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Do German Industrial Confidence Shocks Matter for Central and Eastern Europe?

*Silvo DAJČMAN**

Abstract

This paper studies the transmission of German industrial confidence shocks to industrial confidence, industrial production, and price and interest rate level in nine Central and Eastern European (CEE) countries (Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia). The main questions the paper aims to answer are: (i) Do shocks in German industrial confidence affect economies in CEE? (ii) Which CEE economies are more susceptible to these shocks? (iii) Separating different groups of industrial production goods (capital goods, intermediate goods, and durable consumption goods), which production group is more sensitive to the shocks? We apply impulse response and forecast error variance decomposition analysis and find a heterogeneous response across CEE. The results imply confidence transmission running from Germany to several CEE countries, most notably Slovenia, Slovakia, and the Czech Republic.

Keywords: *confidence, transmission of shocks, industrial production, CEE*

JEL Classification*:* D84, E23, E32

Introduction

In recent years, widespread public and expert interest in more comprehensively understanding business cycle dynamics has resulted in a growing body of literature that re-examines the role of business and consumer confidence[1] in

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[1] Confidence can be defined as a belief or expectation of future economic developments, formed by economic agents (consumers, entrepreneurs) (see, e.g., Nowzohour and Stracca, 2017; Dées and Zimic, 2019). A closely related concept is uncertainty, which can be defined as dispersion of beliefs or expectations of future economic development or a lack of knowledge of this dispersion (see Nowzohour and Stracca, 2017; ECB, 2016; Ferrara, Lhuissier and Tripier, 2018) for definitions and different types of uncertainties). Separate from the confidence literature, a large body of literature has investigated how uncertainty affects economic activity (see, e.g., Bloom, 2014; Baker, Boom and Davis, 2016).

business cycle fluctuations. The scientific research has largely focused on consumer confidence (e.g., Leduc and Sill, 2013; Beaudry and Portier, 2014) or business confidence as a propagator of business cycle fluctuations (e.g., Mendicino and Punzi, 2013; van Aarle and Moons, 2017). The international transmission of confidence shocks has been much less researched (exceptions include Fei, 2011; Dées and Brinca, 2013; Dées and Güntner, 2014; Levchenko and Pandalai-Nayar, 2015), which is surprising considering the globalization of production,[2] trade, and finance. The present study aims to contribute to this strand of literature, analyzing the international transmission of confidence shocks in the industry sector (industrial confidence shocks).

Existing studies on the international transmission of confidence shocks are limited to developed and relatively large economies, while the evidence of transmission to small open economies is still missing. For the European Union (EU), composed of small open economies with deep economic and financial ties, the transmission of confidence shocks among the member states may be of great academic and policy-making relevance. This paper focuses on the transmission of industrial confidence shocks between the largest EU economy (Germany) and a set of smaller, newer EU member states in Central and Eastern Europe (CEE), including the Czech Republic, Croatia, Hungary, Estonia, Latvia, Lithuania, Poland, Slovakia, and Slovenia, which historically have had close economic and financial ties to Germany.

Similar to the majority of studies on transmission of confidence shocks, we apply the vector autoregression (VAR) model with the impulse response and the forecast error variance decomposition analysis to study the effects of German industrial confidence shocks on industrial confidence, industrial output, consumer price index, and money market interest rate in selected CEE countries. We complement the literature with answers to the following questions: (i) Do shocks in German industrial confidence affect the economies of CEE? (ii) Which CEE economies are more susceptible to the shocks? (iii) Separating between different groups of industrial production goods (capital goods, intermediate goods, durable consumption goods), which production group is more sensitive to shocks in German industrial confidence? (iv) To what extent do German industrial confidence shocks explain variation in the industrial output in CEE countries?[3]

[2] Note the increasing role of global value chains (see International Bank for Reconstruction and Development and the World Bank, 2017).

[3] Our study is focused solely on the effect of industrial confidence shocks in Germany on individual CEE countries. We wish to acknowledge the comment of an anonymous reviewer, that even if the industrial confidence and industrial production in the CEE is affected by the German shock, this may not be (fully) reflected in trade between Germany and CEE countries. This analysis exceeds the framework of this paper but is worth further analysis.

The rest of the paper is structured as follows. We first briefly review the literature, then present the methodology. Data and results follow, while the conclusion sums up the main findings.

Literature Review

Building on the foundational contributions of Pigou (1927) and Keynes (1936), the theoretical literature contrasts three main views on how changes in the confidence of economic agents affect the macroeconomy: the animal spirits or noise view, the news view, and the view that expectations of economic agents are self-fulfilling. Beaudry and Portier (2014) state that in the animal spirits or noise view, the changes in confidence reflect changes in the optimism and pessimism of economic agents which are purely psychological in nature and not supported by economic fundamentals. As noted by Di Bella and Grigoli (2019), in the news view economic agents act based on information (which may be imperfect) regarding future economic conditions. If the information available to them[4] signals an optimistic future economic development, they will undertake actions (invest and produce more) that reflect this confidence (Beaudry and Portier, 2014). Blanchard, L'Huillier and Lorenzoni (2013), Beaudry and Portier (2014) and Dées and Zimic (2019), among others, build theoretical models and show how new information impacts the expectations of economic agents and the economic activity. For example, in the model of Beaudry and Portier (2014) the optimistic news will boost investment, consumption and economic activity because expectations of the future state of economy turn optimistic upon the arrival of positive news. However, if the positive news is actually "noise", the positive expectations are proven wrong and the economy might experience a bust. In the third view, even if the positive is "noise", the waves of optimism (or pessimism) are self-fulfilling: an initial surge in optimism (pessimism) by a fraction of economic agents may result in their actions, followed by other agents, which validate the initial optimism (pessimism) (Beaudry and Portier, 2014; Nowzohour and Stracca, 2017). The models of this view of confidence were developed by Cass and Shell (1983) or Farmer (2012) (see Nowzohour and Straca, 2017 for other references). As Di Bella and Grigoli (2019) note, all these theoretical explanations of the economic role of confidence explain at least the short-run effect on the economic activity, which is the main implication, relevant for our empirical research, because we do not aim to empirically discern different components (news/animal spirits) of innovations in industrial confidence.

