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A Country Perspective on the Monetary Policy Transmission in the Euro Area: the Case of Slovenia

Milan Damjanović*

Abstract

This paper investigates the effects of the ECB's common monetary policy on Slovenian economy. Modeling monetary transmission in a particular country within the currency union faces several practical obstacles that this paper attempts to overcome. Specifically, it utilizes the analytical results of lower-bound adjusted term-structure models to consistently measure conventional and unconventional monetary measures and account for potential dichotomy between monetary stance observed at the euro area level and country-specific financing conditions. Moreover, a set of different empirical monetary models is considered, ranging from the most traditional SVAR specification to settings accounting for a small country perspective in analysis of transmission of the common monetary policy in the EA. Results suggest that the common monetary policy affects Slovenian output and financing conditions in expected and significant way, while impact on prices remains inconclusive in the examined period. Following the resolution of systemic issues in Slovenian banking system and more assertive stance the ECB undertaken after 2012, the transmission mechanism in Slovenia became particularly strong, with sustained positive contributions of the monetary policy to recent buoyant economic activity in Slovenia.

JEL-Codes: E0, E3, E4, E5

Keywords: Monetary policy, Structural VAR, Slovenian economy, Monetary stance measure

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1. Introduction

In this paper, we investigate the impact of the ECB's common monetary policy on Slovenian economy. Slovenia adopted the Euro in 2007 with the full transfer of autonomous monetary policy to the Eurosystem. The common monetary policy has been in that period largely influenced by consequences of the global financial crisis, followed by the euro area (hereafter the EA) sovereign crisis and the ensuing missing inflation period. This events pushed the ECB into continuous trajectory of interest rate reductions, which was eventually complemented by the set of historically unprecedented non-standard measures once the economy approached the interest lower bound. Slovenia has in the same period faced several challenges that had potentially profoundly impacted the transmission of monetary policy to the local economy. In particular, Slovenia experienced one of the largest drops in the GDP among the EA countries in the wake of the global financial crisis. This was largely attributed to the fallout of foreign liquidity, which had fueled economic activity in the pre-crisis period. The effect was amplified through the sharp increase in public debt and surge in sovereign yields which put additional hurdles to access to foreign financial markets. The overall outcome was a large increase in non-performing debt and eventual banking crisis that resulted in historically large state induced bank re-capitalization.

Modeling monetary transmission under these circumstances becomes particularly challenging. First question that naturally occurs in the low interest environment is how to appropriately measure monetary stance, taking into account both conventional and unconventional policies. Secondly, the liquidity stance in a particular member country may differ considerably relative to the one observed at the EA level as the degree and propagation of the crisis differed substantially across the countries. These differences were eventually recognized also by the official monetary policy where many of the non-standard measures were specifically aimed at reducing inter-country interest spreads. Therefore, by simply assuming that monetary stance at the aggregate EA level remains the same at individual country level may potentially lead to misleading results and to overlooking of important channels of monetary transmission, e.g. sovereign bond markets. Finally, while the SVAR framework has traditionally been perceived the most convenient way to model monetary transmission, the SVAR's self-contained description of a monetary framework may no longer apply in case of a small country within the currency union. Namely, in a most simplistic case, a small-scale monetary VAR would consist of a monetary measure and macroeconomic variables that enter the policy reaction curve. In this way one can separate the rule-based monetary response (i.e. Taylor rule) from a pure monetary policy shock (e.g. change in policy preferences), essential for examining causal relations with macroeconomic variables included in the system. However, in case of a small country that no longer practices its own monetary policy the identification of monetary policy shock is no longer straightforward. For example, in case of Slovenia, which represents less than half of a percent of the total EA economy, it is highly unlikely that Slovenian macroeconomic determinants alone would be enough to appropriately characterize the monetary policy reaction curve and allow monetary shock identification, exogenous of other influences, in particular the EA output and inflation.

The modeling framework applied in this paper addresses the challenges described above and proposes a way of examining transmission of the common monetary policy in the EA from a perspective of an individual member country. To deal with the issue of modeling monetary stance in a low interest environment, we utilize the lower-bound-adjusted Affine Nelson-Siegel model (hereafter Shadow/ANSM) derived in continuous time by Krippner (2015). Appropriate modeling of term structure is in the context of monetary analysis particularly convenient as the fitted shadow yield curve captures market's response to monetary policy, regardless of whether it is implemented through conventional or unconventional measures. Moreover, the estimated zero-coupon yield curve for a particular country can provide information on financing and credit conditions in a particular economy within the EU. The Shadow/ANSM allows a consistent estimation of a term-structure of interest rates in a near-zero rate environment by decomposing the yield curve to its shadow component, which allows arbitrary development of interest rates to negative values, and an option component, allowing investors to hold physical currency when faced with negative yields. The shadow part of the estimated yield curve could be interpreted as a market's response to a monetary policy rate that would prevail in the absence of lower bound on interest rates. In this setting, the shortest rate on the risk-free shadow curve represents a hypothetical monetary stance that would take effect in the absence of the lower bound. This rate has in literature been referred to as the shadow short rate (SSR) and has recently been applied to increasing number of works dealing with the monetary transmission analysis as a continuous measure of monetary policy through conventional and unconventional times, see Francis et al (2014), Wu and Xia (2016), Krippner (2015).

However, the SSR is essentially a model based estimate and thus sensitive to model specification choice, which can potentially lead to generated regressor problem when applied to monetary SVAR framework. Halberstadt and Krippner (2016) instead propose an alternative monetary policy metric, the Effective Monetary Stimulus measure (EMS), which is analytically derived within the Shadow/ANSM but can be very closely approximated by observable categories. Namely, the EMS expresses the deviation of the short-term monetary policy from its long-run steady state that is consistent with the closed output gap and inflation at the target. Halberstadt and Krippner (2016) argue that the current monetary policy and its expected path is best captured by observable long-term bond yields, whereas the long-term neutral policy can be proxied by long-term projections of real output growth. Using these two observable categories, a model-free estimate of monetary policy stimulus can be derived as a negative deviation of existing monetary policy from its neutral state.

This paper compares the suitability of both measures, the SSR and the EMS, from the perspective of the EA as a whole and Slovenia. In direct comparison of both measures the EMS measure exhibits more intuitive dynamics by closely summarizing the respective economic and monetary developments in the EA and Slovenia. In this respect, the EMS concept is in our empirical framework used to develop a proxy metric for the monetary policy of the ECB and to measure country-specific financing conditions for Slovenia. As the proper identification of monetary policy shocks plays a crucial role for the validity of our analysis, several different SVAR specifications and identification schemes are examined. The set of models employed in this ranges from the specification that is most comparable to the traditional literature (e.g. the system of Slovenian macroeconomic variables and the measure of the monetary policy) to SVAR specifications where variables corresponding to the Slovenian economy form an exogenous block within the EA monetary SVAR model. The results suggest that the ECB monetary policy did act in expected stabilizing manner with significant positive effect on Slovenian industrial production being documented after 2013.

Modeling monetary policy in unconventional times has been an area of rapidly growing research agenda in recent years. For example, using a FAVAR model with the SSR as a policy measure, Wu and Xia (2016) show that non-standard measures introduced by the FED helped reduce unemployment in the US by 1 percentage point. Similar positive effects were also observed for the US GDP growth (over 2 %) by the time-varying parameter VAR of Baumeister and Benati (2010) and DSGE estimates provided by Chung et al (2011). Bridges and Thomas (2012) and Kapetanios et al (2012) use the SVAR with varying identification schemes to show positive impact on the UK GDP growth, in range between 1.5 and 2 %. Studies on macroeconomic effects of non-standard measures in the EA remains scarce. Giannone et al (2012) estimate positive effects on GDP growth in scale of 2 %, taking into account credit easing measures introduced up to 2012. Peersman (2011) finds positive, albeit delayed, effects on the real economic activity compared to the period of conventional monetary policy. Change in monetary transmission alongh with the delayed and attenuated effect on real economy is also shown by Halberstadt and Kripner (2016).

In contrast to existing literature, the analysis performed in this paper is one of the few to analyze the effects of the common monetary policy in a particular country within the EA. The modeling framework introduced in this paper allows continuous examination of monetary policy effects through conventional and unconventional times. By relying on the yield curve data to derive monetary policy metric and country specific financing conditions measure, this study is among the first to examine to what extent are monetary measures homogeneously transmitted across individual member countries. Moreover, taking into account difference in monetary stance at the EA and country-specific level allows one to inspect the extent to which the centralized monetary policy is capable of overcoming the local autonomous drivers that are potentially in a significant way influencing the real economic activity and effectiveness of the policy transmission channel in a particular country.

Structure of the paper closely follows the layout set in the introduction. Section 2 descriptively summarizes macroeconomic and monetary developments in Slovenia between 2007 and 2017; Section 3 introduces examples of alternative monetary measures and examines their consistency with the actual monetary policy events in the EA and Slovenia; Section 4 performs monetary transmission analysis and provides results on the impact of common monetary policy on Slovenian economy; Section 5 concludes.

