

Leuwer, David; Süßmuth, Bernd

Working Paper

The exchange rate susceptibility of European core industries, 1995-2010

Working Paper, No. 147

Provided in Cooperation with:

University of Leipzig, Faculty of Economics and Management Science

Suggested Citation: Leuwer, David; Süßmuth, Bernd (2017) : The exchange rate susceptibility of European core industries, 1995-2010, Working Paper, No. 147, Universität Leipzig, Wirtschaftswissenschaftliche Fakultät, Leipzig

This Version is available at:

<https://hdl.handle.net/10419/162135>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

UNIVERSITÄT LEIPZIG

Wirtschaftswissenschaftliche Fakultät
Faculty of Economics and Management Science

Working Paper, No. 147

David Leuwer / Bernd Süßmuth

**The Exchange Rate Susceptibility of
European Core Industries, 1995-2010**

Mai 2017

ISSN 1437-9384

The Exchange Rate Susceptibility of European Core Industries, 1995-2010

David Leuwer^a and Bernd Süßmuth^{a,b}

^a*University of Leipzig**

^b*CESifo*

Abstract

This study investigates reactions to real exchange rate changes in the German, French and UK automobile and mechanical engineering sectors using monthly data from 1995 to 2010. Our findings indicate that EUR/USD appreciations hamper exports, but do not necessarily imply an aggravated business climate or export order-book assessment. This does not apply to the GBP/USD and corresponding time series for the UK. First and foremost, our fixed coefficient and time varying parameter VAR model estimates confirm the extraordinary role of the German key sectors, while currency union membership seems to play a minor role at best. Overall, the exchange rate susceptibility is less profound than claimed by lobbies and held as popular belief.

Keywords: Exporting sectors, confidence indicators, structural VAR

JEL classification: C30, E42, F41

*Correspondence: Institute for Empirical Research in Economics, University of Leipzig, Grimmaische Str. 12, D-04109 Leipzig, Germany; phone: +49 341 9733782
Email contact: suessmuth@wifa.uni-leipzig.de, david.leuwer@uni-leipzig.de

We would like to thank Richard Kneller and an anonymous referee for helpful recommendations and comments. Our thank is also due to Bastian Gawellek, Marco Sunder, Alfred Maussner, Jan-Egbert Sturm, Alex Rathke, Florian Verheyen, Maurizio Habib, Fabio Canova, Jakob De Haan, and participants of the Macro and Financial Econometrics Conference at Heidelberg University, the DIW-FU Berlin Macroeconometric Workshop, the Conference on Recent Developments in Macroeconomics at ZEW Mannheim, the biannual Centre for International Research on Economic Tendency Surveys (CIRET) Conference in Vienna, the Trinity College INFINITI Conference on International Finance at Sciences-Po Aix, the INFER European Integration Workshop at IW Cologne, the Economics Lunchtime Seminar at the University of Leipzig, the Economics Research Seminar at the University of Augsburg, and the International Economic Policy Seminar at the University of Zurich for many valuable comments and suggestions.

“The Euro should not fluctuate according to the mood of the markets. A monetary zone must have an exchange rate policy ... If not, we are insisting on countries making efforts to be competitive which are destroyed by the rising value of the Euro.”

Francois Hollande (February 2013)

1 Introduction

Throughout the post-war period it is in particular the German economy that is widely regarded as depending on its exports. Public opinion sees exports as driving German –and ultimately also European– economic growth. Following this line of reasoning, key sectors such as the automobile and mechanical engineering industries are perceived as being especially susceptible to an appreciation of the Euro. On the other hand, they arguably profit from a depreciating Euro. In this context, the EUR/USD exchange rate is one of the most intensely observed relationships. In 2003, for example, the US business of German companies is said to have been decreasing by ten percent due to a weak Dollar (Belke *et al.* 2013). As of the second half of the first decade of the 2000s it became popular to talk about a “pain threshold” for European companies with regard to the EUR/USD exchange rate. Prominently the term is used referring to a suffering of German and/or French export industries from a strengthening of the Euro beyond a certain threshold. Recently, even terms such as “strategic depreciation” and “currency wars” are used to refer to the fear of European industries to lose grounds in competitiveness against the backdrop of devaluating competitor countries; see the above quote of French president Francois Hollande. However, with regard to stock market returns Griffin and Stulz (2001), for example, find that common shocks to industries across countries are substantially more important than competitive shocks due to changes in exchange rates. According to their findings, weekly exchange rate shocks explain but a tiny fraction of the relative performance of industries and, in particular, also of sectors that produce internationally traded goods.

In our reading of the existing literature the question of the existence and dimension of the exchange rate susceptibility of European core industries has not been satisfyingly answered. Several studies investigate the EUR/USD exchange rate dynamics in general at the level of a nation or supranation. See, among others, Sinn and Westermann (2001), Fratzscher (2008), and Belke *et al.* (2013). Another strand of literature analyzes the

issue of exchange rate susceptibility at the level of the firm or industry. Griffin and Stulz (2001), for example, investigate different sectors in the US, Canada, the UK, France, Germany, and Japan. As mentioned above, their results suggest that exchange rates play, if at all, only a minor role in determining sectoral performance. Contrary to Griffin and Stulz (2001), Bodnar and Gentry (1993) find significant exposure to exchange rate movements for industries in the US, Canada, and Japan. Williamson (2001) is a study that explicitly investigates the automobile industry finding, in general, significant exchange rate exposure for this sector. However, due to “lack of competition” Williamson excludes the German automobile industry from his analysis. Finally, Greenaway *et al.* (2010) emphasize the effects of exchange rate changes at a firm’s cost side by noting that appreciation may have offsetting effects through relatively cheaper imported intermediate goods. Their empirical results for the UK manufacturing sector indicate that exchange rate dynamics might not have a significant effect at all once effects at the cost side are considered. Overall, there is no coherent picture of the EUR/USD exchange rate susceptibility of key exporting sectors of the core EU economies in the literature to back up the vast narrative evidence on the issue.

Here, we take a different route and define susceptibility more directly as an aggravation of both the sectoral order book indicators and of the business climate in the automobile and mechanical engineering industries. These two sectors account, for example, in the case of Germany for about one third of its total exports in 2011. Our central empirical strategy consists of estimating trivariate VAR models incorporating the real exchange rate, the volume index of exports from the two key exporting sectors, and sectoral confidence indicators using monthly data from 1995 to 2010. Against this backdrop, our study seeks to analyze three fundamental hypotheses:

- The popular belief of a profound exchange rate susceptibility of the core sectors, i.e. the automobile and mechanical engineering industries. [*H1*]
- The Williamson-hypothesis according to which the German economy and its key sector, the automobile industry, stand out (Williamson 2001). [*H2*]
- The Frankel-Rose-Melitz-hypothesis according to which currency union members get immunized as the union fosters intra-Eurozone trade counteracting exchange rate exposure (Frankel and Rose 2002, Melitz 2003). [*H3*]

To address the first point we focus on the German economy as our benchmark case.

Comparing our results to estimates obtained from French sectoral series then allows us to assess a possibly exceptional reaction of German key sectors. Finally, considering the GBP/USD exchange rate along with UK sectoral series we analyze whether the two currency union members witnessed some change in their response to exchange rate shocks *over time*. Overall, our focus is on (foreign) demand-side effects of exchange rates, considering both realized demand, i.e. exports, as well as expected demand, i.e. export order-book assessments, and business confidence.

The remainder of the paper is organized as follows: Section 2 discusses sources of imperfect pass-through in the European context. In section 3, we use German series to estimate a reference case. Section 4 extends our reference case to French and UK time series. In section 5 we look at the sectoral response to an exchange rate shock over time. Finally, section 6 concludes.

2 Sources of Imperfect Pass-through

In a stylized model-world the reaction of exports and ultimately also of the business climate and other confidence indicators to changes in the real exchange rate in the exporting sectors is clear-cut. Both, in traditional Mundell-Fleming-Dornbusch type models (Dornbusch 1976) and in more recent open-economy models (Svenson 2000, Lane 2001) an appreciation (a depreciation) decreases (increases) the demand for domestically produced export goods by increasing (reducing) their relative price. However, in a world of differentiated export goods supplied by firms producing with imported intermediate goods on segmented markets, characterized by imperfect competition and different shades of exposure to trade, the unambiguity of this relationship gets lost. We will discuss four central sources of imperfect pass-through in the following: imported intermediate goods relating to $[H1]$, imperfect competition relating to $[H2]$, strategic firm behavior relating to $[H1]$ and $[H2]$, and exposure to trade relating to $[H3]$.

A straightforward implication of an appreciation of the domestic currency for firms producing with imported intermediate goods is reduced cost of such inputs. This can be seen as particularly important for European companies when it comes to paying the bill for energy used in the production of automobiles and machinery as neither the UK (making less than 3 percent of the world's oil production through North sea oil drilling over our sample period) nor Germany and France are among the major oil producing

economies in the world. Ultimately, this might fully counteract the pass-through for these industries (Greenaway *et al.* 2010).

In general, a full pass-through requires perfectly competitive markets. Incomplete competition implies incomplete and inert price adjustments. For less than fully competitive markets a pass-through will typically be incomplete, referred to as pricing-to-market (PTM) in the literature (Krugman 1986). Accordingly, companies set their export price to $P = (1 + \pi)MC$, i.e., due to some market power they mark-up price their products.¹ PTM can be a possibility to preserve foreign market shares as it allows the exporter to stabilize supply prices in foreign currency by reacting to exchange rate movements with changes in the mark-up. PTM may also help to avoid menu cost in case of exchange rate changes which are only transitory in nature. Additionally, it might serve as a “war chest,” whenever firms believe that regaining forgone market shares is more costly than transitory losses from foregone profits. Several empirical studies have found evidence for PTM on the side of exporters in general (Knetter 1993, Falk and Falk 2000) and for companies in the automobile and mechanical-engineering industry in particular (Belke *et al.* 2013). Ultimately, the extent of exchange rate pass-through and PTM is an empirical question hinged on the price elasticity of exports. PTM may help to cushion negative externalities of an appreciation on the demand side, although it will always go at the cost of firms’ profits. Certainly, the extent of the latter depends on the price elasticity of exports. For example, according to Deutsche Bundesbank (2008), German exports, in particular, to non-European economies, react rather weakly to exchange rate changes.² If, for instance, the domestic currency appreciates by 1% real exports are estimated to fall by only about 0.25%. This is often ascribed to relative price-inelastic goods, for example, individualized investment goods such as specific machinery, making up a considerable share of German exports. Foreign customers may also stick to their supplier even though the value of foreign currency increases because of switching cost being even higher. As German companies are highly specialized in certain industries, “foreign consumers are ‘caught’ in their relation to German suppliers” (Belke *et al.* 2013).³

An alternative to cope with exchange rate risk from the firm perspective is to shift production abroad. This so called “natural hedging” has been widely practiced by the

¹This mark-up (price discrimination) may vary among export destinations.

²For the following arguments and figures see Belke *et al.* (2013).

³However, Chen *et al.* (2012) recently find no evidence that German exporters, in general, benefit from a demand elasticity advantage over other Eurozone countries.

German automobile industry in the past 15 years setting up production plants, particularly, in the US (e.g. BMW in Spartanburg, SC, in the US), but also recently in China (e.g. Volkswagen in Changchun and BMW in Shenyang). Though to a somewhat lesser extent, we also observe this behavior in the French automobile and machinery sectors. It might also motivate different forms of cooperations and mergers and acquisitions (e.g. PSA/General Motors, Daimler/Chrysler or ZF Friedrichshafen/TRW Automotive auto parts suppliers) along the value added chain. Natural hedging assures that local buyers are supplied avoiding exchange rate risks. An additional advantage lies in the possibility of firms to compensate losses from lowered exports with cheaper imports from the foreign country within their company as the domestic currency appreciates.

Exposure to trade is also seen and rationalized in the literature (Melitz 2003) as source of an imperfect pass-through. In our context, it particularly concerns the importance of intra-European trade. When investigating the EUR/USD exchange rate effect on the French or German business climate, one has to consider the role of other trading partners, in particular, intra-EU partners. The overall impact of a weak USD might be small, if forgone exports to the US can be compensated by trade with other (intra-EU) economies. Actually, the US is, for example, ranked third among the top trading partners of Germany in 2009. The list is headed by Europe and Asia: In 2009, 62% of the German exports went to EU member states, of which 17 are also members in the common currency area, while many of the remaining ones have pegged their currencies to the Euro. The latter concerns in particular the Central and Eastern European trading partners. Of course, this bears the implication for Germany that most of its production and trade becomes independent of exchange rate changes. According to estimates reported in Frankel and Rose (2002), a currency union roughly triples trade with other union members. As this externality is reasonably not realized over night but rather following a gradual process, it calls for a time varying analysis. In the sectoral model by Melitz (2003), which incorporates firm-level heterogeneity and counteracts pass-through via export market entry costs and intra-industry allocations across firms, only more efficient firms reap benefits from trade in the form of gains in market share and profit. Less efficient ones lose both. An increase in exposure to trade, according to Frankel and Rose (2002) implied by the installation of the Eurozone, hence, forces the least efficient firms out of the industry. As a consequence fostered intra-zone trade channels into productivity gains that may offset the pass-through of exchange rate shocks. Some micro-level evidence for this channel of transmission is found by Aw *et al.* (2000) and Pavcnik (2002) relying on East Asian and

Latin American data, respectively.⁴

3 Empirical Assessment: the Case of Germany

3.1 Data

Our baseline empirical analysis relies on a sample consisting of monthly data of the EUR/USD real exchange rate (EXR), German exports, measured as volume index of exports (EXP), and the business climate (BC) in the relevant sectors: the automobile industry and the mechanical engineering sector. The period of observation ranges from January 1995 to October 2010 covering 190 observations. Data on the consumer price index (CPI) deflated EUR/USD exchange rate are taken from the Pacific Exchange Rate Service provided by the University of British Columbia (<http://fx.sauder.ubc.ca/data.html>). The exchange rate is denoted in price notation, i.e., $xEUR/1USD$. Hence, an increase of this ratio represents a depreciation of the Euro. Pre-1999 data for the Euro are the official ECU basket rates rather than imputed pseudo rates. Export series of the German automobile and mechanical engineering industry are obtained from Eurostat. The data cover all German exports within the SITC (*Standard International Trade Classification*) system product-group 7 “Machinery and Transport Equipment” to the United States. Exports are measured in 100 kilograms. The series is normalized to January 1995 (= 100). Our series of the business climate in the automobile and mechanical engineering sector are drawn from the detailed analysis of the “*ifo-Geschäftsklimaindex*,” which is published on a monthly base by the ifo Institute. The index is calculated as the mean of balances of percentage shares of positive and negative judgements reported by the companies with regard to their current business situation and their business expectations in the following six months (CESifo 2010, p. 3). Thus, as many other indicators, BC is based on two variables (business situation and business expectations), which are measured on a three-point Likert scale capturing a good, equal or bad state. For the period from 2004 to 2010 the business climate is reported for unified Germany for the automobile industry and the mechanical engineering industry, respectively. We calculate

⁴Recently, Wierds *et al.* (2014) find that the sectoral composition of exports matters for the pass-through: Other things –in particular, characteristics of trading partners– equal, the pass-through is the more imperfect the higher the share of high technology exports. According to the OECD, motor vehicles as well as machinery and equipment are “medium-high technology” industries (Wierds *et al.* 2014, p. 939).

a joint business climate for the two sectors by averaging. Time series along with summary statistics are shown in Appendix A.1.

To judge whether one or all of the three series had to be seasonally adjusted, we used the variate difference method by Tintner *et al.* (1978). We find that our exports series (EXP) need to be seasonally adjusted.⁵ Seasonal adjustment of the EXP series is done using standard US Census Bureau X-12 ARIMA. In a next step, we perform ADF tests for all series. We set and determine the maximum number of lags $k_{max} = \lceil 12(T/100)^{1/4} \rceil$, where T denotes number of observations; here, $k_{max} = 14$. The optimal number of lags is chosen on the base of the AIC. The null of a unit root cannot be rejected at the 5%-level of significance for the series EXR and EXP (p -value equals 0.5927 and 0.5311, respectively).⁶ We apply a Hodrick-Prescott filter (HP) with a smoothing weight of $\lambda = 129,600$ (Ravn and Uhlig 2002) to both series and consider log first differenced (logD filtered) series alternatively. Some reduced form analysis of the correlation structure of series can be found in Appendix A.2.