[4] As Beaudry and Portier (2014) argue, the news relevant for building a (positive or negative) belief regarding the future development of the economy can include versatile information about, for example, future policy, demographic trends, energy prices, and technological development.

The recent empirical literature that studies the transmission of confidence shocks to the macroeconomy can be divided into several strands. The first strand analyzes the domestic transmission of confidence shocks, that is, the effects of consumer and business confidence shocks to major macroeconomic variables, including gross domestic product (GDP) or industrial production, consumption, investment, unemployment, price level, and house prices, among other variables, in different countries and time periods (Leduc and Sill, 2013; Mendicino and Punzi, 2013; Lambertini, Mendicino and Punzi, 2013; D'Agostino and Mendicino, 2015; Ahmed and Cassou, 2016; van Aarle and Moons, 2017).[5] The second strand of literature consists of studies that are primarily interested in disentangling the news from the animal spirits component of the confidence shocks (Beaudry and Portier, 2006; Beaudry and Lucke, 2009; Barsky and Sims, 2011; Barksy and Sims, 2012; Beaudry and Portier, 2014; Dées and Zimic, 2019). The third strand identifies the role of confidence in the transmission of monetary and fiscal policy (Bachmann and Sims, 2012; Nektarios, Savva and Koursaros, 2017). The fourth strand investigates the international transmission of confidence shocks, that is, the international "confidence channel" (Fei, 2011; Dées and Brinca, 2013; Dées and Güntner, 2014; Levchenko and Pandalai-Nayar, 2015). All the listed studies generally validate that positive confidence shocks stimulate economic activity, while negative shocks are detrimental to economic activity.

Our study is most related to the fourth strand, the international confidence channel literature, which shows that confidence has an important role in the international propagation of economic shocks. Fei's (2011) research results testify to this channel. Applying instrumental variable regression on a sample of Group of Seven (G7) countries plus Spain, Fei finds that business and consumer confidence in the larger economies affects the confidence in the smaller studied economies. Dées and Brinca (2013) first assess the effect of confidence on consumption in United States (US) and euro area, applying an instrumental variable and a VAR modeling approach. Once they show that confidence effects consumption, they utilize VAR to study international transmission of confidence shocks between economic areas. For this purpose, they fit a two-country VAR, including consumption, confidence and several other economic fundamentals (including financial variables, interest rates, wealth, and income). They show that a confidence channel runs from the United States (US) to the euro area. Dées and Güntner (2014) apply a VAR model (which includes confidence, consumption, short-term interest rate, unemployment rate, and GDP) to first assess the domestic

[5] The study of Leduc and Sill (2013), for instance, analyses in a standard VAR setting whether expectations of economic agents effect economic activity, inflation rate and monetary policy rate in United States. Similarly, Mendicino and Punzi (2013) study for Portugal whether consumer and business confidence shocks effect industrial production, inflation rate, and money market rate.

transmission of consumer confidence shocks in the US, Germany, France, Italy, and the United Kingdom. They show that confidence shocks are an important driver of domestic business cycle fluctuations. Then they extend the VAR model to a factor-augmented (FAVAR) model to study the international transmission of confidence shocks. Their analysis of the international transmission of confidence shocks shows qualitatively the same results as domestic confidence shock transmission analysis.

Levchenko and Pandalai-Nayar (2015) identify news and animal spirits (labeled by the authors as sentiment) components of business and consumer confidence shocks and their transmission from the US to Canada. For this purpose and to assess the effect of the different components of confidence on output, hours worked and consumption, they build a VAR model with the following variables: total factor productivity, GDP, consumption, hours worked, and a sentiment indicator (or forecasts of GDP). They show that US confidence shocks impact business cycle fluctuation in the US. By adding Canadian variables to the model, they show that confidence shocks are transmitted internationally.

Methodology

The international transmission of industrial confidence shocks is studied within a two-country VAR model, encompassing German and one of the CEE's macroeconomic variables. More specifically, the structural representation of the VAR model estimated is (see e.g. Lütkepohl, 2011):

$$\boldsymbol{A}_0 \boldsymbol{y}_t = \boldsymbol{b} + \sum_{j=1}^{P} \boldsymbol{A}_j \boldsymbol{y}_{t-j} + \boldsymbol{\varepsilon}_t \tag{1}$$

where

$\boldsymbol{y}_t$ – a vector of n endogenous variables, t denotes time ($1,\ldots,T$),
$\boldsymbol{b}$ – a vector of regression coefficients,
$\boldsymbol{A}_j$ – a matrix of regression parameters,
$\boldsymbol{A}_0$ – an invertible matrix depicting the contemporaneous relation between variables,
p – the number of lags,
ε_t – a vector of i.i.d. structural innovations.

The vector of endogenous variables, selection of which is guided by the relevant literature, $\boldsymbol{y}_t = [cf_{t,GER},\ ind_{t,GER},\ cpi_{t,GER},\ r_{t,GER},\ cf_{t,i},\ ind_{t,i},\ cpi_{t,i},\ r_{t,i}]'$ is partitioned into two parts. The first part includes endogenous variables for Germany

in the following order: an indicator of industrial confidence ($cf_{t,GER}$) [6] the industrial production index ($ind_{t,GER}$), consumer price index, ($cpi_{t,GER}$), and the three-month interest rate level ($r_{t,GER}$).[7] The second part of the vector includes the same set of variables for an individual CEE country (denoted by index *i*) in the same order.

Variables $ind_{t,GER}$, $cpi_{t,GER}$, $ind_{t,j}$, and $cpi_{t,j}$ enter the model in log levels,[8] while other variables enter in the levels. There are nine CEE countries in our sample; therefore, we estimate nine two-country VAR models (1). The lag length of VAR, *p*, is determined by Akaike information criteria. Computations are made in Stata.

