The Impact of Monetary Policy Institutional Decisions on Convergence in Central and Eastern European Countries*

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Our study looks at the role of monetary policy related institutional decisions in the nominal and real convergence of the 11 former socialist Central and Eastern European EU Member States over the three decades following their regime change. We use our empirical model to estimate the impact of four key drivers of the monetary policy framework (exchange rate regime, central bank independence, inflation targeting, euro adoption) on inflation and real economic growth. Our main finding is that the convergence rate over the past decades has had little to do with the choice of exchange rate regime or the potential adoption of the euro or inflation targeting and much more with the establishment of central bank independence. The latter has reduced inflation by roughly 5 percentage points, while boosting real GDP growth by about 2 percentage points. This suggests that central bank independence significantly enhances the credibility and predictability of monetary policy and largely determines the success of each monetary regime.

Journal of Economic Literature (JEL) codes: C33, E42, E65, O43

Keywords: monetary policy, convergence, institutions, inflation, economic growth

1. Introduction

Our study looks at the impact that the decisions made by monetary policy institutions had on nominal and real economic convergence of the 11 former socialist EU Member States in Central and Eastern Europe (Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) after their regime change. For more than four decades, these countries operated on the

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basis of the Soviet economic system in which the state dominated the economy, making decisions on investment, production, prices and trade. The market operated only in a negligibly small segment of the economy where it was allowed. Socialist countries essentially traded among themselves and foreign trade was very limited.

All of this suddenly changed in the early 1990s when these countries regained their sovereignty. They immediately faced massive economic challenges as the break-up of the Soviet Union and the disintegration of the COMECON market led to shrinking GDP, while price liberalisation fuelled inflation. These trends were observed in all of the countries covered, albeit to varying degrees.

All of these countries' announced policy goal was to achieve convergence with developed countries as soon as possible. This was also the main hope and expectation of the population after regaining sovereignty, as a result of market reforms and the establishment of capitalism. Governments had to make some important decisions in selecting the economic policy institutional set-up that effectively promote convergence.

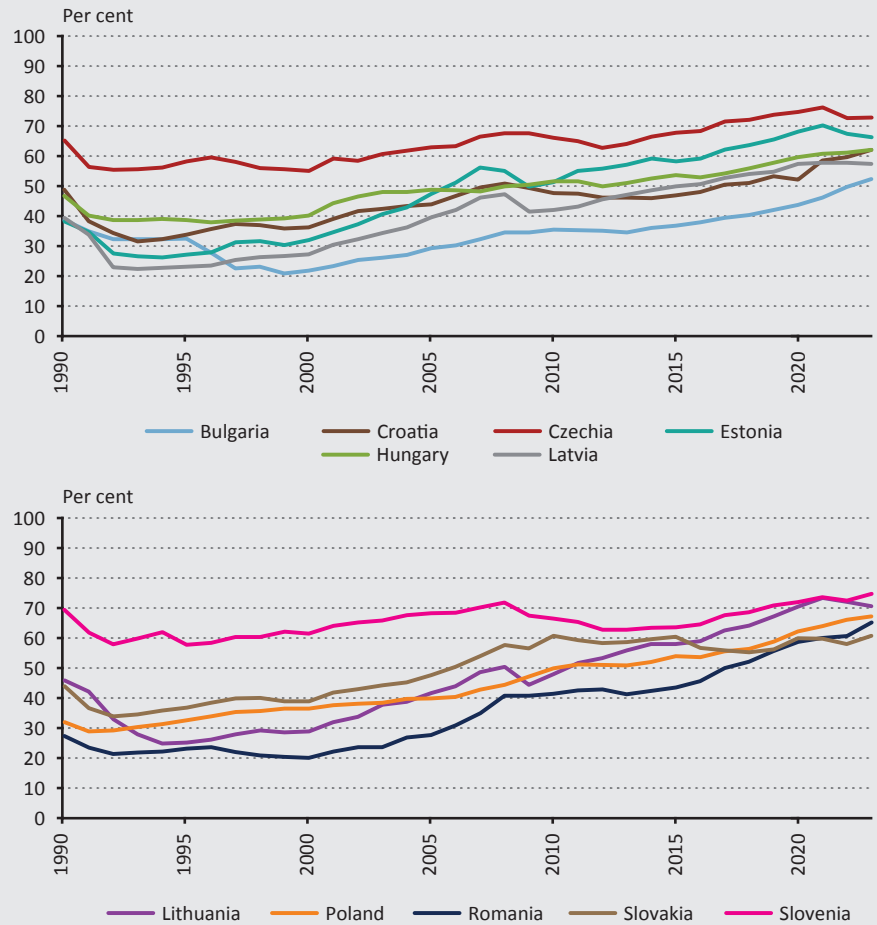
It should be pointed out that policymakers at the time had limited knowledge of how these institutions worked, and even less practical experience, although some former socialist countries, for example Hungary and Yugoslavia, had already initiated limited market reforms in the 1980s. Institutional decisions in the early 1990s, such as the choice of exchange rate regime, were often taken on external advice. Typically, external advisors included the IMF, the World Bank and the EU. Preparation for EU membership itself played a decisive role in the institutional decisions under review.

There is no doubt that all of the former socialist countries have been on a path towards real and nominal convergence since their regime change, which is natural as they started from a much lower level of development compared to developed Western European countries. We present real economic convergence compared to Austria through the evolution of GDP per capita (*Figure 1*).

In all of the countries covered, GDP declined in the years following regime change, mainly due to the break-up of the Soviet Union, the loss of export markets and increases in the prices of oil and gas imported from the Soviet Union. After a few years, as the former socialist countries transitioned to a market economy, all of them embarked on a convergence path, albeit with some differences. Slovenia, which had the highest GDP per capita (69 per cent of that of Austria in 1990), shows slower convergence, but had still made the most progress as of 2022 (75 per cent). By contrast, Romania's convergence has been very significant, with its GDP per capita increasing from 27 per cent to 65 per cent compared to Austria between 1990

and 2023. Over the years, the differences between the levels narrowed sharply, falling from 42 percentage points to 22 percentage points, with differences now ranging from 60 to 75 per cent, with the exception of Bulgaria and Latvia.

Figure 1
GDP per capita in comparison to Austria

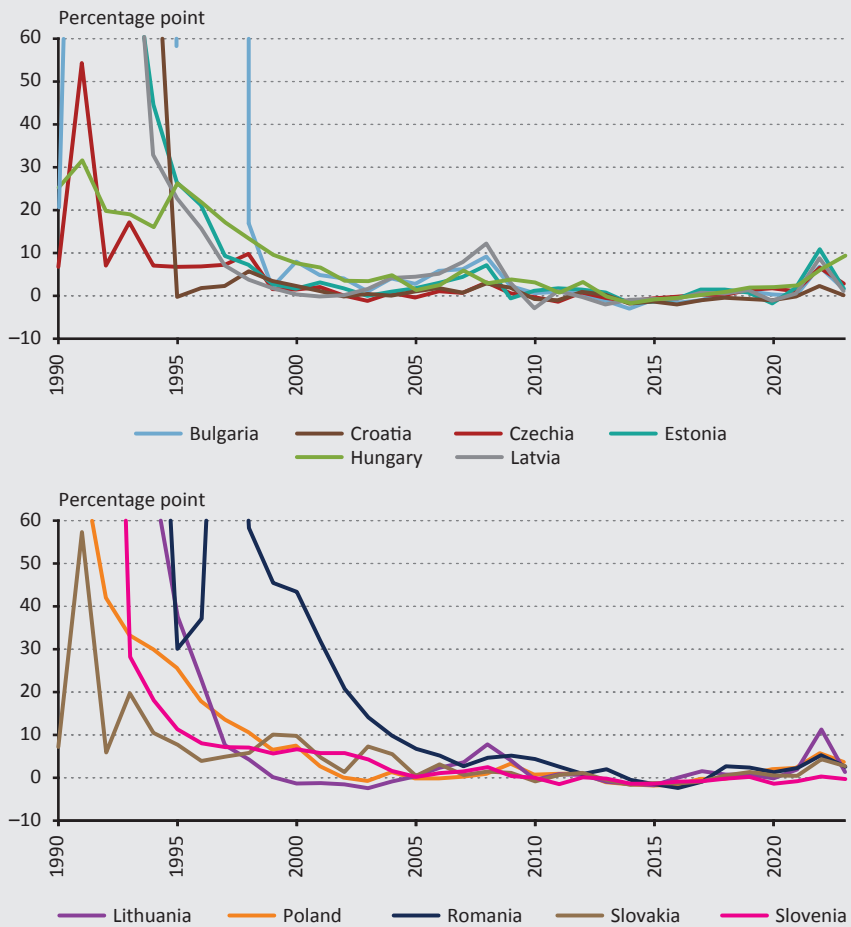


Note: Based on per capita GDP data in USD
Source: World Bank, World Development Indicators, authors' calculations