3.2 VAR model: estimation and model checking

This section describes our selection and estimation of a VAR[p]-model in reduced form

$$\mathbf{y}_t = \mathbf{c} + \mathbf{B}_1 \mathbf{y}_{t-1} + \dots + \mathbf{B}_p \mathbf{y}_{t-p} + \mathbf{u}_t \quad t = 1, \dots, T, \quad (1)$$

where $\mathbf{y}_t = [y_{1t}, \dots, y_{kt}]'$ denotes a $k \times 1$ vector containing observed series (EXR, EXP, BC; i.e $k = 3$), \mathbf{B}_i , $i = 1, \dots, p$, are (fixed) $k \times k$ coefficient matrices, $\mathbf{c} = [c_1, \dots, c_k]'$ denotes a (fixed) $k \times 1$ vector of intercept terms and $\mathbf{u}_t = [u_{1t}, \dots, u_{kt}]'$ a k -dimensional *white noise* process with $E[\mathbf{u}_t] = \mathbf{0}$, $E[\mathbf{u}_t \mathbf{u}_t'] = \mathbf{\Omega}_u$ and $E[\mathbf{u}_s \mathbf{u}_t'] = \mathbf{0}$ for $s \neq t$.

The model order is set to $p = 3$. It is chosen on the base of the AIC and FPE information criterion ($p_{max} = 24$). Although, both criteria, the AIC as well as the FPE, overestimate the true order with positive probability (Lütkepohl 2006, p. 150), this choice seems to be unproblematic regarding degrees of freedom as well as estimation precision.⁷

⁵Data on the business climate have been seasonally adjusted by the ifo Institute.

⁶The null of a unit root can be rejected at a 1%-level of significance for BC (corresponding p -value = 0.0002). Results are robust for different UR/stationarity tests such as the KPSS test.

⁷The negative effect of p being asymptotically too high can be corrected by estimating a subset VAR.

Stacking right hand side terms, we get

$$\mathbf{y}_t = \mathbf{X}_t' \mathbf{B} + \mathbf{u}_t \quad t = 1, \dots, T, \quad (2)$$

where $\mathbf{B} = \text{vec}(\mathbf{B}_1, \dots, \mathbf{B}_p)$ and $\mathbf{X}_t' = \mathbf{I}_k \otimes [1, \mathbf{y}_{t-1}', \mathbf{y}_{t-2}', \dots, \mathbf{y}_{t-p}']$. We proceed with estimating the VAR[3]-model resorting to standard OLS. Results are shown in Table 4 and 4 of Appendix A.5. There is a number of insignificant coefficients. Following the principle of parsimony, we make parameter restrictions setting all insignificant parameters equal to zero. Estimating a subset VAR seems justified for two reasons. First, we know that p selected on the base of AIC and FPE is too large with positive probability implying, at least, the elimination of some lags. Secondly, putting zero constraints on insignificant parameters will improve the model's forecast precision which has a positive impact on the results of impulse response (IR) analysis and forecast error variance decomposition (FEVD) as both rely on estimated "quantities" (Lütkepohl 2006, p. 207; Lütkepohl and Krätzig 2004, p. 180). Estimates for the subset VAR are shown in Table 6 of Appendix A.5. Lagged values of EXR have a significant positive impact on EXP as well as BC. Obviously, this stands in contrast to the exchange rate being best explained exclusively by its own past values. For all of the three single equations we observe satisfactory high values for adjusted R-squares and F-test statistics.

The subset VAR[3]-model is stable if all eigenvalues of \mathbf{B} have moduli smaller than one, i.e., $\det(\mathbf{I} - \mathbf{B}z) \neq 0$ for $|z| \leq 1$. This is equivalent to saying that the characteristic polynomial $\mathbf{B}(z) = \det(\mathbf{I} - \mathbf{B}_1 z - \dots - \mathbf{B}_p z^p)$ of the VAR-filter $\mathbf{B}(L)$ has no roots in and on the complex unit root circle (Lütkepohl 2006). For our model, all eigenvalues of moduli of \mathbf{B} are smaller than one (0.902, 0.857, 0.857, 0.404, 0.404, 0.390, 0.385, 0.271, 0.000). Formal tests for residual autocorrelation do not give rise to concerns. The multivariate Portmanteau test finds that the null $\Gamma_{\hat{\mathbf{u}}}(\tau) = 0$ cannot be rejected at a 5%-level (p -value = 0.077),⁸ i.e. $\hat{\mathbf{u}}_t$ can be viewed as typical realizations of an uncorrelated process $\{\mathbf{u}_t\}$. This finding can be supported by a Breusch-Godfrey test that fits a VMA process

$$\hat{\mathbf{u}}_t = \mathbf{B}_1 \hat{\mathbf{u}}_{t-1} + \dots + \mathbf{B}_q \hat{\mathbf{u}}_{t-q} + \boldsymbol{\eta}_t, \quad (3)$$

where $\boldsymbol{\eta}_t \sim WN(\mathbf{0}, \boldsymbol{\Sigma})$. Following Lütkepohl and Krätzig (2004, p. 127) the number of lags for the Breusch-Godfrey statistics is smaller and equals 12 (p -value = 0.0680).

⁸Lags used for the Portmanteau statistic = 30.

Performing a multivariate Jarque-Bera test comes to the conclusion that the residuals are non-normally distributed. More precisely, only for the residuals of the exchange rate equation the normal distribution cannot be rejected (p -value = 0.2228). As a consequence, forecasting intervals may not be reliable (Lütkepohl 2006, p. 174). However, in sum, we may conclude that the subset VAR[3] is an adequate approximation of the underlying data generating process. In line with basic model logics, we find a positive (negative) effect of a Euro depreciation (appreciation) on exports and business climate.

3.3 Identification and structural interpretation

In the following, we focus on the causal interpretation of the dynamics incorporated in the VAR-model. As we have seen above our subset VAR[3]-model is stable, guaranteeing that it has a VMA[∞]-representation from which impulse response functions (IRF) can be calculated.

In disentangling the reduced form errors \mathbf{u}_t , which are correlated by definition, we –at first– rely on a Cholesky decomposition of the variance-covariance matrix Σ_u . Orthogonalized shocks are given by $\boldsymbol{\epsilon}_t = C^{-1}\mathbf{u}_t$, where C is lower-triangular such that $CC' = \Sigma_u$.⁹ Together with our ordering of variables in $\mathbf{y}_t = [EXR_t, EXP_t, BC_t]'$ this decomposition constitutes a Wold causal chain running from the exchange rate over exports to the business climate. Note, in the context of our basic identification scheme it is crucial to stress that the only real macro-quantity is EXR , whilst all other variables in the system, including exports, represent sectoral quantities referring exclusively to the automobile and mechanical engineering industry. Hence, we implicitly allow only the non-sectoral variable to impact upon all other variables in t . The implicit assumption is that the dynamics of the EUR/USD exchange rate are exogenously determined. This assumption seems justified as the EUR/USD exchange rate equals the relative price of the domestic currency. This price, however, is determined by the amount of Euros supplied by the ECB which can be assumed to act independently of German sectoral exports and/or confidence. Clostermann and Schnatz (2000) identify factors that determine the real

⁹Though model residuals are merely correlated, orthogonalized shocks make sense as they render impulse responses comparable. However, in case IRFs (or the FEVDs) are based on orthogonalized shocks results might be sensitive with regard to the ordering of variables. In our example this objection can, at least partly, be rejected by referring to the merely present instantaneous residual correlation (Lütkepohl and Krätzig 2004, p. 181). For further information on the robustness of results with regard to different variable orderings see Section 3.4.

EUR/USD exchange rate. According to their study, there is no need to assume that the exchange rate should be instantaneously influenced by German car and/or machinery exports to the US or by the business climate in the respective industries.¹⁰ Our assumption can also be supported in a more technical way by testing for Granger-causality. The hypothesis of “No instantaneous causality between: EXR and EXP, BC” can not be rejected at a 5% level of significance (p -value = 0.2151). German sectoral exports on the other hand are assumed to be contemporaneously influenced by the exchange rate. The assumption that the exchange rate in t impacts on exports in t does not seem to be problematic either. There are several (empirical) studies that justify our belief in such a contemporaneous relation (e.g. De Grauwe and Verfaillie 1988, Asseery and Peel 1991, Sauer and Bohara 2001). It is also reasonable to presume –as we do through our ordering– that sectoral export volumes are not contemporaneously influenced by sectoral confidence indicators, while the industries’ business climate might be contemporaneously influenced by sectoral export activity.

Finally, our specification assumes that the business climate is instantaneously influenced by the exchange rate and exports but not vice versa. This is a plausible assumption with regard to the construction of the used indicators. As mentioned earlier, the business climate index published by the *ifo* institute is calculated as the mean of balances of percentage shares of positive and negative judgements reported by companies with regard to their current business situation and business expectations for the following six months. The current business situation and business expectations are measured on a 3-level-Likert scale representing a state $s \in S = \{+, =, -\}$. We may think of a variable on such a scale as resulting from an unobserved process $f(t)$. This idea can be formalized as follows: $s_{i,t}^* = f(t) + \nu_t$ with $\nu_t \sim N(0, \sigma^2)$, $i = 1, \dots, n$ and $t = 1, \dots, T$. However, as survey participant i must answer on the categorical scale we only observe

$$s_{i,t} = \begin{cases} + & \text{for } s_{i,t}^* > \tau^+ \\ = & \text{for } \tau^+ \geq s_{i,t}^* > \tau^- \\ - & \text{for } \tau^- \geq s_{i,t}^*. \end{cases}$$

While the exact shape of $f(t)$ might be undefined, it is usually assumed that the unobserved process represents the business cycle (Seiler 2012). Yet, it seems not unrealistic to

¹⁰Of course, German exports might influence the EUR/USD exchange rate via a change in domestic national income. However, the necessary adjustment processes will take some time.

assume that $f(t)$ by anticipation of the survey participants also captures to some extent assessments of exchange rate dynamics and/or the development of exports to trading partners.

Due to these considerations we are confident that the Cholesky decomposition along with the chosen ordering of variables in \mathbf{y}_t supplies us with structural exchange rate shocks that may be used for causal interpretation in a depreciation scenario.

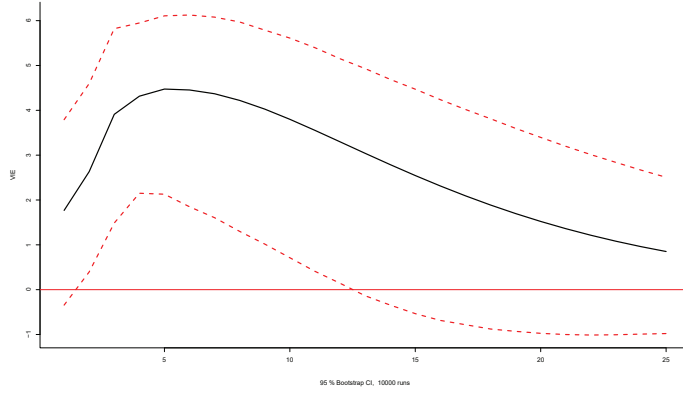


Figure 1. Response of EXP to EXR shock: Germany

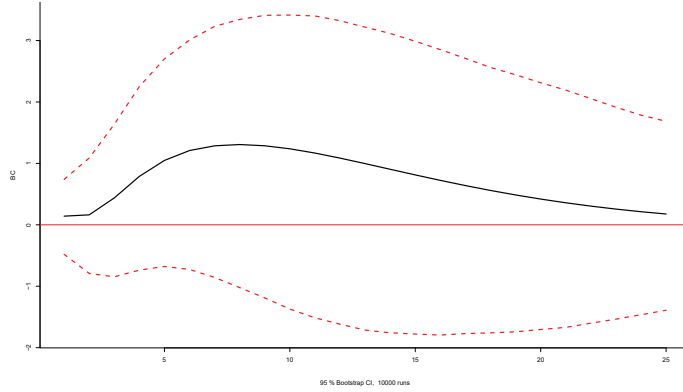


Figure 2. Response of BC to EXR shock: Germany

Our strategy is to focus on the response of exports and business climate to orthogonalized shocks from the exchange rate. Corresponding IRFs are plotted in Figures 1 to 4. Overall, it seems that exports as well as the business climate react positively to a shock in the exchange rate. Exports show a rather instantaneous and significantly positive response in the short run. After about thirteen periods exports are back to normal, i.e.

the bootstrapped confidence intervals¹¹ cover the zero line again. Conclusions are quite different regarding the reaction of the business climate. First of all, BC seems to react in a less clear-cut way to a shock in the exchange rate. Secondly, the response is delayed for about two periods. Thirdly and most importantly, the confidence intervals clearly include the zero line allowing us not to speak of a significantly positive response of the business climate. In other words, exchange rate changes can leave the business climate unchanged.

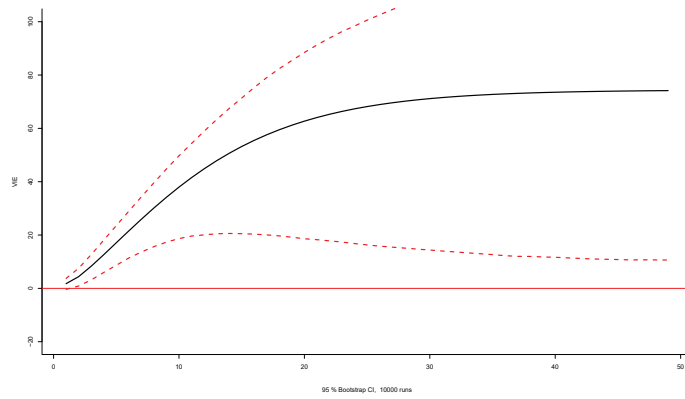


Figure 3. Response of EXP to cummulative EXR shock: Germany

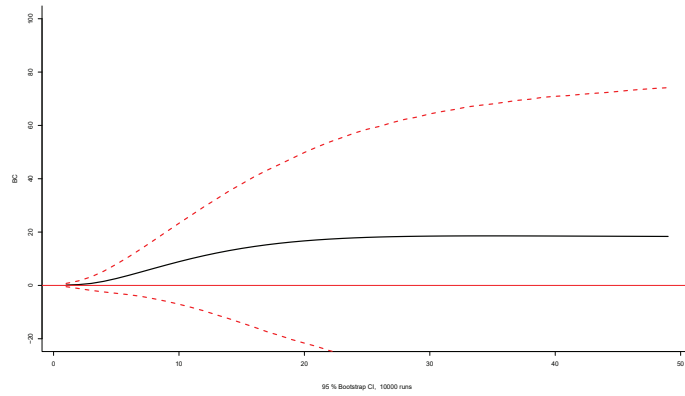


Figure 4. Response of BC to cummulative EXR shock: Germany

Figure 3 and Figure 4 also show the cumulated IRFs of EXP and BC which basically confirm our results. However, in a system of fully flexible exchange rates (free float), as in the case of the EUR/USD exchange rate, it would not be reasonable to assume

¹¹95% confidence intervals were bootstrapped with 10,000 runs.

constant shocks, i.e. an ongoing depreciation or appreciation of the Euro.¹²

In a next and final step of our reference case, it is straight forward to look at the FEVD for the three variables. The forecast horizon is 12 months. Again by the variables ordering in the left hand side vector \mathbf{y}_t the following causal structur is assumed: exchange rate \rightarrow exports \rightarrow business climate. Not surprisingly for the subset VAR[3] the error variance of the exchange rate's h -step forecast is exclusively explained by own innovations. This result does not fundamentally change, if one looks at the unrestricted VAR[3]: The maximum contribution of EXP (BC) to forecast error variance is 6.0% (3.8%). Looking at the FEVD of exports, we see that innovations in the exchange rate gain significant impact on the variable's dynamics. For $h = 12$ shocks of the exchange rate make up 30.9% of exports forecast error variance. Also the business climate has a strong effect on the dynamics of the EXP series (up to 28.5% for $h = 12$). Finally and surprisingly, we observe that the exchange rate makes little to no contribution to the dynamics of the business climate. At maximum 3.6% of the business climate's forecast error variance can be explained by innovations in the exchange rate. Of course, the exports' impact is somewhat stronger (amounting to up to 13.1%). Dynamics of the business climate indicator are best explained by own innovations. Results are summarized in Figure 5.