Identification of the VAR model is achieved by Cholesky decomposition (thus assuming that $\boldsymbol{A}_0$ is a lower triangular matrix) in which a causal relationship between variables is assumed by a specific order of variables in $\boldsymbol{y}_t$. We follow Dées and Güntner (2014) and the related literature (e.g., Leduc and Sill, 2013; Mendicino and Punzi, 2013; Lambertini, Mendicino and Punzi, 2013) and order variables in the order specified above, that is, $cf_{t,GER}$, $ind_{t,GER}$, $cpi_{t,GER}$, $r_{t,GER}$, $cf_{t,i}$, $ind_{t,i}$, $cpi_{t,i}$, $r_{t,i}$. This order of variables implies that confidence shocks contemporaneously affect all macroeconomic variables, while the latter affects confidence only with a lag. As Mendicino and Punzi (2013) note, the measurement of business (and consumer) confidence in the EU is performed before the data on the current macroeconomic developments are publicly released, which justifies the ordering.[9] Assumptions about the contemporaneous relationship between macroeconomic variables (industrial production contemporaneously affecting the price level and interest rates, price level contemporaneously affected by all the variables but interest rate, and the interest rate affected contemporaneously by all variables in the system) are standard in the referenced literature.[10]

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[6] The industrial confidence is proxied by a survey of industrial confidence, as by, e.g., Mendicino and Punzi (2013) and van Aarle and Moons (2017), reflecting expectations and assessment of enterprises in the industrial sector of the economy.

[7] Inclusion of monetary variables is guided by Leduc and Sill (2013), and Dées and Güntner (2014), who use 3-month treasury rate. But those studies are not focused on industrial sector. Instead, we follow Mendicino and Punzi (2013) and include 3-month money market rate.

[8] Following Sims, Stock and Watson (1990) and Hamilton (1994), it is common in the VAR literature to model variables in (log) levels rather than growth rates (see e.g. Nguyen, Papyrakis and van Bergeijk (2019) reviewing some studies applying VAR model in levels).

[9] Placing the confidence last in the VAR assumes that all current information on macroeconomic variables is available to economic agents when they form their confidence. This identification scheme is used, e.g., by Barsky and Sims (2012) and applied in this paper as a robustness check.

[10] It is also common in macroeconomic VARs (e.g. monetary policy VARs) to order indicator of macroeconomic activity (GDP or industrial production), followed by price index and interest rate (see e.g. literature references in Nguyen, Papyrakis and van Bergeijk, 2019).

The specified model also implies that any shock to the variables in the German block contemporaneously affects variables in the CEE block, while the latter block variables affect the first block variables only with a lag.[11] We regard this assumption as reasonable given the size of the economies.

Once model (1) is estimated, two tools of VAR model analysis are utilized to explore the international transmission of German industrial confidence shocks: the impulse response and the forecast error variance decomposition analysis.

Data and Results

The VAR model is estimated on monthly data for Germany and the following CEE countries: Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. All listed CEE countries except Croatia joined the EU in 2004 (Croatia in 2013) and historically have had close economic and financial ties to Germany. The sample covers January 2000 – May 2019[12] and is conditioned on the availability of data for the CEE countries.[13]

The data for $cf_{t,GER}$, $ind_{t,GER}$, $cpi_{t,GER}$, $cf_{t,i}$, $ind_{t,i}$, and $cpi_{t,i}$ are retrieved from Eurostat (2019a,b,c), while $r_{t,GER}$ and $r_{t,i}$ are from the Organization for Economic Cooperation and Development (OECD, 2019) statistical database (except for Estonia, for which the interest rate data were retrieved from the Federal Reserve of St. Louis database (Federal Reserve of St. Louis, 2019), and Croatia, obtained from the European Central Bank (ECB, 2019)). $cf_{t,GER}$ and $cf_{t,i}$ are the industrial confidence indicators for Germany and country *i* from the CEE. The confidence is the industrial confidence, measured by the European Commission on a monthly basis in all EU countries.

According to the European Commission (2019), the survey is conducted in the first two to three weeks of each month among managers of enterprises in the industrial sector, asking them for their next quarter expectations regarding production and their assessment of the current conditions in the business (order books and stocks of finished goods). The indicator is computed as a balance between the share (in percentage) of positive and negative answers and then seasonally adjusted. $ind_{t,GER}$ and $ind_{t,i}$ are the natural logarithms of the index of

[11] Note that this is less stringent an assumption than block exogeneity, which would allow no contemporaneous and no lag impact of the CEE block variables on the German block variables.

[12] For Croatia, the starting date is May 2008, determined by the availability of data for industrial confidence.

[13] We wish to note that this rather short observation period is a limitation of the study that renders the results to some extent less reliable than if longer time periods was available.

industrial production volume for Germany and country *i* from the CEE, seasonally and calendar adjusted. The variables represent aggregate production in the following sectors (per Eurostat definition): mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply, and construction. $cpi_{t,GER}$ and $cpi_{t,i}$ are the natural logarithms of the harmonized consumer price index, while $r_{t,GER}$ and $r_{t,j}$ are the short-term (three-month) nominal money market interest rates.

Descriptive statistics for the industrial confidence indicators for the sampled countries and correlation of the industrial confidence between the countries is presented in Tables 1 and 2.

Table 1 indicates that the long-run mean of balances of answers (i.e., difference between positive and negative views of managers in the industrial sector) is positive in four countries and negative in six. The greatest variability in confidence during the observed period is seen in Germany, Estonia, and Croatia and the lowest is in Poland. Not surprisingly, the industrial confidence is relatively strongly correlated among the observed countries. Correlation with German industrial confidence is strongest for Estonia, the Czech Republic, and Slovenia and weakest for Croatia. A relatively high correlation of confidence suggests that industrial confidence dynamics in the region have a strong common component, driven most likely by the German industrial confidence dynamics. The impulse response analysis therefore focuses on the international transmission of German industrial confidence shocks.

T a b l e 1

Descriptive Statistics for Industrial Confidence (the $cf_{t,GER}$ and $cf_{t,j}$)

Variable	Number of observations	Mean	Std. deviation	Minimum	Maximum
$cf_{t,GER}$	233	–3.870815	11.93424	–42.2	16.4
$cf_{t,CZ}$	233	3.276824	9.737059	–35.6	29.8
$cf_{t,CRO}$	133	–3.849624	11.45026	–28.6	17.7
$cf_{t,EST}$	233	3.997854	11.74578	–39.1	28.5
$cf_{t,HUN}$	233	–1.942489	8.862618	–34.7	17.1
$cf_{t,LAT}$	233	–2.869099	8.450494	–36.3	11.8
$cf_{t,LIT}$	233	–7.342918	9.054498	–41.4	9.8
$cf_{t,POL}$	233	–12.68026	6.030279	–29.1	–.5
$cf_{t,SK}$	233	3.025322	9.13739	–31.8	23.9
$cf_{t,SI}$	233	.2484979	10.19882	–38.0	17.8

Note: Country codes: CZ – Czech Republic, CRO – Croatia, EST – Estonia, HUN – Hungary, LAT – Latvia, LIT – Lithuania, POL – Poland, SK – Slovakia, SI – Slovenia.

