

# The Euro Adoption Debate Revisited: The Czech Case<sup>\*</sup>

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## Abstract

*Although price stability has been achieved in the euro area, the first ten years of the euro have not brought the expected long-term output growth benefits. The Czech Republic – an economy that has achieved price stability without the euro – should then reframe the debate about euro area membership in traditional terms of the exchange rate regime choice, focusing on macroeconomic volatilities in the two regimes. Our experiments show that inflation volatility in the Czech Republic is likely to increase following euro area accession. At the same time, euro area membership is not likely to fundamentally change the volatility of consumption growth. Using past developments, the size of the exchange rate shocks identified relative to the rest of the shocks is simply not high enough to rationalize the abandonment of the flexible exchange rate and independent monetary policy in favor of the fixed exchange rate regime.*

## 1. Introduction

At the onset of European monetary integration eventual euro area membership was associated with several positive effects that were expected to improve the long-term macroeconomic performance of member countries in terms of price stability and long-term output growth and were thus considered by European and national authorities alike to provide the economic rationale for the common currency project. Ten years after the establishment of the euro area, however, long-term macroeconomic effects other than price stability are yet to be seen. Such empirical evidence raises the question that if price stability is the only clear macroeconomic result of euro area membership, what is left for a country that has achieved price stability on its own?

Providing an economically meaningful answer to this question requires reframing the debate about euro area membership as a debate about the choice of the exchange rate regime. Indeed, it is not surprising that the monetary policy framework is neutral or close to neutral in the long run in terms of real economy effects and that price stability can be achieved under various monetary policy regimes. Then only the traditional question of the relative size of nominal versus real shocks and the implied macroeconomic volatilities under the floating or fixed exchange rate regime remains relevant for economic analysis.

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In this article we assess the relative importance of independent monetary policy and of the exchange rate and interest rate channels in reducing macroeconomic volatility. We assume that the absence of exchange rate shocks under euro area membership will *ceteris paribus* reduce macroeconomic volatility (especially for nominal variables). However, the fixed exchange rate also removes the stabilization role of the exchange rate and the absence of this stabilization channel will *ceteris paribus* increase macroeconomic volatility. The volatility increase after euro area membership may be even higher if most of the shocks affecting the economy are asymmetric, because the ECB's interest rate will not respond to them. Our main question is whether the removal of exchange rate-specific shocks under euro area membership will be enough to offset the effect of the missing exchange rate and eventually interest rate stabilization channels in their effects on macroeconomic volatility.

Our experiments show that inflation volatility is likely to increase following euro area accession, while euro area membership is unlikely to bring about a significant change in the volatility of consumption growth. This demonstrates that monetary policy based on a flexible exchange rate has provided a sound stabilization mechanism for the Czech economy and that the advantage of euro area membership cannot be easily assessed using economic analysis only.

The article is organized as follows. Section 2 briefly discusses the expected benefits and costs associated with monetary union membership in general and euro area membership in particular, while section 3 briefly reviews the empirical evidence regarding these benefits. Sections 4 and 5 provide the body of our analysis discussing the methodology applied to volatility measurement and the results achieved, respectively. Finally, section 6 concludes.

## 2. Expected Benefits and Costs

In this section we summarize the expected benefits and possible costs associated with monetary union membership in general and euro area accession in particular. For this purpose one can rely on official European Commission (1990) documents, advanced international economics textbooks such as Obstfeld and Rogoff (1996), or seminal research contributions to the field such as Frankel and Rose (2002). Although disagreeing about the order of transmission channels, all sources agree that the following channels should lead to higher long-term GDP or GDP per capita in the end.

First, euro area members should save transaction costs associated with currency conversion, local pricing behavior, and market imperfection in general. According to the European Commission's (1990) estimation, transaction costs associated with currency conversion alone accounted for 0.25 to 0.4 percent of European community GDP at the time.

Second, euro area members may benefit from importing a more credible monetary policy and from a credible commitment to a low inflation environment. In addition to inflation itself, this should reduce country risk premiums and long-term real interest rates, which together with lower inflation should lead to lower nominal interest rates, higher investment, and eventually a higher long-term level of output. The European Commission (1990) originally estimated that the long-term output level would eventually increase by 5–10 percent thanks to a decline of risk premiums by 0.5 percentage points.

Third, irrevocably fixing the nominal exchange rate insulates the economy from speculative bubbles and disturbances in the foreign exchange market that could otherwise trigger temporary fluctuations in the nominal exchange rate, thanks to price rigidities in the real exchange rate, and consequently in output and inflation. In this respect the European Commission (1990) also stresses the boost to firms' willingness to trade internationally, with eventual spillovers to output, though smaller firms and countries with less developed financial markets are seen as the main beneficiaries.

Given those arguments and original estimations, most new EU members from Central and Eastern Europe are more or less explicit in their accession strategies about the benefits they expect. The Bank of Slovenia (2003) simply stated: "Slovenia would certainly benefit from joining the common currency area," while the National Bank of Slovakia (2003) was fairly precise: "According to available estimates, the major benefit is an annual one percentage point increase in economic growth as a cumulative effect of lower transaction costs, eliminated exchange rate risk against the euro, and lower risk premium and interest rates."

On the cost side, the most prominent argument in the literature is "no monetary policy reaction to country-specific shocks."<sup>1</sup> Given a country-specific negative productivity shock, the only adjustment channel left to the economy is, after all, the labor market, with possible fiscal policy support. Accordingly, shock asymmetries among euro area members have been discussed widely, starting with the seminal contributions of Bayoumi and Eichengreen (1992) and Feldstein (1998) on potential negative consequences for the stability of output and inflation.

Another cost argument is the fact that the nominal exchange rate may serve also as a shock absorber when shocks are either real (productivity or preferences) or foreign nominal ones. This type of argument follows the traditional debate on the choice of optimal exchange rate regime (Obstfeld and Rogoff, 1996). This type of argument has not been discussed extensively in the context of the euro though, assuming implicitly that the losses from nominal exchange rate volatility outnumber any gains from the "shock absorber" role accompanied by stabilizing monetary policy. It is our aim to show that the latter is not necessarily true always and everywhere.