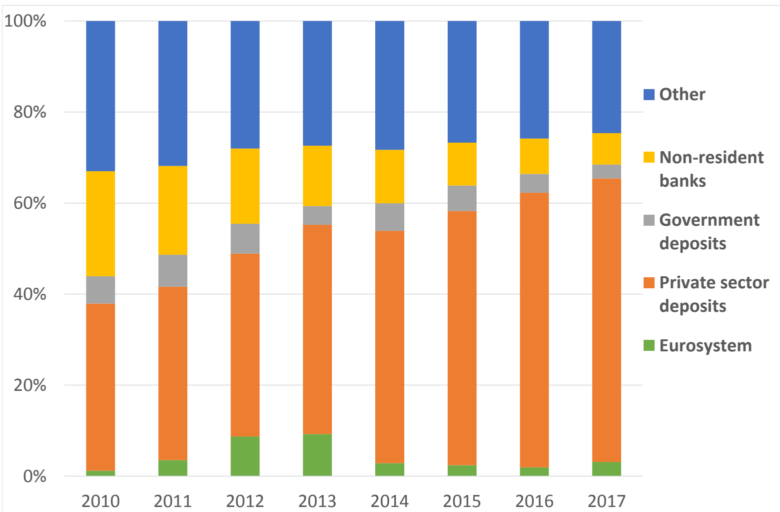
2. Macroeconomic and monetary developments in Slovenia (2007-2017)

Slovenia entered the Exchange Rate Mechanism II in 2004, which initiated rapid a convergence of interest rates in Slovenia to financing conditions observed in the EA. The latter was followed in parallel by ever more accessible funding from international financial markets. A natural consequence was a substantial surge in credit demand that was easily met by the domestic banking sector, which relied predominantly on the wholesale funding from abroad. The strong lending activity in the following years resulted in largely increased domestic consumption and investment activity, primarily on the back of construction sector, retail and financial intermediation services. By the time Slovenia adopted the Euro it reached the historical GDP growth of 7 % that was largely attained at the expense of significant macroeconomic imbalances. Rapidly increasing domestic spending alongside the outflow of interest payments and income transfers contributed significantly to the growing current account deficit, which at the end of 2007 stood at 5 % of GDP. While continuous influx of foreign capital supported this growth for almost half of the decade, it came to abrupt stop with the uncertainty in international financial markets underlying the crisis in 2008. A consequent disruption in interbank lending and foreign funding significantly impacted economic activity through reduced investment. The pressure on private consumption was even further amplified through the record high inflation of 5.7 %. The overall effect can best be summarized by almost 8 % drop in the GDP in 2009, one of the largest among the EA countries.

To counter the drop in consumption and ease frictions in the labor market, the government increased its spending and almost doubled the public debt compared to the pre-crisis level. However, like in many other countries across the EA, a significant drop in the economic activity was closely followed by a considerable drop in asset prices. This further restricted credit supply through devalued collateral and quality of the bank portfolio. Combination of systemic banking issues, high corporate indebtedness and rapid pace of government debt increase pushed Slovenia in 2012 into second recession in three years period. In response, in 2013 Slovenian government adopted important structural reforms, performed recapitalization of the banking system and founded specialized bank asset management company to facilitate the debt restructuring process. The adoption of measures was ensued by instantaneous improvement in financing conditions and regained confidence from the international capital markets. In subsequent years (2014 - 2017), Slovenian economic activity consistently outperformed the GDP growth in the EA. In contrast to the pre-crisis level, the recent economic activity has resembled sound macroeconomic foundations with stable consumer confidence, low private indebtedness, moderate asset price growth, and a current account surplus driven by lively export activity.

Although the economic recovery in Slovenia coincides largely with a period of a more explicit forward guidance adopted by the ECB which abolished temporary nature of non-standard measures and was followed by introduction of quantitative easing programs, the role of monetary policy in recent economic activity in Slovenia remains unclear and hardly distinguishable from local autonomous drivers. Direct utilization of non-standard measures by Slovenian economic agents has remained relatively scarce throughout the period of unconventional monetary policy. The exceptions to that are years 2012 and 2013, where Slovenian banks either repaid or compensated the wholesale funding from international markets by borrowing via the 3-year long-term refinancing operations (LTROs), see Figure 1. At the end of 2013, the proportion of liabilities attributable to Eurosystem's funding accounted to more than 9 %. After 2013 and throughout the recovery period, the demand for this particular source of funding remained fairly low (around 2.5 % of the total banking system liabilities), mainly due to the excessive liquidity, which moved in parallel with lower investment activity, credit demand and strengthened current account position that triggered a surge in deposit liabilities. A rather more direct influence could be sought in the structure of the deposit funding. Namely, the low interest environment and continuous narrowing of spreads between long-term and short-term interest rates caused a rapid conversion of long-term deposit funding into sight deposits. In 2017, the proportion of the latter in total deposit liabilities amounted to roughly 70 %, putting pressure on sustainability of the overall funding structure.

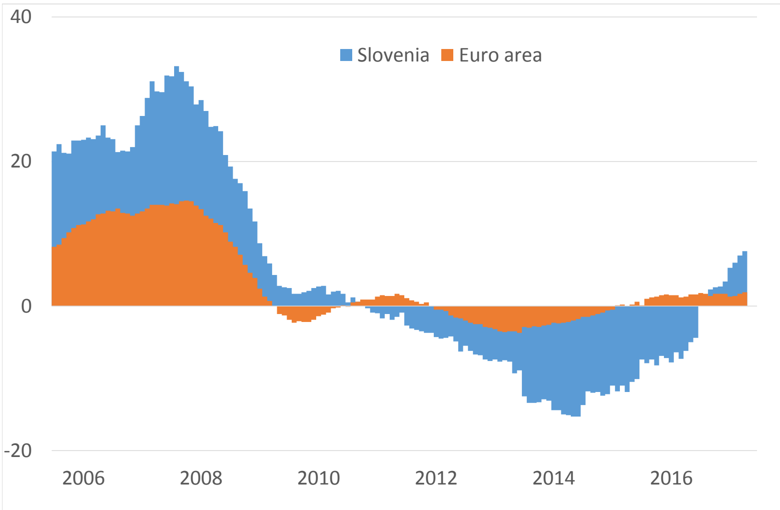
Figure 1: Banking system liabilities



Source: Bank of Slovenia (Balance sheet statistics).

The ambiguity about the effectiveness of the monetary policy can also be visible in bank lending activity to non-financial corporations in Slovenia. Between 2011 and 2017, the debt overhang decreased by 45 %. However, the debt unwinding process was longer than on average observed for other countries and considering the past deleveraging experience following busts, see Chen et al (2015). This could potentially be again attributable to autonomous drivers that caused impairment of transmission channel and hindrance for monetary measures to facilitate the deleveraging process. This is in part visible in Figure 3, which points towards a significantly delayed interest rate pass-through in Slovenia. A more rapid convergence towards interest rates observed at the euro area level has only taken place in the period after 2013, when interest rates on corporate loans fell by 75 basis points. Similar developments could be observed by observing dynamics in Slovenian sovereign yields. In the combined period of sovereign and banking crisis, yields on the 10-year Slovenian government bond increased by 300 b.p.. At the same time, the average spread relative to the EA core amounted to 500 b.p., indicating restrictive financing conditions that Slovenian economy faced at the time of already operating non-standard measures (LTRO-I, LTRO-II, CBPP-I, CBPP-II, SMP).

Figure 2: Newly issued loans to non-financial corporations (annaul growth in %)



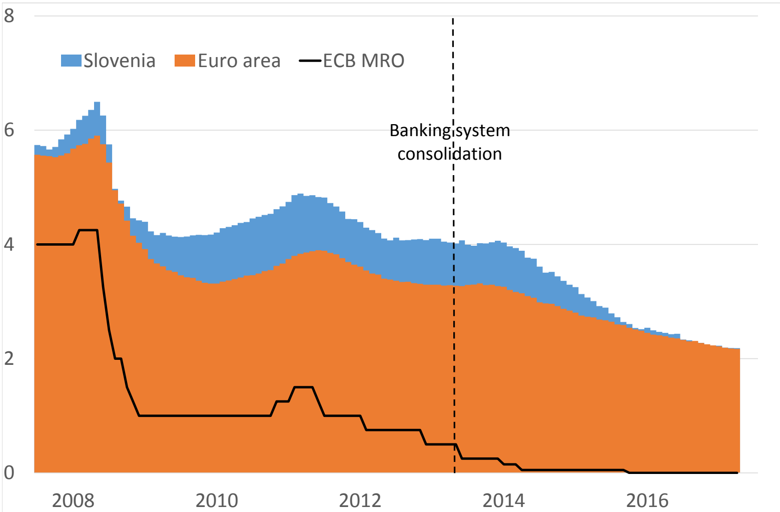
Source: Bank of Slovenia (Balance sheet statistics), ECB Statistical Data Warehouse.