Source: Own calculations, based on data for industrial confidence.

T a b l e 2

Correlation of Industrial Confidence Correlation between Investigated Countries

	$cf_{t,GER}$	$cf_{t,CZ}$	$cf_{t,CRO}$	$cf_{t,EST}$	$cf_{t,HUN}$	$cf_{t,LAT}$	$cf_{t,LIT}$	$cf_{t,POL}$	$cf_{t,SK}$	$cf_{t,SI}$
$cf_{t,GER}$	1.00									
$cf_{t,CZ}$	0.90	1.00								
$cf_{t,CRO}$	0.70	0.62	1.00							
$cf_{t,EST}$	0.94	0.83	0.62	1.00						
$cf_{t,HUN}$	0.86	0.82	0.83	0.82	1.00					
$cf_{t,LAT}$	0.87	0.75	0.68	0.93	0.84	1.00				
$cf_{t,LIT}$	0.86	0.75	0.75	0.85	0.81	0.85	1.00			
$cf_{t,POL}$	0.84	0.78	0.87	0.72	0.87	0.71	0.77	1.00		
$cf_{t,SK}$	0.76	0.82	0.50	0.76	0.73	0.68	0.62	0.64	1.00	
$cf_{t,SI}$	0.90	0.90	0.80	0.85	0.93	0.82	0.81	0.86	0.79	1.00

Note: Correlation over period for which the data for all countries is available (May 2008 – May 2019). Country codes: CZ – Czech Republic, CRO – Croatia, EST – Estonia, HUN – Hungary, LAT – Latvia, LIT – Lithuania, POL – Poland, SK – Slovakia, SI – Slovenia.

Source: Own calculations, based on data for industrial confidence.

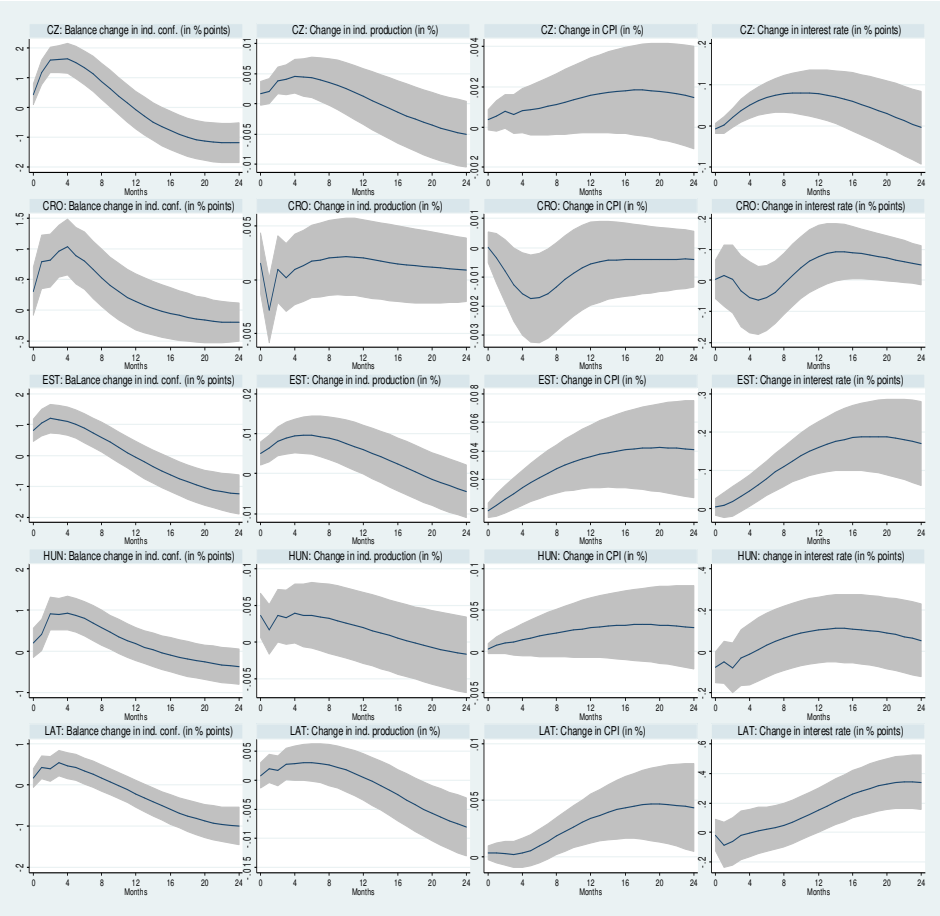
The results of impulse response analysis,[14] based on estimation of model (1), are presented in Figure 1. We draw the orthogonal impulse responses of endogenous variables to a 1 standard deviation shock in $cf_{t,GER.}$[15] The plots of responses are organized row-wise for each country and column-wise for each variable for the individual CEE country. The plots in the first column suggest that a positive shock in German industrial confidence significantly affects industrial confidence in CEE on impact. The effect seems to be the greatest in Slovenia and the Czech Republic, where the balance between positive and negative expectations and the current assessment of economic developments in the industry increases by more than 1.5 percentage points. These two countries also stand out when the size of impact is compared to the standard deviation of the domestic industrial confidence. The shock reaches the maximum impact two months after the shock in Estonia, three months after the shock in Slovenia, Latvia, and Poland, four months after the shock in the Czech Republic, Croatia, Hungary, and Slovakia, and five months after the shock in Lithuania. After approximately one year, the industrial confidence in CEE countries returns to the pre-shock level and afterward drops below the pre-shock level in some countries (Czech Republic, Estonia, Latvia, Lithuania, Slovakia, and Slovenia) (the same holds true for the country of the shock origin, Germany; the impulse responses, however, are not presented to save space).