### **3. Empirical Evidence on Benefits and Costs**

With the euro area having been in existence for more than ten years, expectations of benefits and costs may now be confronted with facts. In this regard it is useful to split the debate into two parts: the achievement of price stability, with consequences for risk premiums and long-term interest rates; and the impact on trade and output.

Regarding price stability, there is little doubt that the European Central Bank (ECB) has been able to maintain price stability on the euro area-wide level. Mongelli and Wyplosz (2008) point out that: "Over the first five post-war decades, with a few exceptions, inflation in all euro area countries was never as low as it was during

<sup>1</sup> Other arguments that can be found in the relevant literature (see Obstfeld and Rogoff, 1996) are a split of seigniorage revenues among the currency union member countries and the impossibility of inflation being used to lower the real level of public debt. With respect to the euro area both can certainly be neglected.

the first ten years of the euro,” adding that inflation dispersion among the euro area countries has declined to a level similar to the one observed in the United States. Bulíř and Hurník (2009) argue, however, that some of the euro area members used fiat measures to achieve low inflation and to enter the euro area, but inflation accelerated sharply thereafter. Nevertheless, the import of credible monetary policy certainly caused country risk premiums, and to lesser extent also inflation expectations, to decline in countries that had not been seen as the “best performers” in respect of inflation before euro area membership. Consequently, many euro area member countries enjoy lower long-term interest rates nowadays than they would otherwise.<sup>2</sup>

There is far less consensus when it comes to the debate about the euro’s impact on trade and output. Concluding that membership in a currency union increases trade among members three-fold, Rose (2000) provoked an enormous stream of literature discussing possible bias in his estimation of the trade effect in general, but also focusing on the euro area’s trade effect in particular. Regarding the euro area, in a summary provided by Baldwin (2006) the trade effect varies across studies from around 6 to 25 percent, and is likely to vary from country to country and industry to industry. More recently, in a meta-analysis of 61 studies (28 for the euro area) on the trade effect of currency unions, Havránek (2009) finds no trade effect for the euro area at all other than a publication bias.

The relatively low intensity of the euro’s “trade effect” has important consequences for the euro’s potential effect on income. Following the conclusion of Frankel and Rose (2002) that “by raising overall trade, currency unions also increase income,” the lower the trade effect is, the lower the effect on income is likely to be. This is of special importance, as according to Frankel and Rose the “trade” channel is probably the only one in place: “we test and find no support for the common argument that currency unions improve income through other channels, e.g., by enhancing the central bank’s credibility or stabilizing the macroeconomy.”

Based on a different methodology Giannone et al. (2008) also come to the conclusion that GDP growth has probably not been affected much by the creation of the euro area, or at least that ten years have not been enough to prove it.

Interestingly, all the above-mentioned estimations discuss the impact of euro area membership on trade and eventually on the long-term level of output growth, while there has been little discussion about the euro’s effect on the volatility of output (or consumption) and inflation. Thus, we have little information about how the non-existence of exchange rate and monetary shocks and, conversely, the non-existence of the exchange rate as a shock absorber and the non-existence of the stabilization role of country-independent monetary policy affect the overall volatility of output and inflation in member countries.

Naturally, one reason for this is probably the difficulty of distinguishing this particular effect on volatility from the overall stabilizing effect stemming from

<sup>2</sup> One may argue that the recent increase in spreads on sovereign debt undermines the argument of a positive impact of the declining risk premium on overall economic performance. Had the country risk premium and interest rate remained higher, macroeconomic imbalances such as current account and/or budget deficits would not have got so high. It remains for future research, however, to answer to what extent the common currency, financial markets, the global savings glut, and excessively loose monetary policy are to blame here.

the import of better monetary policy, which certainly played a role in many euro area member countries. Indeed, to properly identify the “shock-volatility” effect one needs a country that pursued a credible monetary policy even before joining the euro area.

#### 4. Macroeconomic Volatility and Euro Area Membership

We now turn our attention to quantifying the expected impacts of euro adoption on macroeconomic volatility in the Czech Republic, where by macroeconomic volatility we mean volatility in inflation and consumption growth measured by standard deviations. Previous sections suggested that the choice of a de facto fixed exchange rate and euro area membership do not have a detectable impact on the long-term means of economic variables other than inflation (and some other nominal variables) in some cases. We now therefore judge the normative implications of the regime choice against the effect on the variances of inflation and consumption growth.

We study the relative importance of the exchange rate and interest rate channels in reducing macroeconomic volatility. The absence of exchange rate shocks under euro area membership will *ceteris paribus* reduce macroeconomic volatility (especially so for nominal variables). However, the fixed exchange rate also removes the stabilization role of the exchange rate – systematic exchange rate movements following real (technology) shocks as well as changes in interest rates. The absence of this stabilization channel will *ceteris paribus* increase macroeconomic volatility. The volatility increase after euro area accession may be even higher if most of the shocks affecting the economy are asymmetric (country-specific), because the ECB’s interest rate will not react to them.

Our most important question is whether the removal of exchange rate-specific shocks under euro area membership will be enough to offset the effect of the missing exchange (and eventually interest) rate stabilization channels in their effects on macroeconomic volatility.

##### 4.1 Methodology

The basic principle of our method for quantifying macroeconomic volatility consists in identifying economic shocks (unobserved) using a structural model of the Czech economy and information contained in observed variables. The variances of the shocks identified are used later in model simulations under different policy regimes.

###### 4.1.1 The Model

We use the core macroeconomic projection model of the Czech National Bank, which is a standard New-Keynesian DSGE model with a well-defined steady state and transition dynamics driven by a mix of nominal and real rigidities. An earlier version of the model is described in Beneš, Hlédik, Kumhof, and Vávra (2005), while the version that we use is discussed in detail by Andrlé, Hlédik, Kameník, and Vlček (2009). The model includes the sectors of households, intermediaries in the financial market, domestic producers of intermediate goods, importers of intermediate goods, producers of final consumption goods, exporters, and producers of capital goods. The model also includes the central bank and government. The model features

a list of idiosyncratic structural shocks whose variances were calibrated to fit the model's filtration on historical data.