In both cases, interest rates on loans to NFCs and sovereign yields, it is difficult to distill the autonomous drivers from the pure impact of the common monetary policy. Namely, a general improvement in financing conditions only occurred once the major structural reforms were adopted (pension and labour market reforms) and the banking system consolidation was implemented. However, the timing of interest rates and sovereign yield convergence also coincides heavily with more assertive monetary policy agenda undertook by the ECB in that period. Namely, in July 2012 president Draghi gave the renowned "Whatever it takes speech", which landmarked a shift towards more explicit forward guidance that dismissed the temporary nature usually associated with non-standard measures in the earlier stages. The forward guidance shift and determination to preserve integrity of the euro area was at the same time supported by the Outright Monetary Transaction program, which introduced an option of unlimited bond buying and was specifically aimed towards sovereign yield stabilization and narrowing of spreads across countries. Moreover, in the years to follow the ECB introduced first quantitative easing tools, the CBPP-III and the

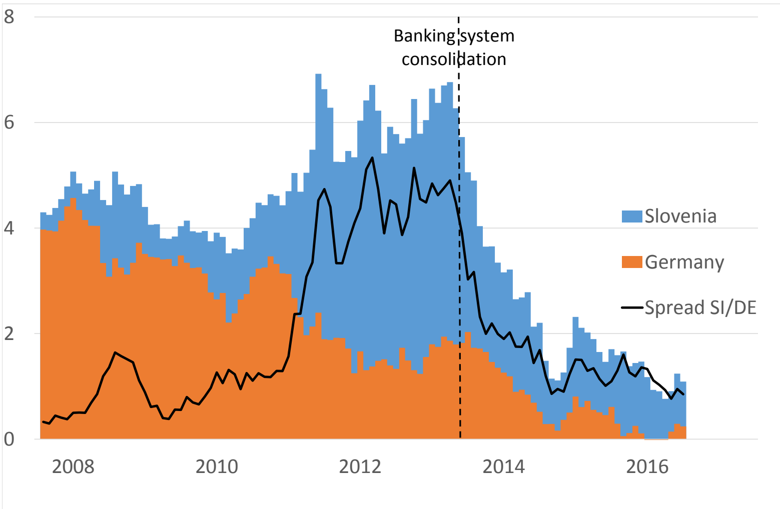
Extended Asset Purchase Programme.

Figure 3: Financing conditions in Slovenia and EA

(a) Interest rates on loans to NFC (%)



(b) Interest rates on 10-year government bond (%)



Source: Bank of Slovenia (Balance sheet statistics), Bloomberg.

Section 3 derives measures of the EA monetary stance and Slovene-specific financing conditions, respectively, which are used to separate the impact of common monetary policy from autonomous drivers in the modeling framework provided in Section 4. However, a first glance on effectiveness of monetary policy may already be given by observing daily yield changes surrounding announcements of non-standard measures. In principal, the one-day window of observing yield changes should be sufficient enough to fully incorporate financial markets adjustments, but at the same time short enough to isolate the influence of monetary policy from other events, see Christensen and Rudebusch (2012). The results of such static event-study analysis are presented in Table 1. Changes in 10-year government bond yields suggest that the common monetary policy does indeed produce positive effects on financing conditions in Slovenia. The largest stabilizing effects are in fact documented in the period connected with largest economic and financial uncertainty in Slovenia. The combined effect of announcements associated with LTRO programs amounted to 29 b.p. reduction in government bond yields, while the option for the ECB to intervene in secondary sovereign markets (within modalities of the OMT program) produced 27 b.p. decrease in government spreads relative to the EA core.

Table 1: Basis point change in 10-year government yields surrounding MP announcements

Announcement	Slovenia	Italy	Germany
15/10/2008 Liq. Prov.	-10.2	0.0	0.0
07/05/2009 CBPP1	11.0	7.0	18.6
10/05/2010 SMP	-16.7	-30.5	17.0
06/10/2011 CBPP2	5.5	-2.7	19.7
08/12/2011 LTRO1	-8.2	57.8	-15.5
20/02/2012 LTRO2	-20.4	-7.7	-9.6
06/09/2012 OMT	-11.1	-42.8	16.1
05/06/2014 TLTRO1	-2.9	-3.8	0.9
04/09/2014 CBPP3	-5.7	-8.4	4.7
22/01/2015 EAPP	-14.3	-13.2	0.2
10/03/2016 TLTRO2	-4.3	-4.1	0.2

Source: *Bloomberg, author's calculations.*

3. Monetary and financing condition measure

The descriptive analysis provided in previous section described monetary developments in Slovenia in the past decade, where the impact of centralized monetary policy implemented by the ECB remained unclear. To separate the monetary policy from other influences we have to resort to model-based framework for monetary transmission analysis. The performance of such a model will essentially depend on appropriate characterization of monetary actions. However, measuring monetary stance in unconventional times becomes particularly complicated. Namely, in a low interest environment and with a more distinct shift in monetary policy beyond standard interest rate tools, central bank policy rates traditionally used to measure monetary stance become uninformative. In addition, previous section showed that in the euro area, which is essentially composed of highly heterogeneous countries, monetary stance measured at aggregated level can markedly differ from the one observed for individual member countries.

To deal with these two practical issues we rely on information provided by the yield curve data. The yield curve represents the term structure of interest rates and provides information on how interest rates are expected to evolve through time (see Cochrane (2001), Piazzesi (2011)). Namely, in the most simplistic case we can interpret long maturity interest rates to represent compounded return that investors would gain by rolling a risk-free short rate over corresponding maturity horizon plus the additional term-premium compensation. In that respect, the information embedded in the underlying shape of the yield curve will by nature be subject to direct influence of monetary policy and its expected path. In particular, the level and slope factors determining the shape of a yield curve have empirically been related to inflation expectations and output growth (Diebold et al, 2002), categories essentially driving the monetary policy-making process.

Although term-structure models have been widely adopted in monetary policy analysis, their applicative value became questionable after the global financial crisis. Namely, the corner stone of the term-structure modeling is the short-rate process, which is most commonly expected to evolve into future randomly with a Gaussian diffusion process and particular mean-reversion property. Interest rate of a given maturity is then just a mean of the projected short rate distribution at this particular horizon. Therefore, since fitted interest rates along the projected horizon follow the Gaussian distribution, in a low interest environment this leads to positive probabilities of interest rates evolving to negative values at any maturity. In this kind of environment traditional term-structure modeling becomes theoretically and practically inconsistent as it in first instance allows for arbitrage opportunities and secondly since the negative realizations of longer maturity rates have not been observed historically.

A way around this problem can be attained by redefining the short rate process according to Black (1995), which decomposes the actual short rate into shadow part that would prevail in absence of the lower bound and an option component allowing to hold physical currency at zero return when shadow rate is negative. Krippner (2011-2015) provides a closed form analytical forward curve expression based on Black (1995) specification for the short rate:

$$\underline{f}(t,\tau) = f(t,\tau) + z(t,\tau) \tag{1}$$

where $\underline{f}(t,\tau)$ is a forward curve at time t with maturity horizon up to tau that is consistent with lower bound, $f(t,\tau)$ is its unconstrained realization or a shadow forward curve, while $z(t,\tau)$ represents the forward option effect allowing for existence of a physical currency. Using standard interest rate relations (Filipovi, 2009) we can derive the instantaneous curve:

$$\underline{R}(t,\tau) = \frac{1}{\tau}\int_0^\tau \underline{f}(t,\tau) = R(t,\tau) + Z(t,\tau) \tag{2}$$

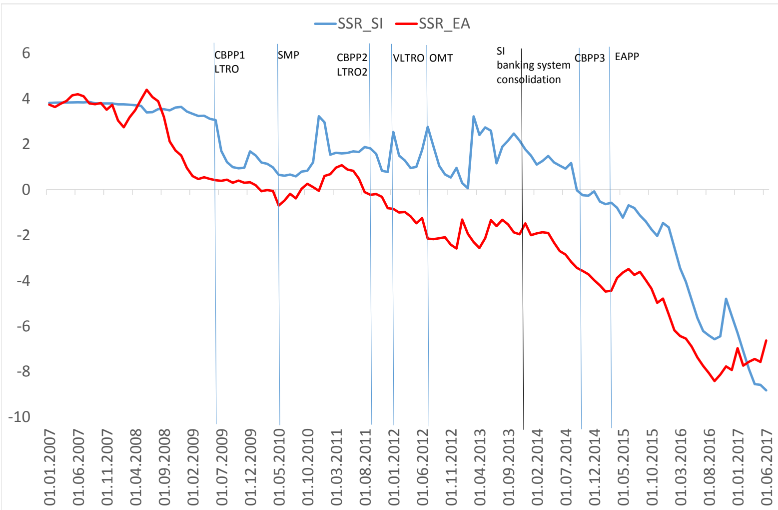
Analytically, the shadow curve $R(t,\tau)$ is defined the same as in the unrestricted case, but the factors determining its shape and evolution through time will be estimated in a theoretically and practically consistent environment. A particularly useful output offered by this setting is the interest rate of shortest maturity, which is extracted from the shadow part of the yield curve or the shadow short rate, $R(t,0)$. If we assume that monetary policy is efficient in a sense that risk-free asset prices respond to monetary policy regardless of the type of measure being used (standard or non-standard), the shadow short rate (hereafter SSR) should summarize policy actions through conventional and unconventional times. In other words, the shadow rate could be perceived as the realization of a policy rate in the absence of a lower bound. Moreover, since we rely on the information embedded in the yield curve data, the SSR measure could also be derived for individual countries within the EA that no longer practice their own monetary policy. However, in contrast to the EA SSR which is based on the risk-free rates, the individual country yield curve might be affected by its access to foreign markets and associated credit risk. In that respect, a more appropriate interpretation of the SSR would be a measure of general financing conditions rather than monetary stance per se. In any case, the country-specific SSR measure provides important information on heterogeneities of monetary policy across member countries within currency union.