The differences between inflation in each of the countries compared to inflation in Austria is shown in *Figure 2*. It can be seen that inflation in the 1990s varied widely in the countries covered, both in terms of level and dynamics. Some countries started from very high levels, typically followed by rapid decline. Others, by contrast, went from the initial levels to even higher inflation levels before a decline occurred.

With the exception of Romania, nominal convergence was more or less achieved by the early 2000s, and the gaps between the countries covered narrowed. This trend was temporarily interrupted after the 2008 global economic crisis and the Russia–Ukraine war that started in 2022, but by 2023, 10 out of the 11 countries had relative inflation rates (compared to Austria) between –0.37 and 3.71 per cent.

Figure 2
Evolution of inflation differences in comparison to Austria



Source: World Bank, World Development Indicators, authors' calculations

Our study does not analyse the rate of convergence of each country, but rather the extent to which the choice of monetary policy framework has contributed to growth and disinflation. This study is novel insofar as it offers guidance on the choice and the timing of introduction of institutional framework to former socialist countries

planning to join the EU. Our results can, of course, be useful for all developing countries.

Our empirical analysis examines the impact on convergence of the following four key drivers of the monetary policy framework: exchange rate regime, central bank independence, inflation targeting and euro adoption. These drivers were chosen as they are associated with institutional decisions that all of these countries had to make and that are measurable.

Our results show that, in these countries, central bank independence was the driver that contributed the most to real and nominal convergence, that is, to GDP growth and inflation decline. However, it is important to stress that the methodology applied does not guarantee that the strong link shown is necessarily causal in nature, meaning that it captures the pure causal effect of central bank independence on inflation and GDP growth. The interpretation of our results is further put into context by the fact that they may also reflect the impact of other institutional changes that took place in parallel with the strengthening of central bank independence, essentially as part of the EU accession process.

Several authors have mentioned that, over the years, the independence of central banks has been steadily growing (*Dincer – Eichengreen 2014; Romelli 2024*). Considering 16 countries over the period between 1955 and 1988, *Alesina and Summers* (*1993*) looked at how inflation and GDP growth and their volatility changed as central bank independence evolved. They found that central bank independence played a significant role in price stability. *Cukierman et al.* (*1993*) studied 70 countries over the period between 1960 and 1989 to show that central bank independence reduces inflation, but its effect on growth varies depending on how developed a country is. For less developed countries, central bank independence also contributed to growth, but for developed countries, this effect disappeared. The authors explained this by the fact that developed countries mostly had a higher level of central bank independence than less developed countries. Looking at 96 developing countries over the period between 1980 and 2014, *Garriga and Rodriguez* (*2023*) showed that central bank independence reduced inflation volatility. *Casinhas* (*2019*) provided a good summary of the results on the impact of central bank independence on inflation and growth.

Several authors highlight the role of central bank independence. To the extent that high inflation has a negative impact on the development of the economy in the long term by reducing investments and their efficiency (*De Gregorio 1996*), the commitment to low and stable inflation by a central bank that is independent and communicates in a transparent manner may be more credible. This improves predictability and confidence among economic agents, thereby reducing the

risk premium, which in turn stabilises money markets and stimulates long-term investment (*Alesina – Summers 1993*). Generally, but not in every case, central bank independence insulates the institution from short-term political pressures, thus also contributing to improved predictability and confidence. This in turn contributes to keeping inflation down and to economic growth. Accordingly, it comes as no surprise that central bank independence is a key driver in our results. In addition, central bank transparency is an important factor, as examined by several previous studies. *Dincer and Eichengreen* (*2014*) found that central bank transparency has also increased in Central and Eastern European countries, alongside central bank independence. For the countries covered, transparency indices are available for only a part of the period covered and are therefore excluded from our model. As *Dincer and Eichengreen* (*2014*) showed that central bank transparency and independence are interrelated, we believe that omitting transparency from the model does not reduce its explanatory power.

Another important implication of our estimation is that inflation targeting has played a key role in reducing inflation in the countries that have adopted it, which is consistent with the results of other studies. *Mishkin and Schmidt-Hebbel* (*2007*) examined the monetary policy and macroeconomic performance of 21 developing and developed countries before and after inflation targeting over the period between 1989 and 2004, comparing them to a group of countries with no inflation targeting. They concluded that the adoption of inflation targeting reduces inflation as well as the volatility of both inflation and growth. This effect is stronger in developing countries. *Arsić et al.* (*2022*) looked at the impact of the adoption of inflation targeting on macroeconomic performance in 26 emerging economies in Europe and Central Asia over the period between 1997 and 2019. The results of the study showed that the adoption of inflation targeting reduced both the level and volatility of inflation and the volatility of GDP but had no effect on GDP growth. Looking at 35 developing countries over the period between 1995 and 2017, *Romdhane et al.* (*2023*) showed that the adoption of inflation targeting helped maintain economic growth and financial stability.

However, no similar effect was found for euro adoption, presumably due to nominal convergence being achieved before accession to the euro area.

For both drivers (inflation targeting and euro adoption), we found a negative, although insignificant, effect on real growth. The results obtained for inflation targeting seem to contradict the generally accepted view that a sustained decline in inflation has a positive impact on potential growth. In our view, however, the impact of the adoption of inflation targeting should not be viewed in isolation, as in the countries covered it has always been accompanied by an increase in central bank independence, and taking the latter into account, we can talk about both significant disinflationary and positive growth effects.

The literature offers varying views on the impact of exchange rate regimes on inflation and growth in developing countries. Some studies find a positive correlation between a fixed exchange rate, and low inflation and accelerated growth. Others, however, consider more flexible exchange rates to be more effective in terms of these two factors. It is always highlighted in the literature that many other factors may influence the role of exchange rate regimes, including, for example, the commitment of governments to maintain a particular regime, or whether a shock to a country's economy is caused by exogenous or endogenous factors. *Ghosh et al.* (*2013*), studying 159 countries, *Ghosh et al.* (*2015*), studying 50 emerging countries, and *Zeev* (*2019*), studying 40 emerging countries, found that a flexible exchange rate regime has a more positive effect on growth than a fixed one. The reason for this was the economy's better resilience due to the flexible regime, which was mostly shown in case of shocks. Authors who have looked specifically at Central and Eastern European (CEE) countries found exactly the opposite correlation, meaning that a rigid, fixed exchange rate regime had an advantage over a flexible one. *Arratibel et al.* (*2011*) and *Morina et al.* (*2020*) studied 14 CEE countries. They argued that exchange rate volatility increased GDP volatility, which curbed growth.

Our study covers a limited group of countries and a period when countries were aiming to join the European Union, with many of them also acceding to the euro area. Our model calculations show that intermediate regimes, such as band pegging and managed floating, may have contributed to disinflation, but we did not see any significant difference for each exchange rate regime in terms of real economic impact. This is in line with *Rose and Rose* (*2024*) that the literature has been unable to find large differences between different exchange rate regimes.