[14] The optimal lag p in all two-country VAR models was 3, except for the Germany – Estonia model, for which the optimal lag was 2.

[15] We suppress the presentation of impulse responses to the shocks to other variables in the VAR model, including the shocks to domestic industrial confidence.

Figure 1a

The Effect of a 1 Standard Deviation Shock in German Industrial Confidence on Individual CEE Countries



Note: The mean orthogonalized impulse responses (solid dark line) to a 1 standard deviation shock in German industrial confidence are plotted along with the 95 percent confidence intervals. The responses are computed over a horizon of 24 months from the shock. Country codes: CZ – Czech Republic, CRO – Croatia, EST – Estonia, HUN – Hungary, LAT – Latvia.

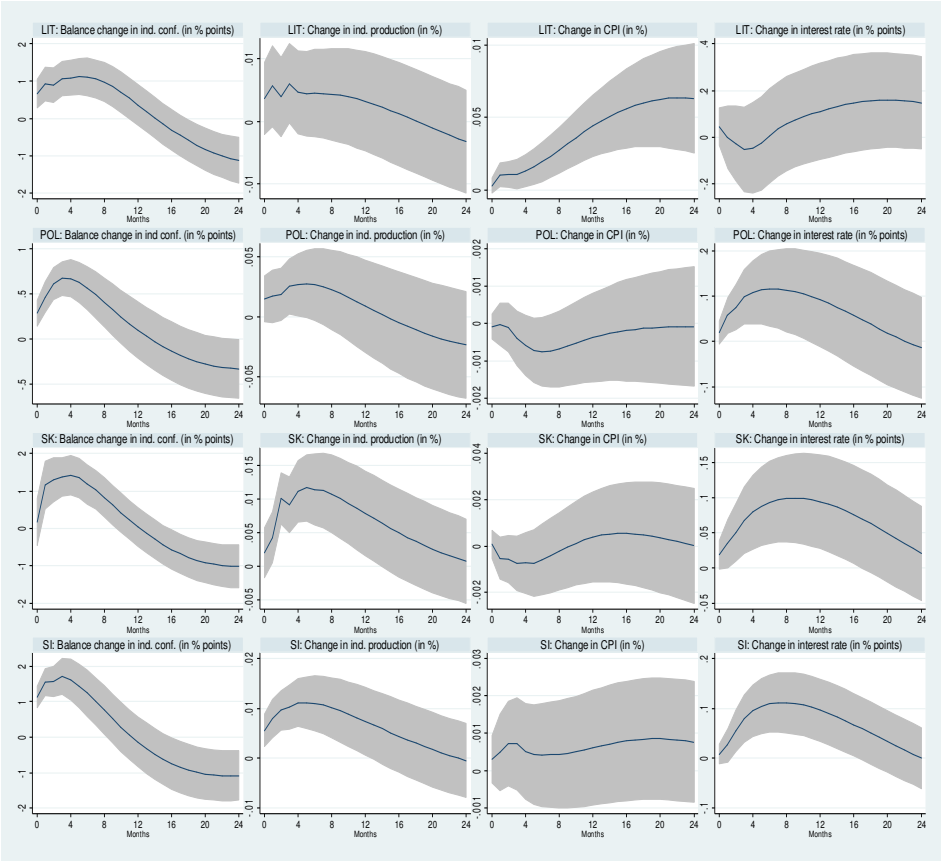
Source: Own calculations.

A positive shock in German industrial confidence also results in a positive industrial output response in the Czech Republic, Estonia, Latvia, Poland, Slovakia, and Slovenia. In these countries, a boost in expectations among managers in the German industrial sector feeds through to the decisions of domestic industrial companies, which in response expand their production as they become more optimistic about their ability to sell the expanded production either in Germany (through exports) and/or at home (due to positive feedback between export and

domestic output growth). The impact culminates at approximately four months after the shock, when it increases by more than 0.1 percent in some of the identified countries (Slovenia, Slovakia).

F i g u r e 1b

The Effect of a 1 Standard Deviation Shock in German Industrial Confidence on Individual CEE Countries (continued)



Note: The mean orthogonalized impulse responses (solid dark line) to a 1 standard deviation shock in German industrial confidence are plotted along with 95 percent confidence intervals. The responses are computed over a horizon of 24 months from the shock. Country codes: LIT – Lithuania, POL – Poland, SK – Slovakia, SI – Slovenia.
Source: Own calculations.

The results corroborate the findings of Fei (2011), Dées and Brinca (2013), Dées and Güntner (2014), and Levchenko and Pandalai-Nayar (2015): confidence shocks spill-over from larger countries to smaller ones. Firms in CEE are following closely the sentiment of German industrial firms and promptly adjust their sentiment in the same direction as their German counterparts, albeit heterogeneity across CEE is observed. Note that the shocks in our research are positive (increase in confidence), and the VAR is linear. A negative German industrial

confidence shock would result in the negative response of industrial confidence and industrial production in CEE. The presented results have an important policy implication since they show that swings of industrial confidence in CEE follow those of German firms with short lags. Negative shocks in German confidence could possibly be countered to some extent by economic policy measures aimed at boosting sentiment of domestic firms. It is however questionable what measures can be utilized within such a short period from the shock, given the response lags of economic policy.[16]

The response of the consumer price level across CEE to a positive industrial confidence shock in Germany is heterogeneous. The increase in price level is observed in the Baltic (Estonia, Latvia, and Lithuania), while in the Czech Republic, Hungary, Poland, Slovakia, and Slovenia the response is nonsignificant. In the latter group of countries (except Hungary), the interest rate also increases in response to a German confidence shock, which is likely related to monetary policy tightening in response to macroeconomic expansion, a finding also documented in Leduc and Sill (2013) and Lambertini, Mendicino and Punzi (2013). Surprisingly, in Croatia the price level drops in response to a boost in German industrial confidence. As a robustness check, we changed the order of variables in the VAR(1) model, placing industrial confidence as the last variable in each country block of variables. This does not affect the results.[17]

T a b l e 3

Forecast Error Variance Decomposition of the Industrial Confidence in Individual CEE Countries to a Shock in $cf_{t,GER}$ (in %)

