EKONOMIA
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MANAGERIAL ECONOMICS

CONTENTS

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Fighting recent inflation: An empirical literature review of monetary and governmental policies

1. Introduction

Inflation affects people in their everyday lives as it shows rising prices for a wide range of goods and services. One can often observe a mismatch between increases in wages and increases in prices within the same time interval since there is no automatic adaptation of wages and pensions to inflation in many countries, as Blanchard (2021) states. This is especially the case when inflation rates are higher than the average of the past few years, and leads on the one hand to the problem of how income is distributed in an economy. On the other hand, if prices are changing in an erratic way for the population they may be insecure about how to decide on their future spending and investments. Inflation leads money to have less and less worth, so the higher the price increases in goods and services, the lower the propensity of people to make long-term decisions in general. A bond with a long maturity and a fixed coupon rate yields the same amount of money every year in nominal terms, but the real value (nominal value less inflation) shrinks more and more when high inflation rates are prevalent. Therefore, investors charge more for lending their money to bond issuers, as well as banks for lending money to companies and private households. Both lead to lower economic activity, further reducing economic growth and also potentially leading to recessions and higher unemployment rates. This in turn can force governments to spend more money on social benefits to support people in need while earning lower government revenue due to decreased economic activity, burdening the budget and leading to a higher debt-to-GDP ratio and may decrease trust in the financial viability of a country.

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This short and simplified representation summarizes some of the probable consequences of high inflation rates. As inflation has an impact on companies, private households, and economies as a whole, it is helpful to understand which forces drive inflation rates, how they can be dampened, and to what extent short-term measures have an impact on long-term economic development. Two main institutions are in charge of observing and trying to influence price increases in economic areas: the central banks – for the euro area the European Central Bank (ECB) – and the (national) governments. The ECB can change their base rates and conduct asset purchases (quantitative easing) whereas governments can adjust their spending and debt levels to cope with inflation. This literature review focuses on how certain monetary policy and governmental policy measures can be conducted to keep inflation around predefined levels and to fight too-high inflation rates. For the causes of inflation and a detailed explanation of policy instruments, see for instance Mishkin (2021). Ideally, both pull together, as some measures of one institution can cancel out those of the other in certain economic situations or lead to even higher inflation rates. This interdependence and the manifold implications for economic development and social impacts make inflation an academic topic of high interest to investigate properly and thoroughly.

Therefore, this empirical literature review answers the following research question:

How can central banks and governments use their respective tools and how do they interact to effectively combat recent high inflation?

The literature review aims to offer a deeper understanding of the impact of certain mechanisms of central banks and governmental policies on the evolution of inflation, particularly within the euro area. It evaluates the existing literature to determine if fiscal measures can account for price increases and, if so, to what degree. It also examines central bank policies, including the unconventional measures implemented in response to the COVID-19 pandemic, and offers insight into how they might shape future inflation. This research contributes to the academic literature by investigating prior findings and establishing relationships between government decisions on national budgets and debt levels aimed at stabilizing the economy in the post-COVID-19 era and the subsequent increase in inflation rates. Table 1 summarizes the main findings for a quick overview.

To answer the research question systematically, the following literature review is based on searches on Google Scholar and EBSCOhost. Using the search term "monetary AND policy AND inflation" yields 2,410,000 results in Google Scholar without publication date restrictions and 27,300 results when starting in 2000. The same search term, but restricted to publication titles and academic journals only, yields 470 results on EBSCOhost (1946 to 2023) and 416 results starting in 2000. The search term "fiscal AND policy AND inflation" yields 1,820,000 results on

Google Scholar without publication time restrictions and 566,000 results when starting in 2000. Again, the same search term, but restricted to publication titles and academic journals only, yields 54 results on EBSCOhost (1946 to 2023) and 42 when starting in 2000. The search term "economic AND policy AND inflation" yields 2,830,000 results on Google Scholar without publication time restrictions and 591,000 results when starting in 2000. Again, the same search term, but restricted to publication titles and academic journals only, yields 38 results on EBSCOhost (1967 to 2023) and 26 when starting in 2000. I chose the time restriction to focus on more recent papers to account for sophisticated methods to deal with a large amount of data and to account for structural changes that have happened just before for even some developed countries, such as inflation targeting and central bank independence. These two search terms are the basis for the further exploration of the topic. After identifying key drivers of monetary and fiscal policy, such as inflation expectations as a proxy for subsequent actual realized inflation rates, I focus on relevant papers that deal with these issues, pointing out possible limitations and pointing to papers with results that contradict those prevailing in the literature.

Table 1

Concise summary of the empirical literature research results

Supporting economies is not new, but has been amplified since the 20th century	Personal views of monetary policymakers influence post-crisis trends inflation	Too little supply and/or too much demand fuel inflation rates
What people think about future inflation affects their decisions and actions, and in turn shapes future inflation rates	Monetary policy tends to be faster and more effective against persistent inflation but can lead to higher debt ratios of countries	Fiscal policy without lower spending leads to higher debt ratios and, as a consequence, higher inflation expectations
The academic literature is divided on whether fiscal policy measures are inflationary or have little effect on inflation	The duration of economic crisis measures must be carefully considered to prevent sudden economic slumps or high inflation	Firms in certain industries with pricing power can accelerate overall inflation
Analyzing data for price stickiness, interconnectedness, and market imperfections is the basis for effective monetary policy decisions	Slow wage growth and low energy prices by law have been two success factors in keeping inflation under control after recent crises	Monetary policy and fiscal policy must work together to ensure effective action against excessive inflation

The rest of the paper is structured as follows: Section 2 contains the empirical literature review that is based on 13 subsections about different influencing variables on inflation. These subsections deal with how central banks supported economies in economic downturns over time (2.1), how beliefs of central bank executives can affect future inflation rates (2.2), the role of supply and demand for strongly rising inflation rates (2.3), how relief programs and expectations of economic actors can shape inflation (2.4), the role of the interplay between monetary and governmental policies in inflation fighting (2.5), how interest rate changes by the central bank can harm national finances (2.6), the consequences of different policies in charge (2.7), the role of heavy fiscal support (2.8), how important a clear and determined stance of a central bank is for fighting persistent inflation (2.9), the impact of companies with high price power (2.10), how theoretically solving a Ramsey problem could be a guideline for central banks (2.11), the importance of a broad data basis for taking decisions (2.12), and a comparison of countries with high and low inflation rates after the COVID-19 crisis (2.13).

2. Empirical literature review

To begin with, the support of the economy in the aftermath of the COVID-19 pandemic is described as a fairly recent policy action. As a consequence of the beginning COVID-19 pandemic, the ECB (European Central Bank) in conjunction with the national central banks started to purchase government bonds and corporate bonds under the Pandemic Emergency Purchase Programme (PEPP) in March 2020, as explained in European Central Bank (2023c). The main objectives were to stabilize the transmission of monetary policy and to ensure price stability in the euro area as well as to maintain favourable financing conditions. In the beginning, the programme was set to a maximum amount of EUR 750bn of government bonds and corporate bonds to be purchased by the ECB, including Greek government bonds as every country was negatively affected by COVID-19. In June 2020 and in December 2020, PEPP was ultimately extended to a total amount of EUR 1,850bn. Moreover, the minimum maturity of corporate bonds that could be purchased under the existing Corporate Sector Purchase Programme (CSPP) was lowered from 180 days to 28 days, also being eligible for PEPP. By March 2022, two years after starting PEPP, the programme was stopped, but the maturing principal payments will be reinvested until the end of 2024, maybe even longer, if the ECB concludes that doing the monetary policy effectively would be negatively affected by stopping it.

2.1. On the support of economies through time

From 50% to 100% expansion. A look into the past shows that central banks supported economies as early as in the 17th century, so this is not a new phenomenon, but their aim moved and their sensitivity rose to fight the adverse impacts of financial crises after the Great Depression of the 1930s. Depending on the kind of economic environment that requires support (financial crisis, war or similar military interventions, pandemics, and other natural disasters, or commercial drivers), central banks expanded their balance sheets by around 50% on average, according to Ferguson et al. (2023). The supporting activity of the central banks during the COVID-19 pandemic, however, exceeded this average a lot, as the Fed more than doubled its balance sheet total between March 2020 and April 2022 from roughly USD 4.2trn to USD 8.9trn. To support the financial markets during the Global Financial Crisis (GFC), it also more than doubled its balance sheet total, but on a much lower absolute level (from 0.9trn to 2.2trn between September 2008 and December 2008), see Board of Governors of The Federal Reserve System (2023). The balance sheet of the ECB developed similarly, as shown in European Central Bank (2023a).

2.2. On the effects of central bankers' positions on inflation

After crises, hawks facilitate deflation, doves inflation. The core of the contemporary scientific literature that has been established around financial crises is dealing with liquidity issues, according to Caballero and Krishnamurthy (2008), Brunnermeier (2009), Negro et al. (2017), or Guerrieri and Shimer (2014), as investors seeking refuge in liquid assets when returns are uncertain to build a cushion against decreasing returns or lower cash flows, as Ferguson et al. (2023) states. But as information asymmetries can cause adverse selection and disincentives can lead to moral hazard, history has shown that banks may take too much risk that they cannot bear themselves, leading to further financial crises and liquidity issues. Central banks being forced to take action against these scenarios by providing liquidity via quantitative easing (QE), i.e. asset purchases, makes the financial markets more susceptible to future liquidity shock scenarios, according to Acharya et al. (2023). Eleftheriou and Kouretas (2023) studied the relationship between monetary policy and inflation starting with 1979 using a Vector Error Correction (VEC) model. A VEC model tries to capture long-term relationships and short-term dynamics between time series variables. In general, the term "error correction" refers to a short-term deviation from the long-run equilibrium that is captured to learn how quickly a dependent variable adjusts to changes in other variables. The goal is to understand how long-term connected variables are

related over time, see Martin et al. (2012). The authors show that unconventional measures like quantitative easing do not have the desired effect on inflation if the central bank interest rate is at zero. In such an environment, inflation dynamics deviate from the usual pattern that can be observed when interest rates are not at the lower end. A central bank institution as such is run by people who are roughly classified in the literature as "hawks" or "doves". For that, Doulamis and Colman (2023) show current classifications of central banks' members. In general, hawks are decision-makers who address moral hazard concerns when thinking about decisions made in banks and are particularly interested in price stability whereas doves look more to economic growth goals and employment goals, according to Ferguson et al. (2023). Therefore, the probability of providing liquidity support by expanding the balance sheet of the central bank is 36% higher among doves than among hawks, as Ferguson et al. (2023) show. Ferguson et al. (2023) as well as Borio and Zabai (2018) found out that when a central bank offers economic support by expanding its balance sheet in the first two years of a financial crisis by conducting private asset purchases, the real GDP growth can be increased without facing strongly increasing inflation rates, while avoiding such support leads to long-lasting deflation. Specifically, for 89 financial crises since 1870 in 17 advanced economies that were examined by Ferguson et al. (2023), the leadership of hawks tendentially led to a more volatile money aggregate (M2) growth, the worse development of real GDP per capita, and a deflation of about 1.3% p.a. within four years since the beginning of the according financial crises. In contrast, when doves were governors, the M2 growth tended to be more stable, real GDP per capita developed positively, and the inflation was about 4.6% p.a. In contrast, although the leadership of doves – or, generally spoken, a more supporting orientation of central banks – seems to have a beneficial impact on an economy, this does not go without a downside. As participants in financial markets know that dovish central bank management focuses more on growth and employment and less on price stability and moral hazard, they tend to take more risk in calm times as they expect that the central bank will take appropriate actions in case of a financial crisis anyway, as shown in Ferguson et al. (2023). This is not only due to psychological reasons, but also because expansions of balance sheets are made through asset purchases on the markets, like for instance the mentioned PEPP programme by ECB, as this leads to fewer safe assets being available on the markets and lower yields, so market participants are even forced to take more risk to fulfill their expected returns, as Kelleher and Basil (2023) state. Grimm et al. (2023) study how a dovish central bank policy can increase the probability of financial crises and come to a similar conclusion. They declare a loose monetary policy as times when a central bank sets its policy rate lower than the neutral interest rate, the estimated real interest rate at which economic activities are in balance where they are not

driven to increase or decrease by the policy rate. Looking at five-year periods, they state that a difference between these two rates that is one percentage point lower results in both strong credit growth and strong asset price growth (according to Greenwood et al. 2022) to be more likely by 3.2 percentage points (household sector) and 1.8 percentage points (business sector) within five years. When both are rising together, they can predict financial crises very reliably. Actually, a financial crisis to happen in this scenario is 5.5 percentage points more likely within the following 5 to 7 years as well as 15.5 percentage points more likely to happen within the following 7 to 9 years. In short, it can therefore be shown that the personal beliefs of central banks' decision-makers can have a strong influence on future inflation rates after external shocks. A predominantly dovish attitude on the part of the central banks in recent years may have had a certain impact on why inflation rose strongly in the aftermath of COVID-19. Reis (2022a) hypothesized that one of the reasons may be the fact that central banks wanted to boost real economic activity, in which they indeed succeeded. However, they did not react properly to the supply shocks as they expected them to be just a short-term phenomenon. Monetary policy remained loose instead of tightening it for too a long time, they argue.

2.3. On how supply and demand affect inflation

Supply shortage and demand excess drive inflation. Bankowski et al. (2023), European Central Bank (2022) as well as Gonçalves and Koester (2022) argue that the strongly growing inflation rates in the euro area starting in August 2021 can be ascribed mainly to the supply side, but partly to the demand side of the economy, too. The supply-side shock was amplified by significantly rising energy prices after the start of the Russian-Ukrainian war at the end of February 2022.[1] As a consequence, governments started to counteract the negative effects on the financial situation of companies and private households. In Austria, for example, the government adopted a total of three relief packages. The first one and the second one amount to 3.7bn euros in total and involve a wide range of different measures to dampen the negative impact of rising energy prices, like e.g. the *Stromkostenbremse* (electricity cost brake) for private households, where prices over 10ct per kilowatt hour (kWh) will be compensated by the budget, up to a maximum of 40ct per kWh for 19 months. This corresponds to a maximum grant of 30ct per kWh for an amount of up to 2,900 kWh of annual power consumption,

[1] This is what the cost-push theory explains as the main cause of inflation. Higher prices for raw materials or higher interest rates. Firms with high pricing power can pass on their higher costs to their customers, see e.g. Totonchi (2011).

as shown in Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie (BMK) (2022). The third package amounts to more than 28bn euros, covers the years until 2026 and implements measures like an increased monthly family allowance and higher tax deduction possibilities for families and employees, see Bundesministerium für Finanzen (2022b). In addition, by the beginning of 2023, the marginal amount in the different tax brackets will be adjusted automatically to inflation rates on an annual basis. Therefore, the bracket creep, as described for instance in Parliament of Australia (2021), has been abolished, which previously led to a higher tax burden for employees every year, because increasing wages due to inflation could get them into higher tax brackets. This measure alone sums up to more than 20bn euros of lower Austrian government revenues until 2026, according to Bundesministerium für Finanzen (2022a).

Ferguson and Storm (2023) agree that the strongly rising inflation rates following COVID-19 are due to supply and demand factors. From the supply side, they identify four factors: imports, energy prices, higher corporate profit margins, and COVID-19 but emphasize that the supply shortages alone cannot account for the strongly rising prices. Instead, the demand side plays an important role.[2] But they refuse to hold the fiscal stimulus, in this case, the US measures, responsible for the amplified demand in this period. In fact, they state that the unequal increase in private households' wealth, especially of the richest ones, caused by ultra-loose monetary policy, see also El-Gamal (2022), during the years of 2020 and 2021 fuelled demand and, in turn, inflation. To cope with the supply-side constraints, on the one hand, the authors suggest establishing or further developing anti-trust policy and regulatory rules as well as investing in public health and renewable energies. On the other hand, they recommend fiscal policy to support monetary policy to fight supply-side shocks to be more effective. To address the demand side, the authors suggest fiscal policy to dampen inflation surges that arise from supply-side shocks by establishing progressive consumption taxes and higher taxes on wealth and capital gains. El-Gamal (2022) uses wavelet coherency to identify the degree of correlation between oil prices, overall price inflation, and changes in real money supply at different frequencies and times. The results show that short-term inflation can be indeed strongly affected by exogenous shocks, the soaring inflation rate in 2022 is mainly the result of the ultra-loose monetary policy. Pasimeni (2022) adds to this perspective the share of the inflation rise that came from the supply side in the United States compared to the euro area. Whereas this share lies about 50% for the United States, it is more than 80% for the euro area,

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[2] This is consistent with the demand-pull theory, which explains the cause of inflation by increased consumer spending and high demand for goods and services, see e.g. Barth and Bennett (1975). For this case, Keynes (1936) recommends central banks to intervene in the money circulation and/ or governments to raise taxes to get inflation under control.

mainly due to the energy crisis following the war in Ukraine. The study points out that shocks affecting one economic sector at first, resulting in lower potential output, can cause falling demand in other sectors and in turn a reduction in overall economic activity. This can particularly come true when it is difficult to shift resources from one sector to another, when consumers are concerned about the future economic prospects and be able to shift their spending, and in markets with restrictions as in this case, some goods and services may be unavailable or difficult to obtain. In contrast to Ferguson and Storm (2023), the author does not suggest including measures on the demand side. Instead, fixing or resolving issues that have caused disruptions in the supply chain and addressing the energy price shock seems essential for ensuring the uninterrupted movement of goods and services, which is critical for a well-functioning economy.

2.4. On the effects of relief programs and expectations on inflation

Relief programs and expectations shape future inflation. If such relief measures are implemented over a longer period, a higher household income they generate may lead to higher demand and, in turn, to higher inflation, according to Committee for a Responsible Federal Budget (2022) and de Soyres et al. (2022). Economic shocks like the one brought out by the COVID-19 pandemic or the soaring energy prices due to the war in Ukraine pressure governments to fight against the adverse consequences of higher budget spending. This leads to higher nominal money growth and thus to higher inflation rates, often letting governments force companies that are under their control to keep their prices to fight against inflation. Frequently, this is hardly effective, as the deficits of such companies have to be financed again by the government, as stated in Blanchard (2021). Soaring inflation rates can have long-lasting negative effects when escalating via wage-price spirals. As employees demand higher wages due to higher living costs, demand is increased and can in turn lead to even higher inflation rates, see Committee for a Responsible Federal Budget (2022).

Besides the national governments, the European Union established its NextGenerationEU, a recovery plan to support the economies of its member countries after the COVID-19 pandemic. Contrary to the past, the volume of 750 billion euros (this and all further data regarding NextGenerationEU are in 2018 prices) is raised by common EUR borrowing on the financial markets, see European Union (2021). According to European Commission (2023), it is made up of grants and loans, where the largest component is the Recovery and Resilience Facility (RRF) with funding of 672.5 billion euros to support reforms and investments undertaken by the EU member states to make them more sustainable and resilient. About 358.1 billion euros of the funds are provided as repayable loans and

about 314.4 billion euros in grants. To be eligible for accessing money, member states have to submit national recovery plans with their agendas that have to include at least 37% of the expenditure to climate objectives and 20% to digital transitions. Besides RRF, another large component is the Recovery Assistance for Cohesion and the Territories of Europe (REACT-EU) with a funding of 47.5 billion euros. REACT-EU focuses on support to maintain jobs, including self-employed people, and aims at helping to create jobs and to establish youth employment measures and healthcare measures, see European Commission (2021).

Much is about expectations. When consumers expect rising prices, they tend to spend more money earlier (which is called "intertemporal substitution"), demand higher wages, or are content to consume at higher prices, whereas companies increase prices for their goods and services when anticipating higher prices for doing business, according to Committee for a Responsible Federal Budget (2022), Bachmann et al. (2015), Coibion et al. (2018, 2019), or Vellekoop and Wiederholt (2019). This is especially true for durable goods as Andrade et al. (2023) found out. They looked at differences in consumers' buying decisions using the French survey results from 2004 to 2018. It turned out that for this period a large fraction of about 33% of the private households tended to expect prices to remain stable instead of rising prices, whereas only 1% of them expected declining prices. The authors show that dividing households into the two factions of those who expect prices to stay the same and those who expect prices to rise impacts their decisions of whether to buy durable goods or not much more than which actual numeric inflation rate differences they expect. Households that are expecting higher inflation rates indeed tend to spend money on durable goods earlier than later. Central banks can learn from this when they provide information about how they want to conduct their policies in the future to shape the inflation expectations of the market (forward guidance) or by balancing target inflation rates over time instead of using a hard limit (inflation targeting) this can have a low impact on guiding aggregate demand, at least in low-inflation periods. The fraction of private households that expect stable inflation evolution cannot be lower than 0 and if nearly all of them expect higher prices, then communicating even higher inflation expectations does not lead to even greater spending on durable goods.