Overall, the monetary policy frameworks of the countries covered have been effective in promoting nominal convergence and have also been able to contribute to economic growth. There were no significant differences in the extent of these effects between countries which based their monetary policy strategy fundamentally on exchange rate policy and early euro adoption, and countries which consistently based their monetary policy on inflation targeting. Our calculations clearly show that central bank independence has a positive impact on reducing inflation and boosting GDP growth.

In the second section of this study, we briefly describe the evolution of monetary policy regimes in the countries covered from regime change to the present. We then set out our empirical model (*Section 3*) and use it as a basis to present our calculations of the extent to which decisions by monetary policy institutions contributed to nominal and real convergence (*Section 4*). *Section 5* summarises the main findings and draws the lessons learned.

2. Evolution of monetary frameworks in the countries covered[1]

In the following, we briefly describe the evolution of the monetary frameworks of the 11 countries in the focus of our study in the decades following regime change.

Bulgaria

During the first years of transition, the Bulgarian central bank's monetary policy focused on the money growth rate. No explicit targets were set for the exchange rate of the Bulgarian lev; interest rate policy, however, was often influenced by significant exchange rate fluctuations (*Mihov 2002*).

With the real economy contracting almost continuously, a banking crisis unfolded in 1995 and inflation dynamics reached hyperinflationary levels in 1997. The stabilisation package implemented in response to the crisis included the establishment of a currency board that pegged the Bulgarian lev to the Deutschmark. Later on, the euro replaced the Deutschmark as the anchor currency. Bulgaria joined ERM II in 2020, retaining the currency board.

Croatia

In 1991, the year when Croatia declared independence, it adopted its own currency, the Croatian dinar. This was replaced in 1994 by the kuna, which remained Croatia's official currency until the country's accession to the euro area in 2023. The Croatian central bank always based its monetary policy on the stability of the exchange rate, mainly due to the openness of the economy and its high degree of euroisation. The regime was often called a quasi-currency board (*Vujčić 2003*) as the central bank's foreign exchange reserves always exceeded the monetary base and the latter was expanded mainly through foreign exchange purchases and increases in the reserves. However, it differed from an actual currency board in that there was no explicit exchange rate target announced and the kuna exchange rate was not fully stable against any of the currencies. Croatia has been a member of the euro area since 2023.

Czechia

Czechia introduced the Czech koruna in 1993 after the dissolution of Czechoslovakia. The exchange rate of the Czech koruna was pegged to a basket of currencies with a narrow intervention band. In addition to exchange rate targeting, the central bank also pursued money supply targets (*Frömmel – Schobert 2006*). In February 1996, the intervention band was widened to ±7.5 per cent. In 1997, following the koruna exchange rate crisis, the Czech central bank moved from pegging the exchange rate to free float.

[1] In this Section, we have drawn on information available on the website of each central bank, in addition to the studies cited.

Czechia was the first in the region to adopt an inflation targeting regime in 1998. Initially, so-called net inflation (net of regulated prices and indirect taxes) was targeted, with target bands that changed from year to year, but were consistently reduced. From 2002, the central bank defined its inflation target band by using the headline inflation rate, and from 2006 a fixed target of 3 per cent was set, which was then reduced to 2 per cent from 2010. This target still applies to this day.

In 2013, the central bank reached the zero lower bound for interest rates and introduced an asymmetric exchange rate target to weaken the koruna, in order to further stimulate the economy. The exchange rate target was maintained until 2017 when the central bank reverted to a pure inflation targeting regime.

Estonia

Gaining its independence in 1991, Estonia adopted its own currency, the kroon, in 1992 and pegged its exchange rate to the Deutschmark in a currency board. In 1999, the euro became the anchor currency. Estonia joined ERM II in 2004 and acceded to the euro area in 2011.

Hungary

In the first half of the 1990s, the Magyar Nemzeti Bank applied an exchange rate peg. Exchange rate targets with a narrow intervention band were often devalued on an ad-hoc basis. The devaluations were aimed at maintaining external balance. In 1995, a crawling peg regime was introduced where the pre-announced monthly devaluation rate of the Hungarian forint's ±2.25 per cent intervention band was gradually reduced from the initial 1.9 per cent to 0.2 per cent in 2001.

Under the crawling peg regime, inflation fell from 30 per cent to 10 per cent, but the disinflation process stalled there. In 2001, the central bank therefore decided first to widen the intervention band to ±15 per cent and then adopted inflation targeting. Initially set for the end of each year, the targets were reduced from 7 per cent in 2001 to 3.5 per cent in 2006. Since 2007, a continuous 3-per cent target has been in place.

Latvia

Latvia declared independence from the Soviet Union in 1990. Adopted provisionally, the Latvian ruble, which had been in circulation simultaneously with the Russian rouble since 1992, was replaced in 1993 by the country's own currency intended to be definitive, the lats, which was pegged to the IMF's unit of account, the SDR, with an intervention band of ±1 per cent. The narrow band, combined with the central

bank's ample foreign exchange reserves, made the regime virtually equivalent to a currency board (*Staehr 2016*). The country switched to pegging to the euro immediately before joining ERM II in 2005. Latvia adopted the euro in 2014.

Lithuania

Gaining independence in 1990, Lithuania initially adopted a temporary currency, the talonas, which was in circulation simultaneously with the rouble, as in Latvia. It was replaced in 1993 by the Lithuanian litas which floated freely for a while. However, in response to persistently high inflation, a currency board regime was set up in 1994, pegging the litas to the US dollar. In 2002, the US dollar was replaced by the euro as the anchor currency. Lithuania joined ERM II in 2004 and adopted the euro in 2015.

Poland

For most of the 1990s, the Polish central bank used money supply and exchange rate targets to curb inflation. Also, with a view to maintaining external competitiveness, it applied a crawling peg to the Polish zloty from 1991. The intervention band around the central parity was widened in several steps from the initial ±0.5 per cent (in 1991) to ±15 per cent before the exchange rate band was abandoned in 2000 (*Jurek – Marszałek 2008*).

Although the central bank had had public targets for inflation since 1995 (*Jurek – Marszałek 2008*), the inflation targeting regime as we understand it today, where the inflation target takes precedence, was introduced in 1999. The crawling exchange rate band target was nevertheless maintained until 2000. Inflation targets were gradually lowered until 2004, from an initial target of 9.5 per cent to the current 2.5 per cent.

Romania

In the first half of the 1990s, the main challenge for the Romanian central bank was inflation, which mostly ranged in the triple digits. Its monetary policy was based on targeting the money supply and the leu exchange rate. Given that ensuring price stability was not yet its primary objective by law, the central bank aimed to strike a balance between disinflation efforts and other objectives such as external balance (*Dragulin – Radulescu 1999*). Inflation was only brought down persistently to double-digit levels in the second half of the decade.

In 2005, the Romanian central bank redenominated the currency (1 new Romanian leu was worth 10,000 old Romanian leu) and introduced an inflation targeting regime. Initially set at 7.5 per cent, the inflation target was gradually lowered to the 2.5-per cent level that has applied since 2013. The Romanian central bank has regularly intervened in the foreign exchange market to prevent excessive volatility in the leu exchange rate.

Slovakia

In the period following the introduction of the Slovak koruna as an independent currency in 1993, Slovakia, similarly to Czechia, maintained a narrow-band exchange rate target, while trying to control the money supply. In 1996, the koruna intervention band was widened from ±0.5 per cent to ±5 per cent in order to reduce speculative capital movements. 1998 marked the move to a floating regime, but the Slovak central bank intervened in the foreign exchange market in both directions on numerous occasions.

The central bank's medium-term monetary programme of December 2004 set up a monetary policy framework for the period up to euro adoption which was based on joining the ERM II and pursuing inflation targeting. The koruna joined the European exchange rate regime in November 2005, where its central parity was revalued once in 2007 at the request of Slovakia. The central bank set the inflation target at 2.5 per cent in December 2006 and 2 per cent in December 2007. Slovakia adopted the euro in January 2009 at a rate stronger than the ERM II central parity.