Horizon	$cf_{t,CZ}$	$cf_{t,CRO}$	$cf_{t,EST}$	$cf_{t,HUN}$	$cf_{t,LAT}$	$cf_{t,LIT}$	$cf_{t,POL}$	$cf_{t,SK}$	$cf_{t,SI}$
2 months	13.9 (5.0/22.9)	9.3 (–0.8/19.2)	13.6 (4.3/22.9)	3.2 (–2.7/9.1)	4.3 (–1.4/9.9)	9.0 (1.2/16.8)	14.7 (5.3/24.1)	4.8 (–0.5/10.0)	37.6 (25.6/49.6)
4 months	35.2 (22.1/48.2)	20.9 (5.4/36.4)	21.2 (8.3/34.1)	19.5 (5.6/33.4)	8.0 (–1.1/17.0)	16.1 (4.5/27.6)	32.6 (19.3/46.0)	14.2 (4.7/23.7)	46.7 (32.7/60.7)
6 months	44.9 (30.2/59.7)	29.9 (10.5/49.2)	25.1 (10.1/40.2)	28.8 (11.3/46.4)	10.2 (–1.5/21.9)	23.3 (8.4/38.1)	39.3 (24.5/54.1)	22.0 (9.4/34.6)	48.4 (31.6/65.1)
9 months	47.6 (31.1/64.2)	32.5 (11.4/53.7)	26.2 (9.4/43.1)	33.7 (14.1/53.4)	10.0 (–2.6/22.6)	30.0 (12.4/47.5)	35.0 (19.2/50.9)	26.7 (12.1/41.4)	43.4 (23.4/63.5)
12 months	44.8 (27.2/62.3)	30.0 (9.3/50.7)	24.2 (7.5/40.9)	32.6 (12.7/52.5)	8.8 (–2.6/20.9)	31.6 (12.3/50.9)	27.8 (12.5/43.1)	26.7 (11.5/41.9)	36.6 (16.0/57.2)
24 months	48.1 (30.8/65.3)	24.0 (5.9/42.2)	28.5 (14.3/42.8)	25.3 (7.4/43.2)	27.2 (10.0/44.3)	33.5 (16.1/51.0)	19.6 (6.8/32.3)	30.8 (16.1/45.4)	35.5 (16.4/54.6)

Note: The table presents the percentage contribution of the German industrial confidence shock to the forecast error variance of industrial confidence in the individual country at the specified forecast window. The parentheses present the 95 percent confidence interval.

Source: Own calculations.

[16] The research of what economic policy can do to counter the swings in pessimism/optimism and its international transmission is left for future research.

[17] The results are not presented here to save space.

To further expand the analysis of the international transmission of confidence shocks, in Tables 3 through 5, we present the results of the forecast error variance decomposition for industrial confidence, industrial production, and price level in the CEE countries.

T a b l e 4

Forecast Error Variance Decomposition of the Industrial Production in Individual CEE Countries to a Shock in $cf_{t,GER}$ (in %)

Horizon	$ind_{t,CZ}$	$ind_{t,CRO}$	$ind_{t,EST}$	$ind_{t,HUN}$	$ind_{t,LAT}$	$ind_{t,LIT}$	$ind_{t,POL}$	$ind_{t,SK}$	$ind_{t,SI}$
2 months	2.4 (–1.9/0.69)	2.8 (–1.2/6.7)	8.5 (0.8/16.3)	3.1 (–2.4/8.5)	1.2 (–1.9/4.3)	1.6 (–1.9/5.1)	1.6 (–2.0/5.2)	2.2 (–1.7/6.2)	10.5 (1.7/19.4)
4 months	7.3 (–0.1/15.6)	2.0 (–0.5/4.6)	14.3 (3.2/25.5)	5.1 (–3.4/13.6)	2.4 (–2.7/7.5)	2.4 (–2.5/7.4)	3.0 (–2.7/8.6)	12.5 (3.2/21.8)	19.1 (6.1/32.1)
6 months	10.2 (–1.1/21.6)	2.0 (–1.0/5.1)	18.1 (4.7/31.4)	6.5 (–5.0/18.1)	3.7 (–3.6/11.0)	2.9 (–3.3/9.1)	4.0 (–3.5/11.5)	20.3 (6.7/33.9)	25.3 (8.7/41.9)
9 months	11.2 (–2.8/25.2)	2.8 (–3.4/8.9)	20.5 (5.0/35.9)	7.3 (–7.0/21.7)	4.5 (–4.5/13.5)	3.4 (–4.4/11.2)	4.3 (–4.4/13.0)	26.2 (9.0/43.5)	28.3 (8.5/48.2)
12 months	10.0 (–4.6/24.6)	3.6 (–5.4/12.5)	20.5 (3.7/37.3)	7.2 (–8.2/22.7)	4.0 (–4.9/12.9)	3.7 (–5.2/12.6)	3.6 (–4.7/12.1)	28.5 (9.0/48.0)	27.6 (5.8/49.4)
24 months	10.0 (6.0/19.3)	4.0 (–8.9/16.9)	16.1 (1.9/30.3)	5.2 (–6.0/16.5)	9.4 (–1.1/20.0)	3.3 (–4.5/11.1)	2.7 (–1.4/6.8)	26.6 (4.6/48.5)	18.5 (–2.3/39.3)

Note: The table presents the percentage contribution of the German industrial confidence shock to the forecast error variance of industrial production in the individual country at the specified forecast window. The parentheses present the 95 percent confidence interval.

Source: Own calculations.