Private households also decide how much to spend on durable goods depending on their wealth situation and the real interest rate. Lieb and Schuffels (2022) use household-level data on balance sheets, inflation expectations, and durable consumer spending from the Dutch Central Bank's Household Survey in their study. They find that households with a lower net worth tend to antedate their spending more likely than those with a higher average net worth when they expect rising prices in the future. This is particularly pronounced for households with fixed-interest rate mortgages. The reason for this lies in the net nominal

position of a household's balance sheet, so the difference between nominal values of assets and liabilities and in different types of assets and liabilities private households hold. When it comes to the real interest rate, when people expect higher inflation, they may demand higher nominal interest rates to compensate for the expected loss of purchasing power. But if they do not adjust immediately, their real interest rate decreases, based upon nominal interest rate minus their expected inflation, so saving money becomes less attractive and spending will increase. Furthermore, as Burke and Ozdagli (2021) point out, households of higher education (college degree) that are highly indebted in mortgages tend to consume more when they expect higher inflation rates in the future as this lowers their real debt which in turn leads to a higher real wealth. They also found that a higher household income leads to a lower spending reaction when inflation expectations change. Lieb and Schuffels (2022) find that financial investments, such as stocks or real estate, can moderate this effect by providing a hedge against inflation. Households with financial investments may be less sensitive to changes in expected inflation because their investments can protect them against the loss of purchasing power.

Firms' decisions on their financing are also driven by the inflation they expect in the future. But there is no strong common sense of how inflation rates are emerging in the future: the general observation is that households that look similar in a demographic way often nevertheless expect future inflation significantly different, as they encounter different kinds of goods and services in their everyday lives, according to Weber et al. (2022). Moreover, firms and private households of even different countries, data sets, and periods tend to have higher expectations of future inflation rates than professional forecasters and higher than the actual realized inflation rates in the future. This bias towards higher inflation expectations is different between certain groups of people. Women and people from lower socioeconomic groups tend to expect future inflation rates higher than others. The latter result is accompanied by a study by Rumler and Valderrama (2020) who examine the influence of information literacy, monetary policy literacy, and financial literacy on inflation expectations. Using data from a survey of 30 questions conducted in the spring of 2013 among 2,000 Austrian households, they found that consumers are not quite literate regarding inflation. The ones that are indeed more familiar with how inflation works expect future inflation rates more realistic with smaller absolute errors, therefore lower than people with lower inflation literacy. But the latter are more convinced about their estimations due to the overconfidence bias which states that especially lower-educated people are more sure than others. The authors also show that the more people trust the central bank and the higher its standing, the more precise are people's expectations.

Inflation expectations can also be connected to job situations. The lower the hierarchical position within a firm, the higher the employees expect future inflation rates, as Gorodnichenko and Candia (2021) state. If firms are split over inflation expectations, this can have unwanted effects on central banks when conducting their monetary policy, as Falck et al. (2021) state. A central bank that unexpectedly tightens its monetary policy by, for instance, increasing interest rates should have a look at the dispersion of inflation expectations when doing this. This is because in an environment of high disagreement on how future inflation will be firms are not able to explain why the central bank lowered the interest rates, like fighting inflation or due to an overheating economy (positive output gap). Instead, they may mistakenly think of less supply due to less productivity because of disruptions in supply chains, adverse technological changes, or reduced efficiency in production processes as a possible reason to dampen the upward pressure on prices. Or, more importantly, firms may interpret rising interest rates as a reaction to an increased willingness of consumers to spend more money due to changes in consumer confidence, expectations of future income growth, or shifts in consumer tastes and preferences. As firms believe that consumers are willing to spend more money, they may increase the prices of the goods or services they provide to increase their sales and profits. Therefore, the initial goal of a central bank of fighting inflation can be counteracted by higher inflation pressure in such an environment. Falck et al. (2021) found that in this case, a 100 basis point increase in interest rates leads to a 0.7 percentage points higher inflation and higher inflation expectation over a period of up to three years. Compared to this, when firms are more or less agreed about inflation expectations, a higher interest rate set by a central bank leads to the intended and expected reaction of an inflation rate of about 0.8 percentage points lower over the upcoming three years.

According to Mankiw et al. (2004), private households and firms not only expect higher inflation rates than professional forecasters, but their expectations are also more widespread than the professionals' ones. This may be due to two potential factors: information sources and interpretation. First, various groups of people have different information sources about what is going on in the economy. Private households experience inflation in buying groceries and other products they need frequently. Professional forecasters have access to more in-depth information through information portals and can comprehensively analyse data. Second, different groups of people interpret shock events differently. Rising oil prices, for instance, may make private households think that the general price level is strongly increasing, but professional forecasters may interpret them just as a temporal phenomenon. Private households and firms are also more uncertain about the actual inflation outlook than professional forecasters. Moreover, people tend to have "sticky inflation expectations" as surveys have shown that

when an economic shock event happens, they not only expect inflation rates to be higher for the upcoming short time but also for longer time horizons, neglecting the fact that central banks take action to fight strongly rising inflation rates, as underpinned in Weber et al. (2022).

Strong drivers for personal inflation expectations are what people believe about how inflation emerged in the recent past and which cognitive abilities they have. Malmendier and Nagel (2015) examined inflation expectations from Reuters and the Michigan Survey of Consumers for 57 years between 1953 and 2009. They figured out that inflation expectations are driven by inflation experiences that people had in the past. Moreover, perceptions vary between different age groups: Younger people tend to revise their inflation expectations more strongly than older people, as for the former their whole life so far has been shorter and therefore, their immediate past has a larger share. Contributing to the former finding, Stokman (2023) finds that there are four main drivers of soaring inflation expectations in the aftermath of the COVID-19 pandemic: prices for energy, food, transportation, and houses. To examine, the study uses information from the Joint Harmonized EU Consumer Survey from 1995 onwards. This survey asks households how they expect the consumer prices within the next 12 months compared to the last 12 months, giving them six possible answers, including "don't know" and averages them to infer expectations. Cognitive abilities play also a role in different inflation expectations among otherwise similar groups of people. D'Acunto et al. (2019) use 120 questions from a cognitive abilities test of the Finnish Armed Forces (FAF) that targets quantitative, verbal, and visuospatial abilities. The quantitative part involves arithmetic calculations and other tasks using numbers. The verbal part consists of questions about comparing words and word pairs as well as synonyms and antonyms. The visuospatial part tests respondents on pattern recognition. The authors ascertain that all three types of abilities influence a person's inflation forecast error. For all three types, higher levels of cognitive abilities are associated with lower inflation forecast errors. Burke and Ozdagli (2021) use a survey panel dataset of households in the US from a period where the Fed held their target rate at the lower limit of 0%, namely mid-2009 to late 2012. They ascertain that only households of higher educated people, at least college education, tend to spend relatively more on durable goods when they await a higher inflation one year, especially when they have a mortgage loan. In contrast, people who are not as educated, in some cases spend more on durable goods when expecting higher prices in the future, but less than college-educated people, but sometimes actually even less than before expecting rising inflation rates. Regardless of the educational type of private households' members' spending on non-durable goods and services (like in their sample food, clothing, utilities, and some other items) is almost not affected by how people estimate

future inflation. This can be challenging for central banks as they try to influence consumer spending in general, not only looking at those of durable goods as they account for only 10% of all consumer spending in the dataset and are similarly low for consumer spending in general.

According to Reis (2020), even as some market participants are better informed, sometimes private households and firms forecast inflation better. This is especially the case when central banks try to balance the expectations of both professional forecasters and private households and firms to stabilize the expected inflation rate as it becomes less uncertain and less volatile. The core reason for this can be found in responsiveness. The more responsive private households are to news, the more they adapt their inflation expectations to new information, and therefore, the more accurately they can predict future inflation rates. The other way around is valid for market participants and financial noise. The stronger market participants react to random price fluctuations that cannot be explained by actual economic factors, the less accurate are their expectations. Speaking of differences in inflation expectations among professional forecasters themselves, Dovern et al. (2012) found that they are built upon actual price levels and the (in) dependence of central banks. The higher the price level, the higher the disagreement between forecasters about future inflation rates tends to be. In countries like Japan or Italy, where central banks became independent much later than in other countries, the differences between forecasters' expectations are more pronounced.

2.5. On steering the economy: monetary vs. governmental policies in combating inflation

Monetary policy should take charge. Monetary policy and governmental policy act via different channels: via setting interest rates to affect how much credit banks lend and customers borrow (interest rate channel and credit channel), how exchange rates are shaped (exchange rate channel), how attractive investment in bonds is (wealth channel), and how much worth assets are as collateral for loans (balance sheet channel). Additionally, monetary policy affects how much demand there is for bonds when conducting unconventional measures (quantitative easing channel). Governmental policy can influence how much money companies and private households have on hand to spend on goods and services by altering taxes or spending.[3] But too high inflation rates are contrary to the main objective

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[3] This is known as fiscal policy where governments can change their spending and/or taxation in order to influence demand and, as a consequence, inflation – see e.g. Horton and El-Ganainy (2019). But they can also intervene through government guarantees, price limits or price bands, and excess profits taxes. Government guarantees are common in international trade to support economic activity, where a government pays for an exporting company of the home country when it is no

of the ECB, i.e. to keep prices in the euro area stable, see European Union (2016). Therefore, the central bank will increase the interest rate on the main refinancing operations to make borrowing money more expensive for commercial banks and hence for private households and companies, too.[4] This dampens credit demand and demand in the real economy, which should in turn be followed by lower inflation. But it is also about the methods of monetary policy. Decreasing interest rates may fuel inflation more than quantitative easing or fiscal policy that is financed by taxes, as Wu and Xie (2023) state. According to them, there can be several reasons behind this rationale, with the first being transmission channels. On the one hand, conducting quantitative easing by purchasing financial assets to provide liquidity to the economy increases the money supply, lowers long-term interest rates, and therefore should increase lending and investment. On the other hand, conventional monetary policy, mainly decreasing interest rates, leads to borrowing cheaper money more directly, and therefore to higher inflationary pressures. Second, limited control over asset allocation. Conventional monetary policy typically involves taking control over short-term interest rates, but the impact might differ between different economic sectors, putting inflationary pressures on some of them. Third, the velocity of money. Lowering interest rates may imply a greater impact on the velocity of money than conducting QE programs, and therefore can fuel inflation more strongly. Hence, the more indirect nature of QE on financing conditions and economic activity may exert lower inflationary pressure compared to lowering interest rates. The existing literature broadly argues that central banks should take the lead in fighting inflation,[5] supported by fiscal policy measures (or more generally, governmental policy measures), see for instance Committee for a Responsible Federal Budget (2022), because due to

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longer able to do so, as e.g. Peterdy (2022) states. According to Rockoff (2008), price ceilings or price bands may be imposed to prevent people and businesses from paying too high prices for essential goods or services. Several countries imposed excess profits taxes on certain industries whose profits were above historical averages due to rising energy prices following the start of the war in Ukraine, as European Commission (2022a) and European Commission (2022b) allowed. Whether such taxes reduce or increase inflationary pressures depends on how the government uses the increased public revenues and for how long they are imposed.

[4] The ECB influences the interest rate by buying or selling securities on the financial markets which refers to the term open market operations (OMO), providing or withdrawing liquidity on the market. Depending on how long the maturities of the securities are, there can be main refinancing operations (MROs) for providing liquidity to banks for one week against collateral or longer-term refinancing operations with a maturity of usually three months. Furthermore, the ECB can conduct fine-tuning operations when there is a sudden need of liquidity or structural operations to smooth the liquidity of the banking sector over a certain time. For detailed explanations, see European Central Bank (2018), European Central Bank (2016), and Deutsche Bundesbank (2023).

[5] But the quantity theory of money and monetarists like Milton Friedman argue that a too-high money supply is the most important factor for high short-term inflation, as Totonchi (2011) state.

Elmendorf and Furman (2008), there are presumably three factors that may be in favour of monetary policy over governmental policy. One is the faster process of applying monetary policy measures, as governmental policy measures are based on bills to be negotiated and passed that need some time to implement them. Another factor that Elmendorf and Furman (2008) propose is potentially controversial, namely that research people working for a central bank are more sophisticated in analysing market conditions and risks than those in governmental organizations. Moreover, fiscal support through lower taxes – as will be the case with the mentioned measures in Austria, see Bundesministerium für Finanzen (2022a) – has to be accompanied by less government spending. Otherwise, they can hinder further economic development for a long time, as Ball and Mankiw (1995) and Sinai et al. (2004) argue, too. Contrary to this widely used monetary policy-centred approach, Kocherlakota (2022) states that when using a heterogeneous agent New Keynesian (HANK) model there are some applications during a crisis where instead fiscal policy seems more reasonable. In a HANK model, households differ in terms of their income, wealth, and borrowing constraints ("heterogeneous agents") which implies different responses to measures of monetary policy or fiscal policy. It assumes prices and wages to be fixed for some time even when supply or demand changes which causes short-run economic fluctuations ("New Keynesian"). If the real interest rate is only slightly lower than the growth rate, the debt burden of an economy is large, it might be difficult to extensively use monetary policy to fight inflation, as higher interest rates mean an even higher debt burden in the future. Instead, governments can use fiscal policy to redistribute transfers to sectors that are more likely to spend and stimulate economic activity without having to change their approach to spending in the future.

Interestingly, according to Glenn and Samad (2012), a lower interest rate set by a central bank leads to lower inflation in the long run. They want to test the hypothesis of Sargent and Wallace (1981) which is the following. If a government persistently produces budget deficits, the debt level increases over time, which may drive the government to allow more money to be printed, leading in turn to higher inflation. As the central bank aims to get higher inflation under control, it can raise interest rates, but this leads to higher costs for the government to finance its debt. Therefore, the government may want to print even more money increasing inflation even more. In contrast, if the central bank keeps the interest rates low, the financing costs for government debt stay low, and even inflation. Indeed, when using data from the US between 1973 and 2011 and a monetary model of inflation, lower inflation as a result of lower interest rates can be observed. A monetary model of inflation focuses on monetary factors like money supply (i.e., how much money circulates in the economy), money demand

(i.e., how much money market participants want to hold), monetary policy, velocity of money (i.e., how quickly money circulates through the economy), and inflation expectations. They use a quite simple model where only the money supply is chosen as a key factor, and they assume money supply growth and inflation to be stable. The study also finds that a sound fiscal policy like lower government spending to produce lower budget deficits and to decrease debt-to-GDP ratio can also contribute to lower inflation rates in the long run.

2.6. On the consequences of contractionary monetary policy on public finances

Higher interest rates are followed by a higher debt burden. According to the Committee for a Responsible Federal Budget (2022), a higher interest rate on the main refinancing operations, like it was imposed by the ECB beginning in July 2022 after more than six years being at zero, may also lead to higher debt-to-GDP ratios of countries. First, refinancing is more expensive, so the government has to finance higher amounts of interest payments. Second, at the same time, tax revenues may decrease due to potentially lower demand and slower economic growth. In the end, investors' confidence in servicing debt may be decreased so they demand even higher interest rates for being willing to invest in government bonds, and/or the money demand decreases too. The latter would impact the currency value adversely and make imported goods more expensive, fuelling inflation again. It has to be mentioned that investors may demand higher interest rates, but do not lose their trust in the financial stability of a country. In this case, the higher interest rates would attract more investors, leading to higher money demand, and a stronger currency value, making imports cheaper and subduing inflation rates. Nevertheless, reversing governmental policy support measures abruptly can in turn lead to slow economic growth in the aftermath, as some authors argue, like Banerjee et al. (2022). Therefore, it is highly important and of interest, how and within what period the governments in the euro area are slowing down their economic support and what the long-term implications on growth, employment, and economic development will be. However, there are some limitations of the paper. The study relies solely on the monetary base, so currency in circulation and bank reserves, but does not include broader money supply measures that have a more direct effect on economic activity, and it also does not include asset purchases or forward guidance. It also does not include structural changes in the US economy over the sample period like, for instance, financial innovation, globalization, inflation targeting, or changes in the length and characteristics of business cycles.

2.7. On How "fiscal policy first" impacts inflation

Fiscal policy in charge means higher inflation rates. Banerjee et al. (2022) examined how different policy regimes impact future inflation rates. They classified them into monetary policy regimes and fiscal policy regimes, according to the strength of their respective effect on inflation, each with two measures, one de facto measure and one de jure measure. A fiscal policy regime is classified as "prudent" or "profligate" by the authors using a de facto measure adapted to Bohn (1998), meaning that a government should aim to spend less money on public goods and services than it receives by taxes in the long run, creating a primary surplus, as shown in OECD (2022). The de jure measure is derived from whether an economy has established binding rules for the design of the budget balance. A monetary policy regime is categorized by whether central banks look out for stable prices and the de facto measure of whether the central bank increases interest rates more than the prevailing inflation. Taylor (1999) and others concluded that if this is not the case, this could lead to inflation rates getting out of hand like it was the case in the 1970s. The example of Turkey shows that this is not just a theoretical framework, but can be observed in reality. According to Gürkaynak et al. (2022), due to political considerations and lacking independence of the Central Bank of the Republic of Turkey, they had to impose an upper limit on interest rates, the so-called effective upper bound (EUB). This resulted in nearly unmanageable, escalating inflation rates for the country. The de jure measure that the authors use leans on to what extent a central bank can act independently from governments by laws that constrain lending to public sectors. The more independent a central bank can make its decisions, the lower the inflation tends to be, at least for advanced economies, as Cukierman et al. (1992) state. The authors found that when fiscal policy dominates, governments are more "profligate", not looking out strongly for bearable debt-to-GDP ratios, and when monetary policy does not pay much attention to price stability, future inflation rates tend to be higher and more volatile on average than under a monetary policy regime. Shifts from a monetary policy regime to a fiscal policy regime and changes in how inflation targets are measured (like for instance average inflation rates instead of a fixed percentage goal) also contribute to higher future inflation rates, as shown in Banerjee et al. (2022).

These results about fiscal dominance and the importance of central bank independence are confirmed by Kliem et al. (2016). Fiscal dominance prevails when a government sets its fiscal policy without coordination with the central bank and their monetary policy, the latter has to finance fiscal deficits by printing money, and therefore, the central bank loses control over inflation, as only governments are in charge. Fiscal deficits that are financed by printing money and a central bank

that cannot effectively fight inflation as it depends on the government's actions lead to a close long-run relationship between growing deficits and inflation. The study investigates such periods for Germany, Italy, and the United States from the 1960s to the 1990s. For Germany, the relationship between the budget deficit as a percentage of GDP and inflation was close to zero for the entire sample period, indicating that the country had governments that maintained fiscal discipline and that the central bank was independent. For Italy, one can observe a highly positive relationship between budget deficit to GDP and inflation from the 1960s to the late 1980s, indicating fiscal dominance during this period. From the early 1990s onward, this relationship dropped sharply and can be attributed to the 1981 decision of the government to make the central bank independent, as Epstein and Schor (1986) state. In the United States, the relationship was high in the 1960s and 1970s but dropped sharply from 1979 onwards, when Paul Volcker became the chairman of the Fed. His focus was on fighting the high inflation of the 1970s by pushing for more independence of the Fed from the government, as shown in Goodfriend (2007). He conducted a hawkish policy, raising interest rates dramatically and helping to sharply reduce inflation for a long period.