Figure 4 depicts the SSR time series for the EA and Slovenia using the Shadow/ANSM framework[1] derived in Krippner (2011-2015). The EA SSR rate was estimated using the ECB's

[1]The estimation was performed using Matlab code extracted from Leo Krippner's personal webpage

publicly available yield curve data based on the bonds with triple-A investment rating[2] with maturity span of 0.25, 0.5, 1, 2, 5, 7, 10, 15, 20, 30 years, monthly frequency and period from September 1997 till July 2017. In case of Slovenia, term-structure based on market data for sovereign yields was used for period between September 2005 and July 2017. Maturity span was restricted to 0.25, 0.5, 1, 2, 4, 5, 7, 10 years where in case of missing market rates the data was imputed using the nearest neighbor method. From the estimated series we can observe evident divergent dynamics occurring in the beginning of the sovereign crisis, with the EA SSR series evolving to negative values indicating the flight to quality and safety premium related to the core EA country, whereas Slovenia was facing restrictive financing conditions in line with the corresponding risk premium. At the peak of the EA sovereign crisis in 2012 the spread between the EA and Slovene SSR surpassed 500 b.p. In general, non-standard measures did manage to produce easing effects on Slovene financing conditions which were however short-lived. In line with descriptive analysis provided in Section 2 a permanent convergence in financing conditions only started to take place once the structural issues pertaining Slovenian economy were resolved and was significantly facilitated with first quantitative easing measures employed by the ECB.

Figure 4: Shadow short rates for the Euro area and Slovenia (%)



Source: ECB Yield curve, Bloomberg.

The SSR measure, however, is prone to several technical and content related issues. Christensen and Krippner (2015b) point to significant sensitivity of the estimated SSR towards particular specification choice of a yield curve model. While dynamics in ordinal sense remains relatively stable the actual estimated values tend to differ significantly with varying maturity span and number of latent factors used in estimation. In our practical example, this deficiency becomes particularly relevant, since maturity and sample range differ significantly for the EA and Slovenia. In addition, the SSR is essentially a fictional realization of a policy rate that

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`https://www.rbnz.govt.nz/research-and-publications/research-programme/research-staff-profiles/leo-krippner`.

[2]`https://www.ecb.europa.eu/stats/financial_markets_and_interest_rates/euro_area_yield_curves/html/index.en.html`

should summarize standard and non-standard measure. Hence, it is not an observed quantity according to which economic agents could shape investment and consumption decisions. In this kind of setting, it becomes extremely hard to assign a linear interpretation to SSR series that would apply in conventional and unconventional times. For example, a 100 b.p. reduction in SSR will very unlikely represent the same monetary stimulus at positive and actually observable interest rates relative to the case of equal reduction in SSR at negative values.

To deal with this particular issue Krippner (2015) proposes the Effective Monetary Stimulus measure (hereafter the EMS), which represents the integrated difference between effective and long-run neutral rate. In the Shadow/ANSM the effective expected short path is represented by the zero-truncated shadow forward curve, while the long-run neutral rate (non-inflationary and non-stimulatory interest rate) is empirically related to the Level factor. Larger the difference between current and expected path of monetary policy from its perceived steady state, larger is the estimated monetary stimulus. The EMS demonstrates several comparative advantages relative to the SSR. Namely it exhibits a substantially stronger robustness towards the choice of model, which enables more convincing comparison of estimated measures among countries with non-necessarily compatible data samples. In addition, it deals with categories (effective expected policy path and neutral rate) consistent and known to economic agents through conventional and unconventional times. Moreover, by relying on the overall effective short-rate path rather than specific point, our measure comes closer to theoretical wisdoms and structural modeling (DSGE), where behaviour of economic agents is commonly characterized in terms of current and expected developments in monetary policy. Using analytical solution for the ZLB forward rate we can define the model-based EMS as:

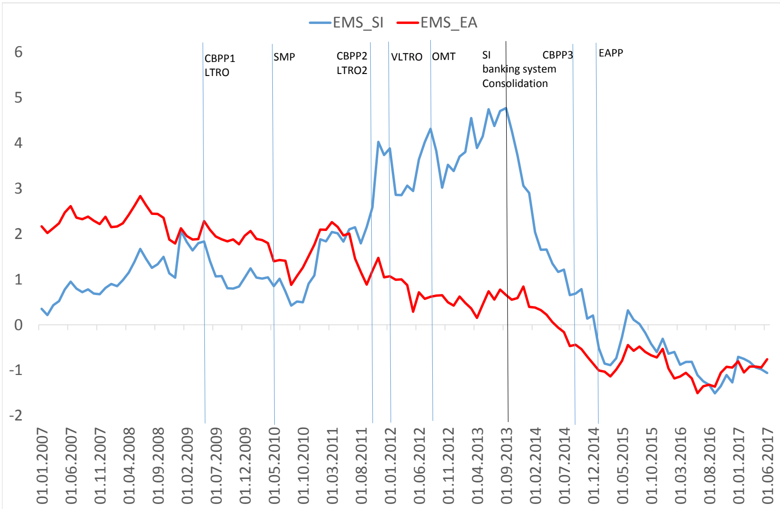
$$EMS(t,\tau_h) = \frac{1}{\tau_h}\int_0^{\tau_h} \left[\underline{f}(t,\tau)d\tau - LNIR(t)\right] \tag{3}$$

where τ_h refers to maturity horizon, $\underline{f}(t,\tau)d\tau$ is the lower-bound adjusted forward rate, and $LNIR(t)$ is the long-run neutral rate at time t without maturity dependency. By explicitly expressing the difference and using the standard interest rate relations we arrive at:

$$\begin{aligned} EMS(t,\tau_h) &= \tfrac{1}{\tau_h}\textstyle\int_0^{\tau_h} \underline{f}(t,\tau)d\tau - \tfrac{1}{\tau_h}\textstyle\int_0^{\tau_h} LNIR(t)d\tau \\ &= \underline{R}(t,\tau_h) - LNIR(t) \end{aligned} \tag{4}$$

This simplification is particularly useful as the interest rate at horizon τ_h, $R(t,\tau_h)$, is a completely observable category, since lower bound is in practice not binding for longer part of a yield curve. In addition, Halberstadt and Krippner (2016) show that the LNIR can be treated as an observable variable using long-term forecasts for the nominal output growth and inflation. The justification for this approximation is based on results from the standard Solow-Swan and Ramsey neoclassical models where in steady state the real interest rate is aligned with the real output growth. Expressing the measure of monetary stance as a completely observable category is particularly appealing from the perspective of modeling monetary transmission as it enables avoiding the generated regressor bias, which we would encounter had we introduced the SSR or model-based EMS as a policy rate in the structural VAR model. The model-free EMS rates for the EA and Slovenia, respectively, are constructed as a difference between the 10-year sovereign bond yield and forecasts for nominal GDP over 10 year horizon. The choice of a 10-year maturity yields enables most consistent comparison of long-term interest rates in Slovenia with the Euro area yields through time. The long-term forecasts of nominal output growth are obtained using Consensus Forecast survey data on real output growth and inflation forecasts. Since the latter are only available on a biannual basis the LNIR approximation is held constant over a 6-month period. Since the LNIR should be fairly persistent in its nature, this kind of interpolation is not disrupting the general interpretation of the EMS measure.

Figure 5: Economic Measure of Stimulus (%)



Source: ECB Yield curve, Bloomberg, Consensus Forecast survey.

The EMS measure for Slovenia exhibits intuitive dynamics following the introduction of the ECB's non-standard measures (with the exception of the CBPP2). As in the case of the SSR measure, the effect seems to be short-lived and not sufficient to prevent considerable divergence in financing conditions in Slovenia and the EA in the wake of the EA sovereign crisis. Following the implementation of structural reforms and in particular the recapitalization of banking system, the convergence is immediate and persistent. Following the introduction of the ECB's quantitative easing measures, financing conditions in Slovenia moved closer to the dynamics observed for the EA. All in all, the EMS measure produces dynamics consistent with the actual monetary and country-specific events. Moreover, the EMS is essentially observed category, aligned with theory-based interpretation of a policy rate. In that respect, the monetary transmission analysis performed in the following section proceeds by using EMS series depicted in Figure 5 to respectively account for the ECB's monetary policy and country-specific financing conditions in Slovenia.

4. Monetary transmission in Slovenia

4.1. Empirical settings

In this section we model the effects of the common monetary policy on Slovenian real economy. Macroeconomic effects of the monetary policy has traditionally been examined within the SVAR mechanism. A typical monetary SVAR, e.g. the one proposed in Bernanke and Gertler (1995), would commonly include a monetary policy variable, measure of output, and inflation. This kind of a tri-variate system would in normal application be self-contained, in a sense that it enables modeler to disentangle a systemic response of a policy rate (e.g. Taylor rule) and a non-systemic part. This would enable the monetary policy shock identification, through which the causal contemporaneous relations to macroeconomic variables could then be observed. However, a descriptive analysis of macroeconomic developments in Section 2 revealed that financing conditions at a country level (in our case Slovenia) do not necessarily match the monetary stance observed at the euro area as a whole. Therefore, to unbiasedly explore effects of the common monetary policy on Slovenia, the appropriate representation of the modeled economy needs to account for country-specific credit and financial developments.