Households consume the final goods basket and accumulate capital, lend that capital, and supply differentiated labor force to domestic producers of intermediate goods. Furthermore, households directly trade in domestic bonds and, through the financial market intermediaries, also in foreign currency-denominated bonds. Households own all firms and, according to their investments, share in the firms' profits. In addition to the corporate profits, households receive government transfers. Households' wage contracts are rigid, i.e., households cannot re-optimize their wage contracts in each period. Those households that do not optimize their wage contracts in a given period then index their wages to the last observed wage inflation. Finally, households move within a competitive insurance market, which ensures that heterogeneous wages have no impact on the distribution of wealth among households. This enables us to use the representative household concept. In accumulating capital, i.e., during their investment activity, households face adjustment costs relative to the required capital level.

Financial market intermediaries operate in a perfectly competitive financial market and their operations are expected to cover two periods. During the first period, intermediaries obtain funds from households and invest them in the international financial market; in the second period, they close their positions and return the invested funds to the households. There are always two intermediary groups in each period, one in the first stage of the financial operation and the other in the second stage. When investing, intermediaries face transaction costs, the existence of which is necessary for achieving model stationarity. The transaction costs are government revenue (a fee imposed on the financial intermediation sector).

Domestic producers of intermediate goods hire capital and labor force from households and, while operating in the monopolistically competitive market, each of them produces one type of intermediate good. For production, they use identical technology that involves labor-augmenting technological progress. Producers maximize their profit under the constraints of technology, factor production costs, and a non-zero probability that they will be unable to optimize their product price in every period. Differentiated intermediate goods are then combined with no additional costs into a composite intermediate good that is sold to the producers of final goods (for private consumption, export, and government consumption).

In addition to the sector of domestic intermediate goods producers, there is the sector of intermediate goods importers. Each importer combines its intermediate good from various imported foreign goods. Similarly to domestic intermediate goods producers, the importers face a non-zero probability that they will not be able to optimize their product price each period. Imported intermediate goods are then sold to the producers of final goods (for private consumption, export, and government consumption).

Final consumption goods producers also operate in a monopolistic market and use domestic and imported intermediate goods as production inputs (the relative proportion being determined by a production technology with constant elasticity of substitution). Nominal price rigidities prevent the producers from optimizing their price each period as elsewhere in the model.

The exporters use both domestic and imported intermediate goods for production and the relative proportion is determined by a production technology with constant elasticity of substitution. As in other sectors exporter prices are rigid; however, the price rigidity applies to export prices in a foreign currency. Exports from the local economy compete with exports from various other economies. Foreign demand for domestic export goods then may be expressed as a share of local exports in foreign imports. The share is determined by the price of export goods relative to the price of foreign goods.

Capital goods producers use only imported intermediate goods for production. This specification is supported by a high import share of investment expenditures and also avoids a quick overflow of increased capital accumulation into production of domestic value added. Price rigidities exist here too.

The last production sector comprises government consumption goods producers. Similarly to the capital goods sector, in this sector producers use only a single production input, specifically a domestic intermediate good. Once again, producers are unable to optimize their production price each period.

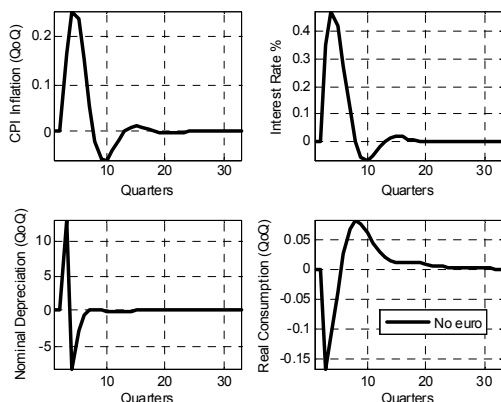
Finally, the model contains the government and the central bank. The government's revenues come from taxes and transaction costs. On the expenditure side, the government purchases government consumption goods and provides transfers to households. The government may accumulate debt, but must remain intertemporally solvent. This is achieved by applying a fiscal rule that adjusts the flow of government transfers in a way that ensures governmental intertemporal solvency. Government consumption is then coupled with household consumption. The central bank carries out credible monetary policy under the inflation targeting regime. In order to achieve its inflation target, the bank manipulates the nominal interest rate, taking into consideration the current value of the interest rate and responding to deviations of expected inflation from the inflation target. Specifically, the central bank responds to deviations of year-on-year consumer price index growth from the inflation target at the one-year horizon.

#### **4.1.2 Model Properties**

It is critical for the results of our analysis to see how the economy reacts to an exchange rate shock under a flexible exchange rate and independent monetary policy regime in comparison to a reaction to a technology shock under a fixed exchange rate regime with a zero or limited monetary policy reaction. Accordingly, we show the responses of the model variables to unitary unexpected one-period shocks that are important volatility sources – exchange rate shocks (*Figure 1a*) and technology shocks (*Figure 1b*).

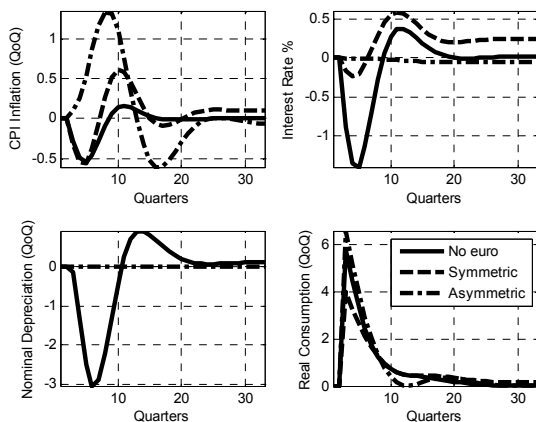
*Figure 1a* displays how an exchange rate-specific shock causes volatility of inflation and the real economy necessitating a corrective policy rate reaction in the absence of the euro, i.e., with a flexible exchange rate. This volatility will be removed by the adoption of the euro. *Figure 1b* shows the model reactions under three scenarios: “no euro” is the scenario under a flexible exchange rate and independent monetary policy, “euro with asymmetric shocks” is the scenario under a fixed exchange rate and no reaction of interest rates, and, finally, “euro with symmetric shocks” is the scenario under a fixed exchange rate with interest rates reacting ac-

**Figure 1a Impulse Responses to an One Period Exchange Rate Shock – ‘No Euro’**



Source: Authors' computations.

