adopting a common currency or pegging their currencies to each other, member countries eliminate exchange rate fluctuations within the union. This stability reduces uncertainty for

businesses and investors engaged in cross-border transactions, fostering economic integration and trade within the union. Additionally, this exchange rate regime often contributes to price stability by anchoring inflation expectations, as member countries may prioritize controlling inflation to ensure the purchasing power of the currency remains stable across the union. This can help promote consumer and investor confidence and support economic growth. Furthermore, a fixed exchange rate can facilitate trade and investment within the monetary union by removing currency exchange risk and transaction costs associated with currency conversion. With stable exchange rates, businesses can more confidently engage in cross-border trade and investment, leading to increased economic activity and integration among member countries. On the other side, costs are present as well. One of the most significant implications of fixed exchange rate regimes, particularly monetary union, is the loss of monetary policy independence for member countries. Under a common currency, member countries relinquish control over their monetary policy to a central authority, which is the ECB for the European Economic and Monetary Union. This means that individual countries cannot use monetary policy tools, such as interest rate adjustments, to address domestic economic challenges. That is the reason why the Maastricht Criteria was introduced, particularly to offset country-specific shocks. Additionally, the presence of asymmetric shocks, or economic disturbances with varying impacts on member countries, could pose challenges for Montenegro, especially without the flexibility to adjust the exchange rate or conduct an independent monetary policy. This can lead to challenges in achieving balanced economic growth and may require other policy measures, such as structural reforms or fiscal transfers, to address disparities within the union.

Like most economic decisions, joining a monetary union has its benefits and costs. Although the optimum currency criteria offer some guidance, assessing the overall impact of monetary integration remains an empirical challenge.⁶⁴ Comparing the aforementioned implications of the monetary union with those of an alternative monetary regime such as DITR, the results confirm the frequent theoretical thesis that no regime is the best. Also, considering that economic conditions are always fluctuating, no regime remains optimal for an extended period.

Naturally, the benefits of joining monetary union should not be taken for granted. Thus, the decision whether to join the European Economic and Monetary Union should ponder Montenegro's specific circumstances. Therefore, deploying a more complex Dynamic Stochastic General Equilibrium model could indeed provide the Montenegrin central bank with a more nuanced understanding of the advantages and disadvantages of alternative monetary regimes. By incorporating additional features such as sectoral dynamics, heterogeneous agents, and financial frictions, a more elaborate DSGE model can better reflect the complexities

⁶⁴ Colonescu, (2017), "Macroeconomic Effects of the European Monetary Union: A counterfactual Analysis"

of Montenegro's economy and the transmission mechanisms of monetary policy. This enhanced modeling approach would enable the evaluation of different macroeconomic concepts with greater precision, which I intend to explore further through my PhD studies and the following professional career.

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