Slovenia

In 1991, Slovenia became an independent state, established its central bank and adopted its own currency, the tolar, which floated freely throughout 1992. From 1993, the central bank sought to reduce inflation through monetary targeting. It also intervened in the foreign exchange market on a regular basis to lower exchange rate volatility. In 1995, capital controls were implemented, allowing monetary and (implicit) exchange rate targets to be decoupled to some extent. During this period, the exchange rate became an intermediate target of equal importance to money supply (*Caprirolo – Lavrač 2003*).

By the early 2000s, adopting the euro as soon as possible already became a priority of the monetary strategy. By 2001, capital controls were fully lifted and a shift was made to a monetary policy purely based on the exchange rate with the primary objective of achieving price stability (*Caprirolo – Lavrač 2003*). Slovenia joined ERM II less than two months after acceding to the EU and was the first former socialist country in Central and Eastern Europe to adopt the euro in 2007.

3. Empirical model for the impact of institutional decisions

In our empirical analysis, we sought to quantify the impact of monetary policy strategy on nominal and real convergence. For this purpose, a linear regression model was estimated based on panel data. The dependent variables in our regression model were the annual average inflation rate and the annual real GDP growth rate. The estimation period runs from 1990 to 2019, but the years for which data are available for all variables in the estimate vary across countries. A fixed

effect model was used to estimate the coefficients. Observations where annual inflation exceeded 100 per cent were excluded from the estimate.

In addition to the 11 countries covered by the study, our panel database included data for Albania, Bosnia and Herzegovina, Moldova, North Macedonia and Ukraine. The reason for this is that, although our study focuses on the countries in the region that have already acceded to the EU, the aforementioned five additional countries, as former members of the former socialist bloc, are also aiming for ever closer European integration, with real and nominal convergence being an important element. We believe that including them in the estimation allows for a greater number of useful observations without significantly increasing heterogeneity, thereby enabling a more accurate estimation of the effects sought.

The monetary strategies implemented are captured by a number of measurable variables, hereinafter referred to as institutional variables. These are the flexibility of the exchange rate regime, the adoption of inflation targeting, euro adoption and central bank independence.

We experimented with two indicators for the exchange rate regime: one is the de facto classification (hereinafter "IRR") by *Ilzetzki et al.* (*2019*) and the other, based on the latter, is the so-called effective exchange rate regime variable (hereinafter "HK") by *Harms and Knaze* (*2021b*). We chose these databases because, first, they cover most of the countries and time periods examined and, second, they are *de facto* classifications, meaning that they do not consider the regime declared by the central bank/government, but rather the actual behaviour of the exchange rate.

As the first step, *Ilzetzki et al.* (*2019*) identify the reference currency or basket of currencies against which the exchange rate of the country covered has shown relative stability. As the second step, exchange rates are classified into the following categories based on their volatility against the reference currency or basket: 1) currency board, peg with a band of up to ±2 per cent; 2) crawling peg with a band of up to ±2 per cent; 3) crawling peg with a wider band, managed float; 4) free float.[2]

The monthly data from *Ilzetzki et al.* (*2019*) were converted to annual data by assigning the value that occurs in most months to each year. A particular feature of the index is that the exchange rate regimes of Poland, which has officially floated its exchange rate freely for a long time, and Czechia before 2014 are classified as managed float (Category 3) and, in our sample, only the Albanian lek's exchange rate for 1994 and 1995 is classified as free float (Category 4).

[2] In our sample period, there are also two additional categories, namely the so-called free falling exchange rate and the case where the official exchange rate does not reflect market conditions, while the actual market ("black") exchange rate is unknown. These observations were excluded from the estimation.

Harms and Knaze (*2021b*) argued that using only one reference currency, the stability of an exchange rate can only be determined to a limited extent, as countries typically engage in foreign trade with many other countries. For this reason, an effective exchange rate regime index was constructed based on, among others, the methodology of *Ilzetzki et al.* (*2019*), by weighting together the bilateral regimes established by *Harms and Knaze* (*2021a*), where the weights were determined by the share of bilateral trade volume in a country's total foreign trade. Given that this indicator is potentially more accurate in capturing *de facto* exchange rate stability, we have also used it to prepare our estimates. The index by *Harms and Knaze* (*2021b*) can be considered as a continuous variable with a potential set of values ranging from 1 to 4.

It should be noted that, in addition to actual (*de facto*) exchange rate flexibility, the declared, i.e. *de jure*, regime in itself can also have a macroeconomic impact. *Ghosh et al.* (*2014*) show that an explicit commitment to a stable exchange rate can help anchor inflation expectations. Similarly to *de facto* exchange rate regimes, *Harms – Knaze* (*2021b*) also calculate an effective *de jure* index using the classification in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. However, this database is only available for the 2000s and, since the 1990s are of great importance to our analysis, we only employed the *de facto* indices.

In addition to exchange rate policy, we also wanted to see whether the adoption of inflation targeting had a demonstrable effect on nominal and real convergence. This is captured by a dummy variable that takes a value of 1 in the year when a country officially applies inflation targeting and 0 otherwise. Similarly, a dummy variable was used to capture the regime change when a country officially accedes to the euro area.[3]

The central bank independence index by *Romelli* (*2022*) was used to approximate the level of development of the institutional set-up. This index assesses the institutional background and statutory mandate of central banks based on 42 criteria, grouped into 6 dimensions: (1) central bank governor and decision-making body; (2) monetary policy and conflict resolution; (3) monetary policy objectives; (4) restrictions on lending to the government; (5) financial independence; and (6) accountability. We chose this indicator because, in addition to being based on previously widely-used indices, it is available for most of the countries in our sample dating back to the early 1990s.

[3] For the dates of adoption of the euro and inflation targeting, see the discussion of each country's monetary regime. The only exception is Slovakia, as we ignored its inflation targeting in ERM II because we did not consider its inflation targets to be the primary nominal anchor during this period; ERM II and the upcoming euro adoption may have been the real nominal anchor via the exchange rate.

In addition to the institutional variables that are the focus of our study, we sought to improve the accuracy of estimates and minimise endogeneity bias by employing a wide range of control variables commonly used in the literature. These included money growth rate, foreign trade openness, financial openness, current account balance as a share of GDP, budget balance as a share of GDP, government debt as a share of GDP, quality of institutions,[4] inflation and GDP growth in the euro area, and the logarithm of GDP per capita (calculated on a PPP basis) lagged by one year. In addition, the inflation model also included the contemporaneous GDP growth in a country, while the GDP model included the contemporaneous inflation rate in a country.[5]

Estimation results may be biased if there is also an inverse relationship between inflation and GDP, and institutional variables, or if a third variable has an impact on both. We seek to minimise the latter risk by including in the control variables as many variables as possible that could affect inflation and GDP, as well as institutional variables. The potential variables were chosen based on the literature (e.g. financial openness may affect the exchange rate regime – *Yeyati et al. 2010*; foreign trade openness and current account balance may affect the adoption of inflation targeting – *Arsić et al. 2022*). In addition, we estimated regression models for the effective exchange rate regime variable, the central bank independence index, the euro and the inflation targeting dummy, with lagged values for inflation and GDP growth included among explanatory variables. The latter variables had no significant effect on institutional variables.[6] The wide range of control variables and the results of the auxiliary regressions provide greater confidence that our estimation results contain no endogeneity bias.

First, we examine the impact of institutional variables on inflation. The first column of *Table 1* shows the results of the model using the exchange rate classification (*IRR*) by *Ilzetzki et al.* (*2019*). It is estimated that the adoption of inflation targeting has led to a considerable and statistically significant reduction in inflation rates. The coefficient of 4.01 is more than twice as high as measured by *Harms and Knaze* (*2021b: Table A8, Specification* (*3*)) on a much larger sample of countries. Adoption of the euro reduces inflation by almost one half a percentage point, but this result is not statistically significant. Increasing central bank independence reduces inflation as well, but this estimate is also not significant. Similarly, the coefficient of the dummy variables for the exchange rate regime (*IRR*) was also not significant.