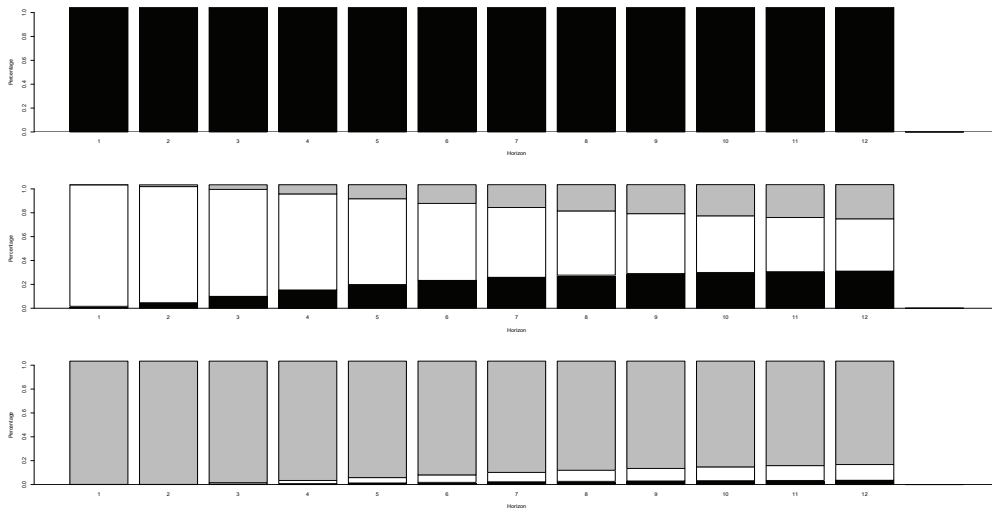


Figure 5. Forecast error variance decomposition (FEVD): Germany
Note: black shaded: EXR, white shaded: EXP, grey shaded: BC
FEVD from first to third row for EXR, EXP, BC

¹²Nevertheless, it might be possible for fixed exchange rate regimes. A constant shock would correspond to a revaluation of the domestic currency.

3.4 Robustness of results

To ensure that our results are not artificially generated by the respective filtering method or climate indicator we consider both logD-filtered series and alternative BC indicators. Figures given in Appendix A.4 show the IRFs and FEVD for different filtering methods (HP and logD) and additional climate indicators for the respective industries (i.e. the Confidence Indicator and the Assessment of Export Order-Book Indicator published by the European Commission). Our results are robust with regard to different filtering methods. In particular the application of the logD filter does not qualitatively change our main finding of a significant reaction of exports and an insignificant reaction of the business climate to an exchange rate shock. Results for the logD-filtered series are shown in Figure 4 of Appendix A.4. The use of alternative climate indicators (i.e. the Confidence Indicator and the Assessment of Export Order-Book Indicator published by the European Commission) neither alters our results in a qualitatively relevant way as can be seen by comparing IRFs in Figure 3 and Figure 4 of Appendix A.4 column by column.

There might remain some objections regarding the use of a business climate or confidence index as proxy for “pain” anticipated by firms against the backdrop of a strengthening Euro. One could argue that exports play only a minor role with regard to firms’ profits compared to domestic sales. If this holds true, an omission bias is a probable caveat. In this case the insignificant reaction of the climate indicator to an exchange rate shock would neither be unexpected nor would it be an indication for hedging strategies or the like. However, there are two arguments speaking against such objections: First, in our baseline analysis we focus on the German automobile and mechanical engineering industries. For our period of observation, cars and machines clearly represent Germany’s most important export goods. Hence, exports most reasonably play a major role for these industries. Secondly, our results are robust with regard to the use of the Assessment of Export Order-Book Indicator. This ensures that only firms are surveyed that actually engage in exporting and that judge their profit situation against the backdrop of export activity. A positive shock to the exchange rate does also not imply a significant impact on the firms’ assessment of their export order-book levels; see respective last column of Figure 3 and Figure 4 in Appendix A.4. This suggests that transitory exchange rate shocks are not internalized in order levels expectations of German companies in the relevant sectors.

Although the ordering of variables in \mathbf{y}_t is reasonable, we also follow the suggestion by Sims (1981) and try various triangular orthogonalizations. It can be shown that our main result of a significant reaction of exports and an insignificant reaction of the respective climate indicator to an exchange rate shock is not altered by different variable orderings.

Notice that all our results do not change qualitatively if we shorten our sample, i.e. either focus on the post-1998 period or leave out the 2008/09 financial crisis.

Finally, we also checked the robustness of our results with regard to the use of trade-weighted exchange rates instead of bilateral exchange rates, i.e. we used the real effective exchange rate (CPI deflated, Euro area-17 countries vis-à-vis the EER-12 group of trading partners: AU, CA, DK, HK, JP, NO, SG, KR, SE, CH, GB and US), which is supplied by the Deutsche Bundesbank. Again, this leaves our results qualitatively unchanged. Detailed findings are available on request from the authors.

4 France and the United Kingdom

We have shown that our main finding using German data is robust with regard to a range of different model specifications. However, do these results apply to other countries' core sectors or do they rather confirm the Williamson-hypothesis [*H2*] of a profound distinctiveness of the German automobile and machinery industry? In order to answer this question, we conduct the analogue analysis using data for France and the United Kingdom.¹³ Results are summarized in Figures 7 to 14 of Appendix A.4. In the case of France, findings from the IR analysis look, at first sight, similar to the German case. However, while there is no significant pass-through of exchange rate shocks down to the confidence or order-book assessments in the case of HP-filtered series, the logD-filtered series generate a slim and weakly significant negative reaction of the French sectors' confidence and order-book indicators. As it represents a net effect, it can be either rooted at the cost side if French firms in the automobile and machinery sectors hinge on many US-imported intermediate goods or in an adverse effect on firms' balance sheet positions¹⁴ or in a mixture of both outweighing the perceived positive effect on exports.

¹³As climate indicator for the respective industries the European Commission Confidence and Assessment of Export Order-Book Indicator were used again.

¹⁴A dollarized liabilities position (i.e. debt service predominantly denominated in US dollars and revenues predominantly realized in domestic currency) deteriorates balance sheets and,

This finding of a fragile reaction depending on different filtering devices carries over to the results of the FEVD. While in case of the HP-filtered series the exchange rate has no significant impact on the climate indicators' dynamics, for the log first differenced series we observe that in case of the Confidence Indicator (Assessment of Export Order-Book Indicator) at maximum 11.7% (8.6%) of the forecast error variance is explained by exchange rate innovations. Compared to the German case this represents quite a share. Results are less ambiguous in case of relying on UK series. The positive reaction of exports is tiny and insignificant at conventional levels. Additionally, from the IRFs there is robust evidence that a positive shock to the GBP/USD exchange rate, i.e. a depreciation of the British Pound against the Dollar, has a significant and comparatively strong and deteriorating effect on both climate indicators. More than in the French case, it is reasonable and straightforward to ascribe the direction of this reaction to an outweighing negative balance sheet effect of depreciation and/or a deterioration at the cost side of firms due to dependence on US-imported inputs. In line with this finding, exchange rate innovations explain quite a substantial part of the indicators' forecast error variance, i.e. up to 16.3% (21.8%) in case of the (logD-filtered) Confidence Indicator (Assessment of Export Order-Book Indicator).

To sum up, in terms of exchange rate susceptibility or pass-through of exchange rate shocks down to the assessment of current and future demand we find the following qualitative ordering of national core sectors: UK (significant pass-through), France (shaky pass-through), Germany (no significant pass-through).

This ordering, at least, leaves open some possibility of a higher immunity against exchange rate changes of the German and French as opposed to the UK automobile and mechanical engineering industries which might be an indirect product of the currency union and the common market. In this sense and against the backdrop of the Optimum Currency Area (OCA) approach, ultimately representing a cost-benefit approach, the cushioning currency union effect that in the end lets exchange rate changes not undermine the general business outlook in the core sectors might even be a part of the “uncommon arguments for common currencies” (Mundell 1973). However, as the Eurozone was not installed over night but in phases and the immunization in the sense of the Frankel-Rose-Melitz-hypothesis [H3] sketched in Section 1 and Section 2 might develop over time, we in the presence of financial frictions, causes the external finance premium to increase and, consequently, investment and expected demand to decrease; see Aghion *et al.* (2000) and Bahmani-Oskooee and Miteza (2003).

try to take account for these aspects in the following section.

5 The Role of the Currency Union

As argued above, if the Frankel-Rose-Melitz-hypothesis [*H3*] holds, the effect of an exchange rate shock on the business climate in the exporting industries should have changed over time. As trade with other currency union members gained in weight, vis-à-vis to the US, the effect of a Euro depreciation or appreciation on the business climate and export assessments might have decreased over time. Consequently, an extraordinarily strong DM, Franc, or ECU implied a strain on the business outlook of German and French exporters that was more severe before the Eurozone than nowadays. This is due to the fact that today foregone sales to the US, due to a strong Euro, can be more easily offset by trade with other Eurozone countries. Additionally, the Frankel-Rose-Melitz argument also applies to intermediate production leading to fostered intra-zone trade of intermediate goods counteracting a pass-through due to the dependence on high shares of US-imported intermediate goods. Both channels are supposed to not (fully) operate for countries that became not members of the currency union. Our period of investigation covers several crucial milestones and phases of Stage II (1994-1998) and Stage III (beginning 1999) of the EMU. For Stage II, we cover, in particular, the set-up of the ERM-II in mid-1997 and the creation of the ECB in mid-1998. For Stage III, i.e. the beginning of the single monetary policy regime of the ECB, we cover the three-year transition period starting 1999 before the Euro cash changeover in early 2002.¹⁵

In order to account for this development and to model indicator responses to an exchange rate shock over time we fit a Time-Varying Parameter-VAR with stochastic volatility à la Primiceri (2005) to our data. Note, although such a model does not require stationary series and, hence, does not require filtering of our series, we proceed in analogy to the preceding analysis. This strategy ensures comparability of standard VAR and TVP-VAR based findings.

¹⁵For evidence of effects of the changeover and inert adjustment to the new common currency on sentiment and confidence at the individual level see Wunder *et al.* (2008).

5.1 TVP-VAR model: estimation and model checking

We fit the following model to the data:

$$\mathbf{y}_t = \mathbf{c}_t + \mathbf{B}_{1,t}\mathbf{y}_{t-1} + \dots + \mathbf{B}_{p,t}\mathbf{y}_{t-p} + \mathbf{u}_t \quad t = 1, \dots, T, \quad (4)$$

where \mathbf{y}_t is an $n \times 1$ vector containing the (logD) exchange rate, exports, and the business climate, respectively, \mathbf{c}_t is an $n \times 1$ vector of time-varying intercepts, $\mathbf{B}_{i,t}$, $i = 1, \dots, p$ are $n \times n$ matrices of time-varying coefficients and \mathbf{u}_t heteroskedastic unobservable shocks, where $\mathbf{u}_t \sim N(0, \mathbf{\Omega}_t)$. As the model is trivariate, $n = 3$. In terms of $\mathbf{\Omega}_t$ we can think of the following triangular reduction

$$\mathbf{A}_t \mathbf{\Omega}_t \mathbf{A}_t' = \mathbf{\Sigma}_t \mathbf{\Sigma}_t',$$

with \mathbf{A}_t denoting the following lower triangular matrix

$$\mathbf{A}_t = \begin{bmatrix} 1 & 0 & 0 \\ \alpha_{21,t} & 1 & 0 \\ \alpha_{31,t} & \alpha_{32,t} & 1 \end{bmatrix}$$

and $\mathbf{\Sigma}_t$ being the diagonal matrix

$$\mathbf{\Sigma}_t = \begin{bmatrix} \sigma_{1,t} & 0 & 0 \\ 0 & \sigma_{2,t} & 0 \\ 0 & 0 & \sigma_{3,t} \end{bmatrix}.$$

From this we obtain

$$\mathbf{y}_t = \mathbf{c}_t + \mathbf{B}_{1,t}\mathbf{y}_{t-1} + \dots + \mathbf{B}_{p,t}\mathbf{y}_{t-p} + \mathbf{A}_t^{-1} \mathbf{\Sigma}_t \boldsymbol{\epsilon}_t \quad t = 1, \dots, T, \quad (5)$$

with $\boldsymbol{\epsilon}_t \sim N(0, \mathbf{I}_n)$. By $\mathbf{B}_t = \text{vec}(\mathbf{B}_{1,t}, \mathbf{B}_{2,t}, \dots, \mathbf{B}_{p,t})$ equation (5) can be rewritten in the following way

$$\mathbf{y}_t = \mathbf{X}_t' \mathbf{B}_t + \mathbf{A}_t^{-1} \mathbf{\Sigma}_t \boldsymbol{\epsilon}_t \quad t = 1, \dots, T \quad (6)$$

with

$$\mathbf{X}_t' = \mathbf{I}_n \otimes [1, \mathbf{y}_{t-1}', \mathbf{y}_{t-2}', \dots, \mathbf{y}_{t-p}'],$$

where \otimes denotes the Kronecker product. The model parameters evolve according to an AR(1) process

$$\mathbf{B}_t = \mathbf{B}_{t-1} + \boldsymbol{\nu}_t, \quad \boldsymbol{\nu}_t \sim N(0, Q), \quad (7)$$

$$\boldsymbol{\alpha}_t = \boldsymbol{\alpha}_{t-1} + \boldsymbol{\zeta}_t, \quad \boldsymbol{\zeta}_t \sim N(0, S), \quad (8)$$

$$\log(\boldsymbol{\sigma}_t) = \log(\boldsymbol{\sigma}_{t-1}) + \boldsymbol{\eta}_t, \quad \boldsymbol{\eta}_t \sim N(0, W), \quad (9)$$

with $\boldsymbol{\alpha}_t$ being the non-zero and non-one element of matrix \mathbf{A}_t and $\boldsymbol{\sigma}_t$ being the vector of the diagonal elements of $\boldsymbol{\Sigma}_t$.¹⁶ S is assumed to be block-diagonal, i.e.

$$S = \text{Var}(\boldsymbol{\zeta}_t) = \begin{bmatrix} S_1 & 0_{1 \times 2} \\ 0_{2 \times 1} & S_2 \end{bmatrix},$$

where $S_1 = \text{Var}(\zeta_{21,t})$ and $S_2 = \text{Var}([\zeta_{31,t}, \zeta_{32,t}]')$, with $\text{Var}(\cdot)$ denoting the variance operator.

Together, equations (6) to (9) form a state-space representation of the TVP-VAR. The model innovations are assumed to be jointly normal. Again the model order has been chosen to be $p = 3$.

In estimating the model we follow a Bayesian approach rather than relying on Maximum Likelihood (ML) estimation. This is due to the fact that, given the high dimensionality and nonlinearity of the problem, ML-estimates are not efficient.¹⁷ Even when being able to compute an ML-estimate of which one can be sure that it is not just a local maximum, it remains unsettled how to deal with the uncertainty related to the estimate. Bayesian inference deals with this problem by evaluating the posterior distributions of states and parameters and thus incorporates the uncertainty about these quantities. We will use a Gibbs sampler, which is a special variant of Markov Chain Monte Carlo (MCMC) methods, to determine the posterior distributions of \mathbf{B}^T , \mathbf{A}^T , $\boldsymbol{\Sigma}^T$, and the hyperparameters (Q, S, W) .¹⁸

¹⁶While \mathbf{B}_t and \mathbf{A}_t are modeled as random walks without drift the stochastic volatilities follow a geometric random walk. The random walk assumption for the coefficients and the contemporaneous relations comes along with a number of disadvantages; see Primiceri (2005) for a detailed discussion. However, it has the great advantage of reducing the number of parameters to be estimated.

¹⁷One particular drawback is that a complicated model as defined in the previous section will usually come along with a Likelihood function including multiple peaks; see Primiceri (2005) for a detailed discussion of problems related to ML-estimation of state space models.