T a b l e 5

Forecast Error Variance Decomposition of the Consumer Price Index in Individual CEE Countries to a Shock in $cf_{t,GER}$ (in %)

Horizon	$cpi_{t,CZ}$	$cpi_{t,CRO}$	$cpi_{t,EST}$	$cpi_{t,HUN}$	$cpi_{t,LAT}$	$cpi_{t,LIT}$	$cpi_{t,POL}$	$cpi_{t,SK}$	$cpi_{t,SI}$
2 months	1.2 (–1.9/4.3)	0.5 (–1.8/2.8)	0.2 (–0.4/0.8)	1.6 (–2.6/5.8)	0.4 (–1.4/2.2)	2.9 (–1.6/7.4)	0.0 (–0.3/0.4)	0.5 (–1.2/2.2)	0.5 (–1.7/2.8)
4 months	2.0 (–2.7/6.7)	3.4 (–4.1/10.9)	1.6 (–2.3/5.4)	2.6 (4.0/9.2)	0.3 (–1.5/2.1)	4.5 (–2.3/11.4)	0.4 (–1.4/2.2)	1.1 (–2.3/4.5)	1.3 (2.9/5.4)
6 months	2.6 (–3.8/9.0)	7.4 (–5.6/20.5)	4.1 (–2.9/11.2)	3.6 (–5.5/12.6)	0.5 (–2.0/3.0)	6.7 (–2.8/16.1)	1.6 (–2.9/6.1)	1.4 (–3.2/6.1)	1.3 (3.5/6.1)
9 months	3.7 (–5.4/12.8)	10.9 (–7.0/28.8)	8.8 (–2.3/20.0)	5.1 (–7.4/17.5)	2.6 (–3.8/9.0)	12.5 (–1.7/26.6)	2.6 (–4.2/9.5)	1.2 (–3.4/5.9)	1.3 (–4.0/6.5)
12 months	5.3 (–6.9/17.6)	10.8 (–7.7/29.4)	13.2 (–1.2/27.8)	6.5 (–8.9/21.9)	7.0 (–4.1/18.2)	20.6 (2.5/38.7)	2.5 (–4.7/9.7)	0.9 (–2.3/4.2)	1.4 (–4.6/7.3)
24 months	10.5 (–12.0/33.1)	9.3 (–8.5/27.2)	22.9 (1.6/44.1)	8.9 (–12.3/30.2)	16.7 (–3.2/36.6)	42.1 (17.5/66.7)	1.3 (–3.5/6.0)	0.8 (–2.0/3.7)	2.8 (–7.6/13.2)

Note: The table presents the percentage contribution of the German industrial confidence shock to the forecast error variance of consumer price index in the individual country at the specified forecast window. The parentheses present the 95 percent confidence interval.

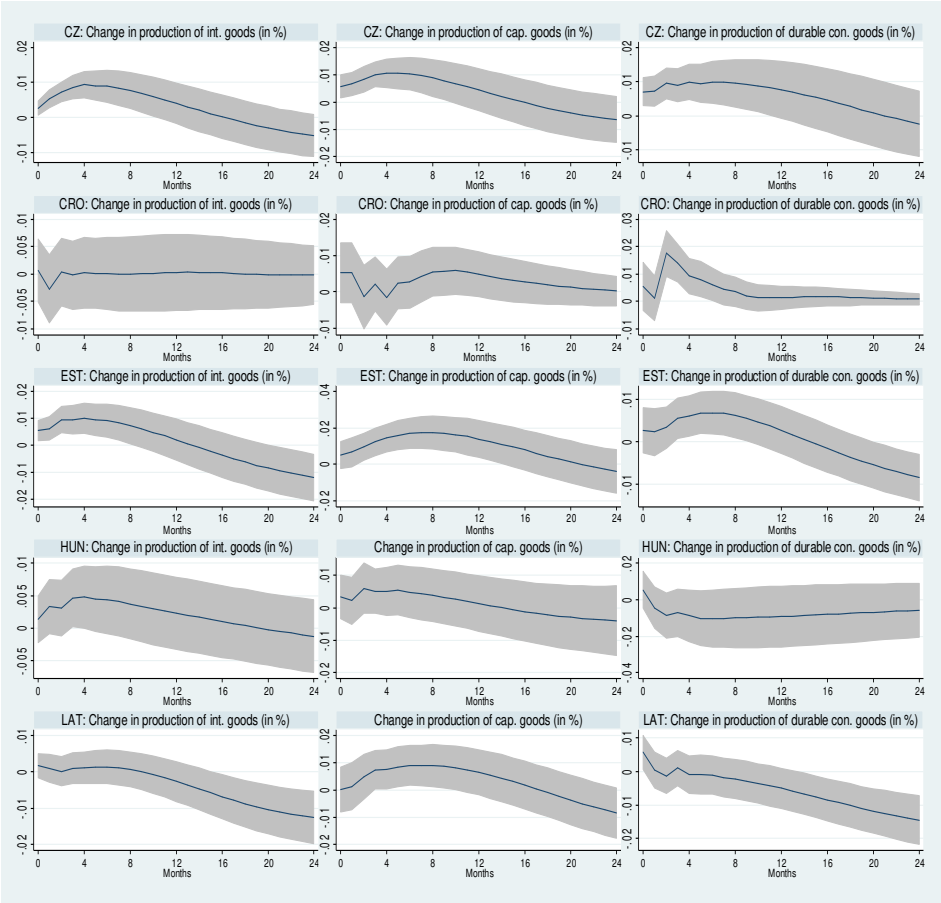
Source: Own calculations.

Over the forecast horizon of 24 months, the shocks in German industrial confidence can explain up to 48.4 percent of forecast error variance of industrial confidence in individual CEE countries and up to 28.5 percent of forecast error

variance in industrial production. Generally, the greatest share of variation in the variables, attributed to German industrial confidence shocks, is observed in Slovenia, Slovakia, the Czech Republic, and Estonia, a group of countries which also the impulse response analysis identified as susceptible to these shocks. German industrial confidence can explain considerably less of forecast error variance in the consumer price index in the CEE: The impulse response estimate is significant only for some countries (Estonia and Lithuania) and at longer horizons.