Kwon et al. (2009) use a dataset of 71 advanced, emerging markets, and developing countries over 42 years from 1963 to 2004 to examine the relationship between public debt, monetary policy, and inflation. Their results support the previously stated insights. Countries that borrow more and more risk that market participants expect higher inflation rates and that inflation goes up. Higher inflation can result in higher interest rates, making it more difficult for the country to fulfil its obligations and may force it to incur an even higher debt burden. A higher debt burden will, in turn, increase inflation expectations even more, ending in a vicious cycle of a debt-inflation trap. In this scenario, monetary policy is constrained as it has to take into account the impact of higher interest rates on the ability to pay off the debt. Instead, fiscal policy has to set measures of consolidation to generate a primary surplus to support monetary policy to cope with rising inflation rates. This is where credibility comes into play. A country with a high debt burden has to make clear that it establishes a policy that aims at fighting high inflation rates and, even more important, that it is willing to conduct it. Otherwise, bondholders may nonetheless demand higher nominal interest rates as they still expect higher inflation in the future. If they believe that the inflation rate is still going up, the country benefits in the short run as borrowing costs are lower, but this can then lead to measures not to be trusted and higher borrowing costs in the longer term. However, even when the policy measures are successful and the inflation rate decreases, the real value of interest payments on debt goes up as the nominal interest rate on debt is fixed which stresses a country's budget. These results underpin how essential it is for countries to not let their debt go out

of hand as it gets more and more challenging to maintain credibility and minimize surprises in this case. Aktas et al. (2010) investigate how monetary policy and fiscal policy interact for a certain country, Turkey, between 1999 and 2006. This paper analyzes the impact of the exchange rate-based stabilization program introduced in 1999 to address high inflation and debt sustainability concerns due to a high debt burden. Moreover, Turkey started inflation targeting in 2002. The study comes to similar conclusions as Kwon et al. (2009). If a central bank raises the interest rate in such a high-indebted country, inflation could go up instead of going down as servicing debts become more expensive, default risk increases, capital flows out of the country and the currency depreciates. As the currency depreciates, imports become more expensive, and therefore, inflation increases.

This interplay between monetary policy and fiscal policy is also covered by Mello and Ponce (2023) with another concrete example. They examine the case of Uruguay between October 2009 and March 2020 with the results of the monthly Inflation Expectations Survey (IES) among firms in the country. The main focus of the study is to examine how the budget deficit to GDP influences inflation expectations of firms as central banks want to anchor the latter to reach their inflation target, see also Visco (2023). The study finds that the budget deficit and the gross debt to GDP are positively correlated with inflation expectations. Therefore, monetary policy and fiscal policy influence each other. As a consequence, if the fiscal outlook of a country gets worse, inflation expectations of firms go up, and this counteracts efforts of the monetary policy to stabilize them. In the specific case of Uruguay for the considered period, the authors state that these efforts worked properly through both the interest rate channel itself and the communication channel of the central bank's goals, leading to a negative correlation with firms' inflation expectations. The positive correlation between a worsened budget deficit and firms' inflation expectations could be balanced by that, resulting in relatively stable inflation expectations. The paper further points out that exchange rate volatility and budget deficit seem to be summarizing factors of other macroeconomic variables that are important reference points for institutions to form their inflation expectations.

The credibility of a fiscal policy is possibly influenced when conducting discretionary fiscal measures. That means that a government changes spending or taxes deliberately, like for instance when decreasing taxes to increase consumer spending. The Brazilian government made use of a discretionary fiscal policy and creative accounting, which was analyzed from January 2005 to June 2018 by Montes and de Hollanda Lima (2022). They wanted to study the impact of fiscal policy on the inflation risk premium. The inflation risk premium is the difference between the break-even inflation rate (BEIR) and the expected inflation rate. The break-even inflation rate results from the difference between yields of bonds of the same maturity, the yield of a traditional bond with a fixed interest rate

(nominal bond), and the yield of a bond whose coupon payments are adapted to rising inflation rates (inflation-linked bond). It is the inflation rate level at which an investor would be indifferent between buying the nominal bond or the inflation-linked bond, as the yield of both bonds is the same. The expected inflation rates in the study are coming from a survey among about 120 forecasters of financial institutions in Brazil. Therefore, the inflation risk premium can express how much investors require to be compensated for unexpected inflation. The study finds that if a government adopts discretionary fiscal policy measures, the more pronounced they are the higher the increase in the inflation risk premium, as such measures increase the uncertainty of investors about the evolution of future inflation rates and therefore lead to higher inflation expectations. It also finds that if the government enhances its fiscal credibility, so credibly signalizing that it will meet fiscal targets and maintain fiscal discipline, the adverse impact on inflation risk premium can be moderated.

However, not only the type of fiscal measures can influence future inflation rates but also the alignment towards a pro-cyclical or counter-cyclical direction, again accounting for the interplay with monetary policy. Kurnia et al. (2021) investigated these relationships for the period of 2003 to 2017 on a dataset of 25 countries where central banks have established frameworks to keep inflation rates within a given target, as is the case for many countries in the world. They apply the generalized method of moment (GMM) method, a statistical technique to estimate parameters in econometric models, in this case about the role of monetary policy's credibility and the alignment of fiscal policy. The study ascertains if fiscal policy is counter-cyclical, future inflation rates tend to be low as a credible monetary policy can secure this and also financial stability. The reason is that there is no need for monetary policy to interfere with fiscal policy as counter-cyclical fiscal policy can help to moderate the fluctuations in economic activity. It can stimulate economic activity during downturns by increasing government spending, leading to more aggregate demand and higher economic growth. Or it can curb economic activity during upturns by decreasing government spending, leading to less aggregate demand and lower economic growth. As a result, inflation rates tend to be stable, and financial stability can be secured, too. If, on the other hand, a government acts pro-cyclically, the actual inflation rate will differ from the one that was expected and the one monetary policy aims at. This counteracts monetary policy's credibility and therefore, a central bank will strive to regain it by using tools like increasing interest rates to fight rising inflation. Due to this, borrowing will be more expensive, leverage will be reduced and as a consequence, asset prices fall and economic activity will shrink, leading to greater financial instability. Again, this study explains how important the interplay between monetary policy and fiscal policy is for inflation evolution.

It can also be postulated that if a government unexpectedly changes its fiscal policy stance, this could have a substantial impact on future inflation rates by hampering the inflation targets of monetary policy. Cevik and Miryugin (2023) study a panel dataset of 139 countries for the period between 1970 and 2021 to investigate how such a fiscal policy shock affects inflation. According to them, a negative fiscal policy shock happens when the budget balance to GDP worsens by one standard deviation. They use the local projections (LP) method, which requires weaker assumptions about the long-term behaviour of the underlying data, is more flexible when dealing with nonlinearities and time-varying relationships, may provide more robust estimates, and is easier to apply to non-stationary time series data than the classical vector autoregression (VAR) model, that is also trying to find relationships between several variables from their past values, as Barnichon and Brownlees (2019) and Jordà (2005) state. The LP method is applied to impulse response functions (IRFs) that measure the reaction of a variable or several variables (in this case, mainly the primary budget balance) to a one-time, temporary shock (in this case, an unexpected worsening of budget discipline) to another variable (in this case, the inflation rate), according to Jordà (2005). The primary budget balance is the difference between the governmental revenue and its spending on goods and services, without considering net interest payments for public debt, see OECD (2022). The study accounts for the public indebtedness of a country, for the state of the economy when such a fiscal policy shock occurs (recession or expansion), as well as for which monetary policy frameworks are established, how a country deals with exchange rates, and whether there are fiscal rules that are implemented. The authors conclude that in countries with a high debt burden, a negative fiscal policy shock (as measured by overall budget balance) lets the inflation rate that includes all relevant items (headline inflation) rise by 0.88 percentage points in the first year (0.72 percentage points cumulatively after four years) of the shock. In countries with a low debt burden, the impact is lower and not statistically significant. Similarly, when the primary budget balance is used as a measure, the impact is only about half as large for low-indebtedness countries as for high-indebtedness countries. Looking at the results for core inflation, i.e. total inflation except highly price-volatile items like energy and food, there is an even stronger impact of a fiscal policy shock in countries with a high debt burden, of about 1 percentage point in the first year after the shock. Regarding the state of the economy, results show that a fiscal policy shock lets the inflation rate rise by 1.2 percentage points in times of a recession, but does not affect it in times of expansion. The reasoning for this may be that during a recession, fewer goods and services are demanded and if a government lowers taxes or increases spending, this can stimulate demand and lead to higher prices. Government

decisions can have a greater impact on inflation during a recession, as monetary policy is constrained by the economic situation and cannot raise interest rates to fight inflation. Regarding monetary policy frameworks, the authors state that when central banks pursue certain inflation targets, headline inflation goes up in these countries as well, but core inflation drops noticeably. In countries without inflation targets, both headline inflation and core inflation go up, stronger than in the other countries, too. Regarding how a country deals with exchange rates, the study states that those who do not intervene in exchange rates benefit from a lower inflation rate increase when a fiscal policy shock hits. The reasoning for this is that higher government spending stimulates demand, which can be partly demand for foreign goods and services, which puts pressure on the exchange rate, making the domestic currency weaker. As the exchange rate depreciates, exports become cheaper for foreign buyers, thus increasing, while imports become more expensive for domestic consumers, leading to a decrease. This depreciation helps to balance the impact of the initial fiscal shock by boosting exports and reducing imports. Regarding the implementation of fiscal rules, the authors state that the inflation rate in countries with established fiscal rules only rises about 0.29 percentage points in the first year after the fiscal policy shock, whereas in countries without such rules, it rises by 1.17 percentage points. The reasoning for this effect is that governments are more restricted to use discretionary fiscal policy, which helps to stabilize inflation expectations. This can help to dampen the impact of fiscal policy shocks on future inflation rates.

Assadi (2017) points in the same direction. Their study examines how fiscal policy can affect monetary policy efforts, using quarterly US macroeconomic data from 1959 to 2013, including 195 series about real output, consumption, employment, exchange rates, interest rates, prices, wages, fiscal variables, money aggregates, orders, and housing. They use Principal Component Analysis (PCA) to extract the most influential factors. PCA is a data-driven technique to identify the main components that are responsible for most of the variance in a dataset to reduce the dimension, so the complexity of the model, to avoid overfitting (i.e. to avoid having too many parameters relative to the number of observations that would result in failing to apply the model properly on new data), according to Zezula (2021). This results in three factors as unobserved forces driving the co-movement in many of the economic variables: inflation, industrial production growth, and federal funds rate, and complement them with a fiscal variable, the debt-to-GDP ratio, feeding a Factor-Augmented Vector Autoregression (FAVAR) model and a Time-Varying Parameter Factor-Augmented Vector Autoregression (TVPFAVAR) model. FAVAR means that the model is extended by the few important factors that are chosen from the large dataset ("factor-augmented"),

using a collection of variables ("vector") where the variables are based on lagged values of their own past values ("autoregression"), as Bernanke et al. (2005) state. TVP-FAVAR allows parameters to change over time ("time-varying parameter") to include effects due to a policy change, so due to different regimes. The results show that when the fiscal variable (debt-to-GDP ratio) is included in the model, inflation generally rises when central banks try to dampen inflation by using a sudden change in their policy (referring to as a monetary policy shock), irrespective of a FAVAR or a TVP-FAVAR model is used. According to the author, this may be due to a wealth effect, as when a central bank imposes higher interest rates, bondholders benefit by achieving higher returns which allows them to consume more. But the strength of the effect is different. In periods when monetary policy is passive and fiscal policy is active, like it was, for instance, in the Burns era in the 1970s, inflation rises more strongly (0.4 percentage points) to a 1% monetary policy shock than in times with passive fiscal policies (0.2 percentage points), as Bordo and Levy (2020) also confirm. The study also confirms that fiscal shocks lead to increasing inflation rates, even when they are relatively low as a fiscal shock of a 1% government spending increase results in a 0.1 percentage point increase in inflation. Ferrara et al. (2021) come to similar conclusions, using a one standard deviation increase in government spending, like Cevik and Miryugin (2023) do. Inflation increases by 0.2 to 0.3 percentage points, peaking around 0.4 percentage points 2 to 3 quarters after the shock.

However, in contrast to the above studies, other studies find no effect of fiscal policy shocks on inflation, or even an opposite effect, i.e. lower inflation rates. For instance, Jørgensen and Ravn (2022) argue that for the quarterly US data from 1960 to 2008, they examined inflation rate shrinks by 0.4 percent six quarters after a fiscal shock. The authors mainly use data on government consumption expenditure, gross investment, real GDP, real personal consumption, tax revenues, a personal consumption price index, the 3-month Treasury bill rate, and the total factor productivity as well as defense spending news shocks and government spending forecast errors. They use different approaches to define fiscal shocks which are forecast errors of government spending growth, a Cholesky decomposition, defence news shocks, and sign restrictions. Forecast errors of government spending shocks are differences that occur when released data about government spending growth are not in line with forecasts of professional forecasters. In a Cholesky decomposition, government spending is ordered first, as the study assumes that before implementing it, a series of decision steps and other preparing steps have to be made, which need time. Government spending can then affect other macroeconomic variables relatively quickly, whereas the opposite is not true, like, for instance, rising prices cannot affect government

spending within one quarter, as this information can only be implemented in the decision process of government spending for the following quarters. Defence news shocks are unexpected changes in defence spending, captured by narrative accounts in news sources, and seem to be suitable to use as they are likely to be exogenous, as they are carried out when geopolitical factors change. Sign restrictions mean that when a shock hits, government spending and, in this case, the output must increase and stay above the steady state for more than three quarters. As a rationale for why inflation shrinks or at least remains stable after a fiscal policy shock, the study uses the available technology level as a supply-side mechanism when demand gets higher due to higher government spending. Hence, firms can utilize available technology more intensively when needed, which can be compared to a higher productivity level. A higher productivity level enables firms to produce more with the same input and to meet higher demand. When governments spend more, the labour demand goes up, and also people tend to demand higher wages. The model assumes that firms can use a higher technology level at relatively low costs, lower ones as if they would employ more people. This leads to lower marginal costs, and, in turn, firms can sell their goods and services at lower prices, resulting in a lower inflation rate. Klein and Linnemann (2020) state somewhat differentiated results. Their study argues that inflation reacted to fiscal policy shocks in various ways over time when using a time-varying VAR model. The dataset consists of quarterly US macroeconomic data over a period of nearly a hundred years from 1920 to 2019 and involves the growth rate of real government spending per capita, unemployment, budget deficit to GDP, inflation rate, and the nominal interest rate based on Federal Funds rate (since 1954) or Treasury bill rate (before). Looking at the eight-quarter averages, inflation was nearly unaffected by government spending shocks in the 1920s and 1930s. From the 1940s to the 1970s, inflation decreased due to such shocks for most of the observations, particularly strongly around 1980. Afterward, inflation turned to a positive reaction to government spending shocks, particularly from the 2000s on. From the 1970s to the 1990s the results are insignificant, suggesting that fiscal policy had a lower or nearly no impact on inflation in that decades. Therefore, the impact of fiscal policy on inflation can be roughly divided into a pre-1980 era and a post-1980 era. All of the results reflect the application of a time-varying model that allows parameters like coefficients, variance/covariance terms, and others to change every quarter. The authors use such a model because they argue that using a constant parameter VAR would not capture the structural changes in the impact of fiscal policy on inflation that have occurred over the decades. The results could be attributed to lower and more stable inflation since the 1980s, in which case fiscal policy measures are more likely to have a greater impact on inflation.

This is because at low and anchored inflation levels there are not many capacity reserves in an economy, so if a government spends more, it is more likely to cause supply constraints. Moreover, inflation targeting and more credible central bank commitments may lead to lower sensitivity of inflation to fiscal policy measures. This is because, in such an environment, fiscal policy measures are not perceived as a threat to price stability. After all, market participants believe that central banks have price developments under control.

2.8. On the impact of fiscal help measures on inflation

Strong fiscal support during crises fuels inflation – de Soyres et al. (2022) point in a similar direction and mention reasons for the soaring inflation rates in the aftermath of COVID-19. They examined the impact of the strong fiscal support by governments on supply and demand as well as on inflation for 52 countries. Core inflation was used instead of headline inflation, as core inflation captures all items except those whose prices fluctuate widely without having much relation to a certain economy or economic area. This is mainly due to seasonal fluctuations or for energy products, as shown in European Central Bank (2023b), so only items that are supposed to be affected strongly by fiscal policy. The effect was split into a domestic effect, representing the impact of a country's fiscal policy on its after-COVID-19 inflation rate, and a foreign effect, representing how the fiscal measurements of other countries affect the domestic inflation rate of a country. The results show that Chile is on top of the countries with the highest impact of its fiscal policy on its inflation rates. A fiscal stimulus of 1% led to a 3.29% increase in inflation there, followed by Greece (2.86%) and Lithuania (2.77%). Chile was, together with Great Britain, the United States, Canada, and Japan, one of the countries with extraordinarily strong fiscal support to fight the impact of COVID-19 on their economies, compared to their fiscal trend before the pandemic. For Austria, a value of 1.61% was calculated, putting the country in 14th place among the 52 countries, therefore ranking relatively high, too. This can possibly be attributed to the extensive support by the Austrian government mentioned before. Looking at the impact of foreign countries' measurements on the inflation rates of an economy shows that Luxembourg (7%) and Ireland (6.61%) are on top of the countries with the highest foreign effect on domestic inflation, clearly ahead of the other countries. This is due to the strong economic ties to foreign partners of these two countries. Half of Luxembourg's workforce consists of people who live in neighbouring countries, according to The Government of the Grand Duchy of Luxembourg (2020). Ireland is the European home to many international corporations, like Apple or Microsoft. Austria is ranked in 13th position with a foreign effect of 3.92%.

2.9. On a determined Central Bank's contribution to lower inflation rates

Proactive central banks successfully fight inflation persistence. An important consideration for policies is inflation persistence, the degree of how past inflation, coming from shock events, influences future inflation. In other words, how flexible or inflexible inflation rates react to changing economic conditions and for how long the effects of a shock event last until inflation rates get back again to their long-run means, according to Marques (2004). The higher the inflation persistence, the more aggressively should monetary policy act to get soaring inflation rates under control. But, according to Michau (2019), when inflation is persistent, monetary policy should also be aggressive in an opposite environment, i.e. when interest rates are near zero and inflation is low. In such a case, being aggressive means that central banks should keep interest rates very low for a long time, even when the economy recovers, as this increases inflation expectations, avoiding deflation. They argue that, again, monetary policy measures should be combined with monetary policy measures, i.e. governments should increase spending to support the economy, to overcome economic weakness. Walsh (2022) criticizes central banks for being too slow and too sluggish in fighting inflation in the aftermath of COVID-19. Instead, according to the author, it seems to be more effective to rather estimate a more persistent inflation and a less robust job market than pure numbers would suggest. The central banks' actions could, on the one hand, be partially explained by their estimations that the equilibrium interest rate, r-star, has fallen. R-star is the directly unobservable estimated real interest rate at which economic activities are neither hindered nor fueled by, therefore often referred to as a neutral interest rate. As a consequence, in such an environment inflation rates stay constant, which is the main goal of the ECB and other central banks. If the policy rate of the ECB is set above r-star plus inflation target, the monetary policy is said to be tightening. If the policy rate is set below this measure, the monetary policy is said to be loosening, possibly increasing future inflation rates, see Reis (2022a). Central banks estimate r-star by focusing on the returns of government bonds solely. These returns reflect changes in quasi-risk-free interest rates, as government bonds are backed by the financial capabilities of whole countries. However, they cannot show how profitable and attractive it is to invest capital in private investment opportunities. Reis (2022b) and Reis (2022a) show that since the middle of the 1980s government bond returns have actually fallen constantly over time. But for the same time interval, private capital returns have risen. The estimates show that starting with a gap of about zero between both in 1985, it has widened to nearly eight percentage points in 2019 (0% return on government bonds and 8% return on private capital, both starting from about 6%). This

widening gap displays that investing in private opportunities became yet less attractive over the decades and that looking solely on government bond returns falsely suggests policymakers accept higher inflation rates than before, leading them to a policy that is not aggressive enough in fighting rising inflation and therefore probably contributing to the soaring inflation rates from 2021 on, as Reis (2022a) underpins.