[4] Captured by the World Bank's Worldwide Governance Indicator (*Kaufmann – Kraay 2024*). The arithmetic mean of the six sub-indices was used.
[5] The data are described in detail *in Appendix A* and their main statistics are included in *Appendix B* (*Table 3*). As the central bank independence index was found to be a key variable, its evolution in the 11 countries covered is also presented there (*Figure* 5).
[6] Estimation results are presented in *Appendix C.*

The second column in *Table 1* presents the results for the model that includes the effective exchange rate regime variable (*HK*) by *Harms and Knaze* (*2021b*). Given that there may be a non-linear effect between the increase in exchange rate flexibility and inflation, we also used the square of the variable in the regression. The estimate still shows a significant disinflationary impact of inflation targeting, both in economic and statistical terms. The estimated coefficient for euro adoption is not statistically significant.

In this model, the effect of central bank independence is much stronger and significant at a confidence level of 1 per cent. To interpret the resulting coefficient of around –14.2, the extent of the variable within the samples should be considered. The lowest value of the index in our sample used for estimation is 0.42, with the highest being 0.91. Increasing the independence of a central bank from 0.42 to 0.91 reduces inflation by roughly 7 percentage points, more than double the estimated impact of inflation targeting. Looking at the impact of the change in the index for each country, an increase in central bank independence contributed to disinflation by 1 to 5 percentage points over the period covered.

From the estimated coefficients of *HK* and HK^2, it can be calculated to what extent annual inflation changes when the flexibility of the exchange rate regime is increased from the hypothetical[7] hard peg (*HK=1*) to 4 (free float). From this, we found that the increase in flexibility has a disinflationary effect, but in a non-linear way: it is strongest in intermediate cases (over 5 percentage points for values between 2 and 3), but decreases when approaching the free-floating regime (only 0.6 when *HK=4*). This is because the quadratic specification allows for a U-shaped effect between the index and inflation. It should be noted here that in the 11 countries and periods covered by our study, the HK index value typically ranged between 1.5 and 3.5, i.e. exactly in the range that is most favourable from a disinflation perspective. Although these values do not clearly correspond to the IRR index, a value of around 2 is more likely to apply to a narrow-band peg and a value of around 3 to managed float.

As apparent from *Table 1*, the effective exchange rate regime variable by *Harms and Knaze* (*2021b*) yields more pronounced results for the effect of institutional variables than the classification by *Ilzetzki et al.* (*2019*), and the exchange rate regime itself is proven to be a more significant factor. However, the latter is widely used in the literature, so we consider it important to present the regression results obtained with both indices.

[7] It is hypothetical because a country can only have a value of 1 if it pegs its exchange rate against all of its trading partners. This is only feasible if the trading partners also peg their exchange rates against each other, which is of negligible practical relevance, but may be a good point of reference.

Table 1
Impact of institutional variables on annual average inflation

	(1)	(2)
Inflation targeting	–4.01*	–2.97**
	(1.97)	(1.16)
Euro	–0.461	0.330
	(0.91)	(0.495)
Central bank independence	–2.80	–14.2***
	(7.03)	(3.84)
Exchange rate regime: IRR#2	0.176	
	(1.56)	
IRR#3	–0.138	
	(1.71)	
HK		–11.8*
		(6.71)
HK^2		2.4
		(1.49)
Money growth	0.098*	0.062**
	(0.052)	(0.027)
Openness	–1.55	0.20
	(2.75)	(3.41)
Financial openness	–0.45	0.555
	(0.875)	(0.489)
Current account balance	–0.087*	–0.133**
	(0.047)	(0.055)
GDP growth	–0.383**	–0.357**
	(0.155)	(0.148)
Budget balance	0.177	0.198*
	(0.12)	(0.1020)
Government debt	0.023	0.025
	(0.026)	(0.028)
WGI index	4.57	5.579
	(3.51)	(3.346)
Euro area inflation	1.25***	1.36***
	(0.289)	(0.212)
Euro area GDP growth	0.368	0.228
	(0.282)	(0.246)
Lagged GDP per capita	–4.98	–7.89
	(3.59)	(3.59)
Number of observations	303	294

*Note: Robust standard errors clustered by country are in brackets. *, ** and *** denote coefficients significant at 10, 5 and 1 per cent, respectively. IRR#2 and IRR#3 are dummy variables which take the value of 1 when the observation is classified in exchange rate regimes 2 and 3, respectively, according to the classification by Ilzetzki et al. (2019). The coefficient of these variables shows how much higher inflation is compared to regime 1 (hard peg).*

Table 2
Impact of institutional variables on annual real GDP growth

	(1)	(2)
Inflation targeting	–0.245	–0.102
	(0.977)	(0.86)
Euro	–0.566	–0.306
	(0.424)	(0.467)
Central bank independence	8.01***	4.79**
	(1.62)	(1.85)
Exchange rate regime: IRR#2	0.426	
	(0.591)	
IRR#3	–0.247	
	(0.98)	
HK		–0.60
		(3.39)
HK²		0.231
		(0.730)
Money growth	0.044	0.033
	(0.03)	(0.027)
Openness	4.8**	5.05**
	(1.87)	(2.13)
Financial openness	–0.112	0.096
	(0.335)	(0.352)
Current account balance	–0.042	–0.05
	(0.076)	(0.070)
Inflation	–0.147***	–0.192***
	(0.044)	(0.049)
Budget balance	0.285***	0.313***
	(0.09)	(0.098)
Government debt	–0.066***	–0.055***
	(0.010)	(0.02)
WGI index	3.1**	3.71**
	(1.128)	(1.672)
Euro area inflation	0.537	0.559*
	(0.316)	(0.31)
Euro area GDP growth	0.924***	0.93***
	(0.119)	(0.130)
Lagged GDP per capita	–6.71***	–7.89***
	(2.30)	(2.31)
Number of observations	303	294

*Note: Robust standard errors clustered by country are in brackets. *, ** and *** denote coefficients significant at 10, 5 and 1 per cent, respectively. IRR#2 and IRR#3 are dummy variables which take the value of 1 when the observation is classified in exchange rate regimes 2 and 3, respectively, according to the classification by Ilzetzki et al. (2019). The coefficient of these variables shows how much higher GDP growth is compared to regime 1 (hard peg).*

The regime variables in the regression models for annual GDP are the same as in the inflation models. The control variables are also identical, with the exception that inflation is used instead of simultaneous GDP growth.

The results presented in *Table 2* show that both inflation targeting and euro adoption slow economic growth, but only to a small extent, and that neither coefficient is statistically significant. Conversely, increasing central bank independence contributes positively to GDP growth. Increasing the index by 0.5 (roughly the difference between the highest and lowest values in our sample) in the two estimated models alone results in 4 and 2.4 percentage point excess growth, respectively; these values are so high that they warrant explanation.

On the one hand, it should be considered that, since independence has been on an upward trend in virtually all of the countries covered, this coefficient may also absorb other effects that influenced growth along a common trend. Perhaps the most important of these is the overall improvement in the quality of institutions, mainly related to EU accession; we try to control for this with the WGI index, but even so we cannot be entirely certain that this actually filters out all relevant factors that are independent of the monetary policy framework.

On the other hand, the increase in central bank independence should be considered in conjunction with the development of the monetary regime. The adoption of inflation targeting, or, even more so, the adoption of the euro, presupposes the improvement of the institutional framework and the establishment of central bank independence. For this reason, the impact of these factors can only be properly understood together. For example, the Magyar Nemzeti Bank adopted inflation targeting in 2001, and the MNB Act was amended in support the same year, increasing the Romelli independence index by 0.24. The combined effect of these two steps on annual GDP growth, calculated with the coefficients presented, is 1 and 1.7, giving a much more realistic picture of the impact of the development of the monetary framework.