¹⁸Superscript $(\cdot)^T$ indicates that all information up to point T is used in the estimation of

We assume that the initial states for \mathbf{B}^T , \mathbf{A}^T , $\mathbf{\Sigma}^T$ and the hyperparameters are independent of each other. Furthermore, it is assumed that the priors $p(\mathbf{B}_0)$, $p(\mathbf{\alpha}_0)$ and $p(\log(\boldsymbol{\sigma}_0))$ are normally distributed, whereas the priors for Q , W and S follow an independent inverse-Wishart distribution with scale matrix Ψ and degrees of freedom m . Estimating a time-invariant VAR by OLS on a small training sample of 30 observations is used to calibrate the priors. Letting \hat{x} denote the point estimate of an unknown parameter x and $\hat{V}_{\hat{x}}$ the respective variance, we get the following priors

$$\mathbf{B}_0 \sim N(\hat{\mathbf{B}}_{OLS}, 3 \cdot \hat{V}_{\hat{\mathbf{B}}_{OLS}}), \quad (10)$$

$$\mathbf{A}_0 \sim N(\hat{\mathbf{A}}_{OLS}, 3 \cdot \hat{V}_{\hat{\mathbf{A}}_{OLS}}), \quad (11)$$

$$\log(\boldsymbol{\sigma}_0) \sim N(\log(\hat{\boldsymbol{\sigma}}_{OLS}), 3 \cdot \mathbf{I}_3), \quad (12)$$

$$Q \sim IW(k_Q^2 \cdot 30 \cdot \hat{V}_{\hat{\mathbf{B}}_{OLS}}, 30), \quad (13)$$

$$W \sim IW(k_W^2 \cdot 3 \cdot \mathbf{I}_3, 3), \quad (14)$$

$$S_1 \sim IW(k_S^2 \cdot 2 \cdot \hat{V}_{\hat{\mathbf{A}}_{1,OLS}}, 2), \quad (15)$$

$$S_2 \sim IW(k_S^2 \cdot 3 \cdot \hat{V}_{\hat{\mathbf{A}}_{2,OLS}}, 3), \quad (16)$$

with $k_Q = 0.01$, $k_S = 0.1$ and $k_W = 0.01$. For (W, S) the degrees of freedom m are set to one plus the dimension of the respective matrix. This is in any case the minimum number of degrees of freedom in order for the inverse-Wishart distribution to be properly specified (Primiceri 2005). In case of (Q) the degrees of freedom m are set to 30, which is the size of the training sample and leads to a slightly tighter prior. Except for W , for all the priors on the hyperparameters the scale matrices are constant fractions of the variances resulting from the model fitted to the training sample. Chosen in that way the priors are not completely uninformative yet still rather diffuse. This guarantees that the information embodied in the priors is soon dominated by the information contained in the data.

Simulating the joint posterior distribution $(\mathbf{B}^T, \mathbf{A}^T, \mathbf{\Sigma}^T, Q, S, W)$ via Gibbs sampling takes place according to the following steps: Sequentially draw (\mathbf{B}^T) , (\mathbf{A}^T) , $(\mathbf{\Sigma}^T)$ and the hyperparameters (Q, S, W) given the data and the rest of the parameters.¹⁹ We perform 30,000 sampling iterations, discarding the first 20,000 draws as burn-in phase. The Gibbs sampler, as every Markov chain sampler, is a dependence chain algorithm, parameters of interest. This is because MCMC is a smoothing rather than a filtering method.

¹⁹See Appendix A.3 for a detailed description of the separate Gibbs sampling steps.

i.e. the different draws are not independent from each other. In order to break the correlation between the different draws, we keep only every tenth draw. Additionally, following Cogley and Sargent (2001), all draws for the coefficient vector that would lead to an explosive solution of the model are discarded.

5.2 The business climate response over time

Figures 6 to 8 display the absolute²⁰ response of the sectoral business climate indicator to an exchange rate shock after six months (6M) by the respective solid line country by country. Additionally, the running mean, i.e. a mean that is calculated anew with each new observation, of this response over time is shown by a dotted line in each diagram. For the sake of comparability ordinate values are identically scaled. Obviously, the medium-term business climate's reaction to an exchange rate shock developed rather differently for the different economies.

Responses of the German and UK automobile and mechanical engineering sectors conspicuously drift apart with the actual implementation of the single currency for the common market in January 2002.²¹ The starkest contrast is given comparing the time-varying response function of German core exporting sectors (Figure 7) with the corresponding one for the UK (Figure 6). Although Germany starts from a slightly lower level of medium run exchange rate susceptibility of its core sectors, it clearly falls over nearly the entire period of observation. The opposite applies in the case of the UK. For French key exporting sectors the reaction of business confidence to exchange rate shocks has been rather stable over the total period of observation (Figure 8). The running mean (dotted line) is basically constant, suggesting no change in responsiveness over time apart from a slight increase coinciding with the beginning of the global crisis. However, the running mean suggests this increase in exchange rate shock susceptibility to rather represent transient changes that are transitory in nature. An immunization in the sense of the Frankel-Rose-Melitz-hypothesis [H3] is not confirmed for French data. Hence, our TVP-VAR based findings leave the impression that it is not the coming into being of

²⁰From the constant parameter VAR impulse responses, we know that a pass-through might result in a significant positive or negative reaction of the expected demand indicator. As we are rather after tendencies or trends, we focus on absolute responses and abstract from calculating confidence bands from the posterior distributions.

²¹In case of France the response is plotted only from 1999 onwards as the training sample consists of 50 as opposed to 30 observations for the other countries.

the Eurozone membership that has led to a jointly declining responsiveness of Eurozone members' sectoral business confidence to a EUR/USD exchange rate shock. For though the German sectoral index reaction clearly appears to markedly decrease after the Euro cash changeover, we see no indication for such a tendency in the case of the French series.

First and foremost, our findings again make the point of an extraordinary role played by the German key sectors. It is most probably rooted in the high specificity and high price-inelasticity of their products as well as in the proliferation of natural hedging strategies. In line with our results reported in Section 3 and Section 4, we regard the Williamson-hypothesis [$H2$] as confirmed.

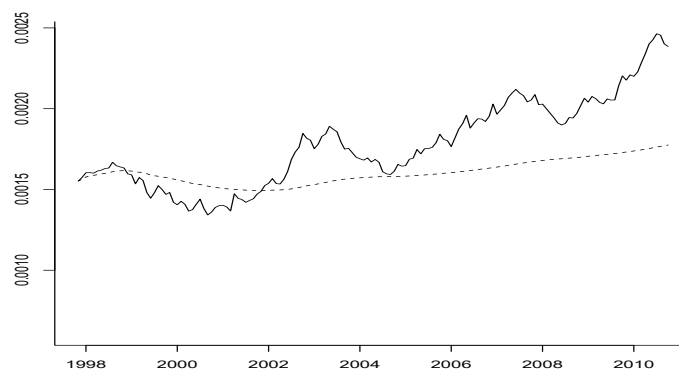


Figure 6. 6M response of BC to EXR shock: UK

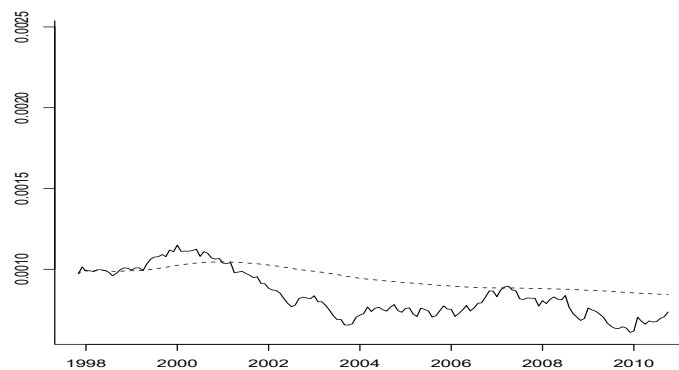


Figure 7. 6M response of BC to EXR shock: Germany

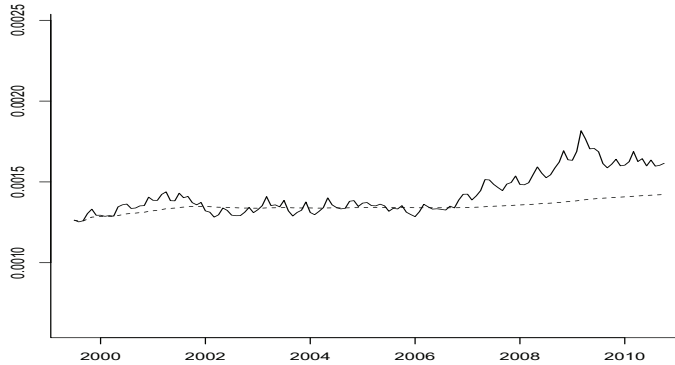


Figure 8. 6M response of BC to EXR shock: France

6 Interpretation and Policy Implications

The German automobile and related industries strategically use offshoring to the US quite differently than, for example, to China, where the prime target is to directly serve a strongly growing regional demand. According to Deutsche Bank Research (2014), virtually 100 percent of German vehicles produced in China are sold in China. The motivation for German offshore-plants in the US is quite different. In 2013, only 42 percent of German automobiles produced in US plants were actually sold in the US. The lion's share was exported from the US to either Europe or Asia. Against the backdrop of international automotive CEOs being more likely than their fellow CEOs to be “extremely concerned” about currency risks (40 percent vs. 22 percent),²² it is straightforward to interpret currency risk or “natural” hedging as being at the heart of offshoring activities in the US. But do German automobile and mechanical engineering sectors play an extraordinary role compared to the corresponding French and UK industries in this regard? The following Table 1 tries to give an answer. It shows the current size (i.e. the number of employees rounded to hundreds) of offshore production plants in the US by the respective top-3 companies in terms of total revenues in the German, French and UK automobile and mechanical engineering sectors, respectively. Our focus is on firms listed in the respective national benchmark stock index (DAX, CAC 40, FTSE 100) that can be ascribed to one of the two key sectors.

²²Implying a higher awareness of the necessity to relocate plants to key currency countries in order to lower the exchange rate risk according to a recent survey among 1,201 business leaders in 69 countries conducted in the fourth quarter of 2010; see PwC (2011).

German offshores		Size	Primary location
Mechanical engineering	(1) <i>Siemens Industry</i>	46,000	Orlando, FL
	(2) <i>Linde Group</i>	5,000	Murray Hill, NJ
	(3) <i>ThyssenKrupp IS</i>	14,800	Calvert, AL
Automobile	(1) <i>Volkswagen</i>	2,000	Chattanooga, TN
	(2) <i>Daimler</i>	5,100	Tuscaloosa, AL
	(3) <i>BMW</i>	8,000	Spartanburg, NC
Total		80,900	

French offshores		Size	Primary location
Mechanical engineering	(1) <i>Schneider Electric</i>	900	Andover, MA
	(2) <i>Thales</i>	3,000	Arlington, VA
	(3) <i>Safran</i>	7,000	Arlington, VA
Automobile	(1) <i>PSA Peugeot Citroën</i>	—	—
	(2) <i>Renault</i>	—	—
	(3) <i>Michelin</i>	11,600	Greenville, SC
Total		22,500	

UK offshores		Size	Primary location
Mechanical engineering	(1) <i>BAE Systems</i>	19,800	Arlington, VA
	(2) <i>Rolls Royce Group plc</i>	7,000	Crosspointe, VA
	(3) <i>Amec Foster Wheeler</i>	—	Houston, TX
Automobile	(1) <i>Delphi Automotive</i>	5,000	Troy, MI
	(2) <i>GKN Driveline</i>	2,000	Newton, NC
	(3) <i>TI Automotive</i>	300	Auburn Hills, MI
Total		34,100	

Table 1: Contemporary offshore production plants in the US; Source: Statista

There are several points to note with regard to the construction of Table 1 before interpreting the figures it is displaying. First, companies usually run more than just one US offshore plant. They frequently include plants that are more or less strongly engaged in joint ventures with local original equipment manufacturers (OEMs) or suppliers. For example, the French aerospace-defence-security group *Safran* runs a joint venture in equal shares with OEM *General Electric* at a plant in Rochester (NH). The 50 percent employees of it are counted in the shown figure, while we refer to Arlington (VA) as primary location, where *Safran USA* is actually headquartered.²³ It is also worth noting

²³Similarly, the UK *Rolls Royce* group's figure subsumes employees from a major defence plant run at Indianapolis (IN).

that the *ThyssenKrupp Industrial Solutions* employees figure includes a steel plant with 2,700 employees in Calvert (AL) that was sold in 2013. The figure for French company *Schneider Electric* misses data from a recently, i.e. in 2015, set up plant in Livermore (CA). Finally, note that both *Amec Foster Wheeler* and *TI Automotive* do not run production sites, but offshore consulting services and administration, in the US, respectively. It is also noteworthy that British vehicle producer *Aston Martin* –with total revenues amounting to GBP 470 million not top-3 in terms of revenues and, thus, not included– recently announced to plan a US offshore plant in Alabama.

Even if we consider the recent selling and setting-up of single offshore plants in the US by our considered European economies and keep in mind the snapshot character and rough classification of sectors in Table 1, the message it is conveying is clear-cut. German key sectors’ US offshoring activity (about 75 to 80 thousand employees) is higher than the one by its French (about 20 to 30 thousand employees) and UK (about 35 thousand employees) counterparts taken together. This fact is suggestive for natural hedging, besides balance sheets and value added chain effects, playing a crucial role with regard to hedging currency risks for European key sectors. It can be interpreted as an idiosyncratic German way in dealing with and immunizing against exchange rate fluctuations that can, at least in parts, explain our findings. Furthermore, the awareness of the industry in general (PwC 2011) as well as the recent plans of *Aston Martin*, in particular, support this reasoning. In sum, natural hedging in the form of offshoring to key currency country locations seems to be a promising strategy to hedge the currency risk for European core industries.

7 Conclusion

Our study was motivated by presuming that looking exclusively at the reaction of exports to real exchange rate changes is not satisfactory when addressing the question whether an appreciation of the Euro causes automobile and mechanical engineering industries in the EU “pain.” Estimating a trivariate VAR, we find a depreciation of the Euro vis-à-vis the US dollar to have a positive impact on exports for German and French data. The effect is, however, insignificant in the case of the confidence indicators for German series throughout and for French series in half of the specifications. Implied impulse responses show that shocks in the exchange rate lead to a significant reaction of exports, while

there might be neither a reaction of the business climate nor of order book assessments or business confidence in general. Additionally, FEVD analysis revealed that the exchange rate contributes little (in the case of France) to nearly nothing (in the case of Germany) to the dynamics of confidence indicators. If we proceed analogously with the GBP/USD exchange rate and the UK sectoral series, the picture is different as we find throughout all our specifications a significant responsiveness to exchange rate shocks. And although this responsiveness is growing over time, it is in its direction reversed to predictions of traditional and standard open-economy models (Dornbusch 1976, Svenson 2000) as well as of the “New open-economy macroeconomics” class of models (Lane 2001). The reversion, i.e. a positive impact on expected sector-specific demand triggered by a real exchange rate depreciation, can be rationalized on two grounds: (i) by an adverse balance sheet effect in case of firms’ liabilities being substantially dollarized or, more generally, denominated in foreign currency paralleled by firm revenues in domestic currency (Aghion *et al.* 2000, Bahmani-Oskooee and Miteza 2003) or (ii) by the dependence on relatively more expensive imported intermediate goods that need to be acquired in foreign currency (Greenaway *et al.* 2010). Both effects, (i) and/or (ii), can outweigh the positive effect depreciation has on net sectoral exports and, consequently, reverse demand expectations.

With regard to the hypotheses set up in the introductory sections of this paper, it is only the Williamson-hypothesis [*H2*] of an extraordinary role being played by the German key sectors that our analysis clearly confirms. In contrast, the hypothesis of an overall high exchange rate susceptibility of the two core sectors, automobiles and mechanical engineering, as claimed by lobbies and held as popular belief [*H1*], can be rejected. From a political economy perspective this raises the question why, in particular, these industries heavily lobby for low exchange rates. A straightforward answer is that immunization strategies such as natural hedging, that is, shifting production (temporarily) abroad, as in particular observed at a relatively large scale in the German automobile and related industries are costly. Finally, we find no clear-cut evidence for the Frankel-Rose-Melitz-hypothesis [*H3*] according to which the coming into being of the Eurozone should imply a joint decline in the responsiveness of members’ sectoral business confidence to real exchange rate shocks. For though the German sectoral index reaction clearly appears to markedly decrease after the Euro cash changeover, we see no indication for a similar tendency in the case of French time series.

In the light of the recent debate triggered by the efforts of the Bank of Japan to strategically lower real exchange rates, our results suggest that “competitive deprecia-

tion” is neither an option nor a threat for Germany and its core industries in the short and medium run. The same applies to the other European economies analyzed in this study showing reversed standard model reactions of expected demand.