On the other hand, Borio et al. (2023) point out another reason why central banks acted too hesitantly at the beginning of the soaring inflation in 2021: relying on core inflation measures. They develop a model of two inflation regimes, a low-inflation regime, and a high-inflation regime, and suggest central banks to conduct monetary policy in different ways, depending on which of the regimes is prevailing. This is because they argue that transition phases from a low-inflation regime to a high-inflation regime reinforce themselves due to three reasons. First, while inflation is not paid much attention to when it is low, people start to notice it more when it is rising in their personal perception of prices when buying goods or using services and via media coverage. Second, when prices start to rise, they tend to rise similarly for many sectors, increasing people's attention as well. Third, as rising prices mean lower firm profits and lower purchase power of households, both groups try to counteract inflation which can make wage-price spirals more likely to happen. As it is adverse to keep prices constant, they are changed more frequently. Central banks try to predict future inflation rates by often using core inflation, i.e. excluding prices of goods and services that tend to fluctuate much, as they want to gain knowledge of factors for long-term inflation evolution. However, the authors argue that when the environment changes from a low-inflation regime to a high-inflation regime the prices that are most noticeable to consumers (salient prices) tend to increase first and have a greater impact on overall inflation than the prices that are typically used to measure underlying inflation (core prices), which is contrary to the normal inflation pattern. This happened after the beginning of the Russian war against Ukraine and the rebound in global demand: the prices of energy and food have increased significantly. Energy and food prices are salient prices for households, but as they are excluded from core inflation measures, central banks might have a wrong impression of how future inflation evolves.

Chin (2022) shows the utmost importance of decisive monetary policy on future inflation using a Bayesian Vector Autoregression (VAR) model informed by a DSGE prior based on a small-scale New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model, as described in An and Schorfheide (2007). The latter uses only a few variables ("small-scale"), assumes prices and wages do not react instantly to changes in demand and supply, leading to short-run economic fluctuations ("New Keynesian"), allows economic variables to change over time due to decisions of market participants and due to external shocks ("dynamic"),

incorporates stochastic shocks like the establishment of disruptive technologies, government policies, or natural disasters ("stochastic"), and refers to adjusting prices until demand and supply quantities for all goods are simultaneously equal, based on interactions between governments, households, and firms ("general equilibrium") to analyze macroeconomic fluctuations and policy issues in a closed economy, see Clarida et al. (1999) or Ireland (2004). This model informs the prior distribution and, therefore represents the ex-ante beliefs about likely values before observing the data, which go into the Bayesian model. Then the coefficients of the VAR model are estimated by the observed data and used to update the beliefs about the likely values, getting to a posterior distribution. Bayesian models can have two benefits. First, applying prior knowledge may increase accuracy and precision. Second, as the updated beliefs (the posterior distribution) are based on both prior beliefs (in this case a small-scale New Keynesian DSGE model) and available data, they can provide a more complete picture of the uncertainty and lead to more informed decisions. Their results suggest that using the DSGE-VAR approach is reasonable for studying where persistent inflation comes from and that inflation persistence declined in the 1980s. This can be significantly attributed to aggressive monetary policy, as the study found that when removing this factor, the decline of inflation persistence did not appear in the results. Critically reflecting on the study, one limitation may be the small scale of the model where there are maybe more variables that can influence the results. Lanne (2015) comes to the same conclusion that since the 1980s inflation persistence has been lower than before. They use non-causal autoregressions in their study. Autoregressions are a statistical model that is based on the assumption that the current values of a variable can be predicted by past ones. As the autoregressions are non-causal in this study, current variable values need not be caused by their past values but may be caused by other factors, as Lanne and Saikkonen (2013) state. They add that large, unexpected decreases in inflation are felt for a longer time (i.e. higher persistence) than small unexpected increases (i.e. lower persistence) in inflation only for the period after 1982. Before, high persistence meant high inflation rates, afterwards it meant low inflation rates, which points back to the monetary policy being more aggressive than before.

Bergholt et al. (2023) add that a more aggressive monetary policy led to a flattening of the demand curve, i.e. that inflation reacts less sensitively to changes in demand than before the 1980s. They applied a Structural Vector Autoregression (SVAR) model. Both the above-mentioned classical Vector Autoregression (VAR) model and the SVAR model try to analyse the relationship between multiple variables ("vector") using time series and linear combinations of the past values of each variable ("autoregression") and the past values of all other chosen variables. As requirements, these models assume that all variables are endogenous

(i.e., having an impact on each other and their own past values influence them) and that linear equations are a proper form of representing the relationship among the variables. In contrast to VAR, which focuses on the statistical relationships among the variables only, the SVAR model tries to find out the reasons for the observed relationships ("structural") by identifying shocks using additional knowledge, based on economic theory for instance. The benefit of using SVAR instead of VAR is that it can help to overcome the issue of potential misspecifications of the model or the need for many parameters that, when left out, can cause error terms and distorted results as a consequence, see Kotzé (2019). Bergholt et al. (2023) explain that if private households and companies expect the central bank to take an active and decisive role in fighting inflation, they may change their own consumption and investment decisions in advance, maybe because of simply being more cautious because of fearing interest rates to be set higher by the central banks. There can also be indirect effects on the demand curve by import prices or export competitiveness caused by an aggressive monetary policy if the central bank wants to counter inflation pressures coming from imported goods.

2.10. On the role of companies with high market power on inflation

Companies that can exert price power are pushing inflation. Carlstrom et al. (2009) spot, among the more aggressive monetary policy, another possible explanation for lower inflation persistence since the 1980s, is a lower variability in technology shocks. Technology shocks are changes in technology that were not expected and emerge suddenly. Such changes can be positive or negative for economic development and macroeconomic variables. Positive shocks can lead to higher productivity, and efficiency, or push innovation activities, whereas negative shocks may lead to lower economic growth. When the impact of technology changes on economic development becomes less fluctuating than in the past, mark-up shocks become relatively more important, as the authors state. Mark-up shocks are sudden, unexpected changes in the pricing power of companies. If they gain more pricing power because of a markup shock, they can raise prices which leads to higher inflation rates.[6] Such a mark-up shock that benefits the pricing power of companies can be observed for the years after the COVID-19 pandemic as the supply side suffered from different restrictions, for example, the long and strict lockdown phase in China, negatively affecting the global supply chain channels, making it difficult for companies to get raw materials or intermediate goods for their production, as Arce et al. (2023) state. However, they observe that

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[6] Again, the cost-push theory comes into play, as mentioned in the remarks on how supply and demand affect inflation rates.

also the high prices for input, like for instance energy, benefit companies to raise prices as they blur the perception of which factor is dominant for higher prices, the higher input costs, or the higher margins companies are charging. Moreover, companies always strive to make up for the past real income losses they incurred during the pandemic.

Santacreu, A.M. and LaBelle, J. (2022) examined the situation in the United States for the year 2021 (January to November) by calculating a measure that shows how much U.S. exports from 26 different industries are affected by foreign supply bottlenecks. They show that, in general, manufacturing industries are (way) more affected than services industries, especially motor vehicles, coke and petroleum products, basic metals, and machinery and equipment. This can be ascribed to their strong dependence on intermediate inputs and the severe supply bottlenecks they faced. Inflation (PPI, producer price index) in these industries was partly among the highest, especially for coke and petroleum products and basic metals, leading the authors to the conclusion that foreign supply bottlenecks and the inflation producers face are positively correlated. But Arce et al. (2023) show that compared to the pre-2022 levels and pre-pandemic levels, company profits increased much stronger than wages, especially in certain sectors, like agriculture (due to higher food prices), energy and utilities, manufacturing (due to higher input costs, less supply, and high demand), construction (due to higher housing demand), and contact-intensive service sectors (due to strong demand). The authors also look back into the past and observe that whereas, in the 24 years between 1999 and 2022, the gross operating surplus per unit of real GDP contributed about a third to the price pressure, in 2022, this share was about two-thirds. If employees' wage demands dampen due to lower rising energy and food prices and companies are less able to exercise pricing power due to easing of tension between the supply and demand side, the price pressure would become lower. This can be supported by an aggressive monetary policy, as higher interest rates lower credit demand and, as a consequence, lower demand. If a central bank does not act decisively enough, both wages and profits may rise strongly, sparking up a wage-price spiral that can lead to long-lasting high inflation rates.

2.11. On the optimal orientation measure for central banks

In theory, solving a Ramsey problem would be best. A key question that arises is which kind of price development should central banks orientate. The ECB focuses on the mentioned HICP when targeting their aim of price stability, but other indices are also conceivable, like the mentioned PPI for instance. Matsumura (2022) studies New Keynesian small economies that are open to international trade and capital flows and are exposed to international price shocks

by solving a Ramsey problem. The Ramsey problem can be traced to the British mathematician, Frank P. Ramsey, who asked about the optimal savings rate of a nation, taking into account individual behaviour, factor prices, and utility and its discounting to identify how resources should be allocated over time to maximize social welfare, see Ramsey (1928). The author examined 35 sectors according to the Word Input-Output Database (WIOD) for 40 countries, taking into account the respective price stickiness for each sector. In addition, it is considered that a higher inflation makes exports more expensive relative to foreign goods and therefore less competitive while goods needed for the production of the later export goods get more expensive, leading to a lower trade surplus. Both effects, price stickiness and how inflation impacts trade surplus, are neither considered by HICP nor by PPI. This leads to worse results given welfare. For each of the 40 countries, the least welfare loss would occur if central banks would switch to orientate to Ramsey model index proposed in the paper. Also to be emphasized is that the ranking of how well orientation to the alternatives (core consumer price index, producer price index, headline inflation) works differs from country to country. For Austria, for instance, the second-best alternative to Ramsey would be the PPI, followed by core CPI, least headline inflation. For the United States, using Core CPI would be the second-best alternative, followed by headline inflation, least PPI. Over the whole dataset, Core CPI would be second best for 18 countries, PPI for 16 countries, and headline inflation only for 6 countries, the latter are mainly northern and eastern Europe countries. In reality, it is not that easy to optimize the ECB's strategy by using the proposed model. It assumes that all countries are small open economies, which is not the case for some of them, like for instance the United States or Germany. Furthermore, it does not consider other sources of shocks (e.g. fiscal shocks) and assumes perfect information from a central bank about the economy. The model also assumes that the economies are in a steady state, meaning that all markets are cleared and there is neither economic growth nor economic contraction.

2.12. On the importance of data for monetary policy decisions

Optimal monetary policy needs a lot of different data to be taken into account. Besides these limitations, Corsetti et al. (2010) discuss factors that should be accounted for when deciding about optimal monetary policy in an open economy. They use a DSGE model to study different policy rules conducted in the US economy. When countries interact and trade with each other internationally, the model proposes to only look at output gaps, so the difference between the output level an economy can provide without being in danger of inflation pressures (potential output) and the actual output, as shown in Jahan and Mahmud (2013).

Conducting this alone is challenging, as the data used for calculating output gaps are based on information about past outputs and combined continuously with new arriving information, making them volatile and biased to past experience. It also seems that the perception in which business cycle an economy is at a certain point in time changes significantly over time, making it hard to just rely on output gaps as indicators for the optimal monetary policy, as Gudmundsson et al. (2020) show in their study of 197 countries between 1995 and 2018. However, three influence factors need to be considered, too. First, taxes, subsidies, and regulations can cause sticky prices of imported goods in terms of local currency when they do not change according to exchange rates, leading to different prices on the domestic market compared to the international markets, according to Nicita (2013). Second, as open economies are connected via trade, the monetary policy of one country or region has an impact on other countries welfare, forcing the domestic central bank to balance output gaps of the own economy with export-to-import price ratios (terms of trade), see Kopp (2022). Third, transaction costs, information asymmetries, and limited access to credit interfere with perfect financial markets and can lead to exchange rates that do not reflect the true economic values of two currencies and can cause excess demand or excess supply in certain countries, as described in Greenwald and Stiglitz (1993). According to Corsetti et al. (2010), a central bank of an open economy needs to take into account these factors to conduct a monetary policy that achieves stabilizing while minimizing the costs of economic fluctuations as well as coordinating monetary policies between different central banks.

Greenwood-Nimmo (2014) simulates different policy regimes and includes such an interplay between different central banks. The study models a stock-flow consistent (SFC) model of two countries to analyse the effectiveness of different approaches of monetary and fiscal policy to stabilize real GDP, inflation, and exchange rates. An SFC model tries to depict an economy as a monetary system with consequent, accounting-based relations ("consistent") between balances of financial assets and liabilities ("stocks") and transactions and cash flows over time ("flows") to give an integrated picture of an economy, according to Godley and Lavoie (2012). The model simulation uses persistent inflation and economic cycles to give an incentive for stabilizing the mentioned macroeconomic variables. It involves three different simulations. One is that the central banks of the two countries try to influence inflation to get it within the set target independently of each other; another one is a leader-follower approach where one central bank sets the interest rate first and the other central bank reacts to that; another one is to combine one of the aforementioned approaches with a countercyclical fiscal policy that reacts when inflation is changing. They are tested under the assumption that either exports decrease, wage pressure increases, or income tax is decreased. The

study concludes that neither monetary policy nor fiscal policy alone is sufficiently capable of stabilizing real GDP, inflation, and exchange rates. If no measures are taken, the result is that those variables fluctuate enormously and cannot be stabilized effectively. The result is similar for uncoordinated decisions on interest rates between the two central banks. If both central banks work together in a leader-follower approach the result is better as exchange rates fluctuate less than in the independent decision approach. Combining monetary policy measures with a countercyclical fiscal policy yields the best results. Inflation can be effectively stabilized even when monetary policy is done independently by the central banks, but even better when using a leader-follower approach that minimizes volatility, too. The author uses a relatively simple model that does not incorporate investment behaviour or a financial sector. Typically, changing interest rates cause investment spending reactions by firms. Without a commercial banking sector, the model is restricted to loans from the central bank to the government to finance budget deficits through purchases of government bills as the only source of money creation. Both restrictions implicate that some real-world cyclical dynamics and how monetary policy affects key macroeconomic variables cannot be covered. However, the model can act as a starting point for further analysis.

2.13. Exemplary high and low inflation countries after COVID-19

In the aftermath of the COVID-19 pandemic, the governments of the euro area countries set different measures to fight the adverse effects, like, for example, strongly rising energy prices. Austria witnessed a comparatively high inflation during this period. While the country's inflation rate was constantly lower than the average of the euro area countries as a whole during the past ten years, this changed in the summer of 2022, see Trading Economics (2023). Austria's inflation rate increased more strongly than the euro area as a whole. As Fritzer et al. (2023) state, three main factors contributed to this development: higher company profits, higher unit labour costs, and government support measures. Higher company profits were mainly due to energy companies which benefitted from increasing wholesale energy prices. Wage negotiations resulted in higher wage increases in Austria, compared to other euro area countries. Wages contributed more than two-thirds to inflation in the second quarter of 2023, making them the main driver. The authors expect that wages will also determine inflation development in the near future, as trade unions negotiated significantly higher wages in 2023 than in 2022. Moreover, the workforce is in demand and wanted. Therefore, companies tend to keep their employees even when the economy weakens, causing higher unit labour costs, too. In addition, the Austrian government lowered taxes for some leisure and cultural sectors and put upward pressure on inflation, too.

Other than Austria, France is a country that experienced higher inflation rates than the euro area average in the past, but had lower rates after COVID-19, at least temporarily. This can be attributed to the country's different energy mix, lower stimulus spending, lower wage growth, and different government policies. France relies heavily on nuclear power which was the reason why it was hit less hard by strongly increasing prices for natural gas and oil, according to the World Nuclear Association (2023). The government spent less fiscal stimulus to fight the adverse economic effects of COVID-19 compared to other euro area countries and therefore generated less upward pressure on inflation, as stated in International Monetary Fund (2021). Wages grew only 3.6% in France in 2022, whereas in Austria they increased by 5.5%, according to Eurostat (2023). Slower growing wages mean subdued increasing income and therefore less upward pressure on prices. Moreover, France conducted different government policies as its government decided to regulate energy prices by lowering taxes on energy, measures to incentivize non-nuclear power suppliers to provide more alternative energy, subsidies for gas and electricity suppliers, and regulations to bind the two largest suppliers Engie (natural gas) and EDF (electricity) on tariffs at the then levels, as shown in Rüdinger (2023).

3. Conclusion

Inflation is a complex economic phenomenon that is well-captured in the academic literature, but the factors that influence it are rather diverse and partly in discussion even nowadays.

This literature review highlights what the monetary policy of the central banks and governmental policy by the governments can do to limit inflation to a certain target. The success of these policies depends on several factors, like, for instance, how decisive the institutions are, what the stance of the deciding people is towards economic growth, price stability, and employment, and how well the measures of monetary policy and governmental policy fit together and support each other. Supporting the economy by monetary policy measures was even common in past centuries, but the amount rose in the 20th century. Decision makers that focus more on stable prices and proper behaviour of market participants may risk deflation after a crisis, whereas decision makers who focus on employment and economic growth risk further financial crises due to excessive support measures. For instance, long-lasting relief programs during and after economic crises may lead to higher inflation rates. Whatever direction these decisions take, they influence supply and demand in an economy and therefore drive future inflation rates. The academic literature suggests preferring monetary policy measures over governmental policy

measures, mainly because the former can be conducted faster and the latter has to be accompanied by lower government spending to avoid a too-high future debt burden of a country or region. Studies suggest that monetary policy measures are also effective in fighting persistent inflation. On the other hand, higher interest rates because of a tighter monetary policy can also lead to higher debt, as governments have to pay more on interest and may face lower tax revenues as economic growth slows down due to lower credit demand. If fiscal policy takes the lead, the literature is split over the consequences of it for inflation. Some of the studies indicate that fiscal policy shocks can lead to higher inflation rates, others suggest that inflation may remain stable or even decrease, depending on the prevailing inflation level, available technology, and the credibility of policy measures. In any case, central banks and governments should cooperate when it comes to fighting inflation to secure an effective and trustful policy.

One limitation of this literature review is that it relies on studies that may not fully capture the dynamic and evolving nature of the global economy. Changing economic conditions, advanced technological developments, and changing geopolitical situations may lead to restricted applicability of the findings of past research literature on future scenarios. Another limitation is the general focus on the euro area, i.e. highly-developed countries. Therefore, the findings in the literature may not be applicable to developing countries as these often have substantially different economic structures.

For these reasons, future research could investigate more in-depth how effective inflation management strategies across different economic systems and development stages are to establish monetary policy and governmental policy measures that fit better to certain economic contexts. Moreover, it could draw on the unconventional policy measures in the aftermath of COVID-19 and other crises to explore their long-term effects on future inflation rates.

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Summary

Inflation is a crucial issue for businesses and households, central banks and governments, in fact for all economic actors, as it has a strong impact on economic growth and welfare. This literature review captures how monetary policy and governmental policy can control inflation, how their measures work, and which are the key points to consider when conducting these policies, especially in times of crises. It uses academic papers from the past eight decades, supplemented by publications from financial and economic institutions, but focuses on literature beginning with the 2000s to capture the latest methods and techniques to find out what drives inflation and how. Monetary policy and governmental policy should act together to effectively fight inflation. Monetary policy can have adverse effects on governments' future tax revenues and debt-to-GDP ratios. Fiscal policy measures should be associated with altered government spending to avoid high inflation rates and/or high debt burdens in the future. Especially during and right after crises, measures have to be evaluated as too long support can fuel inflation in the future. Both parties should also take into account people's inflation expectations, as these shape their economic behaviour.

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Introduction of a general class of entropy-based control charts: The Φ-chart

1. Introduction

Shewhart control charts are an essential tool for quality control in the context of supervising the processes of production. These charts, introduced by Shewhart (1931), are essentially based on the interpretation of mean, standard deviation, and range of samples obtained from production processes.