Finally, the estimated strong effect may also be due to a model specification problem, such as cross-sectional dependence, which seems plausible as the economies of the countries covered show similarities in many respects, and some factors for which we did not control may lead to strong co-movement in shocks assumed to be idiosyncratic. In *Appendix D*, we present cross-sectional dependence tests for the main regression models, which suggest that this type of specification problem is unlikely to result in a significant bias for the estimated coefficients.

The estimated effect of the exchange rate regime is not significant in either model. Of course, this does not mean that changes in the exchange rate do not have an impact on GDP. Our estimation essentially captures the long-term impact of the

regime, so the fact that we found no meaningful effect means that, compared to a full exchange rate peg, more flexible regimes did not demonstrably cause real convergence to accelerate or decelerate over the period between 1990 and 2019. This is in line with the findings of *Rose and Rose* (*2024*).

4. Contribution of monetary policy institutions to convergence

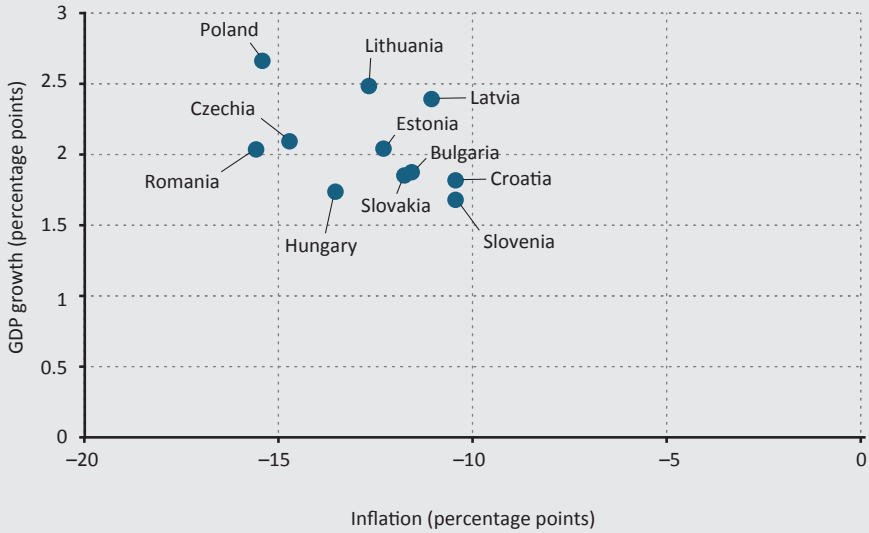
In the following, we use the coefficients estimated above to quantify the extent to which the monetary policy strategies in the 11 countries in the focus of our study contributed to nominal and real convergence. These are defined as the negative contribution to annual inflation rates and positive contribution to annual real GDP growth rates. Monetary strategy includes the choice of exchange rate flexibility, increasing central bank independence, introducing inflation targeting or the adoption of the euro.

Contributions are calculated for the period between 1997 and 2019, as this means that the necessary data are available for all but one country. For Romania, we can only perform calculations for the period between 2003 and 2019.

For the calculations, we use only models with effective exchange rate flexibility (*HK)*, as we were able to identify the impact of institutional choices to a lesser extent when using the classification (*IRR*) by *Ilzetzki et al.* (*2019*). For the sake of simplicity, we calculate direct contributions, meaning that we calculate for each year the extent to which the deviation of the exchange rate flexibility index, the central bank independence index and the inflation targeting and euro adoption dummies from the benchmark directly changed the target variable, i.e. the inflation rate and the GDP growth rate. Indirect effects are ignored. The reason for this is that, while in some cases these are relatively easy to calculate (for example, the effect of monetary strategy on GDP may be reflected in the inflation equation, or may also have a lagged effect through GDP per capita), in other cases a more complex model would be needed (for example, monetary strategy may also affect economic openness, but we do not have any estimates for this).

Our benchmarks were as follows: *HK=1* for exchange rate flexibility, 0.42 for central bank independence (the lowest value in our entire sample) and 0 for the two dummies. Therefore, our calculation will show how much a country has gained in terms of real and nominal convergence by showing some degree of flexibility in its exchange rate policy, strengthening central bank independence and adopting inflation targeting or the euro. This means that the hypothetical benchmark country used a completely rigid exchange rate regime all along, kept central bank independence at a low level and did not adopt either the euro or an inflation targeting regime.

Figure 3
Average annual contribution of the chosen monetary strategies to real growth and inflation between 1997 and 2019



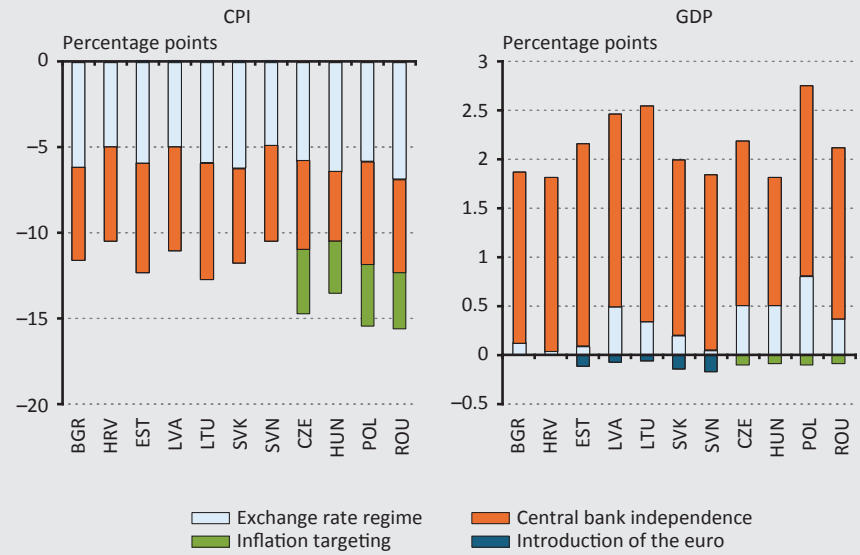
Note: For Romania, calculated for 2003–2019

Figure 3 shows the annual average impact of monetary regimes and the improvement of the institutional set-up on inflation and GDP growth. Essentially, countries can be classified into two groups. The first group consists of countries that relied heavily on inflation targeting regimes to achieve price stability, i.e. nominal convergence (Czechia, Hungary, Poland and Romania). These countries also typically more or less applied and continue to apply a more cautious, wait-and-see strategy for joining the euro area. In their case, a significant disinflationary effect of around 15 percentage points and a growth effect of 1.7 to 2.7 per cent can be quantified.

By contrast, the other 7 countries (Bulgaria, Croatia, Estonia, Latvia, Lithuania, Slovakia and Slovenia) clearly based their strategy on adopting the euro as quickly as possible, focusing typically on exchange rate pegging or strong management in the monetary framework until adoption. In their case, the estimated disinflationary effect is lower, but still significant (10 to 13 percentage points). Growth effects range between 1.7 and 2.5 per cent, in a range similar to that of the other group.

A comparison of growth and disinflationary effects shows that the strategies taking a wait-and-see approach to euro adoption and adopting inflation targeting allowed for slightly faster nominal convergence, with no meaningful difference in real convergence. On this basis, it cannot be concluded that any one strategy is clearly preferable.

Figure 4
Decomposition of contributions to disinflation and growth



Note: The impact of individual institutional factors on annual inflation and annual real GDP growth between 1997 and 2019 (2003 and 2019 for Romania).

Figure 4 shows the decomposition of contributions to growth and disinflation broken down by drivers. Some degree of flexibility of the exchange rate regime, inflation targeting and the increase in central bank independence were all key drivers behind the significant fall in inflation. However, euro adoption in itself did not prove to have a disinflationary effect.

Regarding the drivers of the GDP effect, the positive role of central bank independence is highlighted, although this is not entirely unexpected in the light of regression results. Our decomposition suggests that, while inflation targeting and euro adoption tended to inhibit real convergence, the flexibility of the exchange rate regime had a positive effect offsetting the previous two, but these effects are not statistically significant and are dwarfed by the contribution of central bank independence.