**Figure 1b Impulse Responses to an Unexpected One-Period Labor Technology Shock – ‘No Euro’, ‘Euro with Symmetric Shocks,’ and ‘Euro with Asymmetric Shocks’**



Source: Authors' computations.

according to the reaction function of the euro area monetary policy authority. All the scenarios are discussed in detail in subsection 4.1.3 and section 5.

The volatility of inflation and consumption following a labor technology shock is much higher in the absence of the exchange rate and interest rate channels under the euro (dashed versus solid line). This additional volatility may emerge after the country joins the euro area if technology shocks prevail. The reason for this increase in volatility is fundamental and lies with the fixed exchange rate regime. As discussed extensively by Beneš, Hurník, and Vávra (2008) fixing the exchange rate is equivalent to price level targeting with zero drift. Under such a monetary policy regime any undershooting of the implicitly targeted price level caused by a positive technology shock, for instance, must be followed by an overshooting and vice versa (Woodford, 2008). In this respect, technology shocks cause volatility in inflation



**Table 1 Observed Variables for Structural Shock Identification**

CPI (index)	Foreign 3M interest rates (EURIBOR)
Regulated prices (index)	Nominal exchange rate (CZK/EUR)
Net inflation (CPI adjusted for regulated prices, index)	Nominal wage (average wage in business sector)
Consumption deflator (index)	Real consumption (index)
Investment deflator (index)	Real investment (index)
Export deflator (index)	Real exports (level)
Import deflator (index)	Real imports (level)
Government consumption deflator (index)	Real government consumption (level)
Foreign prices (PPI, euro area, index)	Foreign demand (real imports of euro area, level)
3M interest rates (PRIBOR)	

under the fixed exchange rate.<sup>3</sup> Thus, higher inflation volatility may emerge under the euro, when neither interest rates nor exchange rates react to shocks.

#### 4.1.3 Identification of Structural Shocks

To identify structural shocks we apply the same methodology and the same set of variables as Hurník et al. (2008), but we use a different time span, namely the period from 1998 Q1 up to and including 2009 Q3. A reduced form of the model serves as a starting point for the identification of structural shocks based on the method of Kalman filtration. The Kalman filter applies a reduced form of the model extended for measurement equations that map observed variables to unobserved ones. Based on the state form of the model and using observed variables, the Kalman filter identifies all unobserved variables that are part of the model, including structural shocks. For linear systems it represents an optimum estimate in terms of the least squares criterion (Hamilton, 1994). The application of the filter itself takes on the recursive algorithm form, wherein the conditional probability density of state variables is updated in line with observed variables. *Table 1* provides an overview of the observed variables used for shock identification.

Due to the presence of trends within the model and the resulting non-stationarity of certain variables, the unconditional variance does not have a finite value, which is why a diffuse Kalman filter is applied (De Jong, 1991).

#### 4.1.4 Simulations

The estimated realizations of structural shocks are subsequently used for the simulation of the model to quantify the overall volatility of inflation and consumption growth as well as the contributions of particular shocks to overall volatility. It is clear that structural shocks give rise to volatility of model variables. Because we study the long-term effects of a regime change we focus on their unconditional (that is, long-term) volatility. In the model, the unconditional variance of the model variables roughly matches the observed historical variance of the corresponding macroeconomic data. The simulations result in the *figures* reported in section 5.

In simulating the impacts of euro area membership, we perform two experiments by changing the model specification and the calibration of shock volatilities.

<sup>3</sup> This finding is not surprising. It only repeats the traditional argument that a floating exchange rate is superior to a fixed one if real shocks dominate nominal ones.

These changes should reflect the following features of euro adoption: (i) a fixed exchange rate (that is, the non-existence of a nominal exchange rate), (ii) the loss of the domestic reaction function, (iii) the import of the ECB's monetary policy, which reacts to symmetric (euro area-wide) shocks and ignores country-specific ones.

In the first experiment we study volatility under the assumption that all structural shocks that do not disappear with euro adoption are specific to the Czech economy, that is, they are asymmetric and the ECB does not react to them. In particular, we make the following changes to the model. First, we switch off the central bank reaction function and fix the exchange rate as the new nominal anchor, and second, we remove all identified exchange rate-specific shocks affecting the behavior of domestic interest rates, such as risk premiums.<sup>4</sup>

In the second experiment we study volatility under the assumption that all structural shocks are symmetric, i.e., common to the euro area, and the ECB reacts to them. We make the same alterations to the model as in the first experiment, but in addition we make foreign interest rates move according to a Taylor rule similar to the original policy rule describing the behavior of the Czech National Bank.<sup>5</sup>

In both experiments, we assume that the volatilities of all structural shocks other than exchange rate-specific shocks remain unchanged with or without the euro.

In summary, the model describing the behavior under the euro has a fixed exchange rate, but the interest rate reaction to shocks is alternatively switched on (off) in experiment 2 (1) under (a)symmetric shocks. This allows us to study the relative importance of the exchange rate channel in reducing macroeconomic volatility.

## 4.2 Methodological Caveats

Our methodology is potentially prone to obvious criticism. First, though a general equilibrium in principle, the model can still be subject to the Lucas critique. In particular, one could argue that the parameterizations of certain behavioral processes (for example those governing the formation of expectations) will be affected by the regime change. Many other parameters may not be deep enough – rather, they may represent complex reduced-form functions of “true deep” parameters. To the extent that this is the case and the parameters would change on euro adoption, the model may misrepresent the behavior of the economy under the euro. However, as the model embodies a robust consensus on how the economy functions and is built as a general equilibrium, we have little means of improving its immunity to the Lucas critique. Specifically, we have no priors on how to change the model specification or calibration after moving to the euro. Hence, our best qualified guess is to leave the model parameterization unchanged in the first approximation.