Control charts try to determine whether processes are still under control. A classic example is the $\bar{x}S$-chart, which assumes that the quantity that is to be controlled follows a normal distribution. In this case, the $\bar{x}$-chart monitors the process mean and checks whether the controlled sample values lie between two acceptance boundaries. Additionally, the S-chart checks if the $\bar{x}$-chart's boundaries are still represented by the variance of the monitored process and shows off limits in which the process variance can vary without being classified as *changed*. Here, S is the sample standard deviation, defined as:

$$S = \sqrt{\sum_{i=1}^{n} \frac{\left(X_i - \bar{X} \right)^2}{\left(n-1 \right)}} \tag{1}$$

Burr (1967) analyzed the suitability of $\bar{x}$-chart's boundaries for samples drawn from non-normal parent populations. His results showed that the usual boundaries are still reliable if the sample's distribution does not deviate too much from the normal distribution. In line with these results, Chan et al. (1988) concluded

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that charts, which are designed for normal distributed data, do not work well if the underlying distribution has extremely heavy or light tails.

Next to this, Page (1954) and Ewan (1963) used a cumulative sum and Crowder (1987) an exponentially weighted moving average to supervise production processes and demonstrated these methods' advantages in case of small changes in the nature of the process.

More recent research by Riaz and Saghir (2007) as well as Saghir and Lin (2015) employed Gini's mean difference for tracing the variability of production processes. They carved out situations in which a G-chart[1] can detect changes in the variance of a process more efficiently than charts that are currently applied in supervision, like the previously explained, especially in situations in which the data's distribution is not normal.

We introduce a new class of control charts, the ϕ-chart, which is a generalization based on a new class of entropy, the cumulative paired ϕ-entropy (CPE_ϕ), as introduced by Klein et al. (2016). The CPE_ϕ contains many classes of well-known entropies such as the cumulative (residual) entropy and the differential entropy. We generalize the results of Riaz and Saghir (2007) and Saghir and Lin (2015) as follows. First, a class of ϕ-charts is introduced that inherits the G-chart as a special case. Second, two new control charts are introduced that can be of advantageous use as a control chart in situations in which a sample of the process is not drawn from a normal population.

This paper is organized as follows: At the beginning, we introduce the G-chart by Riaz and Saghir (2007) and Saghir and Lin (2015). Then we introduce the new class of ϕ-charts.[2] Section 3 compares the ϕ-charts to the established S- and G-charts in a showcase scenario. Section 4 summarizes and discusses our findings.

2. Methods

Throughout this paper, we analyze methods to monitor the variability of a process. Information about location is not the focus of this research. Therefore, we assume in the following that any sample mean values lie in their control limits, meaning that the process location is under control.

Control limits for the variability of a sample with n observations are defined as:

$$\text{Lower Control Limit, } LCL = \sigma q_{\frac{\alpha}{2}, n} \tag{2}$$

---

[1] The G-chart is a control chart based on Gini's mean difference.

[2] Note that we will not provide an analysis with respect to the R-chart, which is based on ranks of a sample. This decision is based on the finding of Riaz and Saghir (2007), who showed that the R-chart is either dominated by one, the S- or the G-chart.

$$\text{Upper Control Limit, } LCL = \sigma q_{1-\frac{\alpha}{2},n} \tag{3}$$

If the population's standard deviation σ is unknown, it can be replaced by an unbiased estimator $\hat{\sigma}$ in the case of a normal distribution. The quantiles q_{α} are obtained from a Monte Carlo simulation, since exact distributions can be difficult to determine for finite n[3].

2.1. G-chart

A *G*-chart is based on Gini's mean difference measure:

$$G = \frac{2}{n(n-1)}\left(\sum_{\substack{i=1 \\ i \neq j}}^{n}\sum_{j=1}^{n}\left|x_i - x_j\right|\right) \tag{4}$$

David (1968) showed, that $\left(\sqrt{\pi}/2\right)G$ is an unbiased estimator for the true underlying process variability. Saghir and Lin (2015) analyzed the performance of *G*-charts under several violations of assumptions as non-normality and shifts in the standard deviation of the process.

2.2. ϕ-chart

Klein et al. (2016) introduced a new kind of entropy whose special cases have been used in a variety of fields of research, such as Fuzzy set theory (c.f. Luca, Termini 1972), Uncertainty theory (c.f. Liu 2015), and Reliability theory (c.f. Ebrahimi 1996). This new class of entropy, cumulative paired ϕ-entropy (CPE_{ϕ}), is based on an absolute continuous probability distribution function F. For every concave function ϕ with $\phi(0) = \phi(1) = 0$, the CPE_{ϕ} is defined as:

$$CPE_{\phi}(F) = \int_{\mathbb{R}}\phi\big(F(x)\big) + \phi\big(1 - F(x)\big)dx \tag{5}$$

ϕ is called entropy generating function. Next, we use the following four CPE_{ϕ} as measures of variability resulting in four ϕ-charts:

1. Cumulative paired Leik entropy (CPE_L, following Leik 1966) is generated by

$$\phi(u) = min\{u, 1-u\} = \frac{1}{2} - \left|u - \frac{1}{2}\right|, u \in [0,1] \tag{6}$$

---

[3] See Riaz and Saghir (2007) for further details on the critical values for *S*- and *G*-charts under normality.

which results in:

$$CPE_L(F) = 2\int_{\mathbb{R}} min\{F(x), 1-F(x)\}\, dx \tag{7}$$

2. Cumulative paired α-entropy (CPE_α, following Havrda, Charvát 1967) is generated by:

$$\phi(u) = u\frac{u^{\alpha-1}-1}{1-\alpha}, u \in [0,1] \quad \text{and} \quad \alpha > 1 \tag{8}$$

which results in:

$$CPE_\alpha(F) = \int_{\mathbb{R}} \left(F(x)\frac{F(x)^{\alpha-1}-1}{1-\alpha} + (1-F(x))\frac{(1-F(x))^{\alpha-1}-1}{1-\alpha} \right) dx \tag{9}$$

3. Cumulative paired Shannon entropy (CPE_S, following Burbea, Rao 1982) is generated by:

$$\phi(u) = -u\ln u, u \in [0,1] \tag{10}$$

which results in:

$$CPE_S(F) = -\int_{\mathbb{R}} \Big(F(x)\ln F(x) + (1-F(x))\ln(1-F(x)) \Big) dx \tag{11}$$

The CPE_S is a special case of CPE_α for $\alpha \to 1$.

4. Cumulative paired Gini entropy (CPE_G), which is a special case of CPE_α for $\alpha = 2$, results in:

$$CPE_G(F) = 2\int_{\mathbb{R}} F(x)(1-F(x))\, dx \tag{12}$$

As described by Klein et al. (2016), $G = 4CPE_\phi$. Therefore, G-charts can be generalized to α-charts or even more general ϕ-charts, that contain the G-chart as a special case. See Klein et al. (2016) for more information about the estimation of CPE_ϕ.

We compare these generalizations to the established results in literature in the next section.

3. Results

Following Riaz and Saghir (2007) and Saghir and Lin (2015), we evaluate the charts' performance via a simulation study. For simulating the required quantiles for the control limit, we use a Monte Carlo simulation with 2,000,000 random samples of size $n = 6$ and a significance level of 1% reference case. Table 1 gives an overview on the probability distributions used throughout the simulation. The distributions were chosen based on their potential relevance for various process control settings. For the normal, logistic, Laplace, and exponential distribution, a standardizing parametrization is used. We choose $\nu = 5$ degrees of freedom for the Student's t-distribution for modelling heavy tails, while ensuring the existence of the first four moments (mean, variance, skewness, and kurtosis).

Table 1

Density functions of the analyzed probability distributions

Distribution	Density function	Parameters
Normal	$\dfrac{1}{\sqrt{2\pi\sigma^2}}\exp\left(-\dfrac{(x-\mu)^2}{2\sigma^2}\right)$	$\mu = 0,\ \sigma = 1$
Student's t	$\dfrac{\Gamma\left(\dfrac{\nu+1}{2}\right)}{\sqrt{\nu\pi}\,\Gamma\left(\dfrac{\nu}{2}\right)}\left(1+\dfrac{x^2}{\nu}\right)^{-\frac{\nu+1}{2}}$	$\nu = 5$
Logistic	$\dfrac{\exp\left(-\dfrac{x-\mu}{\sigma}\right)}{\sigma\left(1+\exp\left(-\dfrac{x-\mu}{\sigma}\right)\right)^2}$	$\mu = 0,\ \sigma = 1$
Gamma	$\dfrac{1}{\Gamma(\tau)\theta^\tau}x^{\tau-1}\exp\left(-\dfrac{x}{\theta}\right)$	$\tau > 0,\ \theta = 1$
Laplace	$\dfrac{1}{2b}\exp\left(-\dfrac{|x-\mu|}{b}\right)$	$\mu = 0,\ b = 1$
Exponential	$\lambda\exp(-\lambda x)$	$\lambda = 1$

3.1. Evaluation metric

Following Saghir and Lin (2015), we use the average run length (ARL) as the performance criterion for the suitability of the proposed charts in several scenarios. It can be interpreted as the average required number of observations from the process until an out-of-control situation is detected. The ARL is a transformation of the testing procedure's power and defined as $1/(1 - \beta)$. Here, β is the probability of a type II error and $1 - \beta$ is the power of a test. Conclusively, a high power translates into a high probability of identifying out-of-control situations. We distinguish between ARL_0 (run length when a process is under control) and ARL_1 (run length when a process is not under control). For a suitable chart, ARL_0 must be large – since an alarm would be a wrong decision – and ARL_1 must be small – to detect out-of-control situations as quickly as possible. The ARL values that are displayed in the following are the results of a Monte Carlo experiment with 200,000 repetitions.

The reference standard deviation σ for each distribution is defined by the corresponding parameters in Table 1. The violation of the process' assumptions is implemented by shifting the reference standard deviation for each distribution from σ to $k\sigma$ with $k > 0$. Furthermore, we change the actual distribution of the process, implemented by using one of the other 5 distributions from Table 1 instead of the Gaussian distribution.

3.2. Performance of ϕ-charts

α-charts for α = 2

First, we are interested in analyzing the close surrounding of the special case $\alpha = 2$. We compared ARL_0 and ARL_1. As it turns out, there is no relevant improvement in neither ARL_0 or ARL_1 from using the G-chart[4] to any value $\alpha \neq 2$, neither if the variance increases while the distribution remains Gaussian nor if other distributions from Table 1 are applied. Figure 1 illustrates this finding exemplarily by showing the standardized ARL_0 (a) and ARL_1 (b) values of the α-charts (including the G-chart) as ratio with respect to the ARL_0 and ARL_1 values of the S-charts – for different values of α, for the Gaussian and the exponential distribution.

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[4] The G-chart is an α-chart with α = 2.

a)

b)
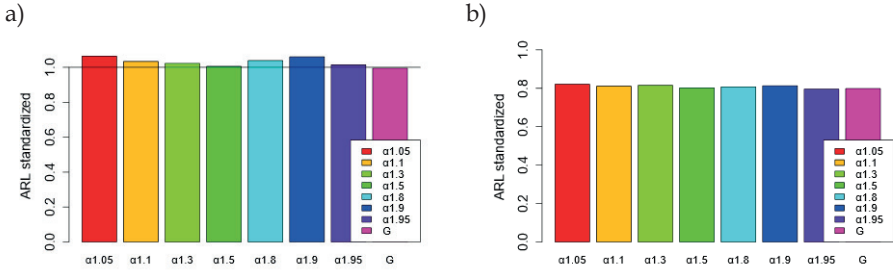
Figure 1. Ratios of *ARL* of α-charts for $1 < \alpha < 2$ and the *ARL* of *S*: a) ARL_0 for standard Gaussian data; b) ARL_1 of sample from exponential distribution with $\lambda = 0.625$

We see that Figure 1 shows nearly no difference between the performance of α-charts and the *S*-charts for any value of $\alpha \in (1, 2]$. This seems to be surprising at first glance – a closer look at the entropy generating function ϕ clarifies this finding. All of the functions weigh data points in a similar manner, the more they are located in the tails of a distribution. Since those observations are responsible for tremendous changes in variability, the detection of out-of-control situations by α-charts for any value of α is similar. The functional form of the CPE_ϕ's integrand $\phi(u) + \phi(1 - u)$ (see formula (5)) for different values of α is displayed in Figure 2. As we will see in the following subsection, more advantageous behavior of a ϕ-chart can only be expected if the shape of $\phi(u) + \phi(1 - u)$ varies considerably, as with the Leik-chart (see Figure 2b).

a)

b)
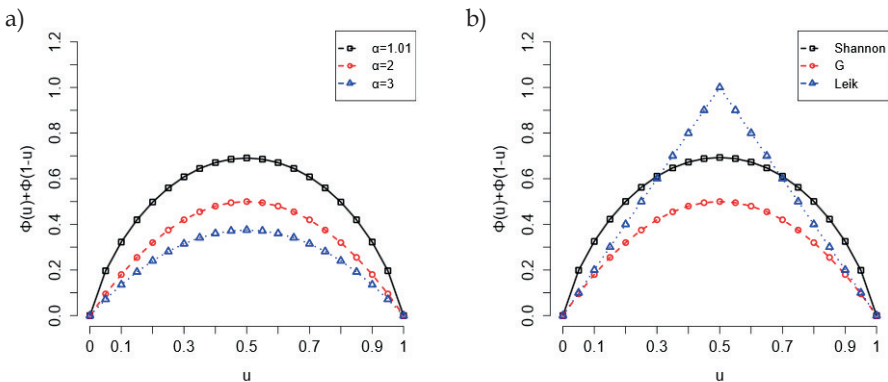
Figure 2. The integrands of: CPE_α for $\alpha = 1.01, 2, 3$ (a); CPE_S, CPE_G, and CPE_L (b)

Shannon- and Leik-charts

In this subsection we analyze the *ARL* of charts that are based on the Leik entropy CPE_L as well as on the Shannon entropy CPE_S. As can be seen from Figure 2, the integrands of the resulting CPE_ϕ have substantially different slopes in the tail regions. In the following, we take a closer look on how this affects the *ARL* of the associated ϕ-charts. We use the Shannon-chart and the *G*-chart as representatives of the α-charts, since the previous subsection showed very similar behavior referring different values of α.

At first, we evaluate the Leik- and Shannon-chart in the default setting, shifting the standard deviation of a Gaussian distribution. Figure 3 summarizes the *ARL*-values of *G*-charts in comparison to Shannon- and Leik-charts. All values are displayed relative to the respective *ARL* of the benchmarking *S*-chart. Results show that neither of the new ϕ-charts outperforms the *S*-chart in the sense of a higher ARL_0 or a lower ARL_1. However, the ARL_0 of the *G*-, Leik-, and Shannon-charts are not significantly different from values of the *S*-chart. All ARL_1 values converge as the multiplicative shift *k* of the standard deviation increases. However, the Leik-chart has difficulties detecting smaller shifts around $k \in (1, 2)$. In contrast to the *S*-chart, the Leik-chart needs up to 20% more observations to detect a shift in the process' variance and is therefore not recommended for use in this particular scenario.
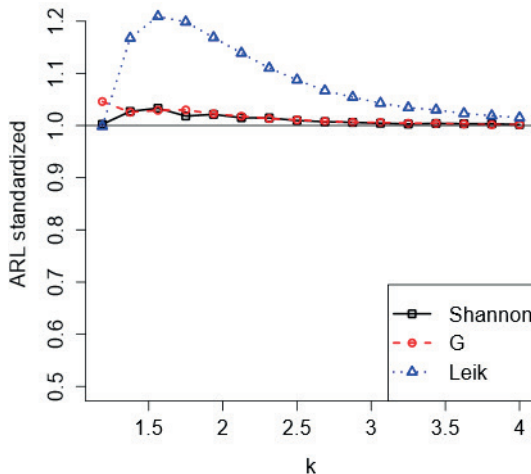
Figure 3. *ARL* ratios of CPE_S, CPE_G, and CPE_L for a standard Gaussian distribution where the standard deviations are multiplied by the shift-factor *k*.
All *ARL*-values are reported as ratios compared to the *ARL*-value of the *S*-chart

Nonetheless, we assume that there are situations in which the Leik-chart outperforms every other control chart. For this purpose, we analyze the φ-chart's behavior under several alternative families of distributions, which are summarized in Table 1. Figure 4 compares the Shannon-, *G*-, and Leik-chart at non-normal distributions. Again, all *ARL*-values are reported as ratios of the chart's *ARL* compared to the *ARL* of the *S*-chart. Three results can be derived by interpreting the ratios of *ARL*-values. As the first result, it seems that for heavy tail symmetric distributions (excess kurtosis of 6), deviations can be detected similarly by any of the applied procedures. If the process is e.g., from a Student's *t*-distribution with $\nu = 5$, extreme observations occur way more often as under a Gaussian distribution. In our simulation, the *S*-chart can detect such outliers very quickly, since an arbitrarily large value has an arbitrarily large effect on *S* which makes *S* very sensitive to outliers. However, in this scenario, the *G*-chart, as already discussed by Riaz and Saghir (2007), and the Shannon-chart perform similarly to the regular *S*-chart. Merely the Leik-chart needs about 5% more observations in order to detect an out-of-control process.

The second result is that at symmetric distributions with lighter tails than the *t*(5)-distribution[5], all three charts (Shannon-, *G*-, Leik-chart) require less observations to detect an out-of-control process than the classical *S*-chart. Shannon- and *G*-chart perform similar, while both are dominated by the Leik-chart, which requires the lowest number of observations.

All three analyzed alternative distributions – Student's *t*, logistic, and Laplace distribution – share one common feature. The larger the shift in variability, the more similar are Shannon-, *G*-, and Leik-charts to each other as well as they are to the *S*-chart. This convergence seems to be accelerated if the tails of the distribution are heavy.

The third result is that with increasing shift in the standard deviation at non-symmetric distributions (see Figure 4d), the better the improvement achieved by using the Leik-chart compared to any other chart (up to 25% fewer observations needed on average to detect an out-of-control process). However, for large shift values this improvement seems to vanish as the *ARL*-curve converges to 1.

The exponential distribution, used as non-symmetric distribution, is commonly used for modeling waiting time in production processes, see e.g., Qiu (2013). Therefore, in the next subsection, we apply the Leik-chart to a more general family of distributions with a half-bounded domain[6] that contains the exponential family and as a special case, the gamma distribution.

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[5] That is e.g., the logistic or the Laplace distribution.
[6] The real-valued probability density function of the gamma distribution is defined for $x \in (0, \infty)$.

a) *ARL*-ratios for samples from the Student's *t* distribution with ν = 5
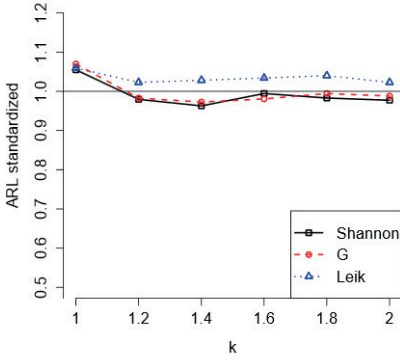
b) *ARL*-ratios for samples from the standardized logistic distribution
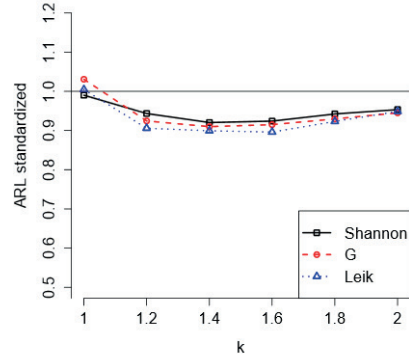
c) *ARL*-ratios for samples from the standardized Laplace distribution
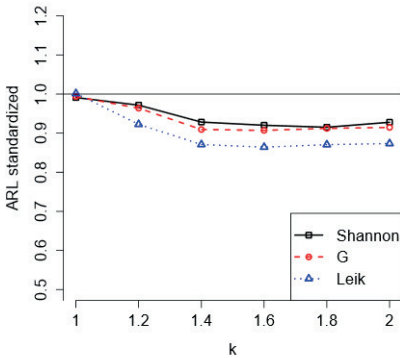
d) *ARL*-ratios for samples from the exponential distribution with λ = 1
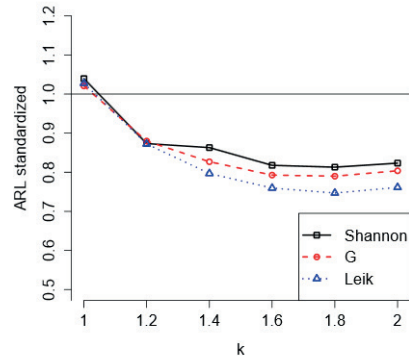
Figure 4. *ARL* ratios of the Shannon-, *G*-, and Leik-chart for the Student's *t* (a), the logistic (b), the Laplace (c), and the exponential distribution (d). The standard deviations of each distribution are multiplied by the shift-factor *k* – the horizontal axis displays the shift of the applied distributions (*k* = 1 refers to ARL_0, *k* > 1 to ARL_1). All *ARL*-values are reported as ratios compared to the *ARL*-value of the *S*-chart

3.3. φ-charts for the gamma distribution

In some situations, especially when some kind of waiting time is involved in a production process, the quantity of interest follows a gamma distribution

(c.f. Zhang et al. 2007). The shape parameter τ of a gamma distribution regulates the hazard rate – one can distinguish between

$\tau < 1$: monotonically decreasing hazard rate,
$\tau = 1$: constant hazard rate (exponential distribution),
$\tau > 1$: monotonically increasing hazard rate.