F i g u r e 2a

The Effect of a 1 Standard Deviation Shock in German Industrial Confidence on Different Industrial Group Goods in Individual CEE Countries



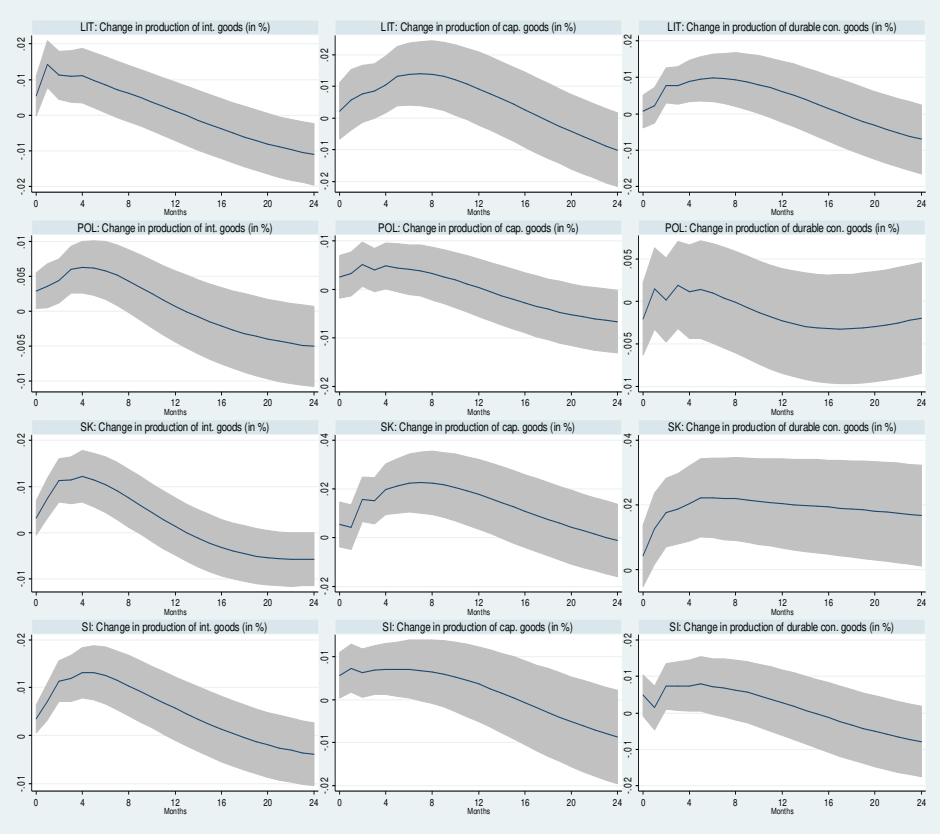
Note: The mean orthogonalized impulse responses (solid dark line) of the logarithmic level of production of intermediate goods, capital goods, and durable consumer goods to a 1 standard deviation shock in German industrial confidence are plotted along with the 95 percent confidence intervals. The responses are computed over a horizon of 24 months from the shock. Country codes: CZ – Czech Republic, CRO – Croatia, EST – Estonia, HUN – Hungary, LAT – Latvia.

Source: Own calculations.

Last, potential heterogeneity in the response of different groups of industrial goods to industrial confidence shocks in Germany is inspected. Figure 2 presents the impulse response of intermediate goods, capital goods, and durable consumption goods in the CEE countries.

F i g u r e 2b

The Effect of a 1 Standard Deviation Shock in German Industrial Confidence on Different Industrial Group Goods in Individual CEE Countries (continued)



Note: The mean orthogonalized impulse responses (solid dark line) of logarithmic level of production of intermediate goods, capital goods, and durable consumer goods to a 1 standard deviation shock in German industrial confidence are plotted along with the 95 percent confidence intervals. The responses are computed over a horizon of 24 months from the shock. Country codes: LIT – Lithuania, POL – Poland. SK – Slovakia, SI – Slovenia.

Source: Own calculations.

The heterogeneity of responses to industrial confidence shocks in Germany is noticeable. In the Czech Republic, Estonia, Lithuania, Slovakia, and Slovenia the positive response of industrial production is broadly based across all groups of industrial goods. In Poland, the German confidence shocks affect production of intermediate and capital goods, while in Croatia only the production of durable

consumption goods and in Latvia the production of capital goods respond positively to a boost in German industrial sector confidence. Also, slight differences in the duration of response across the goods groupings and countries can be observed. The differences in responses can likely be attributed to differences in industrial structure across the countries and their dependence on the German economy (and the involvement in the supply chains with the German industrial companies), but a definite answer requires a more comprehensive study, which is left for future research. This heterogenous dependence of industrial subsectors to German industrial confidence (and industrial production) has important implications. Our results show that not all subsectors are equally dependent on the swings in optimism/ pessimism in the German industrial sector, implying that the economic policy in CEE countries that aim to counter negative impulses from the German economy need to apply measures that are ˝tailor-cut˝ to individual subsectors.

All in all, the presented results indicate international transmission of confidence shocks (or a channel) running from Germany to several CEE countries, most notably Slovenia, Slovakia, and the Czech Republic, showing that these economies are the most susceptible to changes in German industrial confidence.

Conclusion

This paper has studied the international transmission of German industrial confidence shocks to the industrial confidence, industrial output, price level, and money market rate level in nine CEE countries: Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. We found that industrial confidence in the observed CEE is highly correlated with German industrial confidence, especially in some countries, indicating a strong common component in industrial confidence dynamics most likely from the German industrial confidence dynamics. The results of impulse response analysis show that shocks in German industrial confidence affect industrial confidence in all investigated CEE countries, industrial output in the Czech Republic, Estonia, Latvia, Poland, Slovakia, and Slovenia, the price level in the Baltic (Estonia, Latvia, and Lithuania) and Croatia, and the money market interest rate level in the Czech Republic, Poland, Slovakia, and Slovenia. Looking at different groups of industrial goods, we found that in some countries (Czech Republic, Estonia, Lithuania, Slovakia, and Slovenia) all groups of industrial goods respond positively to industrial confidence shocks in Germany, while in Poland intermediate and capital goods, Croatia durable consumption goods, and in Latvia the production of capital goods respond positively. The forecast error variance decomposition supports

the important role of German industrial confidence for the dynamics of industrial confidence and industrial output in individual CEE countries and strengthens the implication of impulse response analysis that the international transmission of confidence runs from Germany to several CEE countries, most notably Slovenia, Slovakia, and the Czech Republic. The results bear important empirical implications: since the they show that swings of industrial confidence in CEE follow those of German firms, and have real, yet heterogenous, effects in industrial production in CEE. This opens some space for economic policy to counter the negative effects of negative shocks in German industrial confidence on CEEs' economies, yet more research work is needed to assess the power of economic policy to affect confidence.

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