Second, the specification of shocks and the estimation of their variances are very much driven by our specific historical experience and the model's historical fit. There is little doubt that going forward the absolute magnitudes as well as the rel-

<sup>4</sup> We ignore the possibility that a small risk premium and its shocks will probably persist even after euro adoption.

<sup>5</sup> The rule is modified somewhat to reflect the higher perceived sluggishness with which the ECB has been changing its policy rates relative to the CNB. Specifically, we increase the autoregressive coefficient from the 0.75 of the CNB rule to 0.95. We calibrate the variance of the policy shock in this rule to that of the present CNB rule.

ative importance of shocks and their volatilities will change, with or without the euro. For instance, the high importance of technology shocks in the transition period is likely to subside over time as the real convergence process proceeds. To what extent this process depends on euro adoption is an open matter and we have no priors that a certain group of shocks would become more or less important following euro adoption.

However, even if euro adoption has no effect on the variability of shocks, a changing relative importance of shocks going forward would still affect our results. Euro adoption affects the model's reaction to different shocks differently. For instance, assuming adoption of the euro has little effect on how the model reacts to a technology shock, but has a large effect on how it copes with a domestic demand shock. If technology shocks disappear in the future, euro adoption will have a large impact on macroeconomic volatility, and vice versa.

In order to address this weakness we divide the structural shocks into several groups and test the robustness of our results by alternatively assuming that one of these groups will eventually disappear by calibrating their variances to zero. We then rerun our experiments and compare the resulting macroeconomic variances again under these alternative assumptions.

Third, our treatment of symmetric and asymmetric shocks and the EMU-wide policy reaction is simplistic. Our model is not a two-country model and cannot capture the synchronization of economic cycles in Europe, feedback loops between the small open economy and the EU, and ECB reactions. Again, it is difficult to foresee which groups of shocks will be felt symmetrically and which ones will not, but at least our approach provides a crude corridor for future volatilities under the euro.

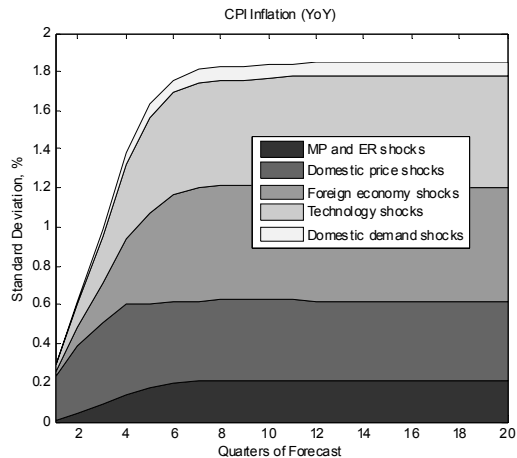
## 5. Results

### 5.1 No Euro

As our benchmark we use model volatility corresponding to historical observations. We focus on the volatility of inflation and consumption growth. Inflation is used because it is the target variable under the CNB's current monetary policy regime (and also the numeric objective of the ECB). Consumption growth volatility serves as a proxy for utility.

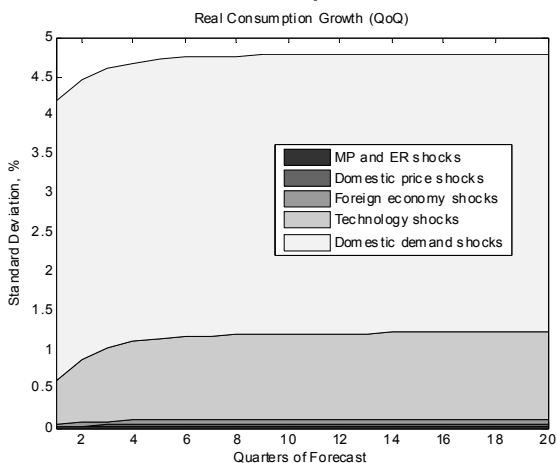
*Figures 2a* and *2b* show the evolution of the conditional volatility (measured by standard deviations) of inflation and consumption growth and its decomposition into the relative contributions of the main groups of structural shocks: monetary policy and exchange rate shocks; technology shocks; and price-specific, demand-specific, and foreign economy shocks. The figures describe how forecast uncertainty and its shock contributions gradually evolve with the forecasting horizon until they converge to their unconditional values. Forecast uncertainty is a product of structural shocks that may affect the model economy in the future and whose volatility has been calibrated to match the Czech data. At the beginning of the forecast horizon the uncertainty is low – the forecast is fairly precise. The uncertainty increases with the forecast horizon, as shocks in more and more periods may hit the economy, until it reaches its bounds given by the model-implied unconditional volatility. This unconditional volatility is close to the actual historical volatility of the series. The de-

**Figure 2a Standard Deviation of Inflation Forecast Error – “No Euro”**



Source: Authors' computations.

**Figure 2b Standard Deviation of Consumption Growth Forecast Error – ‘No Euro’**



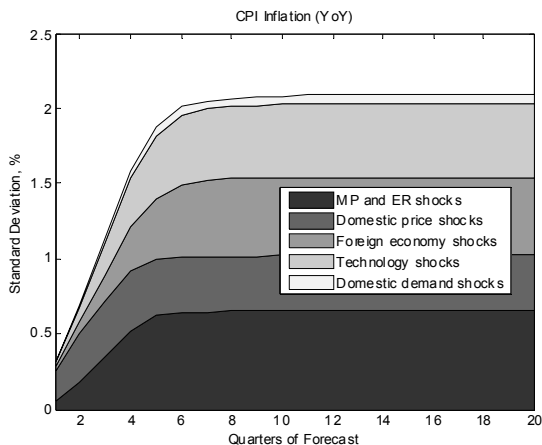
Source: Authors' computations.

composition of the forecast uncertainty shows the contributions of the individual structural shock volatilities into the overall forecast uncertainty, assuming that all other shocks (as sources of uncertainty) are switched off.