Moreover, inclusion of country-specific financing conditions can also be perceived important from the perspective of fully capturing the systemic policy response of the ECB. Namely, with introduction of unconventional measures, the ECB monetary policy allowed for deviation from its predictable path suggested by the standard Taylor rule. For example, the implementation of some of the non-standard measures, e.g. the OMT, has assumed actions aimed at specific distressed countries and reduction of their interest rate spreads relative to the EA core. In that sense, the inclusion of the country-specific financing measure is necessary for capturing the wider mandate that the ECB adopted during and after the crisis.

Therefore, the first model we consider in our analysis is a 4-variate SVAR, incorporating the measure of the EA common monetary policy stance (EMS_EA), real industrial production index for Slovenia (IP_SI), Harmonized Index of Consumer Prices for Slovenia (CPI_SI), and the measure of country-specific financing conditions for Slovenia. The structural shock identification in this model relies on the Cholesky decomposition of residual variance-covariance matrix. For this purpose, an ordering where EMS_EA variable is placed first in the system (followed by IP_SI, $HICP$, EMS_SI) is considered. With this ordering it is assumed that from the perspective of Slovenian economy the ECB's monetary policy is exogenously determined. The validity of this assumption, however, depends on the degree of spillovers from the EA to Slovenia. For example, a large demand shock in the EA is expected to be resembled both, in the policy rate through systemic policy response, as well as in the Slovenian real economy due to potentially large spillovers. Placing the EA monetary stance measure first in the system would then most likely produce counterintuitive positive response of Slovenian output and prices to contractionary common monetary policy shock. For this reason, an alternative ordering is additionally considered, with EMS_EA variable being put after variables IP_SI and $HICP\_SI$.

Nevertheless, while the above specification allows fairly straightforward comparability to monetary VAR models that have most widely been used in the literature, solely putting together the measure of monetary stance and Slovene-specific macroeconomic variables would most probably not suffice for appropriate monetary policy shock identification and consequent drawing its actual impact on Slovenian economy. The caveat would stand regardless of the variable ordering adopted in the system. Namely, the degree of spillovers and comovement between the EA and Slovenian real economy is unknown and may differ considerably through time, depending on the country-specific events and size of local economic shocks. Therefore, to properly identify the EA common monetary policy it is necessary to account for consistent ECB's policy setting. Thus, the analysis is proceeded by augmenting the 4-variate SVAR model with variables corresponding to the EA industrial production index and Harmonized Index of Consumer Prices for the EA (IP_EA, $HICP\_EA$). To avoid discussing to what extent are country-specific macroeconomic conditions relevant for actual monetary policy setting, we consider a model with entirely endogenous set of variables $\{IP\_EA, HICP\_EA, IP\_SI, HICP\_SI, EMS\_EA, EMS\_SI\}$ and a separate model where variables corresponding to Slovenian economy are entering the system as an exogenous block.

Inclusion of the EA macroeconomic determinants in the system also allows for utilization of already established conventional wisdoms. Namely, instead of relying solely on Cholesky factorization for the purpose of monetary shock identification, we can now also consider several set-identifying sign restrictions that can mimic empirical results obtained for the EA as a whole.

For example, in line with Smets and Wouters (2004), IP_EA and $HICP\_EA$ are restricted to respond negatively to an unanticipated increase in the ECB's policy rate. Moreover, we can combine above restrictions with restrictions that follow closely the actual mandate that the ECB at least implicitly adopt. Namely, following Arias et al (2018), additional restrictions are imposed on systemic component of the policy variable, assuming contemporaneous increase of the EMS_EA in response to increases in IP_EA and $HICP\_EA$, while impulse responses are left unrestricted.

Different specifications of SVAR models are summarized in Table 2. To ensure comparability, the independent normal-Wishart prior distribution for reduced-form parameters is assumed in all types of model. The analysis is performed on monthly data, spanning the period from 2007M1 to 2017M12. Industrial production indices are expressed in real terms using producer price indices as deflators. Industrial production and price indices are log transformed, while EMS measures are left unchanged. Description of the Effective Monetary Stimulus measure was described in Section 3.

Table 2: Summary of empirical setting

Type	Description	Label
4-variate SVAR & Cholesky	Ordering 1: $\{EMS\_EA, IP\_SI, CPI\_SI, EMS\_SI\}$	Model 1a
	Ordering 2: $\{IP\_SI, CPI\_SI, EMS\_EA, EMS\_SI\}$	Model 1b
SVAR with EA block & cholesky	System 1: $\{IP\_EA, CPI\_EA, IP\_SI, CPI\_SI, EMS\_EA, EMS\_SI\}$	Model 2a
	System 2: Model 2a & ex. block: $\{IP\_SI, CPI\_SI, EMS\_SI\}$	Model 2b
Model 2 & sign restrictions	Restriction 1: $-IRF_{IP\_EA,EMS\_EA,0-4}$ & $-IRF_{CPI\_EA,EMS\_EA,0-4}$	Model 3a
	Restriction 2: $Restr.1$ & + on sys. response of EMS_EA_t to $\{IP\_EA_t, CPI\_EA_t\}$	Model 3b

4.2. Results

In previous subsection, several alternative SVAR specifications were laid out, starting from the one most comparable to the traditional empirical setting for modeling monetary transmission to ones that allow capturing the notion of the common monetary policy and the individual country perspective. The support for a particular type of model can first be examined by the probability of producing our dataset with a particular model. Table 3 presents reciprocal Bayes factors (i.e. ratios of marginal likelihoods for two competing models).

Table 3: Reciprocal Bayes factors for competing models

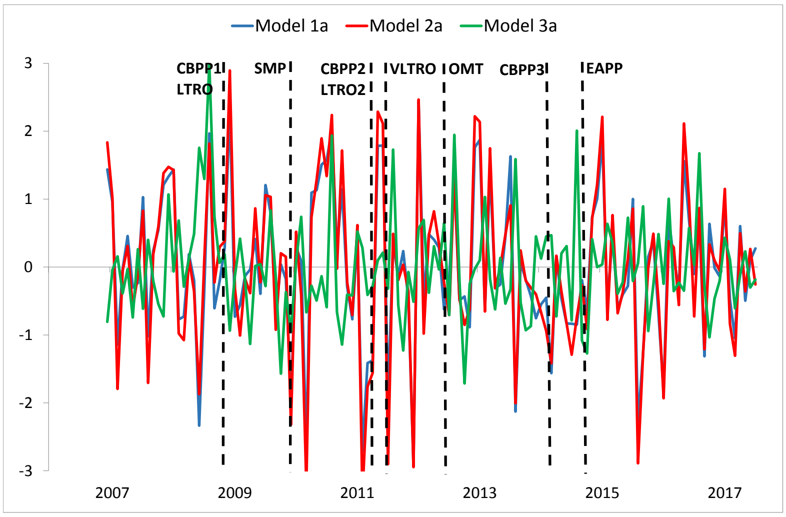
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b
Model 1a	1	0.97	0.43	0.98	0.92	0.44
Model 1b	1.03	1	0.45	1.01	0.94	0.45
Model 2a	2.30	2.25	1	2.27	2.11	1.02
Model 2b	1.02	0.99	0.44	1	0.93	0.45
Model 3a	1.09	1.06	0.47	1.07	1	0.48
Model 3b	2.26	2.20	0.98	2.22	2.07	1

The odds presented in the table suggest that the Model 2a is comparatively most likely to describe the data used in analysis. The model considers all variables (those corresponding to the

EA as a whole and Slovenia) in the system as endogenous. From the perspective of monetary policy this would mean that country-specific macroeconomic and financing conditions do matter for the policy setting, which would actually quite fairly resemble the nature of several non-standard measures deployed by the ECB in the past. For example, at least implicit objective of reducing intra-Euro spreads can be interpreted from modalities of the EAPP, the OMT and the SMP. However, by relying on standard conventions for interpretation of Bayes factor (Jeffrey, 1961), no decisive evidence for support or elimination of particular model could be provided at this point.

Additionally, we could compare models from the perspective of a proper identification of the EA monetary policy shock. Figure 6 depicts estimated monetary shock series for a particular model type[3]. Structural shock series corresponding to models 1a and 2a seem to be highly correlated (correlation coefficient exceeds 0.9), while series corresponding to the Model 3a shows a bit more divergent dynamics (correlation with Model 2a is less than 0.1). Considering specific announcement dates for several non-standard measures, series corresponding to models 1a and 2a provide intuitive dynamics (that is expansionary MP shock) for almost all specific non-standard measures. The exception is the CBPP1 program, where all three series counterintuitively point towards a small contractionary shock. The series corresponding to the Model 3a on the other hand additionally suggests more stringent monetary conditions at the announcements of the OMT and the CBPP3, which opposes the expansionary intention of these measures. The strongest surprise component in monetary policy response can be detected in case of SMP and VLTRO announcements, where identified expansionary shocks are largest.