References

- [1] Aghion, P., Bacchetta, P., and A.V. Banerjee (2000). A simple model of monetary policy and currency crises. *European Economic Review* 44, 728-738.
- [2] Asseery, A. and D.A. Peel (1991). The effects of exchange rate volatility on exports: some new estimates. *Economics Letters* 37, 173-177.
- [3] Aw, B.Y., Chung, S., and M.J. Roberts (2000). Productivity and turnover in the export market: micro-level evidence from the Republic of Korea and Taiwan (China). *World Bank Economic Review* 14, 65-90.
- [4] Bahmani-Oskooee, M. and I. Miteza (2003). Are devaluations expansionary or contractionary? A survey article. *Economic Issues* 8, 1-28.
- [5] Belke, A., Göcke, M., and M. Günther (2013). Exchange Rate Bands of Inaction and Play-Hysteresis in German Exports – Sectoral Evidence for Some OECD Destinations. *Metroeconomica* 64, 152-179.
- [6] Bodnar, G.M. and W.M. Gentry (1993). Exchange rate exposure and industry characteristics: evidence from Canada, Japan, and the USA. *Journal of International Money and Finance* 12, 29-45.
- [7] Carter, C.K. and R. Kohn (1994). On Gibbs sampling for state space models. *Biometrika* 81, 541-553.
- [8] CESifo (2010). Industrie: Optimismus nimmt wieder zu. *ifo Konjunkturperspektiven* 37, 1-12.

- [9] Chen, R., Milesi-Ferretti, G.M., and T. Tressel (2012). Euro Area Debtor Countries: External Imbalances in the Euro Area. IMF Working Paper, No. WB/12/136.
- [10] Clostermann, J. and B. Schnatz (2000). The Determinants of the Euro-Dollar Exchange Rate-Synthetic Fundamentals and a Non-existing Currency. Economic Research Group of the Deutsche Bundesbank Discussion Papers, No. 2.
- [11] Cogley, T. and T.J. Sargent (2001). Evolving Post-World War II US Inflation Dynamics. *NBER Macroeconomics Annual* 16, 331-388.
- [12] Croux, C., Forni, M., and L. Reichlin (2001). A measure of comovement for economic variables: theory and empirics. *Review of Economics and Statistics* 83, 232-241.
- [13] De Grauwe, P. and G. Verfaillie (1988). *Exchange Rate Variability, Misalignment, and the European Monetary System*. University of Chicago Press, Chicago.
- [14] Deutsche Bank Research (2014). Zukunft des Automobilstandorts Deutschland. DB Research, Frankfurt a.M., April 2014.
- [15] Deutsche Bundesbank (2008). Macroeconomic Effects of Changes in Real Exchange Rates. Bundesbank Monthly Report 03/08, 33-46.
- [16] Dornbusch, R. (1976). Expectations and exchange rate dynamics. *Journal of Political Economy* 84, 1161-1176.
- [17] Falk, M. and R. Falk (2000). Pricing to market of German exporters: evidence from panel data. *Empirica* 27, 21-46.
- [18] Frankel, J. and A. Rose (2002). An Estimate of the Effect of Common Currencies on Trade and Income. *Quarterly Journal of Economics* 117, 437-466.
- [19] Fratzscher, M. (2008). Communication and exchange rate policy. *Journal of Macroeconomics* 30, 1651-1672.
- [20] Greenaway, D., Kneller, R., and X. Zhang (2010). The effect of exchange rates on firm exports: the role of imported intermediate inputs. *World Economy* 33, 961-986.
- [21] Griffin, J.M. and R.M. Stulz (2001), International competition and exchange rate shocks: a cross-country industry analysis of stock returns, *Review of Financial Studies* 14, 215-241.

- [22] Kim, S., Shephard, N., and S. Chib (1998). Stochastic volatility: likelihood inference and comparison with ARCH models. *Review of Economic Studies* 65, 361-393.
- [23] Knetter, M. (1993). International comparisons of pricing-to-market behavior. *American Economic Review* 83, 473-486.
- [24] Krugman, P. (1986). Pricing to market when the exchange rate changes. NBER Working Paper, No. 1926.
- [25] Lane, P.R. (2001). The New Open-Economy Macroeconomics: A Survey. *Journal of International Economics* 54, 235-266.
- [26] Lütkepohl, H. (2005). *New introduction to multiple time series analysis*. Springer, Heidelberg.
- [27] Lütkepohl, H. and M. Krätzig (2004). *Applied time series econometrics*. Cambridge University Press, Cambridge.
- [28] Melitz, M.J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* 71, 1695-1725.
- [29] Mundell, R.A. (1973). Uncommon arguments for common currencies, in H.G. Johnson and A.K. Swoboda (eds.). *The Economics of Common Currencies*. Allen & Unwin, Sydney, 114-132.
- [30] Pavcnik, N. (2002). Trade liberalization, exit, productivity improvements: evidence from Chilean plants. *Review of Economic Studies* 69, 245-276 .
- [31] Primiceri, G.E. (2005). Time varying structural vector autoregressions and monetary policy. *Review of Economic Studies* 72, 821-852.
- [32] PwC (2011). Growth reimaged: Automotive industry summary of the 14th Annual Global CEO Survey, PricewaterhouseCoopers International Ltd.
- [33] Ravn, M.O. and H. Uhlig (2002). On adjusting the Hodrick-Prescott filter for the frequency of observations. *Review of Economics and Statistics* 84, 371-376.
- [34] Sauer, C. and A.K. Bohara (2001). Exchange rate volatility and exports: regional differences between developing and industrialized countries. *Review of International Economics* 9, 133-152.

- [35] Seiler, C. (2012). On the Robustness of the Balance Statistics with respect to Non-response. ifo Working Paper, No. 126.
- [36] Sims, C.A. (1981). An autoregressive index model for the U.S. 1948-1975, in J. Kmenta and J.B. Ramsey (eds.). *Large-Scale Macro-Econometric Models*. North-Holland, Amsterdam, 283-327.
- [37] Sinn, H.-W. and F. Westermann (2001). Why has the euro been falling? An investigation into the determinants of the exchange rate. NBER Working Paper, No. 8352.
- [38] Svensson, L.E.O. (2000). Open economy inflation targeting. *Journal of International Economics* 50, 155-183.
- [39] Tintner, G., Rao, J.N.K., and H. Strecker (1978). *New results in the variate difference method*. Vandenhoeck und Ruprecht, Göttingen.
- [40] Wierds, P., Van Kerkhoff, H., and J. De Haan (2014). Composition of Exports and Export Performance of Eurozone Countries. *Journal of Common Market Studies* 52, 928-941.
- [41] Williamson, R. (2001). Exchange rate exposure and competition: evidence from the automotive industry. *Journal of Financial Economics* 59, 441-475.
- [42] Wunder, C., Schwarze, J., Krug, G., and B. Herzog (2008). Welfare effects of the euro cash changeover. *European Journal of Political Economy* 24, 571-586.

A Appendix

A.1 Time series and descriptive statistics

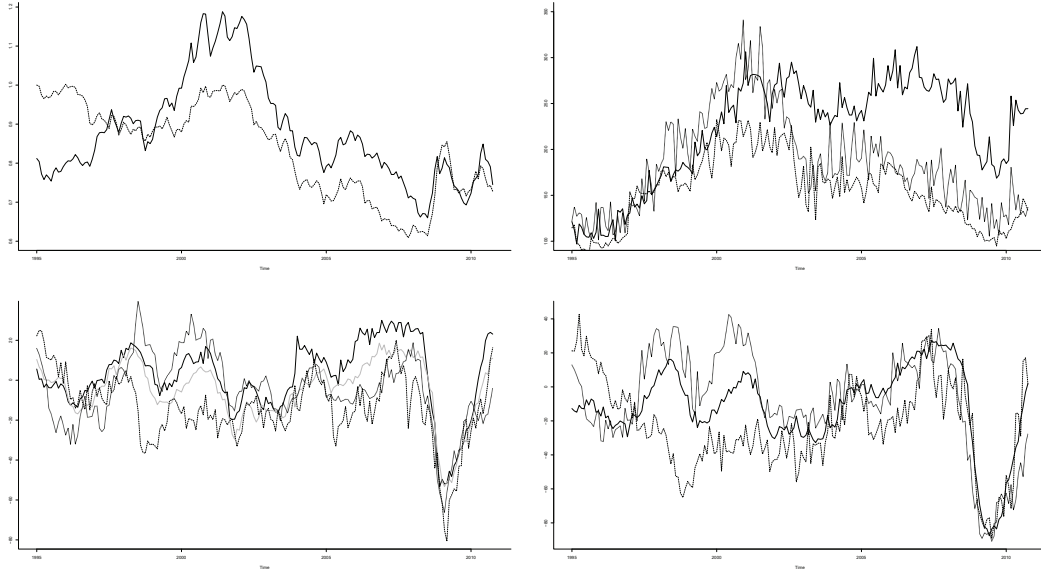


Figure 1: Clockwise from upper left corner: real EUR/USD exchange rate (solid) and real GBP/USD exchange rate (dashed), vehicle and machinery exports to U.S. for Germany (solid), UK (dashed) and France (dotted), Assessment of Export Order-Book Indicator in automobile and mechanical engineering industry for Germany (solid), UK (dashed) and France (dotted), *ifo* Business Climate (solid) as well as European Commission Confidence Indicator in automobile and mechanical engineering industry for Germany (grey), UK (dashed) and France (dotted)

Variable	Germany				France				UK			
	Min	Max	Mean	Sd	Min	Max	Mean	Sd	Min	Max	Mean	Sd
EXR	0.66	1.19	0.88	0.131	0.66	1.19	0.88	0.13	-	-	-	-
EXR_GB	-	-	-	-	-	-	-	-	0.61	1.00	0.83	0.12
EXP	96.97	312.02	219.80	57.25	101.16	341.04	185.59	53.37	85.45	232.54	154.99	37.72
BC	-53.35	30.00	1.99	17.72	-	-	-	-	-	-	-	-
COF	-53.30	18.60	-4.89	14.90	-66.30	39.65	-4.79	17.88	-80.70	24.95	-13.62	17.01
ASS_EXP	-87.60	27.25	-12.02	24.20	-90.75	42.60	-7.61	29.83	-89.15	42.65	-23.59	26.11

Table 2: Descriptive statistics for real EUR/USD exchange rate (EXR), real GBP/USD exchange rate (EXR_GB), value index of exports (EXP), ifo Business Climate (BC), European Commission Confidence Indicator (COF) and European Commission's Assessment of Export Order-Book Indicator (ASS_EXP)

Note: Prior to 2004, the business climate in the two sectors is published for West Ger-

many and East Germany separately. For West Germany the series of the mechanical engineering industry is subsumed under the sub-category “Investment goods without cars” (manufacturing sector), while the business climate of the automobile sector is classified under “Commodities” (manufacturing sector). For East Germany, we draw the business climate for the respective industries from the “Investment goods manufacturing industry” category. The business climate for Germany, taking East and West together, is calculated by aggregating and taking means.

A.2 Reduced form analysis of correlation structure of series

A visual inspection of the correlation function $\mathbf{P}_y(\tau)$ both for HP(129,600) and log first difference filtered series (not shown here) indicates a significant positive correlation between the series EXR and EXP as well as EXP and BC.

There is only little significant correlation between EXR and BC while there is evidence for significant cross-series dynamics between the exchange rate and exports on the one hand and exports and business climate on the other. This result is backed up and broadened by inspection of the cross-series dynamics in the frequency domain.²⁴ We calculate several multivariate measures in the frequency domain. If one considers two stationary time series x_t and y_t the cross-spectrum between these two is given by

$$f_{xy}(\omega) = c_{xy}(\omega) - iq_{xy}(\omega), \quad (17)$$

with $\omega \in [-\pi, \pi]$. The cospectrum $c_{xy}(\omega)$ measures the “in-phase” covariance between the two series, whereas the quadrature spectrum $q_{xy}(\omega)$ measures the covariance between the “out-of-phase” components. Together with the series autospectra this can be used to calculate the squared coherency

$$sc(\omega) = \frac{|f_{xy}(\omega)|^2}{f_x(\omega)f_y(\omega)}, \quad (18)$$

which is defined $0 \leq sc(\omega) \leq 1$. The squared coherency can be interpreted as a measure for the strength of the linear relationship between the two series at different frequencies.

²⁴The following common link exists between the time and frequency domain:
 $f_x(\omega) = (1/2\pi) \sum_{\tau=-\infty}^{\infty} \gamma_x(\tau) e^{-i\omega\tau}$ with $\omega \in [-\pi, \pi]$, i.e., the spectrum of a series is defined as the Fourier transform of the autocovariance function.

Unfortunately, the squared coherency does not contain information about a potential phase-shift, i.e. the lead-lag structure of the two series at different frequencies. This is why it should be interpreted jointly with the phase spectrum

$$\phi_{xy} = -\arctan(q_{xy}(\omega)/c_{xy}(\omega)). \quad (19)$$

Alternatively, one may also judge the linear relationship between the two series by looking at the dynamic correlation

$$\rho(\omega) = \frac{c_{xy}(\omega)}{\sqrt{f_x(\omega)f_y(\omega)}}, \quad (20)$$

with $-1 \leq \rho(\omega) \leq 1$. The dynamic correlation measures the correlation between the “in-phase” components of x_t and y_t at frequency ω (Croux *et al.* 2001). Figure 2 shows the autospectra, integrated spectra, amount of explained variance and dynamic correlation computed from bivariate VARs fitted to our vector of observations \mathbf{y}_t for the HP and logD filtered series, respectively.

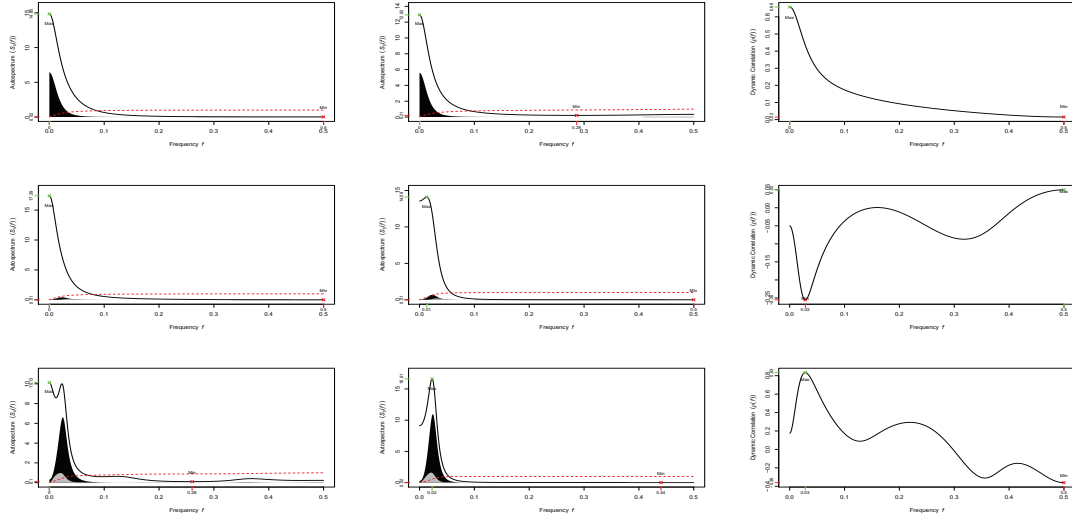


Figure 2. Bivariate spectral properties: EXR, EXP, BC; filter: HP

Note: First row – EXR vs. EXP, second row – EXR vs. BC,
third row – EXP vs. BC

The first row of Figure 2 shows the autospectra of the real EUR/USD exchange rate and exports as well as the dynamic correlation between the series. Looking at the series’ autospectra, we see that quite a significant part of the exports’ variance is explained by

exchange rate dynamics and vice versa.²⁵ Furthermore, the two series are highly and positively correlated at the most relevant frequencies ($\rho_{max} = 0.66$).²⁶

Things look somewhat different in case of the intra-series dynamics between the exchange rate and the business climate (second row of graphs). It can be seen that only a negligible part of the business climate’s variance can be explained by the EUR/USD exchange rate. Additionally, the absolute value of the dynamic correlation at the relevant frequencies is much smaller. Looking at the last row of Figure 2 we see that there is a strong relationship between exports and the business climate in terms of explained variance and profound dynamic correlation. The latter takes on a maximum value of $\rho = 0.83$ around the dominating low frequencies. Though less pronounced, the results for using the logD-filter are, in general, qualitatively in line with this picture. Detailed results are available on request from the authors.

A.3 Gibbs sampler

This section briefly sketches the Gibbs sampling algorithm. A more detailed explanation of the different sampling steps can be found in Primiceri (2005).