For inflation, the most important sources of volatility are technology, price-specific, and external shocks. While the contribution of the exchange rate is important, it is not a dominant source of inflation volatility in the Czech economy. Besides, exchange rate volatility plays almost no role in explaining the variance of consumption growth. For consumption, demand and technology shocks apparently dominate.

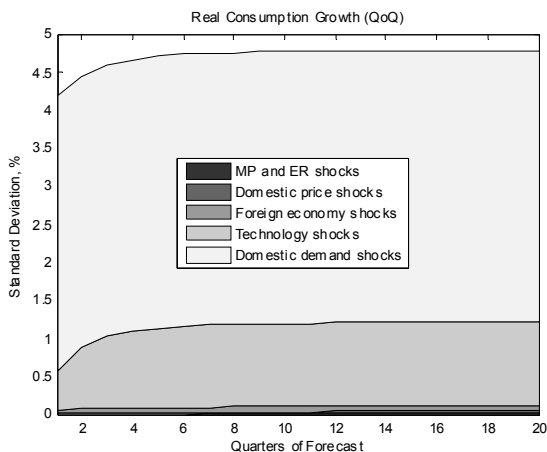
For comparison and robustness check, we re-compute the unconditional volatilities assuming higher variance of the exchange rate-specific shocks (see *Figure 3a*

**Figure 3a Standard Deviation of Inflation Forecast Error – “No Euro”  
(Three Times Higher Ex Rate Shock Volatility than Historical Average)**



Source: Authors' computations.

**Figure 3b Standard Deviation of Consumption Growth Forecast Error – No Euro  
(Three Times Higher Ex Rate Shock Volatility than History Average)**



Source: Authors' computations.

and 3b). This experiment is motivated by the fact that the past two years saw a dramatic increase in short-term exchange rate volatility – far in excess of the historical averages that have guided the calibration of model shocks. According to some measures, volatility increased three to five times, and although it has subsided since, it is still well above the historical averages. Should the higher volatility persist for a longer period, one can expect higher macroeconomic volatility overall. The attractiveness of euro adoption would be higher.

In examining how sensitive macroeconomic volatility is to the higher exchange rate variance of the crisis period, we increase the variance of the exchange rate shock

threefold. *Figure 3a* shows that this induces an increase in overall inflation volatility of about 20 percent (compare to *Figure 2a*). Under this assumption monetary and exchange rate shocks become the dominant source of inflation volatility. At the same time, the impact on consumption growth variance remains negligible (*Figure 3b* versus *Figure 2b*). This suggests that monetary policy is effective in insulating the real economy from the impacts of nominal exchange rate shocks – much more effective than in insulating inflation from such shocks.

## 5.2 Euro and Asymmetric Shocks

In this experiment, simulating euro accession, both the exchange rate and interest rate stabilization channels are switched off and the identified exchange rate shocks are set to zero. After switching off the exchange rate shocks and also the stabilization channels, inflation volatility increased 2.5 times relative to the “no-euro” case and technology and foreign economy shocks became the dominant sources of inflation volatility (*Figure 4a*).

For consumption growth, the increase in volatility is less dramatic (*Figure 4b*). The standard deviation is up by about 10 percent only.

## 5.3 Euro and Symmetric Shocks

In this experiment, the exchange rate channel remains switched off, but domestic (that is, EMU-wide) interest rates react to all shocks using an ECB-like Taylor rule. The openness of the Czech economy and the increasing positive correlation in time with Czech and euro area output are enough strong motivation to assume that technology shocks and foreign shocks originating outside the euro area may have a symmetric impact on the Czech economy as well as on other euro area economies (see CNB, 2009). The common monetary policy may thus react and stabilize the economy if technology shocks occur after euro accession.

*Figure 5a* shows, however, that inflation volatility is still higher than in the benchmark “no euro” case (less than two times), but much lower than in the case of asymmetric shocks (when both channels are switched off). The simulated ECB interest rate reaction helps in reducing the overall inflation volatility caused by euro adoption. However the absence of the exchange rate channel still makes inflation more volatile than without the euro. At the same time, consumption growth is marginally less volatile now than in the benchmark “no euro” case.

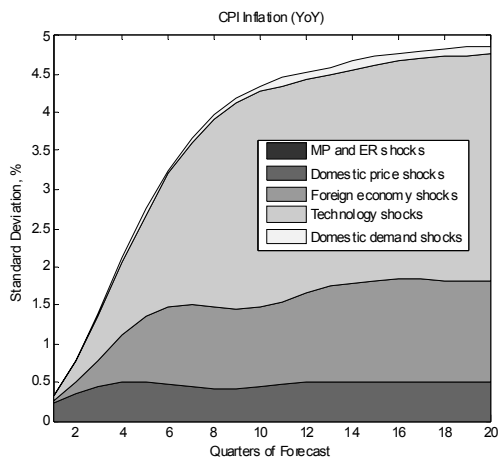
## 5.4 Sensitivity to Changes in Shocks

In this section we report sensitivity tests with respect to changes in the relative importance of groups of shocks (*Table 2*). We show the absolute contributions of each shock group to the increase in the standard deviation of inflation and consumption growth from the baseline – the “no euro” case – for both asymmetric and symmetric shocks.

For inflation, the results differ substantially between the scenarios. We can expect an increase in volatility after euro adoption irrespective of whether the shocks will be symmetric or asymmetric or whether their relative importance will change.<sup>6</sup> This is because each shock group adds positively to the overall variance.

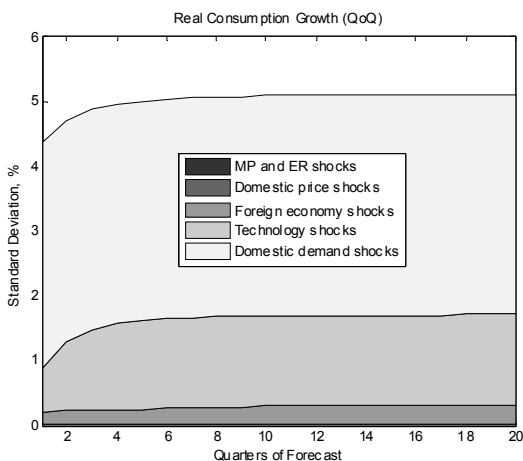
The largest addition to inflation under the “euro” scenarios’ volatility comes from technology shocks in the asymmetric case and from foreign shocks in the sym-

**Figure 4a Standard Deviation of Inflation Forecast Error  
“Euro with Asymmetric Shocks” (No Interest Rate Reaction)**



Source: Authors' computations.