As mentioned earlier, it might not make sense to look at each element of the monetary framework reform separately. For both the effective functioning of inflation targeting and the adoption of the euro, it was essential to create the right institutional and legal environment to underpin the credibility of monetary policy. These steps were taken to an almost similar extent by countries opting for both rapid euro adoption and an inflation targeting strategy. Thus, it can be argued that the monetary strategies chosen were able to ensure rapid nominal convergence

while also having a positive impact on real convergence. Increasing central bank independence played a significant role in this, as it was able to strengthen the credibility and predictability of the chosen monetary regime, ultimately reducing the costs of disinflation for the real economy. This is in line with the results of *Spéder and Vonnák* (*2023*), who examined the aftermath of major inflation shocks and found that the disinflation phase was less painful in countries with higher central bank independence indices.

Of course, our study does not seek to evaluate all of the relevant consequences of decisions related to monetary policy institutions. Our analysis is limited to quantifying the impact on growth and inflation of the most tangible decisions. These decisions can have numerous other consequences that may be relevant to the welfare of individual societies. It is also important to stress that we did not evaluate the monetary policies of the central banks concerned, although this could be just as important in terms of growth and inflation, but rather the contribution of the choice of framework to convergence.

5. Conclusions

In our study, we looked at nominal and real convergence in the 11 former socialist Central and Eastern European EU Member States in the decades after 1990. In particular, we sought to answer the question to what extent monetary policy strategy and institutional decisions contributed to economic growth and achieving price stability. The strategy chosen is described by the flexibility of the exchange rate regime, the possible use of inflation targeting, the possible adoption of the euro and the strengthening of central bank independence.

Two strategies emerge in the countries covered. The first aims at rapid euro adoption, while seeking to ensure price stability with a pegged or more tightly managed exchange rate until adoption. This group includes the Baltic countries, Slovenia, Slovakia, Croatia and Bulgaria. Conversely, the other group, which includes Czechia, Poland, Hungary and Romania, took more of a wait-and-see, dilatory approach to adopting the euro, while providing a nominal anchor through inflation targeting.

The results of our regression model estimation suggest that in the countries covered, the improvement of the institutional set-up contributed the most to nominal and real convergence. In our model, this factor is captured by central bank independence. The increase in central bank independence in the countries covered typically contributed more than 5 percentage points to disinflation and around 2 percentage points to real GDP growth on average per year between 1997 and 2019. This comes as no surprise as an independent central bank's commitment to fighting inflation is more credible, which increases confidence and predictability,

thereby promoting real growth. All of the countries covered set their sights on EU membership and the establishment of the institutional set-up expected by the EU, including central bank independence.

In the countries that adopted it, inflation targeting curbed the annual inflation rate by another 3 to 4 percentage points.

The choice of exchange rate regime may have aided disinflation efforts, but the results were not as marked as for central bank independence or inflation targeting. Our estimation results show that disinflation was achieved most effectively in intermediate exchange rate regimes such as pegging with an intervention band and managed floating. No significant differences in the impact on economic growth were identified among the exchange rate regimes applied. Here, we can once again cite *Rose and Rose* (*2024*), who argued that no obvious differences between exchange rate regimes were found in the literature.

Euro adoption in itself had no demonstrable disinflationary effect and only a marginal negative impact on real convergence in the countries and period covered. This does not mean, however, that the strategy based on adoption as soon as possible was not effective in achieving price stability and GDP growth, as – similarly to inflation targeting – one of the prerequisites for adoption was the establishment of central bank independence, for which we were able to show a significant impact in this respect. On the other hand, nominal convergence is a prerequisite for euro adoption, and thus the countries that have already adopted it achieved price stability even before its adoption.

Accordingly, over the past 30 years or so, the development of the monetary policy framework has demonstrably supported not only nominal but also real convergence in the Central and Eastern European EU Member States. Among the countries that followed two different paths, those that based their strategy on euro adoption as soon as possible saw the choice of monetary regime and the establishment of central bank independence contribute to price stability to a slightly lesser, albeit overall significant, extent as compared to those that have pushed less for euro adoption and employed inflation targeting. Overall, however, it cannot be concluded that any (ex post) strategy was preferable.

The lesson drawn from our study for countries seeking EU membership is that inflation targeting and strengthening central bank independence can promote convergence. However, as in the literature, we did not find marked differences in the impact of exchange rate regimes on convergence. The exchange rate regime should be chosen in consideration of the economic conditions of a country, in particular the importance of foreign trade, the openness of capital markets, foreign currency debt, the competitiveness of the economy and the predictability of the fiscal position.

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Appendix

A. Sources of other data used in regressions

GDP growth: World Bank, World Development Indicators (WDI) – "GDP growth (annual %)"

Inflation: WDI – "Inflation, consumer prices (annual %)"

GDP per capita: WDI – "GDP per capita, PPP (constant 2021 international $)"

Money growth: WDI – "Broad money growth (annual %)" (for several countries, incomplete time series had to be supplemented with data available on their central banks' website)

Openness = (export+import)/GDP: WDI – "Exports of goods and services (current LCU)", "Imports of goods and services (current LCU)", "GDP (current LCU)"

Financial openness: The *Chinn – Ito (2006*) index, which measures the degree of capital account openness based on restrictions on cross-border financial transactions, https://web.pdx.edu/~ito/Chinn-Ito_website.htm

Current account balance: WDI – "Current account balance (% of GDP)"

Budget balance: International Monetary Fund, World Economic Outlook Database, April 2024 (WEO) – "General government net lending/borrowing" Percent of GDP

Government debt: WEO – "General government gross debt" Percent of GDP

WGI index: arithmetic average of the World Bank's WGI sub-indices (*Kaufmann – Kraay 2024*). Initially, when indices were calculated only every two years, the average of the two adjacent years was projected to interim years.

Euro area inflation: Federal Reserve Economic Data (FRED) – "Consumer Price Index: Harmonised Prices: All Items: Total for the Euro Area (19 Countries), Growth rate same period previous year"

GDP growth in the euro area: WDI – "GDP growth (annual %), Euro area [EMU]"

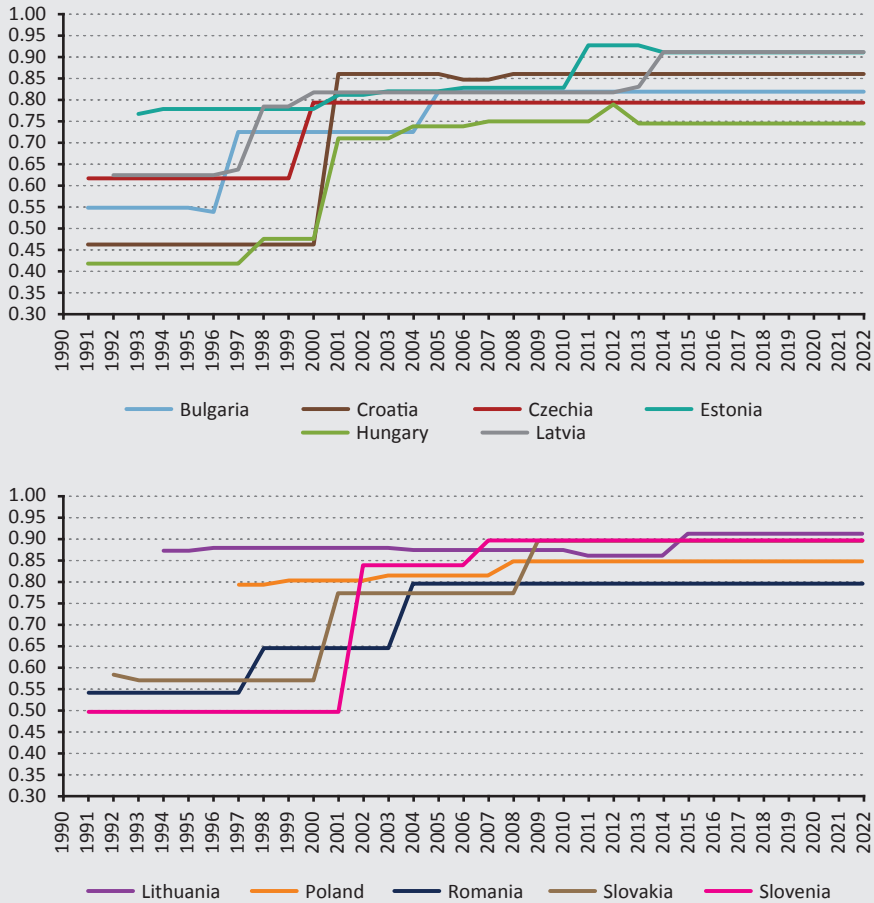
B. Descriptive statistics for the variables used in regressions