We showcase two parametrizations of the gamma distribution from Table 1 covering both decreasing ($\tau = 0.5$, Figure 5a) as well as increasing ($\tau = 2$, Figure 5b) hazard rates.

As we can see in Figure 5, in case of monotonically increasing as well as decreasing hazard rates, the Leik-chart outperforms the S-chart by far in detecting out-of-control situations. The Leik-chart has an even lower ARL_1 value than the Shannon- or the G-chart ($k > 1$). It needs approximately 5–15% fewer observations to detect an out-of-control situation. All four control charts show a similar ARL_0 value if the process' standard deviation lies in between its boundaries ($k = 1$).
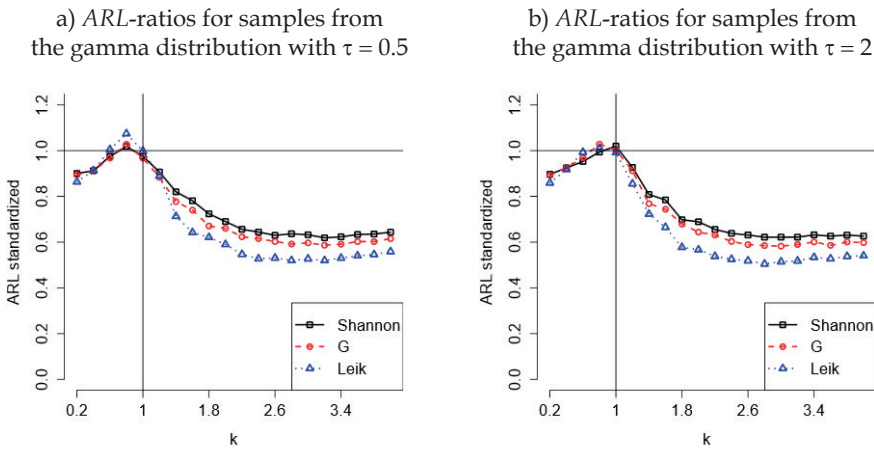
Figure 5. *ARL* ratios of the Shannon-, *G*-, and Leik-chart for the gamma distribution with shape parameter $\tau = 0.5$ (a) and $\tau = 2$ (b) for different shifts k

This promising result encourages us to apply the new control charts to an actual data set from a refrigerator production process.

3.4. Application to real data

In this subsection, we evaluate the *S*-, Shannon-, *G*-, and Leik-chart to a data set from Wild and Seber (2000), which contains the thickness of paint on refrigerators for a sample of size $n = 5$ from 20 shifts of production. The first 15 shifts are set as training data and for the last 5 shifts (test data) a quality check is performed to determine whether or not the process is still under control. Table 2 lists all available data, normalized using the standard deviation from the first 15 shifts.

A goodness of fit test for the first 75 observations results in p-values of 0.4112 for the gamma and 0.3073 for the Gaussian distribution. Therefore, we use the gamma distribution for determining the critical values of the control charts. Maximum likelihood estimation leads to parameters $\tau = 78.8544$ and $\theta = 0.1102$. After the training set, the control charts are initialized using simulated UCL and LCL based on 1,000,000 samples of size $n = 5$ at a level of 0.5%. Figure 6 lists the four resulting processes and the application to the 5 test shifts.
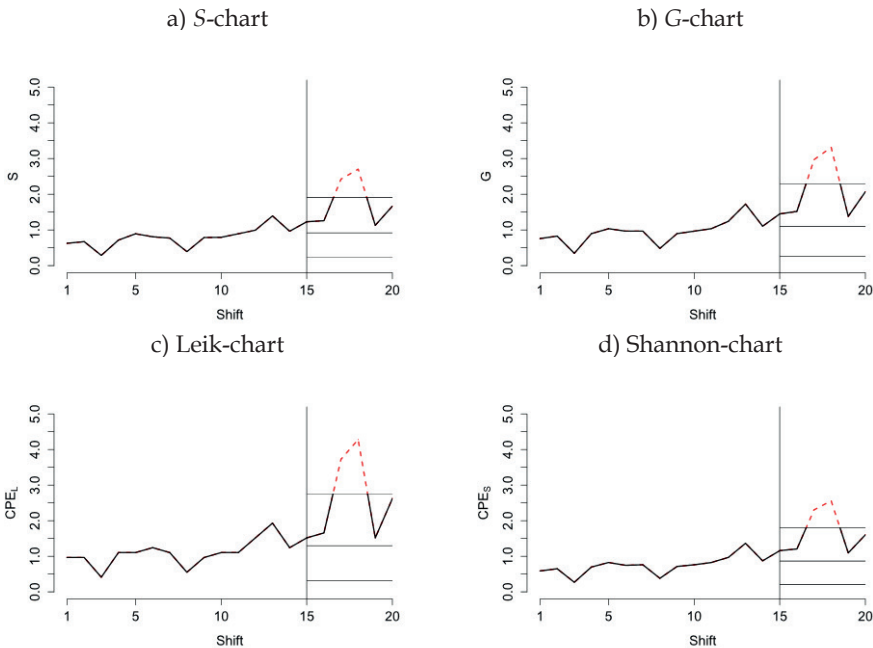
Figure 6. *S*-, *G*-, Leik-, and Shannon-chart of the data set from Table 2. The first 15 shifts have been used to calibrate the control chart by estimating LCL and UCL. The charts are applied to the last 5 test shifts. Horizontal lines denote the UCL, the mean of the process, and LCL (top down). The red dashed line indicates an out-of-control situation

Table 2

Data set of the thickness of paint on refrigerators for a sample of size $n = 5$ from 20 shifts of production. The data set has been split into a training set containing the first 15 shifts, and a test set containing the remaining 5 shifts. The sample data has been normalized using the standard deviation of the training data

	Shift no.	Samples					Subgroup					
		Normalized thickness					Mean	R	S	G	CPE_S	CPE_L
Training	1	9.3223	7.9412	8.9770	8.2865	9.3223	8.7699	1.3811	0.6272	0.7596	0.5881	0.9668
	2	8.9770	8.2865	8.9770	7.9412	9.6676	8.7699	1.7263	0.6731	0.8286	0.6514	0.9668
	3	7.9412	7.9412	8.2865	8.6317	8.2865	8.2174	0.6905	0.2889	0.3453	0.2701	0.4143
	4	9.6676	7.9412	8.2865	8.9770	9.3223	8.8389	1.7263	0.7160	0.8977	0.6993	1.1049
	5	8.9770	8.6317	8.9770	7.2507	9.6676	8.7008	2.4169	0.8937	1.0358	0.8258	1.1049
	6	7.5959	7.9412	9.3223	7.5959	8.9770	8.2865	1.7263	0.8097	0.9668	0.7471	1.2430
	7	7.5959	8.9770	8.2865	6.9054	7.9412	7.9412	2.0716	0.7720	0.9668	0.7626	1.1049
	8	9.6676	8.9770	8.9770	9.3223	8.6317	9.1151	1.0358	0.3937	0.4834	0.3813	0.5524
	9	8.2865	9.6676	8.2865	7.5959	7.9412	8.3555	2.0716	0.7873	0.8977	0.7147	0.9668
	10	8.9770	7.9412	6.9054	8.6317	8.2865	8.1484	2.0716	0.7949	0.9668	0.7626	1.1049
	11	10.7034	10.3581	12.0844	9.6676	10.3581	10.6343	2.4169	0.8937	1.0358	0.8258	1.1049
	12	8.2865	9.6676	7.5959	10.0128	8.6317	8.8389	2.4169	0.9947	1.2430	0.9694	1.5192
	13	7.2507	11.0486	8.6317	8.9770	9.6676	9.1151	3.7980	1.3940	1.7263	1.3661	1.9335
	14	7.5959	9.6676	7.2507	7.5959	8.2865	8.0793	2.4169	0.9643	1.1049	0.8737	1.2430
	15	8.2865	10.3581	8.6317	8.6317	6.9054	8.5627	3.4527	1.2304	1.4501	1.1592	1.5192
Test	16	10.7034	8.9770	8.9770	9.6676	7.2507	9.1151	3.4527	1.2592	1.5192	1.2071	1.6573
	17	10.0128	8.2865	10.0128	4.4885	6.2149	7.8031	5.5243	2.4243	2.9693	2.3047	3.7289
	18	6.5601	5.5243	8.9770	11.3939	11.3939	8.7699	5.8696	2.7033	3.3146	2.5595	4.2813
	19	7.9412	8.9770	9.3223	9.6676	11.0486	9.3913	3.1074	1.1294	1.3811	1.0960	1.5192
	20	6.2149	9.6676	7.9412	6.9054	10.0128	8.1484	3.7980	1.6666	2.0716	1.6054	2.6241

Clearly, all four control charts detect an out-of-control situation in the shifts 17 and 18, which would in practice result in a termination of the production process. To strengthen the results from the Monte Carlo simulations of the previous sections, however, more data would be required together with the information of whether the process has actually been out-of-control or not.

4. Conclusions

Our results showed that the broad class of α-charts, containing the well-known *G*-chart as a special case for α = 2 as well as the Shannon-chart as a limiting case for α → 1, does not provide any improvement over the classical Shewhart control charts for values of α ≠ 2. The *ARL* of α-charts is very similar to the *ARL* of the *G*-chart in the analyzed scenarios. One reason for this finding could be the almost equally shaped kernel functions of the underlying CPE_α, which weigh observations in a similar manner.

However, we discovered that the usage of Leik control charts can be advantageous compared to established Shewhart control charts if the underlying process follows an exponential, Laplacian, or gamma distributed law. Leik control charts are found to outperform both the classical *S*-chart and the *G*-chart if the variability of the process is out-of-control. Further research should focus on applying this Leik-chart to actual data from production processes following a gamma distribution and investigate the economically advantageous implications of using this new ϕ-chart compared to using a classical Shewhart control chart.

Furthermore, for processes which follow a distribution with domain $\mathbb{R}^+$ the analysis of the performance of a control chart that is based on the cumulative residual entropy (as in Wang et al. 2003), could be of interest for further research.

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Summary

We introduce a new class of Shewhart control charts, namely the φ-chart. This new class is based on the cumulative paired φ-divergence that generalizes both the cumulative (residual) entropy and the differential entropy. The φ-chart contains several subclasses; of which one has a special case, the *G*-chart, which uses Gini's mean difference as a measure of dispersion. We investigate the performance of three of the subclasses of φ-charts in a showcase scenario, comparing its average run length under the Gaussian and several alternative distributions relevant for process control. We find especially the new Leik control chart to outperform classical Shewhart charts, which are based on ranks, standard deviation, or Gini's mean difference. The results imply that monitoring a production process using φ-charts results in a faster detection of out-of-control processes, which can be crucial for a variety of application areas.

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Investment attractiveness factors in the opinion of companies from Special Economic Zones in Poland

1. Introduction

International competitiveness and investment attractiveness are two concepts that are intimately associated with a nation. Specifically, a nation's strong international competitiveness is a prerequisite, but not a sufficient one, for the nation to draw in foreign direct investments from businesses. As a result, it is critical to take a nation's investment attractiveness into account when evaluating its competitiveness in relation to other global economies. An investment made by a foreign corporation or another entity founded by a nationally registered firm is referred to as foreign direct investment, or FDI. The United Nations Conference on Trade and Development (UNCTAD) states that foreign direct investment (FDI) may have several advantages for the host nation in addition to the influx of cash, including the transfer of skills and technology. Thus, the influx of FDI boosts the economy's competitiveness and creates more prospects for job creation. Results from theoretical and empirical analyses by Behrman (1972), Findlay (1978), Blomström and Kokko (2003), Alfaro et al. (2004), Blomkvist (2009), and Sabir et al. (2019) corroborate these benefits. One of the things affecting the nation's economic growth is said to be the strategy for drawing in foreign investment. A nation can offer a variety of inducements to attract foreign direct investment (FDI). These might include cyclical considerations (dynamic economic growth), demographic factors (access to an educated workforce), and geographical factors (access to the sales market).

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Furthermore, foreign investors consider institutional factors like the caliber of institutions in the host nation and financial factors like tax burdens when making investment decisions. The amount of taxes owed has an indirect impact on an organization's ability to compete and a direct impact on capital flows from investments. Bellak et al. (2009) demonstrate that the profitability of foreign direct investment (FDI) is adversely impacted by a high corporate income tax rate. Economically developing nations are viewed as desirable locations for foreign direct investment inflows because of their comparative advantage in the form of inexpensive labor, alluring pro-investment policies from their governments, abundant raw materials, and rich mineral resources. However, it makes sense that these nations' governments use high tax rates to ensure sufficient budget revenues given their limited financial resources and the heavy pressure on the budget deficit.

Poor institutional quality is becoming a global issue that affects many facets of the economy, not just in developing nations as a whole, but also in individual countries. Corruption is a result of low-quality institutions. In theory, corruption can be viewed as a "grabbing hand" since it makes transactions riskier and prevents foreign direct investment (FDI). But in nations where institutions are still inefficient and bureaucratic, corruption can be helpful because it "lubricates" the flywheel. As a result, businesses can obtain crucial information and benefits for a minimal financial investment, resulting in increased profits (Heckelman, Powell 2010).

Tax competition between nations attempting to draw in foreign direct investment is becoming a global issue in today's economy. Investors frequently contrast the tax burdens of nations with comparable markets in terms of size and location. Tax rate reductions in these nations are seen as inevitable, even as international tax competition tends to rise. Nevertheless, there is no hard proof that this tax cut will encourage foreign direct investment to flow into developing nations. Tax revenue reductions will lead to lower infrastructure investment, which will decrease public goods and services delivery and cause problems with public money distribution. It is unclear, therefore, if these nations are still the best places for foreign investors to invest.

Moreover, one of the primary obstacles to economic development and progress may be low-quality institutions that breed corruption. Specifically, data from the World Bank and Transparency International indicates that in certain developing nations, the corruption issue has grown more intricate and pervasive. Numerous international empirical studies have demonstrated that corruption and poor institutional quality tend to impede economic growth by decreasing the effectiveness of public investment and limiting private investment (Gupta et al. 2002; Knack, Keefer 1995; Mauro 1995; Tanzi, Davoodi 2001).

Ehrlich and Lui (1999), however, contend that corruption has a wide range of negative effects that have a big impact on the economy. Growth in the economy is severely constrained by corruption in many South American and African nations. Nonetheless, in many nations with notable regional disparities, such as China and India, widespread corruption does not seem to be impeding growth. Both the percentage of corporate foreign direct investment (FDI) in economic growth and the overall amount of capital flows in developing nations have increased dramatically in recent years.

2. Literature review

The amount of taxation in the host nation is one of the variables that determines the amount of foreign direct investment that enters a nation. Most empirical studies indicate that countries with high tax rates will not be as attractive to FDI inflows as those with low tax rates, although the exact type of tax has a significant influence on the impact on FDI inflows. But Hartman (1984) was the first to draw the conclusion that not all FDI inflows are equally tax sensitive. This indicates that the tax burden of the host nation does not apply to FDI investors in certain sectors.

Using a meta-analysis approach, de Mooij and Ederveen (2003) demonstrated that FDI has a tax elasticity of −3.3, meaning that a 1% reduction in the tax rate in the host country will, on average, result in a 3.3% increase in FDI inflows to that nation. In the meantime, Bellak et al. (2009) carried out a comparable analysis, and their findings indicated that this elasticity is less than –1.45. In addition, Stöwhase (2005) examined how FDI was affected by tax rates. He came to the conclusion that the region in which FDI flows considerably influences this sensitivity. Consequently, when compared to the average reported in earlier studies, this study finds that the FDI tax elasticity is either overestimated or underestimated. The study also implies that inaccurate conclusions from earlier research may have resulted from challenges with data access, measurement, and estimation techniques.

Another institutional component thought to influence the amount of foreign direct investment that enters the nation is corruption. The World Bank defines corruption as the misuse of official authority for one's own benefit. It is widely thought that corruption has a detrimental effect on FDI inflows. Nevertheless, there isn't much of a connection between FDI flows and corruption. Wheeler and Mody (1992) examined how corruption affected foreign direct investment (FDI) in the context of low-quality national institutions. This characteristic shows up as onerous administrative processes, an overabundance of bureaucracy, and an opaque legal system. The effects of corruption on foreign direct investment are not statistically significant, according to the study. To put it another way, weak

institutions in developing nations do not prevent corruption from impeding FDI inflows. Wei (2000), however, drew attention to the fact that Wheeler and Mody's (1992) study had certain shortcomings and influenced the research findings. Wheeler and Mody (1992) included twelve variables in the model analysis; Wei (2000) reports that they included only one corruption variable. As a result, it is difficult to determine how corruption affected FDI in this particular instance.

Wei (2000) mined data from 45 different nations, with the Tobit method used to estimate the model. The study's findings demonstrated that corruption has a detrimental impact on FDI flows. Abed and Davoodi (2002) examined the relationship between per capita FDI flows in transition economies and levels of corruption using panel and cross-sectional data. The findings demonstrate that nations with low levels of corruption draw more foreign direct investment (FDI). But when an institutional reform control variable was added to the model, the corruption variable lost its significance. Thus, this study clarifies the crucial finding that, in order to draw foreign direct investment (FDI) inflows to different nations, institutional reform is more crucial than lowering the level of corruption.

In a 2002 study, Habib and Zurawicki examined the effects of corruption on bilateral FDI flows by examining 89 countries that received direct investments and seven countries that provided financing. In this instance, the theory that FDI inflow will be less if corruption in the host nation is higher than in the home country was tested. Thus, the explanatory variable in the empirical model is the variation in the degree of corruption between the countries that make investments and the countries that receive them. Since FDI inflows are thought to be associated with unethical activity, it has been argued that they tend to avoid corruption. Furthermore, Voyer and Beamish (2004) employed solitary data for both the source nation, Japan, and the 59 developing nations that received these investments. The study's authors discovered evidence linking Japanese foreign direct investment inflows to host nation corruption.

In his investigation into foreign direct investment in Africa, Asiedu (2002) looked at the primary variables influencing FDI inflow to the continent. The findings demonstrate that FDI flow is negatively impacted by both political unrest and corruption. Foreign investors are more concerned with economic freedom than political freedom when it comes to making decisions about capital flows, as noted by Mathur and Singh (2013). The essay looks at what influences foreign direct investment inflows to 29 developing nations. The choice of destination made by investors is significantly impacted by corruption, according to empirical findings. FDI inflows to developing nations in particular are very dependent on one another. The influx of foreign direct investment into these nations is adversely impacted by the high level of corruption. According to some research, corruption has no detrimental effect on foreign direct investment. This is predicated on the idea that

corruption may occasionally serve as a helpful hand in cases where other facets of governance are deficient or when economic policies are thought to be ineffectual (Leff 1964). Corrupt practices can sometimes be advantageous to investors as they allow them to get past obstacles and take advantage of host nation incentives.