**Figure 4b Standard Deviation of Consumption Growth Forecast Error  
“Euro with Asymmetric Shocks” (No Interest Rate Reaction)**



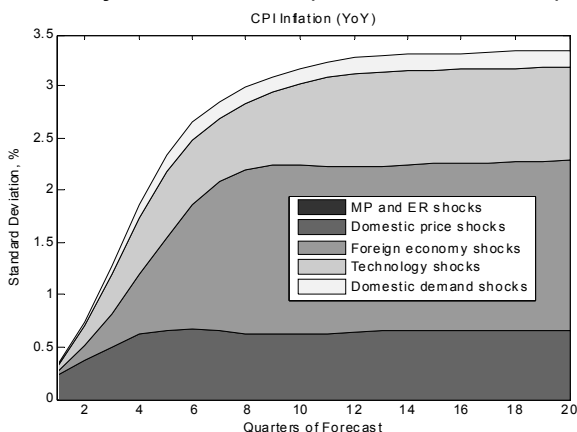
Source: Authors' computations.

metric case, as discussed in subsection 4.1.3. However, even if technology shocks completely disappear in the future, inflation will still be more volatile under the “euro” than without it. The same holds for the other shock groups, most notably foreign economy shocks.

The relative comparison of the symmetric and asymmetric euro cases is less robust to these changes. For instance, without technology shocks inflation will be

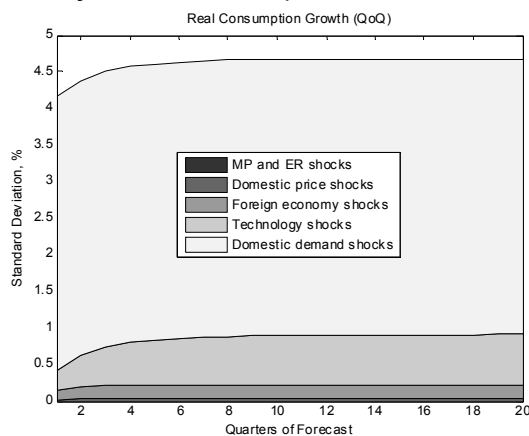
<sup>6</sup> This assertion is made only with respect to the shock group as a whole – the variances of the individual shocks making up the groups are not perturbed in the experiment. Hence, it is possible that the results would have changed with respect to some individual shocks.

**Figure 5a Standard Deviation of Inflation Forecast Error  
“Euro with Symmetric Shocks” (Interest Rate Reaction)**



Source: Authors' computations.

**Figure 5b: Standard Deviation of Consumption Growth Forecast Error  
“Euro with Symmetric Shocks” (Interest Rate Reaction)**



Source: Authors' computations.

less volatile if shocks are asymmetric (and interest rates do not move) than if they are symmetric.

The results for consumption growth are not as invariant to changes in the relative importance of the individual shock groups as those for inflation. Although the absence of domestic demand shocks will not alter the sequence, the absence of technology shocks will make consumption growth least volatile in the “asymmetric euro” case, followed by the “no euro” and “euro with symmetric shocks” cases.

Besides, if foreign economy shocks become the most dominant in the future, we could even expect to have the lowest consumption growth volatility without the euro. This is because the economy reacts to foreign shocks with more volatility



**Table 2 Absolute Contributions of Shock Groups to the Increase in the Standard Deviation of Inflation and Consumption Growth after Euro Adoption**

Variable	Scenario\shock group	Technology	Foreign	Domestic price	Domestic demand	Monetary and exchange rate	Total
Inflation	euro asymmetric	2.3642	0.7329	0.086	0.0393	-0.2089	3.0135
	euro symmetric	0.3314	1.0321	0.2512	0.0924	-0.2089	1.4982
Consumption growth	euro asymmetric	0.2865	0.2142	-0.0072	-0.1724	-0.0086	0.3125
	euro symmetric	-0.4169	0.1095	0.0044	0.2027	-0.0086	-0.1089

Source: Authors' computations.

with the euro than without the euro – but in history these shocks have not been the dominant source of volatility.

### 5.5 Some Empirical Evidence

The above evidence naturally raises the question whether the above-proposed increase in volatilities is observed in the data. That means searching for the volatilities in inflation and consumption growth before and after currency union membership among the currency union's members. For the comparison to be relevant, however, the analysis must concentrate on countries that had credible monetary policy even before joining the currency union. Otherwise the analysis would be biased by the overall stabilization implied by the import of better monetary policy.

Unfortunately, we do not have enough observations to test our hypothesis: only Germany and Finland qualify as countries that entered the euro area with an independent and credible monetary policy. The rest were either more or less pegging against the Deutsche Mark or their monetary policy would not have qualified as a low inflation-oriented credible monetary policy. Furthermore, even for those two countries the analysis is only indicative because of the short data sample before euro area membership. It is not that the data are not available; rather, the data sample is shortened by a structural break that appears at the beginning of the 1990s and is associated with the re-unification of Germany and the break-up of the Soviet Union, which affected Finland. Using 1994–1999 data thus gives us only five years of observation before euro area membership.

In providing the indicative evidence in question, *Table 3* shows the standard deviations of quarterly inflation and consumption growth for Germany and Finland, and *Table 4* the same for Sweden as the control country. We include Sweden as a non-member country with a sound monetary policy to control for a common factor that could influence the volatilities in question one way or the other.

It is evident that while in Germany (and Sweden) the volatility in inflation remained the same, it increased by roughly 40 percent in Finland. Regarding consumption growth volatility we see an increase of 20 percent in Germany and of more than 60 percent in Finland. Consumption growth volatility increased also in Sweden, but only by 10 percent.