Table 3
Main statistics for the variables in regressions on the full sample

	Mean	Median	Minimum	Maximum	Standard deviation	Number of observations
Inflation targeting	0.222	0	0	1	1	627
Euro adoption	0.094	0	0	1	1	627
CBI index	0.756	0.796	0.33	0.929	0.599	508
IRR	1.576	1	1	4	3	476
HK	2.357	2.3	1.36	4	2.64	382
Money growth	24.11	11.004	–55.16	1,809.2	1,864.3	502
Openness	1.027	0.973	0.134	2.041	1.907	554
Financial openness	0.577	1.034	–1.931	2.299	4.23	433
Current account balance	–4.897	–4.55	–49.65	10.28	59.93	520
GDP growth	2.865	3.53	–29.1	88.96	118.1	544
Budget balance	–2.901	–2.68	–15.75	8.431	24.18	510
Government debt	42.18	39.34	3.765	213.8	210	481
WGI index	0.242	0.233	–1.212	1.298	2.51	489
Euro area inflation	2.175	2.2	0.2	8.4	8.2	608
GDP growth in the euro area	1.623	2.054	–6.108	5.966	12.073	627
GDP per capita	21,860	19,206	2,001	48,784	46,783	560

Note: For each variable, statistics are calculated on the basis of all the data available for the period between 1990 and 2022. The sample for regression estimates is narrower as the entire observation is excluded if there is a data gap for even one variable.

Figure 5
Evolution of the Romelli's central bank independence index in the 11 countries covered



C. Results of auxiliary regressions

Auxiliary regressions were estimated to identify potential endogeneity problems. In these regressions, the dependent variable was always a monetary institutional variable used in baseline models, while the explanatory variables included inflation and GDP growth lagged by one year and the control variables used in the baseline models. For the adoption of inflation targeting and the euro, a logit model was estimated due to the binary nature of variables, while a fixed effect model was estimated with country fixed effects for countries in the case of central bank independence and the HK index measuring exchange rate flexibility.

Table 4
Results of auxiliary regressions

	Inflation targeting	Euro	Central bank independence	Exchange rate regime (HK)
Inflation	0.014	–0.457***	–0.001	–0.006
	(0.025)	(0.143)	(0.001)	(0.007)
GDP growth	0.064*	–0.076	0.001	0.006
	(0.038)	(0.083)	(0.001)	(0.011)
GDP per capita	2.59***	–0.025	0.081	–0.214
	(0.583)	(0.553)	(0.064)	(0.267)
Money growth	–0.027*	0.001	0.000	0.001
	(0.015)	(0.033)	(0.001)	(0.003)
Openness	–3.21***	6.03***	0.039	–0.505
	(0.583)	(1.187)	(0.051)	(0.360)
Financial openness	0.291**	–0.542	0.037***	0.009
	(0.126)	(0.350)	(0.011)	(0.060)
Current account balance	–0.073**	0.125	0.000	–0.023**
	(0.030)	(0.097)	(0.001)	(0.009)
Budget balance	–0.048	0.002	0.000	–0.021*
	(0.054)	(0.108)	(0.002)	(0.011)
Government debt	0.027***	–0.031	0.001	–0.002
	(0.007)	(0.020)	(0.001)	(0.003)
WGI index	–0.463	6.51***	–0.019	–0.101
	(0.419)	(1.68)	(0.079)	(0.237)
Number of observations	346	348	346	285

Note: standard errors in brackets

The results presented in *Table 4*, with the exception of the model explaining euro adoption, suggest that changes in inflation and GDP growth do not lead to changes in monetary frameworks one year later. Given that both variables are relatively persistent, it is very likely that the possibility that the results obtained with baseline regression models reflect lagged reverse causality can be ruled out. However, because of the lag, these results do not reveal anything about any potential simultaneous endogeneity. Nevertheless, decisions by monetary institutions are typically preceded by a longer preparation period, and thus the likelihood that, for example, an inflation decline would lead to the adoption of an inflation targeting regime in the same year or that a third factor would cause a regime change and inflation decline in the same year is limited.

For euro adoption, the inflation coefficient one year earlier was significantly negative at a 5-per cent level, implying that the probability of euro adoption increases after

inflation declines. In this case, however, the time-consuming nature of institutional changes is particularly important as a prerequisite for euro adoption is compliance with the Maastricht criteria, including the criterion for low inflation. This means that adoption of the euro is naturally preceded by an inflation decline. Therefore, it cannot be clearly concluded that there is reverse causality as from our perspective, adoption of the euro does not only mean the replacement of the currency, but the whole journey there, including nominal convergence. However, in our baseline regression explaining inflation, increased caution is warranted when interpreting the dummy coefficient for euro adoption.

The coefficients obtained for control variables, which are significant in some instances (particularly in the estimate for inflation targeting), confirm that these variables should be included in the baseline regressions, helping to eliminate potential endogeneity bias.

D. Cross-sectional dependence tests

In the following, we test the cross-sectional dependence of the model's residuals (without fixed effects) for the estimates explaining inflation and GDP growth. To do so, we use *Stata's xtcd2 routine*, which performs four different tests that are most appropriate for our sample, i.e. when the dimensions T and N are nearly equal and relatively large. The CD test is the test proposed by *Pesaran* (*2015*) and *Pesaran* (*2021*). The disadvantage is that it tends to reject the null hypothesis even if it is true. For this reason, we also present the results of the following alternative tests: weighted CD test (CDw; *Juodis – Reese 2021*), "Power Enhanced" CDw test (CDw+; *Fan et al. 2015*; *Juodis – Reese 2021*), and "Bias Corrected" CD test (CD*; *Pesaran – Xie 2022*). For each test, the null hypothesis is weak cross-sectional dependence and the alternative hypothesis is strong cross-sectional dependence. Therefore, rejection of the null hypothesis may indicate a specification problem of relevance to us.

Table 5
Results of cross-sectional dependence tests

	CPI		GDP	
	(1)	**(2)**	**(1)**	**(2)**
CD	3.34	3.36	1.04	1.19
	(0.001)	(0.001)	(0.298)	(0.234)
CDw	1.16	–0.75	0.69	0.04
	(0.246)	(0.456)	(0.489)	(0.972)
CDw+	96.22	90.83	84.79	84.16
	(0.000)	(0.000)	(0.000)	(0.000)
*CD**	–0.5	0.77	–1.63	2.76
	(0.615)	(0.441)	(0.103)	(0.006)

Note: p-values in brackets

The tests show a mixed picture (*Table 5*). For inflation regressions, two tests (CD and CDw+) reject the null hypothesis even at a significance level of one per cent. The other two cannot reject H0 at conventional significance levels. It should also be considered that one test that rejects weak cross-sectional dependence is prone to Type I errors (CD test).

Of the regressions on GDP growth, only one test for weak dependence is rejected for the model with the IRR indexed (*Column 1*) and two for the model with the HK index (*Column 2*). As the tests are presented primarily due to the surprisingly strong growth effect of central bank independence, it is noteworthy that in the model where this effect is much stronger, three out of four tests find no specification error.

All of this leads us to conclude that the estimated strong effects are unlikely to be the result of cross-sectional dependence.