Figure 6: Identified structural monetary policy shock series



In addition to structural shock examination, we can also discuss the validity of identified

[3]Since series of same type of model (e.g. Model 1a and 1b) are highly correlated, only one series per type is presented for the sake of better transparency.

monetary policy from the perspective of its impact on real economy and prices in the EA. Namely, in line with the conventional wisdom one could expect industrial production and prices in the EA to decrease in response to an unanticipated monetary policy shock. Figures A.11 and A.12 (Appendix A.2), present impulse responses based on relevant model specifications that allow the effect on the EA as a whole to be observed (2a, 2b, 3a, 3b). For all models, evidence points towards expected and intuitive reduction of both, the EA industrial production and the EA HICP in response to a contractionary monetary policy shock. In case of impulse responses related to the EA industrial production index, respective smaller portions of posterior probability masses of models 2a and 2b lie above the zero line, suggesting that puzzling response could not be entirely excluded. However, the depicted credible intervals are obtained at (for Bayesian analysis) conservative 95 percent of equally tailed posterior probability bands. In case of price responses, the Model 2a produces intuitive and significant negative response, while the Model 2b points towards material probability of a puzzling price response.

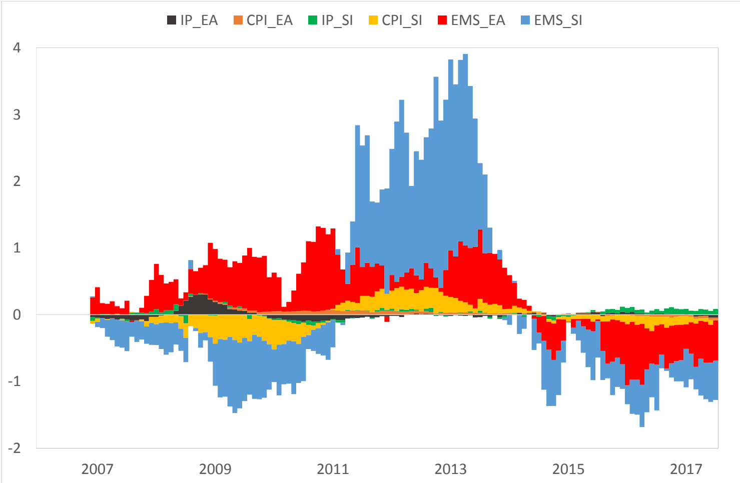
Given the interpretation of structural shocks and impulse responses of the EA industrial production and prices, the Model 2a seems to be comparatively the most reasonable choice for modelling effects of the common monetary policy on Slovenian economy. Nevertheless, for the sake of robustness of suggested evidence we proceed by presenting results for all models where applicable and follow results from the Model 2a where due to conservation of space results from only one model could be presented.

Following the logical sequential steps of monetary transmission mechanism we start the analysis of impact on Slovenian economy by first examining the effects of the common monetary policy on Slovene-specific financing and credit conditions. Evidence of the estimated impulse response functions of EMS_SI to EMS_EA (Figure A.9, Appendix A.1) suggest that monetary stance observed at the EA level is in fairly direct way translated into Slovenian financing conditions. The effect is persistent and significant throughout the whole horizon. The opposite causality, response of the EA monetary stance to Slovenian financing conditions, expectedly remains insignificant throughout the period (see Figure A.13, Appendix A.2). As far as the impact on Slovenian output is concerned, Figure A.8, Appendix A.1, shows that following the unanticipated contractionary common monetary policy shock, industrial production in Slovenia responds negatively, with significant and persistent effect produced by all models. In contrast, the impact of the common monetary policy on Slovenian prices remains insignificant throughout the horizon with no supportive evidence against the puzzling response.

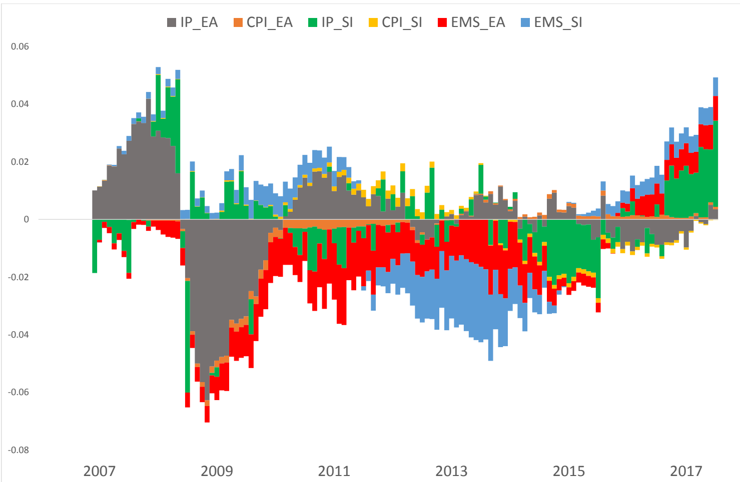
Moreover, we can additionally examine characteristics of the monetary transmission through time. Figure 7 provides historical decompositions of the stochastic components for variables EMS_SI and IP_SI. Historical decomposition of the Slovenian industrial production resembles closely the narrative of the double deep recession that Slovenia weathered between years 2009 and 2013. Namely, in 2009 Slovenian economic activity endured a severe shock that originated from a drop in external demand, which is in panel (b) visible in substantial negative contributions of IP_EA to IP_SI. The initial shock consequently revealed macroeconomic instabilities and several systemic issues that had pilled up in the pre-crisis and crisis period and eventually caused a fatal deterioration of financing conditions in Slovenia. The latter can best be observed in panel (a), where severe stringent conditions were primarily driven by autonomous autoregressive component, resembling the amplifying effect of the local domestic shocks. The deterioration of financing conditions peaked in 2013, eventually leading to the second dip amids the height of the sovereign crisis. At the same time, from the perspective of Slovenian economy the monetary policy stimulus provided by the ECB before 2013 remained too weak to offset the accumulated adverse demand and financing condition shocks. After 2013, however, sustained positive effects of the common monetary policy on Slovenian financing conditions and real economy can be observed. Historical decomposition of the EMS_SI reveals permanent contribution of the monetary policy to reduction of financing costs in Slovenia after 2013. Moreover, the contribution of the monetary policy shock is largest among all shocks driving the stochastic component of the EMS_SI. Likewise, the monetary policy seems to have also substantially contributed to the recent upward output dynamics in Slovenia as continuous positive contributions to rising industrial production are observed. Anecdotally, this landmark coincides heavily with more assertive monetary policy employed by the ECB after 2013 (implemented through explicit forward guidance and Asset Purchasing Programs) and completed banking recapitalization in Slovenia, which seems to have successfully recovered the impaired monetary transmission mechanism in Slovenia.

Figure 7: Historical decomposition of stochastic components

(a) Slovene-specific financing conditions (EMS_SI)



(b) Real Industrial Production



4.3. Robustness

The analysis presented above was subject to several robustness checks. Results remain robust under the Minnesota prior distribution with residual variance-covariance estimated using the OLS. Results obtained through models applying sign-restriction identification schemes (Models 3a and 3b) remain robust to inclusion of exogenous block incorporating variables related to

Slovenian economy (in line with Model 2b). Model 3a and 3b remain robust to various alternative horizons over which the sign restrictions on impulse responses on IP_EA and $HICP\_EA$ are imposed. Additionally, several models adopting more agnostic types of sign restrictions were examined, e.g. Uhlig (2004), Arias et al (2018) and Arias et al (2018) in combination with Uhlig (2004) type of restrictions, however, intuitive identification of monetary policy shock could not be ensured due to puzzling response of either EA industrial production index or bot the IP_EA and $HICP\_EA$. Models examined above assumed a 4-lag specification, but results remain broadly the same at different lag choice (2, 6 and 8). However, results do display some sensitivity towards inclusion of deterministic trend. Under assumption of the linear trend, results remain qualitatively the same, but compared to our benchmark specification (i.e. Model 2a), a non-trivial portion of posterior probability mass point towards possibility of puzzling output and price responses in Slovenia to a common monetary policy shock.

5. Conclusion and policy implications

This paper was one of the first formal analysis of impact of the euro area common monetary policy on Slovenian economy. Analyzing the impact of the common monetary policy on a specific country within the currency union remains challenging in several aspects: (i) first being how to continuously measure monetary policy through conventional and unconventional times; (ii) secondly, how to appropriately account for differing aggregate monetary stance and country-specific financing conditions; (iii) thirdly, how to develop a self-contained modeling framework for monetary policy shock identification while at the same time accounting for domestic autonomous drivers influencing the local economy; (iv) and lastly, how to account for the short data sample commonly associated with countries that adopted the Euro in recent period. To appropriately characterize the monetary policy throughout the low-interest environment we relied on extracting a yield curve information, which proved to be particularly appealing as the term structure framework allowed us to continuously track the current monetary stance and its expected future path, essentially crucial categories for decision-making of economic agents. Moreover, the yield curve information helped us observe monetary stance and the associated risk-premium in countries like Slovenia that no longer practices their sovereign monetary policy. Therefore, to observe the monetary stance at the euro area and financing conditions in Slovenia we relied on the recently proposed Effective Monetary Stimulus measure (the EMS). The EMS estimates for both, the euro area and Slovenia, were then jointly incorporated into set of different monetary SVAR specifications to analyze the transmission of the common monetary policy to Slovenian economy.