Given the size of the Finnish economy and its openness, the results for Finland are probably more relevant to the Czech economy than those of Germany. With all the caveats, these examples do show that euro area membership can be associated with an increase in inflation and/or consumption growth volatilities and that our model-based projections should be treated seriously.

**Table 3 Inflation and Consumption Growth Volatilities in Germany and Finland**

Time	Germany (volatility, stand. dev.)			Finland (volatility, stand. dev.)		
	1994Q1– –1998Q4	1999Q1– –2008Q2	Diff. (%)	1994Q1– –1998Q4	1999Q1– –2008Q2	Diff. (%)
Inflation	1.53	1.44	-5.9	1.09	1.52	+39.4
Consumption growth	2.41	2.97	+23.1	1.10	1.81	+64.5
GDP growth	2.55	2.25	-11.8	2.39	2.52	+5.4

Sources: IMF database and authors' calculations.

**Table 4 Inflation and Consumption Growth Volatilities in Sweden**

Time	Sweden (volatility, stand. dev.)		
	1994Q1–1998Q4	1999Q1–2008Q2	Diff. (%)
Inflation	1.49	1.55	+4.0
Consumption growth	2.07	2.28	+10.1
GDP growth	2.11	2.07	-1.9

Sources: Sweden Statistics and authors' calculations.

## 6. Conclusion

Our experiments show that in the case of a country with a sufficiently credible monetary policy, inflation volatility is likely to increase following euro area accession. For instance, in the Czech case the likely increase in inflation volatility is significant and unambiguous, irrespective of whether interest rates respond to shocks or not and whether certain shock groups will become more or less important in the future. At the same time, in this case euro area membership is not likely to fundamentally change the volatility of consumption growth. The more asymmetric shocks are, the more we can expect consumption growth to be more volatile under the euro than without it. However, if the shocks are more symmetric, consumption growth may be less volatile than without the euro, and especially so if technology shocks dominate. Alas, the differences are relatively small and so the results are much less robust to possible alternative models or specifications than those for inflation.

The results demonstrate that monetary policy based on a flexible exchange rate and a credible inflation-targeting regime has provided a sound stabilization mechanism for the Czech economy and that the advantage of euro area membership cannot be easily (if at all) assessed by economic analysis. Although euro adoption would remove an important source of volatility, the absence of the exchange rate reaction would bring about even more volatility – especially so for inflation and possibly also for consumption growth depending on the nature of the shocks.

The size of the exchange rate shocks identified relative to the rest of the shocks is simply not high enough to rationalize the fixed exchange rate regime and abandonment of the flexible exchange rate and independent monetary policy. Naturally, one can never exclude the possibility that this is going to change in the future, and one should not forget that this is a country-specific conclusion.

## REFERENCES

- Andrle M, Hlédík T, Kameník O, Vlček J (2009): Implementing the new structural model of the Czech National Bank. *Czech National Bank, Working Paper*, no. 2.
- Baldwin R (2006): The euro's trade effects. *European Central Bank, Working Paper*, no. 594.
- Bank of Slovenia (2003): *Programme for the ERM II entry and adoption of the euro*. Bank of Slovenia.
- Bayoumi T, Eichengreen BJ (1992): Shocking aspects of European monetary unification. *National Bureau of Economic Research, Working Paper*, no. 3949.
- Beneš J, Hlédík T, Kumhof M, Vávra D (2005): An Economy in Transition and DSGE: What the Czech National Bank's New Projection Model Needs. *Czech National Bank, Working Paper*, no. 12.
- Beneš J, Hurník J, Vávra D (2008): Exchange Rate Management and Inflation Targeting: Modeling the Exchange Rate in Reduced-Form New Keynesian Models. *Finance a úvěr-Czech Journal of Economics and Finance*, 58(3-4):166–194.
- Buliř A, Hurník J (2009): Pre-Euro Inflation Convergence: Just Another Gimmick? *Journal of Financial Economic Policy*, 1(4):355–369.
- Czech National Bank (2009): *Analyses of the Czech Republic's current economic alignment with the euro area*. Czech National Bank, December 2009.
- De Jong P (1991): The diffuse Kalman filter. *The Annals of Statistics*, 19(2):1073–83.
- European Commission (1990): One market, one money: an evaluation of the potential benefits and costs of forming an Economic and Monetary Union. *European Economy*, no. 44.
- Feldstein M (1998): The political economy of the European economic and monetary union: political sources of an economic liability. *National Bureau of Economic Research, Working Paper*, no. 6150.
- Frankel J, Rose A (2002): An estimate of the effect of common currencies on trade and income. *The Quarterly Journal of Economics*, 117(2):437–66.
- Giannone D, Lenza M, Reichlin L (2008): Business cycles in the euro area. *National Bureau of Economic Research, Working Paper*, no. 14529.
- Hamilton JD (1994): *Time Series Analysis*. Princeton, Princeton University Press.
- Havránek T (2009): Rose effect and the euro: is the magic gone? *MPRA Paper*, no. 18479 (University Library of Munich).
- Hurník J, Kameník O, Vlček J (2008): The history of inflation targeting in the Czech Republic through the lens of a dynamic general equilibrium model. *Finance a úvěr-Czech Journal of Economics and Finance*, 58(9–10):454–69.
- Mongelli FP, Wyplosz C (2008): The euro at ten: unfulfilled threats and unexpected challenges. *Fifth ECB Central Banking Conference – The Euro at Ten: Lessons and Challenges*.
- National Bank of Slovakia (2003): Strategy of the Slovak Republic for the adoption of the euro. *Biatec*, 11(8):1–10.
- Obstfeld M, Rogoff K (1996): *Foundation of International Macroeconomics*. Cambridge, The MIT Press.
- Rose A (2000): One money, one market? The effect of common currencies on international trade. *Economic Policy*, 30:7–45.
- Woodford M (2008): The case for forecast targeting as a monetary policy strategy. *Journal of Economic Perspectives*, 21(4):3–24.