Over the years 1995–1999, Egger and Winner (2006) evaluated the correlation between FDI inflows and corruption in 73 developed and developing nations. According to empirical findings, corruption can encourage foreign direct investment (FDI) inflows by assisting entrepreneurs in evading onerous regulations and administrative processes. They maintained that by empowering entrepreneurs to rectify or do away with government mistakes, corruption could increase efficiency. Additionally, Lui (1985) demonstrated through the use of a queuing model how corruption can shield businesses from the negative effects of ineffectual policies. The findings indicated that bribing officials can create an incentive to expedite the administrative process.

According to Bayley (1966), corruption can help businesses find appropriate and constructive solutions by enhancing institutional quality and assisting them in avoiding governmental policies that impede their operations. The macroeconomic environment may also play a big role in influencing how much foreign direct investment enters the nation. Behrman (1972) carried out one of the first notable studies on the influence of these factors on FDI flows. A study of seventy-two American companies with a significant presence overseas revealed that foreign direct investment (FDI) fosters growth not just in capital but also in managerial and technical skills.

Findlay (1978) demonstrated through the use of the dynamic model that the diffusion of technology accelerates technological advancement in a comparatively "less developed" area, which in turn makes the region more appealing to foreign direct investment (FDI). These earlier results imply that FDI is drawn to nations experiencing rapid development. FDI inflows and economic growth, however, may not always be correlated and may differ for developed and developing nations.

Two major categories of factors, according to Nunnenkamp (2002) and Blonigen (2005), affect the FDI inflow. Efficiency and the market (conventional factors) are key. The population, tax burden, rate of economic growth, and other factors are market factors. In turn, the level and dynamics of operating expenses for businesses in the nation – such as taxes, salaries, employee non-wage costs, etc. — have an impact on the FDI inflow. These days, the analysis of the change in emphasis between the two sets of factors previously mentioned is central to the literature on the determinants of FDI inflow.

Mottaleb and Kalirajan (2010) and Kumari and Sharma (2017) examined the effect of the host nation's market size on foreign direct investment flows in a recent publication. Although the results are not definitive, these studies offer

evidence regarding the macroeconomic factors influencing foreign direct investment inflows in both developed and developing nations. According to studies on the influence of efficiency on FDI flows, a key factor influencing FDI inflow to the nation is the degree of human capital development and associated expenses. The country's ability to attract foreign direct investments is positively impacted by lower labor costs, as noted by Noorbakhsh et al. (2001) and Braconier et al. (2005). One of the factors that drives FDI flows is human capital.

3. Research methods and results

While recognizing the importance of the discussed approaches, it is worth noting that they typically overlook the question of whether the indicators included in the analysis align with market requirements and the interests of the business community representatives. Meanwhile, it is the correctly selected factors that largely determine the quality, and, consequently, the relevance of each specific methodology. It should also be noted that comprehensive studies on the opinions of potential investors regarding which factors most significantly influence their decisions in planning foreign capital investments and, consequently, shape the investment climate, are lacking in economic literature. Therefore, this article can fill an existing gap in this area and serve as the foundation for the development of a new methodology that aligns with market demands. After a thorough examination of various methodologies for assessing the investment climate and approaches to their comparative analysis, we identified the need to survey potential investors to understand their opinions on the aforementioned issues.

In order to to asses a set of determinants that exert the most significant influence on a country's investment climate was developed a questionnaire consisting of 25 questions of various orientations. These questions were designed to assess the opinions of potential investors regarding the degree of influence of various factors on their decision on capital allocation and the investment climate of a country. The survey was conducted among 506 enterprises and 14 management bodies of Special Economic Zones in Poland from June 10 to July 20, 2023.

The data from the Table 1 present the distribution of the number of employees employed in the surveyed companies. Companies with the smallest number of employees (from 1 to 9) accounted for 7.71% of the surveyed enterprises. Companies employing 10 to 49 employees accounted for a slightly smaller percentage, at 7.31%. A much larger group consisted of companies with the number of employees ranging from 50 to 249, which constituted 20.36% of the surveyed sample. However, the largest percentage of surveyed companies (64.62%) were companies employing over 250 employees.

Table 1

Number of employees in the companies

Number of employees	Frequencies	Percent	Percentage valid	Cumulative percentage
1–9	39	7.71	7.71	7.71
10–49	37	7.31	7.31	15.02
50–249	103	20.36	20.36	35.38
Over 250	327	64.62	64.62	100.00
All	506	100.00	–	–

The companies surveyed came from the United States, Sweden, and Germany. The data presented in the Table 2 shows that 181 companies, representing 35.77% of all surveyed enterprises, have branches abroad and have experience in foreign direct investment. However, the majority, 325 companies (64.23% of all respondents), do not have branches abroad. These data suggest that although a significant number of Polish companies have expanded their operations outside the country, the majority are still focused on the domestic market.

Table 2

Branches of companies abroad

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	181	35.77	35.77	35.77
No	325	64.23	64.23	100.00
All	506	100.00	–	–

The research conducted showed that among the surveyed companies, those that declared having foreign branches were located in Germany, Italy, Great Britain, Spain, Scandinavian countries, Bosnia and Herzegovina, Macedonia, Croatia, Romania, Ukraine, the Czech Republic, Slovakia, Bulgaria, United Arab Emirates (UAE), USA, Sweden and Greece.

The research shows that the vast majority of respondents (93.48%) believe that it is worth using the services of specialized rating agencies to obtain information about the country of planned investments. Only a small percentage of companies (6.52%) disagreed with this statement. This data suggests that companies value the professionalism and specialist knowledge that rating agencies can offer when planning their foreign investments (Tab. 3).

Table 3

Services of specialized rating agencies

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	473	93.48	93.48	93.48
No	33	6.52	6.52	100.00
All	506	100.00	–	–

The data in the Table 4 shows that the majority of respondents see the benefits of using rating agencies. The most popular reason, known by 91% of respondents, is that rating agencies offer a broader assessment of the risk and prospects for planned investments. Additionally, 40% of respondents believe that it is worth using rating agencies because they have access to difficult-to-access information that may be crucial for making business decisions. Moreover, 24% of respondents emphasized the possibility of obtaining high-quality expertise at a relatively low cost as an important reason for using the services of rating agencies. Finally, 23% of respondents stated that they use CRAs for other reasons not mentioned in the study.

Table 4

Reasons for using rating agencies

This provides a broader assessment of risks and prospects [%]	Specialized agencies have access to information that is difficult to access [%]	Possibility of obtaining high-quality expertise at a relatively low cost [%]	From a different [%]
91	40	24	23

Analysis of the responses of respondents who do not use the services of rating agencies revealed various reasons for this decision. The most common reason, indicated by 36% of respondents, was the high cost of obtaining the necessary data. Respondents may have felt that the costs of CRA services outweighed the potential benefits. 14% of respondents indicated that the information provided by rating agencies is incomplete. This could mean that agencies are not providing all the information that companies consider necessary to make investment decisions. 10% of respondents indicated other reasons for not using the services of rating agencies that were not specified in the study. Finally, 8% of respondents said their companies prefer to conduct their own analysis rather than relying on information provided by rating agencies (Tab. 5).

Table 5

Reasons for not using rating agencies

High cost of obtaining the necessary data [%]	Incomplete information [%]	Other [%]	Our company prefers its own analysis [%]
36	14	10	8

The results of analysis presented in the Table 6 indicate that the vast majority of companies did not use the services of specialized agencies or external experts to assess the investment attractiveness of the country (region) of planned investments. Only 2.57% of respondents indicated that their company used such services. In turn, as many as 97.43% of companies responded not to use such services.

Table 6

The use of services offered by specialized agencies

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	13	2.57	2.57	2.57
No	493	97.43	97.43	100.00
All	506	100.00	–	–

The analysis of the answers to the open question shows that the average assessment of companies' experience in using the services of specialized agencies or external experts is 6.6 points for 10 points. This result suggests that these companies have generally had a positive experience in this regard. However, it should be noted that the analysis is based on nine responses, which means that the sample is quite small and may not reflect the experiences of all companies.

Moreover, the data shown in the Table 7 suggests that 8.10% of companies consider hiring specialized rating agencies or external experts to obtain the necessary information about the host country (region) when they plan to make foreign direct investments. In turn, the vast majority of companies, as many as 91.90%, do not consider this option. These results suggest that companies often decide to obtain the necessary information on their own or use other methods to assess investment attractiveness.

Table 7

Hiring specialized rating agencies

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	41	8.10	8.18	8.18
No	460	91.90	91.82	100.00
All	506	100.00	–	–

3.1. Financial and economic factors

The analysis of the survey results presented in the Table 8 shows that the most important financial and economic factors when planning foreign direct investments for companies are: the level of taxation and non-tax burdens (71%) and the situation on the labor market (66%). GDP/GNP, including per capita, is a decisive factor for 34% of companies. The availability of loans (short, medium, and long-term) is important for 22% of respondents, and inflation for 18%. In turn, 11% of companies indicated "other" factors not mentioned in the survey. These results indicate that the priority for most companies is a favourable tax situation and a stable labor market in the target country.

Table 8

Determining financial and economic factors when making foreign direct investments

Level of taxation and non-tax burdens [%]	The situation on the labor market [%]	GDP/GNP (including per capita) [%]	Availability of loans (short, medium and long-term) [%]	Inflation [%]	Other [%]
71	66	34	22	18	11

3.2. Political factors

The survey results show that the most important political factors for companies planning foreign direct investments are political stability (90%) and favorable government policy towards business (80%). The level of corruption is important for 31% of respondents, and the availability, credibility and transparency of

information for 26%. About 19% of companies pay attention to government intervention in the economy, and 7% chose "other" factors not included in the survey (Tab. 9). Therefore, for most companies, the key factors are stable and pro-business political conditions in the country where they plan to invest.

Table 9

Determining political factors when making foreign direct investments

Political stability [%]	Favorable government policy towards business [%]	Level of corruption [%]	Availability, reliability and transparency of information [%]	Government intervention in the economy [%]	Other
90	80	31	26	19	7

3.3. Legal factors

The study shows that companies attach great importance to legal factors when planning foreign direct investments. The most important factor is the independence of the judiciary, which was indicated by 77% of respondents. Next, 74% of companies pay attention to possible discriminatory measures and control of foreign capital in relation to domestic capital. The effectiveness of the legal environment is important for 67% of respondents. Protection of property rights is a decisive factor for 44% of companies. About 30% companies indicated other legal factors not included in the survey, and 16% of companies take into account the repatriation of capital, i.e. the possibility of withdrawing invested funds, paying particular attention to the threat of nationalization (Tab. 10). These results show that for most companies, a stable and effective legal environment in the target country is crucial.

Table 10

Determining legal factors when making foreign direct investments

Independence of the judiciary [%]	Discriminatory measures and control of foreign capital in relation to domestic capital [%]	Effectiveness of the legal environment [%]	Protection of property rights [%]	Other [%]	Repatriation of capital (threat of nationalization) [%]
77	74	67	44	30	16

3.4. Socio-demographic factors

When planning foreign direct investments, companies take into account various sociodemographic factors. According to research presented in the Table 11, 53% of respondents believe that the unemployment rate is an important factor determining investment. The development of social infrastructure, including services, education, medicine, etc., is taken into account by 48% of companies. The level of education of the population and the quality of human capital are decisive factors for 45% of respondents. The crime rate is important for 40% of companies, and the availability and structure of the working-age workforce – for 31%. Only 10% of companies indicated "other" sociodemographic factors not included in the survey as decisive when planning a foreign investment.

Table 11

Determining socio-demographic factors when making foreign direct investments

Unemployment rate [%]	Development of social infrastructure (services, education, medicine, etc.) [%]	The level of education of the population and the quality of human capital [%]	Crime rate [%]	Availability and structure of the working-age labor force [%]	Other [%]
53	48	45	40	31	10

3.5. Infrastructure factors

The results presented in the Table 12 show the decisive infrastructure factors when making foreign direct investments. Own research has shown that 81% of respondents consider the general development of infrastructure to be a key factor influencing such investments. In turn, 79% of respondents consider the development of telecommunications infrastructure to be important.

Next, the development of transport infrastructure (e.g. car, railway, air) is a key factor for 67% of respondents. The simplicity and cost of connecting to the power grid is of great importance to 37% of respondents, while the development of investment infrastructure (e.g. Special Economic Zones, Technoparks) was mentioned by 16% of respondents.

It is worth noting that there is also another, unspecified infrastructure factor, which also received 16% support from respondents. These results show that developed infrastructure, both in general and in a specific field, is a key factor in attracting foreign direct investment.

Table 12

Determining infrastructure factors when making foreign direct investments

General infrastructure development [%]	Development of telecom-munications infrastructure [%]	Development of transport infrastructure (car, railway, air, etc.) [%]	Simplicity and cost of connecting to the power grid [%]	Development of investment infrastructure (SEZ, Techno-parks, etc.) [%]	Other [%]
81	79	67	37	16	16

3.6. Technological factors

The results presented in the Table 13 show the decisive technological factors when making foreign direct investments. The authors' research has shown that corporate research and development is of key importance to 76% of respondents, which means that the ability to conduct own research and innovative activities is an important factor influencing decisions to invest abroad.

Access to technical knowledge was indicated as an important factor for 72% of respondents. This means that the ability to use existing technical knowledge and technology is an important advantage when making investments.

The level of innovation development is also a key factor for 47% of respondents, which means that a country's attractiveness as an investment destination is linked to its ability to innovate.

Research and development costs are also an important factor for 19% of respondents. This is understandable because lower research and development costs can attract investors.

Table 13

Determining technological factors when making foreign direct investments

Corporate research and development (access to technical knowledge) [%]	Level of innovation develop-ment [%]	Research and development costs [%]	Other [%]	Availability of mobile communication and Internet [%]	Number of patent applications (innovative activities) [%]
76	72	47	19	16	11

The availability of mobile communications and the Internet was mentioned by 16% of respondents, which indicates the importance of good telecommunications infrastructure for business.

The number of patent applications (innovative activity) was mentioned by 11% of respondents, which suggests that an innovative approach to business is a factor that attracts investors.

Overall, the results indicate that aspects related to research, innovation, technical knowledge and costs have a significant impact on foreign direct investment decision-making.

3.7. Natural and geographical factors

The results presented in the Table 14 show the decisive natural and geographical factors when making foreign direct investments. Our own research has shown that geographical location plays a key role, being the most important factor for as many as 90% of respondents. This means that the country's location and its accessibility to various markets and regions is the main advantage that attracts investors. The supply of minerals and other natural resources is also of great importance, indicated by 52% of respondents. Owning natural resources can be attractive to companies that engage in mining activities and resource-based industries. The level of raw material independence was mentioned by 42% of respondents, which indicates the importance of a country that has its own resources and does not have to rely on imports of raw materials. Climate affects 42% of respondents, which may mean that favorable climatic conditions may be beneficial for specific industries or economic sectors.

The level of environmental pollution such as water, air and soil is an important factor for 31% of respondents. Countries with lower levels of pollution may be seen as more attractive to investors concerned about social and environmental responsibility. There is also another, unspecified natural or geographical factor, which was mentioned by 6% of respondents.

In summary, the results indicate that geographical location, natural resources, resource independence and the state of the environment have a key impact on decisions about foreign direct investment.

Table 14

Determining natural and geographical factors when making foreign direct investments

Geographic location [%]	Resource of minerals and other natural resources [%]	Level of raw material independence [%]	Climate [%]	Environmental pollution level (water, air, soil, etc.) [%]	Other [%]
90	52	42	42	31	6

The most important factors in assessing the investment climate of the country receiving investments indicated by respondents are the country's innovation, country's GDP value, market demand for a products or services, the level of the country's overall economic development and the competitiveness of the sector, pollution level and caring for clean air, good communication infrastructure and the ability to handle matters in English, simplification of bureaucracy and transparency of regulations as well as the condition of the natural environment in investment areas.

The study shows that 85.38% of respondents know that there are various methods of assessing the investment climate (attractiveness) of countries or regions. However, 14.62% of respondents answered negatively, i.e. they do not know about the existence of such methods (Tab. 15).

Table 15

Methods of assessing the investment climate

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	432	85.38	85.38	85.38
No	74	14.62	14.62	100.00
All	506	100.00	–	–

These results suggest that most respondents are aware of the existence of various tools and techniques for assessing the investment climate that can be used to analyze the attractiveness of investments in different places around the world. This may mean that these respondents have more extensive knowledge of markets and investment decision-making. However, a smaller group of people who lack this awareness may need more support or information in assessing potential investment locations (Tab. 16).

Table 16

Respondents' knowledge about the existence of various methods for assessing the investment climate (attractiveness) of countries (regions)

Number of employees	Data	Yes	No	All
1–9	Numbers	34.00	5.00	39.00
	%	87.18	12.82	100.00

Table 16 cont.

Number of employees	Data	Yes	No	All
10–49	Numbers	27.00	10.00	37.00
	%	72.97	27.03	100.00
50–249	Numbers	82.00	21.00	103.00
	%	79.61	20.39	100.00
Over 250	Numbers	289.00	38.00	327.00
	%	88.38	11.62	100.00
All	Numbers	432.00	74.00	506.00
	%	85.38	14.62	100.00

Chi-squared test result = 9.76; p = 0.02 indicate that there is a statistically significant relationship between the size of the company and the respondents' knowledge about the existence of various methods of assessing the investment climate (attractiveness) of countries (regions). Larger and micro companies had this knowledge to a greater extent than small and medium-sized companies. However, the strength of the relationship was not very high: Cramér's V = 0.14.

3.8. Knowledge of various approaches to assessing the investment climate (attractiveness)

The study presented in the Table 17 took into account various methods of assessing the investment climate used by respondents. The most popular method is the "Country Attractiveness Index", preferred by 38% of respondents, which is an indicator comparing different countries in terms of attractiveness for investment. Second in line is the approach based on "Venture Capital and Private Equity", chosen by 32% of respondents, which often provides information on potentially attractive places to invest. The methodology developed by Harvard Business School is popular and was indicated by 31% of respondents. The "BERI Index", used to assess political and economic risk, received 13% preference. Forbes magazine's methodology is chosen by 12% of respondents.

Other methods, such as "Methodology of the International Financial Corporation", "Methodology of Euromoney Magazine", "Methodology of RSPP and KPMG", "Methodology of the Bank of Austria (Regional Risk Assessment in

Russia)" and "Methodology of RAEX-Analytics", scored lower preference numbers of between 10% and 5% of respondents.

The results indicate a diversity of preferred methods for assessing the investment climate, which may result from the diversity of needs and specifications of the respondents. The choice of specific methods may depend on data availability, investment goals, type of industry and risks associated with specific investment destinations. This study may be a valuable indication for investors and enterprises who make decisions about foreign investments and need reliable tools to assess the attractiveness of a given country or region.

Table 17

Approaches to assessing the investment climate

Venture Capital and Private Equity country attractiveness index [%]	Harvard Business School methodology [%]	BERI Index [%]	Forbes magazine methodology [%]	Business Enabling Environment (BEE) of the World Bank Group [%]
38	32	31	13	12
Methodology of the International Financial Corporation [%]	Euromoney magazine methodology [%]	RSPP and KPMG methodology [%]	Bank of Austria methodology ("Regional risk assessment in Russia") [%]	Methodology of the company "RAEX-Analytics" [%]
10	7	7	5	0

The study shows that 38.54% of respondents indicated that their company uses investment attractiveness assessment methodologies when planning investment activities. However, 61.46% of respondents responded negatively, i.e. their company does not use such methods (Tab. 18).

These results show that the use of investment attractiveness assessment methodologies in companies is not common and the vast majority of respondents indicated that their company does not use such tools. It is possible that these companies base their investment decisions on other criteria or do not consider such analysis to be crucial in undertaking investment activities. However, for those companies that use investment attractiveness assessment methodologies, this analysis may be an important tool supporting decision-making processes and allowing for a more precise assessment of the risk and potential associated with given investments.

Table 18

Application of the investment attractiveness assessment methodology

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	195	38.54	38.54	38.54
No	311	61.46	61.46	100.00
All	506	100.00	–	–

The study presented in the Table 19 concerned respondents' preferences and the importance of various criteria when choosing a methodology for examining the investment attractiveness of the host country. The results indicate that the diversity of methods used and the availability of information are important factors for most respondents, obtaining high average values (8.66 and 7.49, respectively). Access to a wide range of information and international recognition of the methodology are also valued, with average values of 7.49 and 7.47.