The analysis revealed that the monetary policy produced expected and persistent effects on Slovenian output and financing conditions, while the effect on prices remained insignificant in the examined period. A detailed historical analysis additionally showed that from the perspective of the Slovenian economy, the monetary policy observed before 2013 remained too weak to be able to offset foreign demand shocks and local systemic issues that were accumulated in the Slovenian economy over the period encompassing the global financial crisis and the EA sovereign crisis. Nevertheless, the joint effect of the banking sector resolution and a more assertive monetary stance adopted by the ECB in the second part of the examined period provided a sustained monetary stimulus to Slovenian economy that can still be tractable in the recent economic upswing.

References

[1] Arias, J.E., Caldara, D., & Rubio-Ramirez, J.F. (2018). The Systemic Component of Monetary Policy in SVARs: An Agnostic Identification Procedure. *Journal of Monetary Economics.*

[2] Bernanke, B., Getler, M., & Glichrist, S. (1996). THE FINANCIAL ACCELERATOR AND THE FLIGHT TO QUALITY. *The Review of Economics and Statistics, 78*(1), 1-15. of Monetary Economics 60(8), 950-966.

[3] Black, F. (1995). Interest Rates as Options. *Journal of Finance, 50* (5), 1371-1376.

[4] Chen, S., Kim, M., Otte, M., Wiseman, K., & Zdzienicka, A. (2015). Private Sector Deleveraging and Growth Following Busts. Working Paper /15/35, International Monetary Fund.

[5] Christensen, J., & Rudebusch, G. (2012). The response of interest rates to US an UK quantitative easing. *Economic Journal 122*(564), 385-414.

[6] Christensen, J., & Rudebusch, G. (2015). Modeling Yields at the Zero Lower Bound: Are Shadow Rates the Solution? *Advances in Econometrics,35*(1), 75-125.

[7] Cochrane, J. (2001). *Asset Pricing.* Princeton: Princeton University Press.

[8] Cochrane, J. H., & Piazzesi, M. (2005). Bond risk premia. *The American economic review, 95*(1), 138-160.

[9] ECB (2012a). Speech by Mario Draghi, President of the European Central Bank at the Global Investment Conference in London. *ECB Speeches.* Retrieved January 22, 2015, from `https://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html`.

[10] *ECB Euro area yield curve.* Retrieved January 22, 2016, from `https://www.ecb.europa.eu/stats/money/yc/html/index.en.html`.

[11] *ECB Monetary policy decisions published in 2008.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2008/html/index.en.html`.

[12] *ECB Monetary policy decisions published in 2009.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2009/html/index.en.html`.

[13] *ECB Monetary policy decisions published in 2010.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2010/html/index.en.html`.

[14] *ECB Monetary policy decisions published in 2011.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2011/html/index.en.html`.

[15] *ECB Monetary policy decisions published in 2012.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2012/html/index.en.html`.

[16] *ECB Monetary policy decisions published in 2013.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2013/html/index.en.html`.

[17] *ECB Monetary policy decisions published in 2014.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2012/html/index.en.html`

[18] *ECB Monetary policy decisions published in 2015.* Retrieved February 22, 2016, from `https://www.ecb.europa.eu/press/govcdec/mopo/2013/html/index.en.html`.

[19] *ECB Statistical Data Warehouse*. Retrieved February 22, 2016, from `http://sdw.ecb.europa.eu/`.

[20] Francis, N. R., Jackson, L. E., & Owyang, M. T. (2014). How Has Empirical Monetary Policy Analysis Changed After the Financial Crisis. Working Paper No. 2014-019A, Federal Reserve Bank of St. Louis.

[21] Giannone, D., Lenza, M., Pill, H., & Reichlin, L. (2012). The ECB and the interbank market. *The Economic Journal, 122*(564), 467-486.

[22] Halberstadt, A. and Krippner, L. (2016). The effect of conventional and unconventional euro area monetary policy on macroeconomic variables. Discussion Paper No. 49/20116, Deutsche Bundesbank.

[23] Kapetanios, G., Mumtaz, H., Stevens, I., & Theodoridis, K. (2012). Assessing the economy-wide effects of quantitative easing. *The Economic Journal, 122*(564).

[24] Krippner, L. (2011). Modifying Gaussian term structure models when interest rates are near zero lower bound. Discussion Paper No. 36/2011, Centre for Applied Macroeconomic Analysis.

[25] Krippner, L. (2012). Measuring the stance of monetary policy in zero lower bound environments. Discussion Paper No. 2012/04, Reserve Bank of New Zealand.

[26] Krippner, L. (2013). Faster solution for Black zero lower bound term structure models. Discussion Paper No. 66/2013, Centre for Applied Macroeconomic Analysis.

[27] Krippner, L. (2014). Measuring the stance of monetary policy in conventional and unconventional environments. Working Paper No. 6/2014, Centre for Applied Macroeconomic Analysis.

[28] Krippner, L. (2015a). *Zero Lower Bound Term Structure Modeling.* New York: PALGRAVE MACMILLAN.

[29] Krippner, L. (2015b). A comment on Wu and Xia (2015), and the case for two-factor Shadow Short Rates. Working Paper No. 48/2015, Centre for Applied Macroeconomic Analysis.

[30] Nelson, C., & Siegel, A. (1987). Parsimonious modelling of yield curve. *Journal of Business 60*(4), 473-489.

[31] Piazzesi, M. (2010). Affine Term Structure Models. *Stanford University.* Retrieved December 12, 2014, from `https://web.stanford.edu/~piazzesi/s.pdf`.

[32] Smets, F., & Wouters, R. (2004). Comparing Shocks and Frictions in US and Euro Area Business Cycles: A Bayesian DSGE Approach. Working paper 61. National Bank of Belgium.

[33] Taylor, J. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy 39*, 195-214.

[34] Uhlig, H. (2004). What are the effects of monetary policy on output? Results from an agnostic identification procedure. *Journal of Monetary Economics, 52*(2005), 381-419.

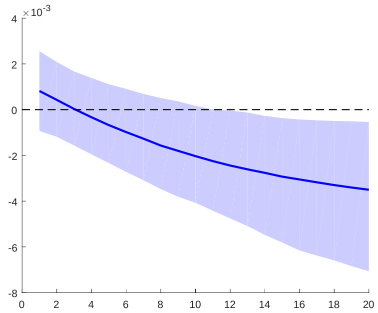
[35] Wu, J. C., & Xia, F. D. (2016). Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. *Journal of Money, Credit, and Banking, 48*(2-3), 253-291.

Appendix A. Impulse Responses for Slovenia and the euro area

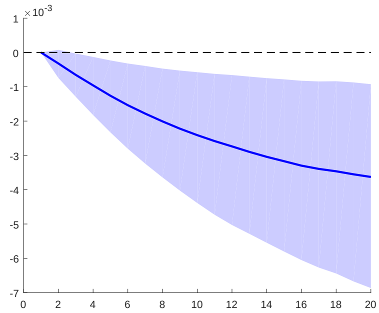
Appendix A.1. Slovenia

Figure A.8: Impulse response of Slovenian industrial production to the EA common monetary policy shock

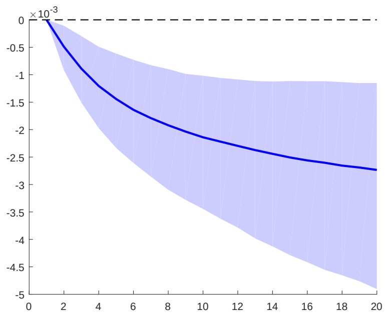
(a) Model 1a



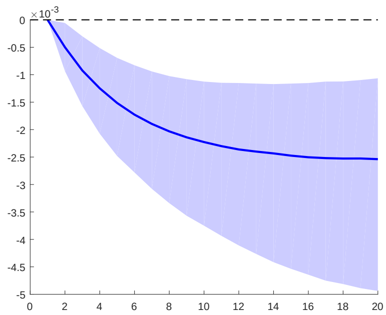
(b) Model 1b



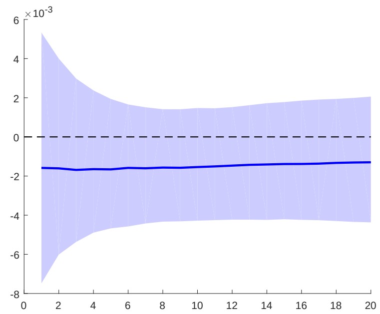
(c) Model 2a



(d) Model 2b



(e) Model 3a



(f) Model 3b

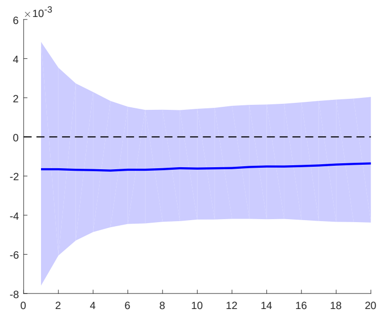
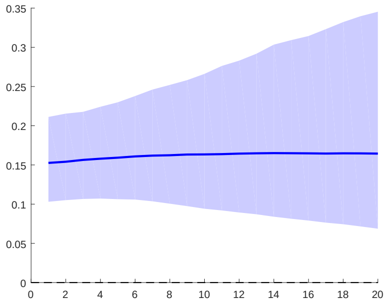
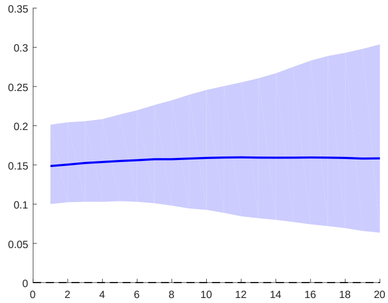