A.3.1 Step 1: Initialization

Initialize \mathbf{A}^T , \mathbf{B}^T , $\mathbf{\Sigma}^T$ and the hyperparameters Q , W , S .

A.3.2 Step 2: Drawing coefficient states \mathbf{B}^T

Conditional on the data and all other parameters the observation equation 6 is linear and has Gaussian innovations. \mathbf{B}^T is sampled from $p(\mathbf{B}^T | \mathbf{y}^T, \mathbf{A}^T, \mathbf{\Sigma}^T, Q, W, S)$. Based on the algorithm of Carter and Kohn (1994) draws for $\mathbf{B}_t = \mathbf{B}_{t-1} + \nu_t$ are obtained from $p(\mathbf{B}^T | \mathbf{y}^T, \mathbf{A}^T, \mathbf{\Sigma}^T, Q, W, S)$, which is $N(\mathbf{B}_{t|t+1}, \mathbf{P}_{t|t+1})$ with

$$\mathbf{B}_{t|t+1} = E(\mathbf{B}_t | \mathbf{B}_{t+1}, \mathbf{y}^T, \mathbf{A}^T, \mathbf{\Sigma}^T, Q, W, S),$$

$$\mathbf{P}_{t|t+1} = Var(\mathbf{B}_t | \mathbf{B}_{t+1}, \mathbf{y}^T, \mathbf{A}^T, \mathbf{\Sigma}^T, Q, W, S).$$

²⁵The explained variance is given by the colored area (black shaded area – “in-phase” component, grey shaded area – “out-of-phase” component of explained variance).

²⁶“Relevant” in the sense of these frequencies covering most of the series’ variance.

$\mathbf{B}_{t|t+1}$ and $\mathbf{P}_{t|t+1}$ are calculated using the forward filtering, backward sampling (FFBS) algorithm.

A.3.3 Step 3: Drawing covariance states \mathbf{A}^T

Together equation 6 and $\mathbf{X}'_t = \mathbf{I}_n \otimes [1, \mathbf{y}'_{t-1}, \mathbf{y}'_{t-2}, \dots, \mathbf{y}'_{t-p}]$ can be rewritten as $\mathbf{A}_t(\mathbf{y}_t - \mathbf{X}'_t \mathbf{B}_t) = \mathbf{A}_t \hat{\mathbf{y}}_t = \Sigma_t \epsilon_t$, where, given \mathbf{B}^T , $\hat{\mathbf{y}}_t$ is observable. Under the assumption that S is block-diagonal the Carter and Kohn (1994) algorithm can be used again to draw $\alpha_{i,t}$ from $N(\alpha_{i,t|t+1}, \Lambda_{i,t|t+1})$, where

$$\alpha_{i,t|t+1} = E(\alpha_{i,t} | \alpha_{i,t|t+1}, \mathbf{y}^T, \mathbf{A}^T, \Sigma^T, Q, W, S) \text{ and}$$

$$\Lambda_{i,t|t+1} = Var(\alpha_{i,t} | \alpha_{i,t|t+1}, \mathbf{y}^T, \mathbf{A}^T, \Sigma^T, Q, W, S).$$

See Primiceri (2005) for a discussion of the problem of non-linearity and the assumptions made with regard to S in drawing \mathbf{A}^T .

A.3.4 Step 4: Drawing volatility states Σ^T

In a next step we consider $\mathbf{A}_t(\mathbf{y}_t - \mathbf{X}'_t \mathbf{B}_t) = \mathbf{y}_t^* = \Sigma_t \epsilon_t$. Now, given \mathbf{A}^T and \mathbf{B}^T , \mathbf{y}_t^* can be observed. Squaring and taking logs transforms this system of equations into a linear one: $\mathbf{y}^{**} = 2\mathbf{h}_t + \mathbf{e}_t$ with $\mathbf{h}_t = \mathbf{h}_{t-1} + \boldsymbol{\eta}_t$, where $y_{i,t}^{**} = \log((y_{i,t}^*)^2 + \bar{c})$, $\bar{c} = 0.001$ is an offset constant that makes the estimation procedure more robust, $e_{i,t} = \log(\epsilon_{i,t}^2)$, $h_{i,t} = \log(\sigma_{i,t})$. Although, the system is now linear, its innovations are non-Gaussian since the errors are $\sim \log\chi^2(1)$. Following Kim *et al.* (1998) we use a mixture of seven normal densities for each element of \mathbf{e} . The seven normal densities have component probabilities q_j , means $m_j - 1.2704$ and variances v_j^2 , with $j = 1, \dots, 7$. If we define $\mathbf{s}^T = [s_1, \dots, s_T]'$ to be the matrix of indicator variables that select for each element of \mathbf{e}_t the respective member of the mixture, conditional on \mathbf{B}^T , \mathbf{A}^T , Q , W , S and \mathbf{s}^T the system is now linear and approximately Gaussian. Thus, the Carter and Kohn (1994) algorithm can be used again to recursively draw the volatilities \mathbf{h}_t from $N(\mathbf{h}_{t|t+1}, \mathbf{H}_{t|t+1})$, with $\mathbf{h}_{t|t+1} = E(\mathbf{h}_t | \mathbf{h}_{t+1}, \mathbf{y}^T, \mathbf{A}^T, \mathbf{B}^T, Q, W, S, \mathbf{s}^T)$ and $\mathbf{H}_{t|t+1} = Var(\mathbf{h}_t | \mathbf{h}_{t+1}, \mathbf{y}^T, \mathbf{A}^T, \mathbf{B}^T, Q, W, S, \mathbf{s}^T)$.

j	q_j	m_j	v_j^2
1	0.0073	-10.12999	5.79596
2	0.10556	-3.97281	2.61369
3	0.00002	-8.56686	5.17950
4	0.04395	2.77786	0.16735
5	0.34001	0.61942	0.64009
6	0.24566	1.79518	0.34023
7	0.25750	-1.08819	1.26261

Table 3: Mixing Distributions as in Kim *et al.* (1998)

A.3.5 Step 5: Drawing hyperparameters Q , W and S

Conditional on \mathbf{y}^T , \mathbf{B}^T , \mathbf{A}^T and Σ^T the hyperparameters Q , W and S can be obtained directly from their inverse-Wishart posterior distributions.

A.3.6 Step 6: Sampling replications

Go back to Step 2.

A.4 Impulse responses and FEVD

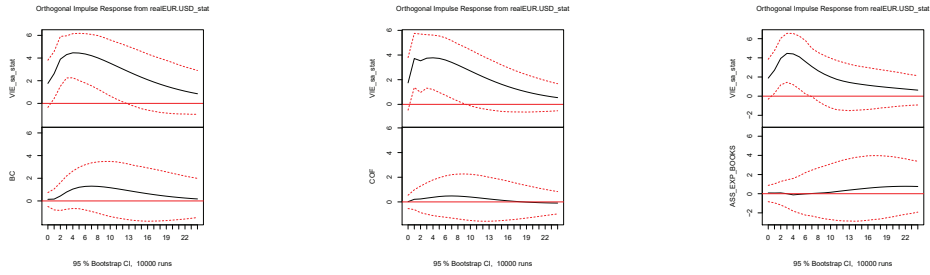


Figure 3: Impulse responses of EXP and respective climate indicator for orthogonal shock in EXR (HP-filtered series)

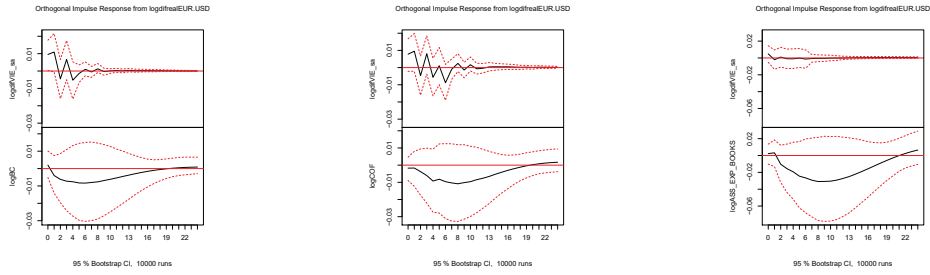


Figure 4: Impulse responses of EXP and respective climate indicator for orthogonal shock in EXR (logD-filtered series)

Note:

The underlying VAR models of the first column of figures on this page use the ifo business climate indicator, of the second column the EC confidence indicator, and of the third column the EC assessment of export order-book indicator as third variable in endogenous vector, respectively. All indicators refer to the automobile and mechanical engineering industries only.

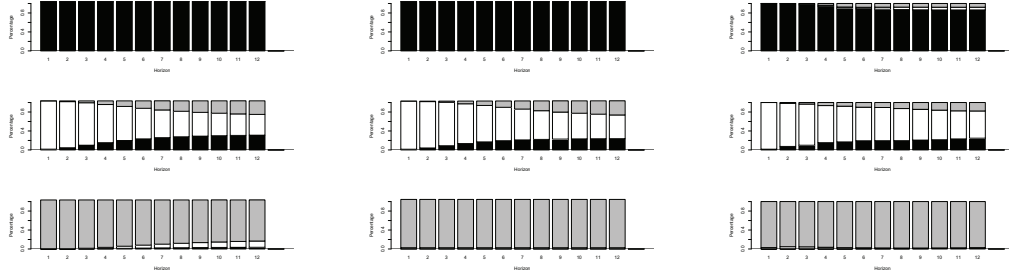


Figure 5: FEVD for EXR, EXP and respective climate indicator (HP)

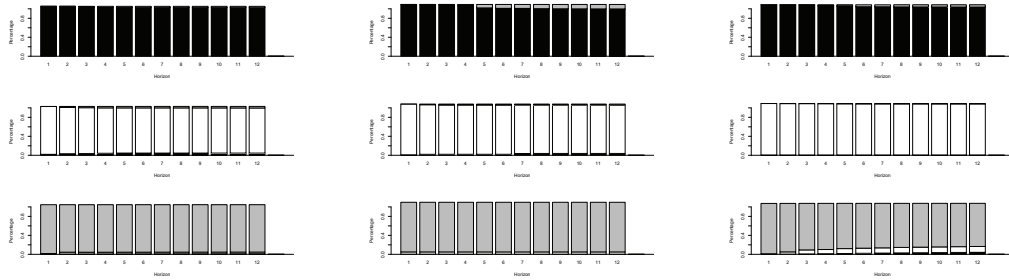


Figure 6: FEVD for EXR, EXP and respective BC indicator (logD)

Note:

The underlying VAR models of the first column of figures on this page use the ifo business climate indicator, of the second column the EC confidence indicator, and of the third column the EC assessment of export order-book indicator as third variable in endogenous vector, respectively. All indicators refer to the automobile and mechanical engineering industries only.

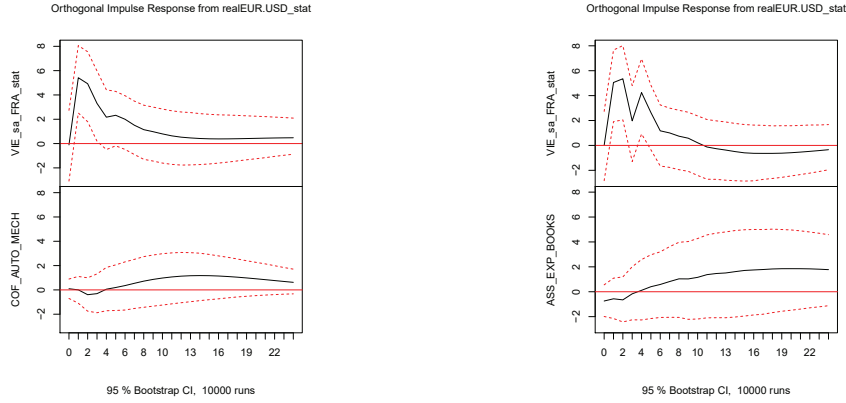


Figure 7: Impulse responses of EXP and respective climate indicator for orthogonal shock in EXR (HP): France

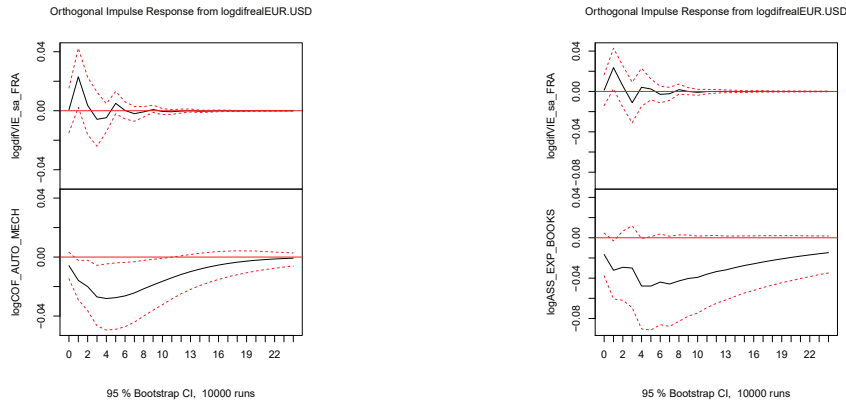


Figure 8: Impulse responses of EXP and respective BC indicator for orthogonal shock in EXR (logD): France

Note:

The underlying VAR models of the first column of figures on this page use the EC confidence indicator, the second column the EC assessment of export order-book indicator, respectively. All indicators refer to the automobile and mechanical engineering industries only.

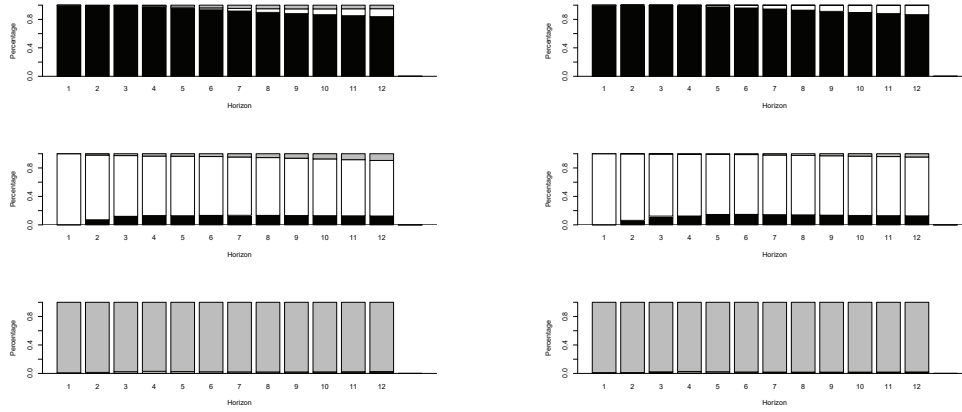


Figure 9: FEVD for EXR, EXP and respective climate indicator (HP): France

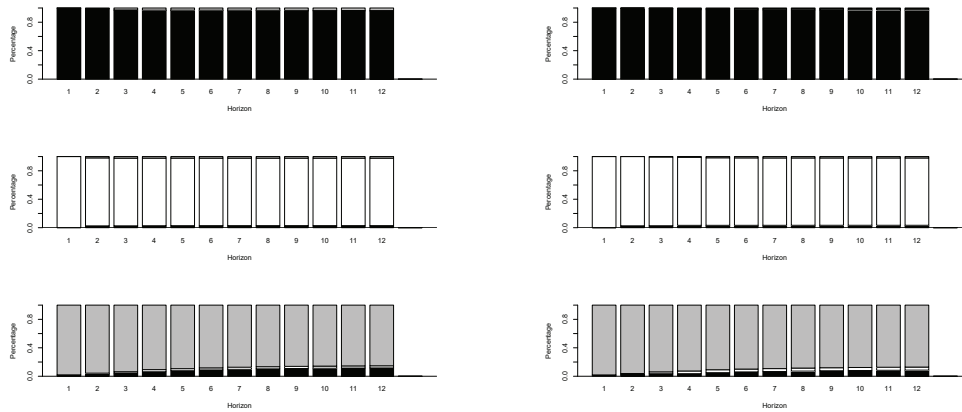


Figure 10: FEVD for EXR, EXP and respective climate indicator (logD): France

Note:

The underlying VAR models of the first column of figures on this page use the EC confidence indicator, the second column the EC assessment of export order-book indicator, respectively. All indicators refer to the automobile and mechanical engineering industries only.