The simplicity of the algorithm was considered less important, with an average value of 5.21, suggesting that it is not a key factor in the choice of methodology. Evidence of the effectiveness of the methodology was also important to respondents, with an average value of 7.94. This means that respondents want to prove that the selected methodology is reliable and effective.

The conclusions from this study may be valuable for companies and investors who make decisions about foreign investments and need tools to assess the attractiveness of potential investment locations. Preferred criteria may vary depending on the individual needs and specifications of respondents, therefore the choice of the appropriate methodology should be well thought out, taking into account the purpose and nature of the investment.

Table 19

Criteria of the methodology (approach)
for examining the investment attractiveness (climate) of the host country

Determinants	Important	Mean	Standard deviation	Minimum	Maximum
Information coverage	506	7.49	2.26	1.00	10.00
Simplicity of the algorithm	506	5.21	3.31	1.00	10.00

Table 19 cont.

Determinants	Important	Mean	Standard deviation	Minimum	Maximum
Availability of information	506	7.49	2/13	3.00	10.00
International recognition of the methodology	506	7.47	2.53	1.00	10.00
Variety of methods used	506	8.66	1.83	3.00	10.00
Proof of effectiveness of the methodology	506	7/94	2.16	4.00	10.00

The Table 20 presents the results of the Pearson correlation analysis between various criteria of the methodology for assessing the investment attractiveness of the host country. Information coverage and algorithm simplicity have a slight positive correlation ($r = 0.08$, $p = 0.09$). This means that the greater the information coverage, the simpler the algorithm is, but this relationship is not strong and is not statistically significant ($p > 0.05$).

The scope of information has a small negative correlation with the availability of information ($r = -0.13$, $p = 0.00312$) and the variety of methods used ($r = -0.13$, $p = 0.00309$). This suggests that the greater the information coverage, the less information availability and the less variety of methods used, but these relationships are weak. Information coverage has a small positive correlation with international recognition of the methodology ($r = 0.09$, $p = 0.05$) and evidence of effectiveness ($r = 0.16$, $p < 0.001$). This means that the greater the coverage, the greater the international recognition of the methodology and the evidence of effectiveness, but these relationships are weak.

The simplicity of the algorithm has a slight positive correlation with the availability of information ($r = 0.14$, $p = 0.00189$), but there is no significant correlation with the diversity of methods used ($r = -0.00377$, $p = 0.93$), international recognition of the methodology ($r = -0.03$, $p = 0.54$) and evidence of effectiveness ($r = 0.03$, $p = 0.53$).

Availability of information has a small positive correlation with the diversity of methods used ($r = 0.10$, $p = 0.03$), but a small negative correlation with international recognition of the methodology ($r = -0.09$, $p = 0.04$) and no significant correlation with evidence of effectiveness ($r = -0.04$, $p = 0.35$). The variety of methods used has a small positive correlation with evidence of effectiveness

($r = 0.12$, $p = 0.00773$), but no significant correlation with international recognition of the methodology ($r = −0.05$, $p = 0.25$). International recognition of the methodology has no significant correlation with evidence of effectiveness ($r = –0.07$, $p = 0.09$). All of these results should be interpreted taking into account the fact that correlations are general measures of the relationship between variables and do not indicate causal relationships.

Table 20

Pearson r correlations for variables: criteria of the methodology (approach) for examining the investment attractiveness (climate) of the host country

Determinant 1	Determinant 2	r	p
Information coverage	Simplicity of the algorithm	0.08	0.09
Information coverage	Availability of information	−0.13	$3.12 \cdot 10^{-3}$
Information coverage	Variety of methods used	−0.13	$3.09 \cdot 10^{-3}$
Information coverage	International recognition of the methodology	0.09	0.05
Information coverage	Proof of effectiveness of the methodology	0.16	$< .001$
Simplicity of the algorithm	Availability of information	0.14	$1.89 \cdot 10^{-3}$
Simplicity of the algorithm	Variety of methods used	$−3.77 \cdot 10^{-3}$	0.93
Simplicity of the algorithm	International recognition of the methodology	−0.03	0.54
Simplicity of the algorithm	Proof of effectiveness of the methodology	0.03	0.53
Availability of information	Variety of methods used	0.10	0.03
Availability of information	International recognition of the methodology	−0.09	0.04
Availability of information	Proof of effectiveness of the methodology	−0.04	0.35
Variety of methods used	International recognition of the methodology	−0.05	0.25
Variety of methods used	Proof of effectiveness of the methodology	0.12	$7.73 \cdot 10^{-3}$
International recognition of the methodology	Proof of effectiveness of the methodology	−0.07	0.09

The study shows that only 16.21% of respondents believe that it is possible to fully assess the investment climate of a country (region) solely on the basis of expert opinions. However, the vast majority, 83.79% of respondents, answered negatively that a full assessment of the investment climate is not possible only on the basis of expert opinions (Tab. 21).

These results suggest that most respondents recognize that assessing the investment climate of a country or region requires taking into account a broader range of factors than just expert opinions. There is a belief that a full assessment should be based on a variety of information sources, such as macroeconomic data, market analyses, economic indicators, statistics, support from financial and research institutions, as well as consultations with local entrepreneurs and experts.

A complete assessment of the investment climate is a complex task that requires a holistic approach and the consideration of many factors, not just one source of information. Respondents' responses suggest that investment researchers and entrepreneurs recognize the need to collect and analyze a wide range of data and perspectives to make well-informed investment decisions.

Table 21

Full assessment of the investment climate

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	82	16.21	16.21	16.21
No	424	83.79	83.79	100.00
All	506	100.00	–	–

The study shows that a qualitative methodology for assessing the investment climate should be based on a variety of analytical tools to provide a more complete and objective picture of the attractiveness of a given country or region for investment. The most frequently mentioned tool is relying on expert assessments, which are valued by 94% of respondents for their knowledge and experience in the field of investments. Statistical analysis of the dynamics of quantitative indicators was indicated as a key tool by 80% of respondents, which highlights the importance of numerical data and economic measures in assessing potential investments. Specialized stakeholder questionnaires were selected by 56% of respondents, suggesting that the views of various stakeholder groups, such as entrepreneurs, investors and government representatives, are also crucial in the analysis of investment attractiveness (Tab. 22).

Overall, the survey results show that a qualitative assessment of the investment climate requires a holistic approach and taking into account various sources of information. The use of expert assessments, statistical data, and stakeholder opinions allows for a better understanding of the investment context, risk and return potential. This study has important implications for businesses and investors who are looking for reliable tools to assess the attractiveness of potential investment locations and make well-informed investment decisions.

Table 22

What tools should the qualitative methodology
for assessing the investment climate be based on?

Expert ratings [%]	Statistical analysis of the dynamics of quantitative indicators [%]	Specialized stakeholder questionnaires [%]	Other [%]
94	80	56	16

4. A survey conducted among the management boards of Special Economic Zones

In a survey conducted among members of the management boards of special economic zones in Poland regarding the use of the services of specialized rating agencies, 85.71% of respondents believe that it is worth using these services to obtain information about the country of planned investments. However, 14.29% of respondents expressed the opposite opinion. These results indicate that rating agencies are perceived as a valuable source of information for most decision-makers in special economic zones in Poland (Tab. 23).

Table 23

Services of specialized rating agencies

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	12	85.71	85.71	85.71
No	2	14.29	14.29	100.00
All	14	100.00	–	–

In a survey conducted among members of the management boards of special economic zones in Poland regarding the use of the services of specialized agencies or external experts to assess the investment attractiveness of a country or region, all SEZs (100%) replied that they had not used such services in the past (Tab. 24).

Table 24

Services of specialized agencies

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
No	14	100.00	100.00	100.00
All	14	100.00	–	–

In response to a question addressed to members of the management boards of special economic zones in Poland regarding planning foreign direct investments and possible hiring of specialized rating agencies or external experts, the majority of SEZs (92.86%) declared that they were not considering such a step. Only one SEZ (7.14%) expressed interest in such support (Tab. 25).

Table 25

Hiring specialized rating agencies

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	1	7/14	7/14	7/14
No	13	92.86	92.86	100.00
All	14	100.00	–	–

4.1. Financial and economic factors

According to a survey conducted among members of the management boards of special economic zones in Poland, the most important financial and economic factors when planning foreign direct investments are the situation on the labor market (78.57% of respondents consider it decisive) and GDP/GNP (including per capita) and the level taxation and non-tax burdens, which were indicated by 64.29% of respondents each. Inflation was important to 28.57% of respondents and credit availability to 14.29%. Only 7.14% indicated another decisive factor (Tab. 26).

Table 26

Determining financial and economic factors when making foreign direct investments

Determinants	Frequency	Percent
Other	1	7.14
Availability of loans (short, medium and long-term)	2	14.29
Inflation	4	28.57
GDP/GNP (including per capita)	9	64.29
Level of taxation and non-tax burdens	9	64.29
The situation on the labor market	11	78.57

4.2. Political factors

In a survey conducted among members of the management boards of special economic zones in Poland on the decisive political factors when making foreign direct investments, as many as 85.71% of respondents indicated the favorable government policy towards business as a key factor. Not much less, 78.57%, consider political stability to be decisive. The importance of the availability, reliability and transparency of information and government intervention in the economy was emphasized by 28.57% of respondents. Meanwhile, only 21.43% of respondents indicated the level of corruption as an important factor, and only 7.14% indicated another decisive factor (Tab. 27).

Table 27

Decisive political factors when making foreign direct investments

Determinants	Frequency	Percent
Political stability	11	78.57
Level of corruption	3	21.43
Government intervention in the economy	4	28.57
Availability, reliability and transparency of information	4	28.57
Favorable government policy towards business	12	85.71
Other	1	7.14

4.3. Legal factors

In response to the question regarding key legal factors when making foreign direct investments in a survey conducted among members of the management boards of special economic zones in Poland, as many as 85.71% of respondents indicated discriminatory measures and control of foreign capital in relation to domestic capital and the effectiveness of the legal environment as decisive. An almost equally high percentage, 78.57%, considers the independence of the judiciary to be a key element. About 57.14% of respondents indicated other legal factors as important. However, the protection of property rights was important for 35.71% of study participants, while the repatriation of capital and the threat of nationalization were considered important by 14.29% of respondents (Tab. 28).

Table 28

Decisive legal factors when making foreign direct investments

Determinants	Frequency	Percent
Repatriation of capital (threat of nationalization)	2	14.29
Protection of property rights	5	35.71
Other	8	57.14
Independence of the judiciary	11	78.57
Discriminatory measures and control of foreign capital in relation to domestic capital	12	85.71
Effectiveness of the legal environment	12	85.71

4.4. Socio-demographic factors

In a survey conducted among members of the management boards of special economic zones in Poland regarding decisive sociodemographic factors when making foreign direct investments, the level of education of the population and the quality of human capital as well as the crime rate were considered crucial by 50% of respondents. Moreover, 42.86% of survey participants emphasized the importance of developing social infrastructure, such as services, education and medicine. The availability and structure of the working-age labor force were important for 35.71% of respondents. Only 7.14% of respondents indicated other sociodemographic factors as important for the investment process (Tab. 29).

Table 29

Determining sociodemographic factors when making foreign direct investments

Determinants	Frequency	Percent
Other	1	7.14
Availability and structure of the working-age labor force	5	35.71
Development of social infrastructure (services, education, medicine, etc.)	6	42.86
The level of education of the population and the quality of human capital	7	50
Crime rate	7	50

4.5. Infrastructural factors

In a survey conducted among members of the management boards of special economic zones in Poland on the decisive infrastructure factors when making foreign direct investments, the development of telecommunications infrastructure was considered crucial by 85.71% of respondents. For 64.29% of respondents, the development of transport infrastructure was also important, including, among others: road, rail or air transport. Half of the survey participants emphasized the importance of the overall development of infrastructure and the simplicity and cost of connecting to the power grid. In turn, 28.57% of respondents paid attention to the development of specific investment infrastructure, such as special economic zones or technoparks. Only 7.14% indicated other infrastructure factors as important for the investment process (Tab. 30).

Table 30

Decisive infrastructure factors when making foreign direct investments

Determinants	Frequency	Percent
Other	1	7.14
Development of investment infrastructure (SEZ, Technoparks, etc.)	4	28.57
General infrastructure development	7	50
Simplicity and cost of connecting to the power grid	7	50
Development of transport infrastructure (car, railway, air, etc.)	9	64.29
Development of telecommunications infrastructure	12	85.71

4.6. Technological factors

In a survey conducted among members of the management boards of special economic zones in Poland regarding the decisive technological factors when making foreign direct investments, the most important factors were the level of innovation development and corporate research and development (concerning access to technical knowledge) – both of these aspects were indicated by 78.57% respondents. More than half of the survey participants (57.14%) also emphasized the importance of research and development costs. The number of patent applications proving innovative activity and other technical factors were important for 28.57% of respondents. However, the availability of mobile communication and the Internet was crucial for 21.43% of respondents (Tab. 31).

Table 31

Decisive technological factors when making foreign direct investments

Determinants	Frequency	Percent
Availability of mobile communication and Internet	3	21.43
Number of patent applications (innovative activities)	4	28.57
Other	4	28.57
Research and development costs	8	57.14
Level of innovation development	11	78.57
Corporate R&D (Access to technical knowledge)	11	78.57

4.7. Natural and geographical factors

In response to a question addressed to members of the management boards of special economic zones in Poland regarding decisive natural and geographical factors when making foreign direct investments, all respondents (100%) emphasized the importance of geographical location. Another important factor, indicated by 64.29% of survey participants, is the level of raw material independence of the country hosting the investment. Half of the respondents (50%) attached importance to the level of environmental pollution (including water, air, soil), mineral resources and the climate of the destination country. Only 14.29% of respondents indicated other natural and geographical factors that were not mentioned in the survey (Tab. 32).

Table 32

Determining natural and geographical factors when making foreign direct investments

Determinants	Frequency	Percent
Other	2	14.29
Environmental pollution level (water, air, soil, etc.)	7	50
Resource of minerals and other natural resources	7	50
Climate	7	50
Level of raw material independence	9	64.29
Geographic location	14	100

In response to a question addressed to members of the management boards of special economic zones in Poland regarding their knowledge of various methods for assessing the investment climate (attractiveness) of countries (regions), the vast majority of respondents (92.86%) confirmed that they were aware of the existence of such methods. Only one management board member (7.14%) did not have this knowledge (Tab. 33).

Table 33

Methods of assessing the investment climate

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	13	92.86	92.86	92.86
No	1	7.14	7.14	100.00
All	14	100.00	–	–

Research conducted among members of the management boards of special economic zones in Poland concerned approaches to assessing the investment climate of countries and regions. The results indicated that the most popular methodology among respondents is the BERI Index, which was chosen by 64.29% of respondents. The second most popular methodology, with a 50% popularity rate, is the approach developed by Harvard Business School. The Venture Capital and Private Equity country attractiveness index was supported by 35.71% of respondents.

Moreover, the Bank of Austria's methodology for assessing regional risk in Russia was recognizable to 21.43% of respondents. The same percentages, i.e. 14.29%, were achieved by the methodology of Forbes magazine and the Business Enabling Environment (BEE) of the World Bank Group (Tab. 34).

Table 34

Approaches to assessing the investment climate

Methodologies	Frequency	Percent
Forbes magazine methodology	2	14.29
Business Enabling Environment (BEE) of the World Bank Group	2	14.29
Bank of Austria methodology ("Regional risk assessment in Russia")	3	21.43
Venture Capital and Private Equity country attractiveness index	5	35.71
Harvard Business School methodology	7	50
BERI Index	9	64.29

Research conducted among members of the management boards of special economic zones in Poland concerned whether their SEZs use investment attractiveness assessment methodologies when planning investment activities.

The analysis of the research results shows that the majority of SEZs (71.43%) do not use such methodologies in the process of planning investment activities. Only 28.57% of SEZs used investment attractiveness assessment methodologies in their investment activities. It can therefore be concluded that despite the existence of various methodologies for assessing investment attractiveness, many SEZs in Poland do not use them in practice (Tab. 35). It is worth adding that the lack of use of these tools does not necessarily mean that these SEZs do not analyze the risk and investment potential in a different way. They may use their own internal assessment methods or rely on the experience and intuition of the management board.

Table 35

Application of the investment attractiveness assessment methodology

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	4	28.57	28.57	28.57
No	10	71.43	71.43	100.00
All	14	100.00	–	–

The research was aimed at determining whether, in the respondents' opinion, it is possible to fully assess the investment climate of the country (or region) based solely on the opinion of experts. The presented research results in the table 36 show that the vast majority of respondents (78.57%) believe that it is not possible to fully assess the investment climate of a country (or region) based only on the opinion of experts. Only 21.43% of respondents believe that such an assessment is possible.

These results suggest that the majority of management board members believe that additional tools, data, or analyses are necessary to accurately assess the investment climate, and that expert opinion is only a component of a comprehensive assessment. This may also indicate that decision-makers consider practical experience, specific data and analyses to be a more reliable source of information than expert opinions, which may be subjective.

Table 36

Full assessment of the investment climate

Answers	Frequencies	Percent	Percentage valid	Cumulative percentage
Yes	3	21.43	21.43	21.43
No	11	78.57	78.57	100.00
All	14	100.00	–	–

The research conducted among members of the management boards of special economic zones in Poland was aimed at understanding what analytical tools the respondents consider necessary for a qualitative methodology for assessing the investment climate. The research results show that expert assessment is most important to them, with 85.71% of respondents indicating it as a key tool. Nearly equally important is the statistical analysis of the dynamics of quantitative indicators, the importance of which was emphasized by 78.57% of respondents. About one third of respondents (35.71%) believe that specialized questionnaires addressed to stakeholders are an important element of the assessment. In turn, 14.29% of survey participants paid attention to other tools not included in the survey, which suggests a variety of approaches to assessing the investment climate (Tab. 37).

Table 37

What tools should the qualitative methodology
for assessing the investment climate be based on?

Tools	Frequency	Percent [%]
Other	2	14.29
Specialized stakeholder questionnaires	5	35.71
Statistical analysis of the dynamics of quantitative indicators	11	78.57
Expert ratings	12	85.71

5. Conclusions

Based on the research conducted, we have compiled a list of the most significant factors shaping the investment climate of a country, as perceived by potential investors. The selected determinants were categorized (grouped) into respective clusters. Leading positions among the group of financial and economic factors are held by: the level of taxation and non-tax payments, labour market stability, and GDP/GNP (including per capita).

Among the legal factors, respondents noted the independence of the judicial authority, potential discriminatory measures, foreign capital control compared to domestic capital, and the effectiveness of the legal environment. The most important determinants in the group of political factors, as indicated by the survey participants, include the overall political stability in the host country, the favourability of government policies toward business, and the level of corruption.

The most significant socio-demographic indicators of the investment environment's development are the unemployment rate, the development of soft infrastructure, the level of education, and the quality of human capital. Opinions on infrastructure factors leaned in favour of the development of general physical infrastructure (energy, housing, offices, etc.), as well as communication and transportation infrastructure. The determining technological determinants were identified as corporate research and development, the level of overall innovation development, and the cost of conducting research and development activities.

Among the climatic and geographical factors, the potential investors express the greatest interest in the country's geographical location, the balance of various natural resources, including valuable minerals, climate conditions, and the level of resource independence. The obtained results will be further used by us in the development of the author's methodology for evaluating the investment climate.

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Summary

The purpose of the research is the identification of important determinants shaping the investment attractiveness of the country (region) from the point of view of potential investors and an assessment of the degree of stakeholder satisfaction with existing methods of examining the investment climate and their availability for practical use. In order to assess a set of determinants that exert the most significant influence on a country's investment climate, a questionnaire was developed consisting of 25 questions of various orientations. These questions were designed to assess the opinions of potential investors regarding the degree of influence of various factors on their decision on capital allocation and the investment climate of a country. The survey was conducted among 506 enterprises and 14 management bodies of Special Economic Zones in Poland from June 10 to July 20, 2023. The final step involved the analysis of the survey results using statistical methods.

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