Figure A.9: Impulse response of Slovenian financing conditions to the EA common monetary policy shock

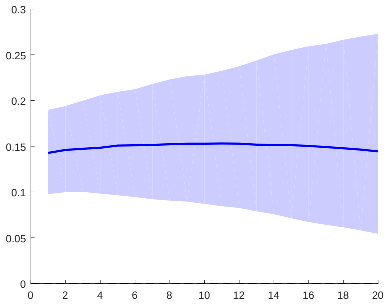
(a) Model 1a



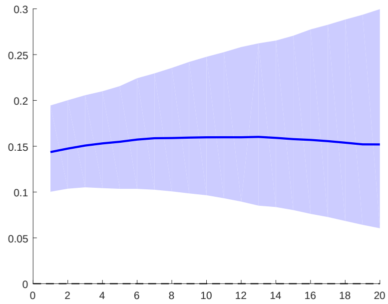
(b) Model 1b



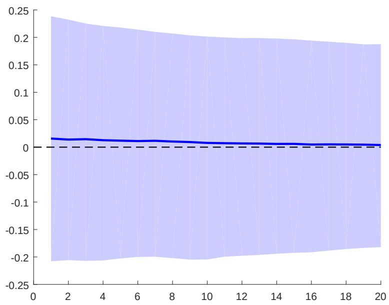
(c) Model 2a



(d) Model 2b



(e) Model 3a



(f) Model 3b

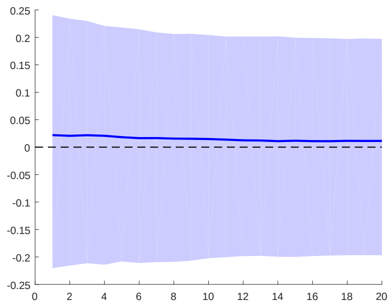
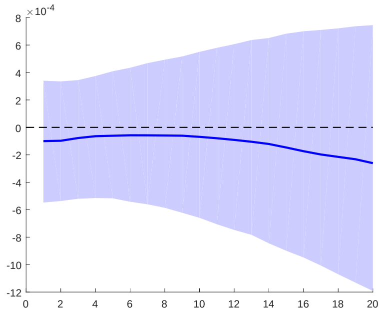
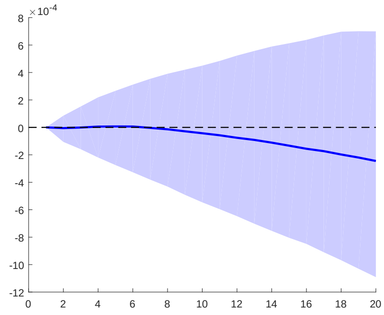


Figure A.10: Impulse response of Slovenian HICP to the EA common monetary policy shock

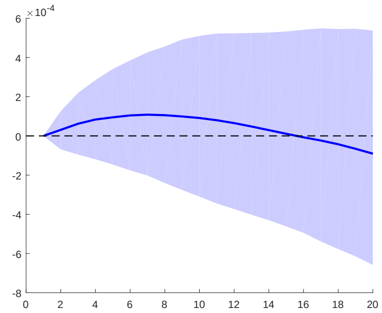
(a) Model 1a



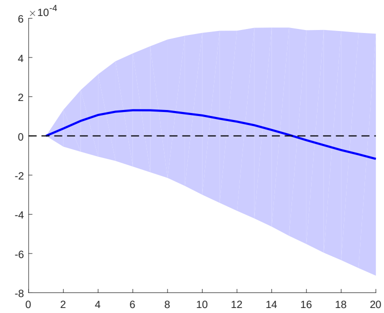
(b) Model 1b



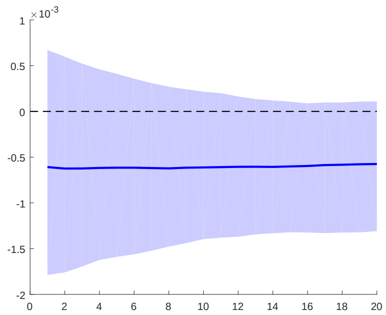
(c) Model 2a



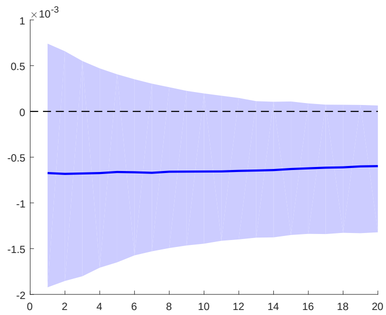
(d) Model 2b



(e) Model 3a



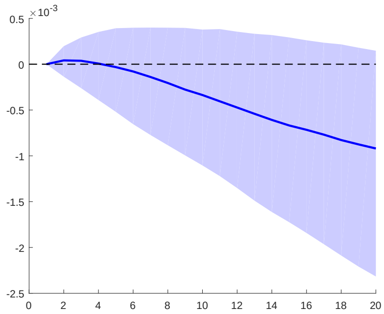
(f) Model 3b



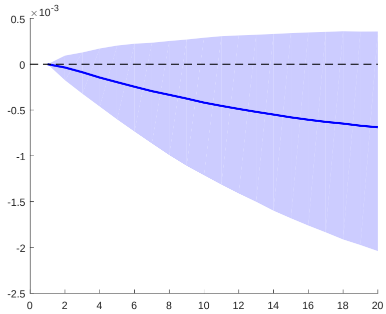
Appendix A.2. Euro Area

Figure A.11: Impulse response of the EA industrial production to the EA common monetary policy shock

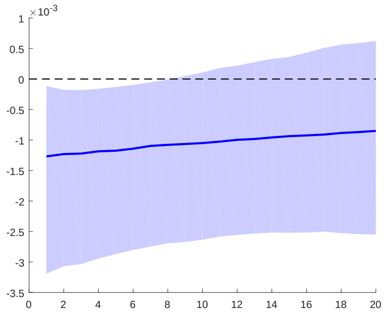
(a) Model 2a



(b) Model 2b



(c) Model 3a



(d) Model 3b

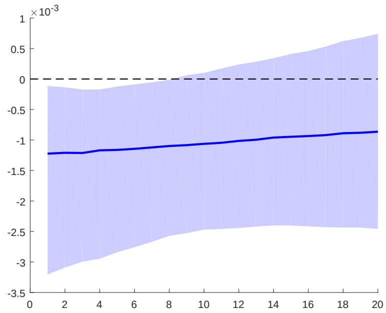
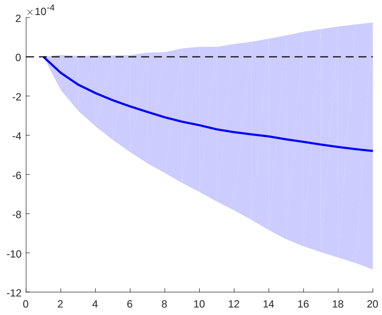
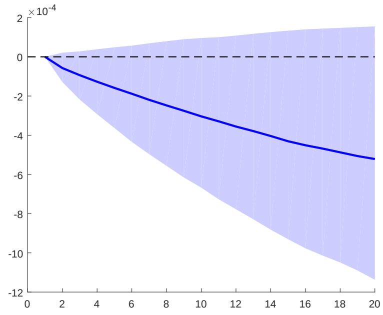


Figure A.12: Impulse response of the EA HICP to the EA common monetary policy shock

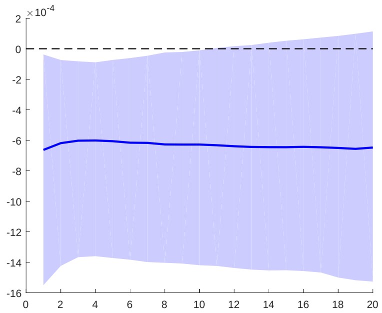
(a) Model 2a



(b) Model 2b



(c) Model 3a



(d) Model 3b

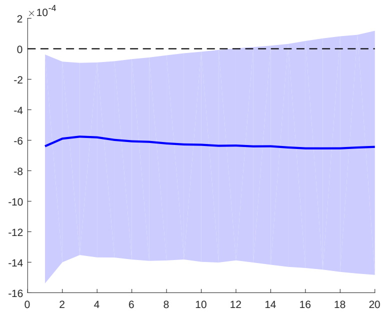


Figure A.13: Impulse response of the EA monetary stance to Slovene specific financing conditions