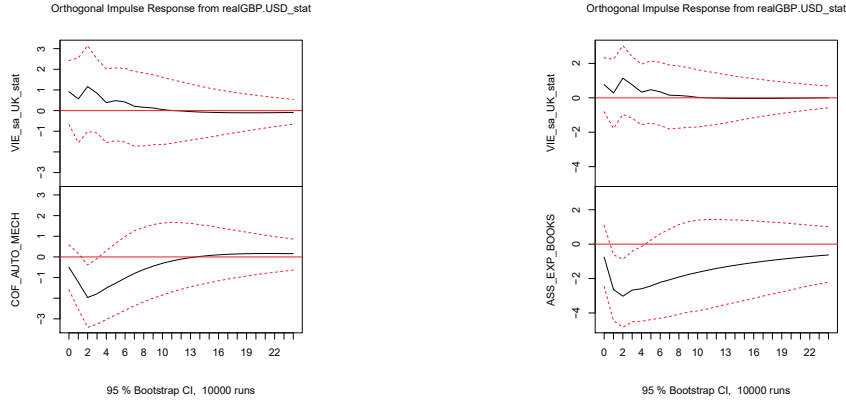


Figure 11: Impulse responses of EXP and respective climate indicator for orthogonal shock in EXR (HP): UK

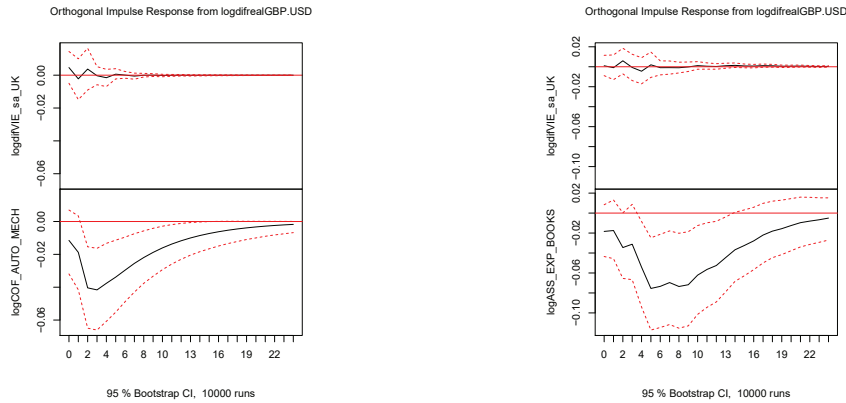


Figure 12: Impulse responses of EXP and respective climate indicator for orthogonal shock in EXR (logD): UK

Note:

The underlying VAR models of the first column of figures on this page use the EC confidence indicator, the second column the EC assessment of export order-book indicator, respectively. All indicators refer to the automobile and mechanical engineering industries only.

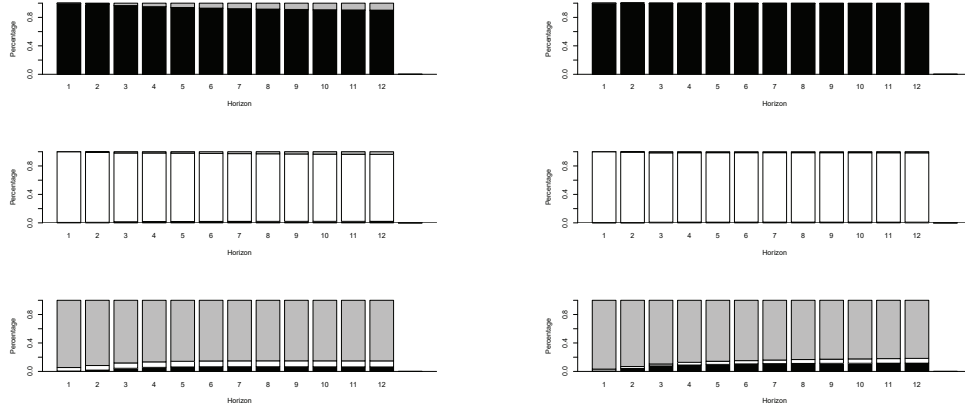


Figure 13: FEVD for EXR, EXP and respective climate indicator (HP): UK

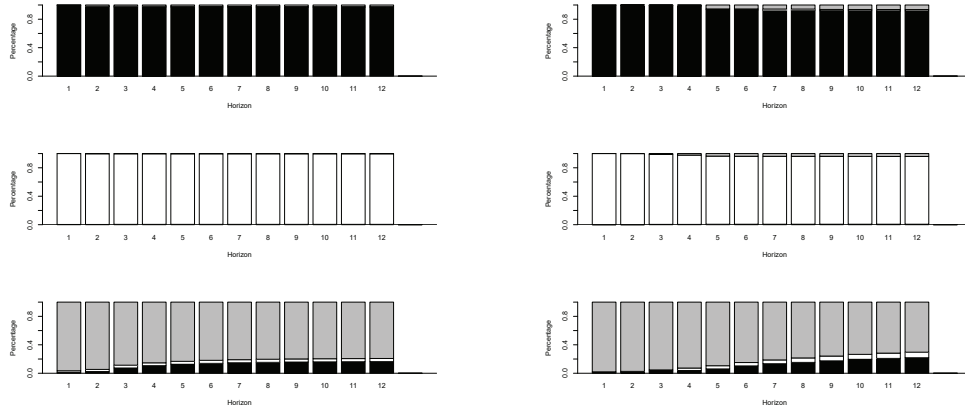


Figure 14: FEVD for EXR, EXP and respective climate indicator (logD): UK

Note:

The underlying VAR models of the first column of figures on this page use the EC confidence indicator, the second column the EC assessment of export order-book indicator, respectively. All indicators refer to the automobile and mechanical engineering industries only.

A.5 Estimation results

Endogenous variables: EXR, EXP, BC				
Deterministic variables: const				
Method: Ordinary Least Squares				
Sample: Jan1995 Oct2010				
Sample size: 187				
Log Likelihood: -806.912				
Equation: $EXR = EXR.l1 + EXP.l1 + BC.l1 + EXR.l2 + EXP.l2 + BC.l2 + EXR.l3 + EXP.l3 + BC.l3 + const$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR.l1	$1.287e + 00$	$7.494e - 02$	17.179	$< 2e - 16^{***}$
EXP.l1	$1.438e - 04$	$1.067e - 04$	1.347	0.1796
BC.l1	$-3.613e - 05$	$3.380e - 04$	-0.107	0.9150
EXR.l2	$-5.535e - 01$	$1.149e - 01$	-4.815	$3.14e - 06^{***}$
EXP.l2	$1.445e - 04$	$1.091e - 04$	1.324	0.1871
BC.l2	$-6.117e - 04$	$4.868e - 04$	$4.868e - 04$	0.2106
EXR.l3	$1.569e - 01$	$7.582e - 02$	2.070	0.0399*
EXP.l3	$-1.234e - 04$	$1.084e - 04$	-1.138	0.2566
BC.l3	$4.566e - 04$	$3.392e - 04$	1.346	0.1799
const	$3.582e - 04$	$1.464e - 03$	0.245	0.8070
Multiple R-squared	0.8975	Adj. R-squared	0.8923	
F-statistic	172.2 on 9 and 177 DF	p-value	$< 2.2e-16$	

Table 4: Estimation Results VAR[3]-Model

Equation: $EXP = EXR.l1 + EXP.l1 + BC.l1 + EXR.l2 + EXP.l2 + BC.l2 + EXR.l3 + EXP.l3 + BC.l3 + const$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR.l1	$1.637e + 02$	$5.314e + 01$	3.080	0.002399**
EXP.l1	$2.858e - 01$	$7.568e - 02$	3.777	0.000217***
BC.l1	$4.932e - 01$	$2.397e - 01$	2.058	0.041070*
EXR.l2	$-1.018e + 02$	$8.151e + 01$	-1.249	0.213151
EXP.l2	$2.234e - 01$	$7.737e - 02$	2.887	0.004374**
BC.l2	$-3.598e - 02$	$3.452e - 01$	-0.104	0.917115
EXR.l3	$3.624e + 01$	$5.377e + 01$	0.674	0.501174
EXP.l3	$7.433e - 03$	$7.688e - 02$	0.097	0.923089
BC.l3	$-5.433e - 02$	$2.405e - 01$	-0.226	0.821541
const	$-7.250e - 01$	$1.038e + 00$	-0.698	0.485860
Multiple R-squared	0.6426	Adj. R-squared		0.6244
F-statistic	35.36 on 9 and 177 DF	p-value		<2.2e-16

Equation: $BC = EXR.l1 + EXP.l1 + BC.l1 + EXR.l2 + EXP.l2 + BC.l2 + EXR.l3 + EXP.l3 + BC.l3 + const$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR.l1	-12.78167	16.01834	-0.798	0.42597
EXP.l1	0.03538	0.02281	1.551	0.12264
BC.l1	1.02815	0.07224	14.233	< 2e - 16***
EXR.l2	41.99795	24.56937	1.709	0.08914.
EXP.l2	-0.06798	0.02332	-2.915	0.00402**
BC.l2	0.20088	0.10405	1.931	0.05511.
EXR.l3	-12.96744	16.20730	-0.800	0.42473
EXP.l3	-0.03612	0.02317	-1.559	0.12086
BC.l3	-0.22625	0.07250	-3.121	0.00211**
const	0.06351	0.31291	0.203	0.83938
Multiple R-squared	0.947	Adj. R-squared		0.9443
F-statistic	351.3 on 9 and 177 DF	p-value		<2.2e-16

Table 5: Estimation Results VAR[3]-Model cont'ed

Endogenous variables: EXR, EXP, BC
Deterministic variables: const
Method: Ordinary Least Squares
Sample: Jan1995 Oct2010
Sample size: 187
Log Likelihood: -817.391

Equation: $EXR = EXR.l1 + EXR.l2 + EXR.l3$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR.l1	1.31033	0.07320	17.901	$< 2e - 16^{***}$
EXR.l2	-0.53173	0.11495	-4.626	$7.02e - 06^{***}$
EXR.l3	0.14730	0.07324	2.011	0.0457*
Multiple R-Squared	0.8924	Adjusted R-squared		0.8907
F-statistic	508.8 on 3 and 184 DF	p-value		$<2.2e-16$

Equation: $EXP = EXR.l1 + EXP.l1 + BC.l1 + EXP.l2$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR.l1	102.54018	22.34386	4.589	$8.24e - 06^{***}$
EXP.l1	0.28481	0.07148	3.985	$9.75e - 05^{***}$
BC.l1	0.41549	0.07809	5.321	$3.00e - 07^{***}$
EXP.l2	0.21449	0.06836	3.138	0.00198**
Multiple R-Squared	0.6376	Adjusted R-squared		0.6297
F-statistic	80.5 on 4 and 183 DF	p-value		$<2.2e-16$

Equation: $BC = BC.l1 + EXR.l2 + EXP.l2 + BC.l3$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BC.l1	1.15062	0.04566	25.198	$< 2e - 16^{***}$
EXR.l2	18.87177	6.74269	2.799	0.005678**
EXP.l2	-0.07381	0.02065	-3.575	0.000448***
BC.l3	-0.13906	0.05005	-2.778	0.006036**
Multiple R-Squared	0.945	Adjusted R-squared		0.9438
F-statistic	786.6 on 4 and 183 DF	p-value		$<2.2e-16$

Table 6: Estimation Results Subset VAR[3]-Model

Universität Leipzig

Wirtschaftswissenschaftliche Fakultät

Nr. 1	Wolfgang Bernhardt	Stock Options wegen oder gegen Shareholder Value? Vergütungsmodelle für Vorstände und Führungskräfte 04/1998
Nr. 2	Thomas Lenk / Volkmar Teichmann	Bei der Reform der Finanzverfassung die neuen Bundesländer nicht vergessen! 10/1998
Nr. 3	Wolfgang Bernhardt	Gedanken über Führen – Dienen – Verantworten 11/1998
Nr. 4	Kristin Wellner	Möglichkeiten und Grenzen kooperativer Standortgestaltung zur Revitalisierung von Innenstädten 12/1998
Nr. 5	Gerhardt Wolff	Brauchen wir eine weitere Internationalisierung der Betriebswirtschaftslehre? 01/1999
Nr. 6	Thomas Lenk / Friedrich Schneider	Zurück zu mehr Föderalismus: Ein Vorschlag zur Neugestaltung des Finanzausgleichs in der Bundesrepublik Deutschland unter besonderer Berücksichtigung der neuen Bundesländer 12/1998
Nr. 7	Thomas Lenk	Kooperativer Föderalismus – Wettbewerbsorientierter Föderalismus 03/1999
Nr. 8	Thomas Lenk / Andreas Mathes	EU – Osterweiterung – Finanzierbar? 03/1999
Nr. 9	Thomas Lenk / Volkmar Teichmann	Die fiskalischen Wirkungen verschiedener Forderungen zur Neugestaltung des Länderfinanzausgleichs in der Bundesrepublik Deutschland: Eine empirische Analyse unter Einbeziehung der Normenkontrollanträge der Länder Baden-Württemberg, Bayern und Hessen sowie der Stellungnahmen verschiedener Bundesländer 09/1999
Nr. 10	Kai-Uwe Graw	Gedanken zur Entwicklung der Strukturen im Bereich der Wasserversorgung unter besonderer Berücksichtigung kleiner und mittlerer Unternehmen 10/1999
Nr. 11	Adolf Wagner	Materialien zur Konjunkturforschung 12/1999
Nr. 12	Anja Birke	Die Übertragung westdeutscher Institutionen auf die ostdeutsche Wirklichkeit – ein erfolg-versprechendes Zusammenspiel oder Aufdeckung systematischer Mängel? Ein empirischer Bericht für den kommunalen Finanzausgleich am Beispiel Sachsen 02/2000
Nr. 13	Rolf H. Hasse	Internationaler Kapitalverkehr in den letzten 40 Jahren – Wohlstandsmotor oder Krisenursache? 03/2000
Nr. 14	Wolfgang Bernhardt	Unternehmensführung (Corporate Governance) und Hauptversammlung 04/2000
Nr. 15	Adolf Wagner	Materialien zur Wachstumsforschung 03/2000
Nr. 16	Thomas Lenk / Anja Birke	Determinanten des kommunalen Gebührenaufkommens unter besonderer Berücksichtigung der neuen Bundesländer 04/2000
Nr. 17	Thomas Lenk	Finanzwirtschaftliche Auswirkungen des Bundesverfassungsgerichtsurteils zum Länderfinanzausgleich vom 11.11.1999 04/2000
Nr. 18	Dirk Büttel	Continuous linear utility for preferences on convex sets in normal real vector spaces 05/2000
Nr. 19	Stefan Dierkes / Stephanie Hanrath	Steuerung dezentraler Investitionsentscheidungen bei nutzungsabhängigem und nutzungsunabhängigem Verschleiß des Anlagenvermögens 06/2000
Nr. 20	Thomas Lenk / Andreas Mathes / Olaf Hirschfeld	Zur Trennung von Bundes- und Landeskompetenzen in der Finanzverfassung Deutschlands 07/2000
Nr. 21	Stefan Dierkes	Marktwerte, Kapitalkosten und Betafaktoren bei wertabhängiger Finanzierung 10/2000
Nr. 22	Thomas Lenk	Intergovernmental Fiscal Relationships in Germany: Requirement for New Regulations? 03/2001
Nr. 23	Wolfgang Bernhardt	Stock Options – Aktuelle Fragen Besteuerung, Bewertung, Offenlegung 03/2001

Nr. 24	Thomas Lenk	Die „kleine Reform“ des Länderfinanzausgleichs als Nukleus für die „große Finanzverfassungs-reform“? 10/2001
Nr. 25	Wolfgang Bernhardt	Biotechnologie im Spannungsfeld von Menschenwürde, Forschung, Markt und Moral Wirtschaftsethik zwischen Beredsamkeit und Schweigen 11/2001
Nr. 26	Thomas Lenk	Finanzwirtschaftliche Bedeutung der Neuregelung des bundestaatlichen Finanzausgleichs – Eine allkoative und distributive Wirkungsanalyse für das Jahr 2005 11/2001
Nr. 27	Sören Bär	Grundzüge eines Tourismusmarketing, untersucht für den Südraum Leipzig 05/2002
Nr. 28	Wolfgang Bernhardt	Der Deutsche Corporate Governance Kodex: Zuwahl (comply) oder Abwahl (explain)? 06/2002
Nr. 29	Adolf Wagner	Konjunkturtheorie, Globalisierung und Evolutionsökonomik 08/2002
Nr. 30	Adolf Wagner	Zur Profilbildung der Universitäten 08/2002
Nr. 31	Sabine Klinger / Jens Ulrich / Hans-Joachim Rudolph	Konjunktur als Determinante des Erdgasverbrauchs in der ostdeutschen Industrie? 10/2002
Nr. 32	Thomas Lenk / Anja Birke	The Measurement of Expenditure Needs in the Fiscal Equalization at the Local Level Empirical Evidence from German Municipalities 10/2002
Nr. 33	Wolfgang Bernhardt	Die Lust am Fliegen Eine Parabel auf viel Corporate Governance und wenig Unternehmensführung 11/2002
Nr. 34	Udo Hielscher	Wie reich waren die reichsten Amerikaner wirklich? (US-Vermögensbewertungsindex 1800 – 2000) 12/2002
Nr. 35	Uwe Haubold / Michael Nowak	Risikoanalyse für Langfrist-Investments Eine simulationsbasierte Studie 12/2002
Nr. 36	Thomas Lenk	Die Neuregelung des bundesstaatlichen Finanzausgleichs auf Basis der Steuerschätzung Mai 2002 und einer aktualisierten Bevölkerungsstatistik 12/2002
Nr. 37	Uwe Haubold / Michael Nowak	Auswirkungen der Renditeverteilungsannahme auf Anlageentscheidungen Eine simulationsbasierte Studie 02/2003
Nr. 38	Wolfgang Bernhard	Corporate Governance Kodex für den Mittel-Stand? 06/2003
Nr. 39	Hermut Kormann	Familienunternehmen: Grundfragen mit finanzwirtschaftlichen Bezug 10/2003
Nr. 40	Matthias Folk	Launhardtsche Trichter 11/2003
Nr. 41	Wolfgang Bernhardt	Corporate Governance statt Unternehmensführung 11/2003
Nr. 42	Thomas Lenk / Karolina Kaiser	Das Prämienmodell im Länderfinanzausgleich – Anreiz- und Verteilungsmittelnwirkungen 11/2003
Nr. 43	Sabine Klinger	Die Volkswirtschaftliche Gesamtrechnung des Haushaltsektors in einer Matrix 03/2004
Nr. 44	Thomas Lenk / Heide Köpping	Strategien zur Armutsbekämpfung und –vermeidung in Ostdeutschland: 05/2004
Nr. 45	Wolfgang Bernhardt	Sommernachtsfantasien Corporate Governance im Land der Träume. 07/2004
Nr. 46	Thomas Lenk / Karolina Kaiser	The Premium Model in the German Fiscal Equalization System 12/2004
Nr. 47	Thomas Lenk / Christine Falken	Komparative Analyse ausgewählter Indikatoren des Kommunalwirtschaftlichen Gesamt-ergebnisses 05/2005
Nr. 48	Michael Nowak / Stephan Barth	Immobilienanlagen im Portfolio institutioneller Investoren am Beispiel von Versicherungsunternehmen Auswirkungen auf die Risikosituation 08/2005

Nr. 49	Wolfgang Bernhardt	Familiengesellschaften – Quo Vadis? Vorsicht vor zu viel „Professionalisierung“ und Ver-Fremdung 11/2005
Nr. 50	Christian Milow	Der Griff des Staates nach dem Währungsgold 12/2005
Nr. 51	Anja Eichhorst / Karolina Kaiser	The Institutional Design of Bailouts and Its Role in Hardening Budget Constraints in Federations 03/2006
Nr. 52	Ullrich Heilemann / Nancy Beck	Die Mühen der Ebene – Regionale Wirtschaftsförderung in Leipzig 1991 bis 2004 08/2006
Nr. 53	Gunther Schnabl	Die Grenzen der monetären Integration in Europa 08/2006
Nr. 54	Hermut Kormann	Gibt es so etwas wie typisch mittelständige Strategien? 11/2006
Nr. 55	Wolfgang Bernhardt	(Miss-)Stimmung, Bestimmung und Mitbestimmung Zwischen Juristentag und Biedenkopf-Kommission 11/2006
Nr. 56	Ullrich Heilemann / Annika Blaschzik	Indicators and the German Business Cycle A Multivariate Perspective on Indicators of Ifo, OECD, and ZEW 01/2007
Nr. 57	Ullrich Heilemann	“The Suol of a new Machine” zu den Anfängen des RWI-Konjunkturmodells 12/2006
Nr. 58	Ullrich Heilemann / Roland Schuhr / Annika Blaschzik	Zur Evolution des deutschen Konjunkturzyklus 1958 bis 2004 Ergebnisse einer dynamischen Diskriminanzanalyse 01/2007
Nr. 59	Christine Falken / Mario Schmidt	Kameralistik versus Doppik Zur Informationsfunktion des alten und neuen Rechnungswesens der Kommunen Teil I: Einführende und Erläuternde Betrachtungen zum Systemwechsel im kommunalen Rechnungswesen 01/2007
Nr. 60	Christine Falken / Mario Schmidt	Kameralistik versus Doppik Zur Informationsfunktion des alten und neuen Rechnungswesens der Kommunen Teil II Bewertung der Informationsfunktion im Vergleich 01/2007
Nr. 61	Udo Hielscher	Monti della citta di firenze Innovative Finanzierungen im Zeitalter Der Medici. Wurzeln der modernen Finanzmärkte 03/2007
Nr. 62	Ullrich Heilemann / Stefan Wappler	Sachsen wächst anders Konjunkturelle, sektorale und regionale Bestimmungsgründe der Entwicklung der Bruttowertschöpfung 1992 bis 2006 07/2007
Nr. 63	Adolf Wagner	Regionalökonomik: Konvergierende oder divergierende Regionalentwicklungen 08/2007
Nr. 64	Ullrich Heilemann / Jens Ulrich	Good bye, Professir Phillips? Zum Wandel der Tariflohndeterminanten in der Bundesrepublik 1952 – 2004 08/2007
Nr. 65	Gunther Schnabl / Franziska Schobert	Monetary Policy Operations of Debtor Central Banks in MENA Countries 10/2007
Nr. 66	Andreas Schäfer / Simone Valente	Habit Formation, Dynastic Altruism, and Population Dynamics 11/2007
Nr. 67	Wolfgang Bernhardt	5 Jahre Deutscher Corporate Governance Kodex Eine Erfolgsgeschichte? 01/2008
Nr. 68	Ullrich Heilemann / Jens Ulrich	Viel Lärm um wenig? Zur Empirie von Lohnformeln in der Bundesrepublik 01/2008
Nr. 69	Christian Groth / Karl-Josef Koch / Thomas M. Steger	When economic growth is less than exponential 02/2008
Nr. 70	Andreas Bohne / Linda Kochmann	Ökonomische Umweltbewertung und endogene Entwicklung peripherer Regionen Synthese einer Methodik und einer Theorie 02/2008
Nr. 71	Andreas Bohne / Linda Kochmann / Jan Slavik / Lenka Slaviková	Deutsch-tschechische Bibliographie Studien der kontingenten Bewertung in Mittel- und Osteuropa 06/2008

Nr. 72	Paul Lehmann / Christoph Schröter-Schlaack	Regulating Land Development with Tradable Permits: What Can We Learn from Air Pollution Control? 08/2008
Nr. 73	Ronald McKinnon / Gunther Schnabl	China's Exchange Rate Impasse and the Weak U.S. Dollar 10/2008
Nr. 74	Wolfgang Bernhardt	Managervergütungen in der Finanz- und Wirtschaftskrise Rückkehr zu (guter) Ordnung, (klugem) Maß und (vernünftigem) Ziel? 12/2008
Nr. 75	Moritz Schularick / Thomas M. Steger	Financial Integration, Investment, and Economic Growth: Evidence From Two Eras of Financial Globalization 12/2008
Nr. 76	Gunther Schnabl / Stephan Freitag	An Asymmetry Matrix in Global Current Accounts 01/2009
Nr. 77	Christina Ziegler	Testing Predictive Ability of Business Cycle Indicators for the Euro Area 01/2009
Nr. 78	Thomas Lenk / Oliver Rottmann / Florian F. Woitek	Public Corporate Governance in Public Enterprises Transparency in the Face of Divergent Positions of Interest 02/2009
Nr. 79	Thomas Steger / Lucas Bretschger	Globalization, the Volatility of Intermediate Goods Prices, and Economic Growth 02/2009
Nr. 80	Marcela Munoz Escobar / Robert Holländer	Institutional Sustainability of Payment for Watershed Ecosystem Services. Enabling conditions of institutional arrangement in watersheds 04/2009
Nr. 81	Robert Holländer / WU Chunyou / DUAN Ning	Sustainable Development of Industrial Parks 07/2009
Nr. 82	Georg Quaas	Realgrößen und Preisindizes im alten und im neuen VGR-System 10/2009
Nr. 83	Ullrich Heilemann / Hagen Findeis	Empirical Determination of Aggregate Demand and Supply Curves: The Example of the RWI Business Cycle Model 12/2009
Nr. 84	Gunther Schnabl / Andreas Hoffmann	The Theory of Optimum Currency Areas and Growth in Emerging Markets 03/2010
Nr. 85	Georg Quaas	Does the macroeconomic policy of the global economy's leader cause the worldwide asymmetry in current accounts? 03/2010
Nr. 86	Volker Grossmann / Thomas M. Steger / Timo Trimborn	Quantifying Optimal Growth Policy 06/2010
Nr. 87	Wolfgang Bernhardt	Corporate Governance Kodex für Familienunternehmen? Eine Widerrede 06/2010
Nr. 88	Philipp Mandel / Bernd Süßmuth	A Re-Examination of the Role of Gender in Determining Digital Piracy Behavior 07/2010
Nr. 89	Philipp Mandel / Bernd Süßmuth	Size Matters. The Relevance and Hicksian Surplus of Agreeable College Class Size 07/2010
Nr. 90	Thomas Kohstall / Bernd Süßmuth	Cyclic Dynamics of Prevention Spending and Occupational Injuries in Germany: 1886-2009 07/2010
Nr. 91	Martina Padmanabhan	Gender and Institutional Analysis. A Feminist Approach to Economic and Social Norms 08/2010
Nr. 92	Gunther Schnabl / Ansgar Belke	Finanzkrise, globale Liquidität und makroökonomischer Exit 09/2010
Nr. 93	Ullrich Heilemann / Roland Schuhr / Heinz Josef Münch	A "perfect storm"? The present crisis and German crisis patterns 12/2010
Nr. 94	Gunther Schnabl / Holger Zemanek	Die Deutsche Wiedervereinigung und die europäische Schuldenkrise im Lichte der Theorie optimaler Währungsräume 06/2011
Nr. 95	Andreas Hoffmann / Gunther Schnabl	Symmetrische Regeln und asymmetrisches Handeln in der Geld- und Finanzpolitik 07/2011
Nr. 96	Andreas Schäfer / Maik T. Schneider	Endogenous Enforcement of Intellectual Property, North-South Trade, and Growth 08/2011
Nr. 97	Volker Grossmann / Thomas M. Steger / Timo Trimborn	Dynamically Optimal R&D Subsidization 08/2011

Nr. 98	Erik Gawel	Political drivers of and barriers to Public-Private Partnerships: The role of political involvement 09/2011
Nr. 99	André Casajus	Collusion, symmetry, and the Banzhaf value 09/2011
Nr. 100	Frank Hüttner / Marco Sunder	Decomposing R^2 with the Owen value 10/2011
Nr. 101	Volker Grossmann / Thomas M. Steger / Timo Trimborn	The Macroeconomics of TANSTAAFL 11/2011
Nr. 102	Andreas Hoffmann	Determinants of Carry Trades in Central and Eastern Europe 11/2011
Nr. 103	Andreas Hoffmann	Did the Fed and ECB react asymmetrically with respect to asset market developments? 01/2012
Nr. 104	Christina Ziegler	Monetary Policy under Alternative Exchange Rate Regimes in Central and Eastern Europe 02/2012
Nr. 105	José Abad / Axel Löffler / Gunther Schnabl / Holger Zemanek	Fiscal Divergence, Current Account and TARGET2 Imbalances in the EMU 03/2012
Nr. 106	Georg Quaas / Robert Köster	Ein Modell für die Wirtschaftszweige der deutschen Volkswirtschaft: Das "MOGBOT" (Model of Germany's Branches of Trade)
Nr. 107	Andreas Schäfer / Thomas Steger	Journey into the Unknown? Economic Consequences of Factor Market Integration under Increasing Returns to Scale 04/2012
Nr. 108	Andreas Hoffmann / Björn Urbansky	Order, Displacements and Recurring Financial Crises 06/2012
Nr. 109	Finn Marten Körner / Holger Zemanek	On the Brink? Intra-euro area imbalances and the sustainability of foreign debt 07/2012
Nr. 110	André Casajus / Frank Hüttner	Nullifying vs. dummifying players or nullified vs. dummified players: The difference between the equal division value and the equal surplus division value 07/2012
Nr. 111	André Casajus	Solidarity and fair taxation in TU games 07/2012
Nr. 112	Georg Quaas	Ein Nelson-Winter-Modell der deutschen Volkswirtschaft 08/2012
Nr. 113	André Casajus / Frank Hüttner	Null players, solidarity, and the egalitarian Shapley values 08/2012
Nr. 114	André Casajus	The Shapley value without efficiency and additivity 11/2012
Nr. 115	Erik Gawel	Neuordnung der W-Besoldung: Ausgestaltung und verfassungsrechtliche Probleme der Konsumtionsregeln zur Anrechnung von Leistungsbezügen 02/2013
Nr. 116	Volker Grossmann / Andreas Schäfer / Thomas M. Steger	Migration, Capital Formation, and House Prices 02/2013
Nr. 117	Volker Grossmann / Thomas M. Steger	Optimal Growth Policy: the Role of Skill Heterogeneity 03/2013
Nr. 118	Guido Heineck / Bernd Süßmuth	A Different Look at Lenin's Legacy: Social Capital and Risk Taking in the Two Germanies 03/2013
Nr. 119	Andreas Hoffmann	The Euro as a Proxy for the Classical Gold Standard? Government Debt Financing and Political Commitment in Historical Perspective 05/2013
Nr. 120	Andreas Hoffmann / Axel Loeffler	Low Interest Rate Policy and the Use of Reserve Requirements in Emerging Markets 05/2013
Nr. 121	Gunther Schnabl	The Global Move into the Zero Interest Rate and High Debt Trap 07/2013
Nr. 122	Axel Loeffler / Gunther Schnabl / Franziska Schobert	Limits of Monetary Policy Autonomy and Exchange Rate Flexibility by East Asian Central Banks 08/2013
Nr. 123	Burkhard Heer / Bernd Süßmuth	Tax Bracket Creep and its Effects on Income Distribution 08/2013
Nr. 124	Hans Fricke / Bernd Süßmuth	Growth and Volatility of Tax Revenues in Latin America 08/2013
Nr. 125	Ulrich Volz	RMB Internationalisation and Currency Co-operation in East Asia 09/2013

Nr. 126	André Casajus / Helfried Labrenz	A property rights based consolidation approach 02/2014
Nr. 127	Pablo Duarte	The Relationship between GDP and the Size of the Informal Economy: Empirical Evidence for Spain 02/2014
Nr. 128	Erik Gawel	Neuordnung der Professorenbesoldung in Sachsen 03/2014
Nr. 129	Friedrun Quaas	Orthodoxer Mainstream und Heterodoxe Alternativen Eine Analyse der ökonomischen Wissenschaftslandschaft 04/2014
Nr. 130	Gene Callahan / Andreas Hoffmann	The Idea of a Social Cycle 05/2014
Nr. 131	Karl Trela	Klimaanpassung als wirtschaftspolitisches Handlungsfeld 06/2014
Nr. 132	Erik Gawel / Miquel Aguado	Neuregelungen der W-Besoldung auf dem verfassungsrechtlichen Prüfstand 08/2014
Nr. 133	Ulf Papenfuß / Matthias Redlich / Lars Steinhauer	Forschend und engagiert lernen im Public Management: Befunde und Gestaltungsanregungen eines Service Learning Lehrforschungsprojektes 10/2014
Nr. 134	Karl Trela	Political climate adaptation decisions in Germany - shortcomings and applications for decision support systems 11/2014
Nr. 135	Ulf Papenfuß / Lars Steinhauer / Benjamin Friedländer	Beteiligungsberichterstattung der öffentlichen Hand im 13-Länder-Vergleich: Erfordernisse für mehr Transparenz über die Governance und Performance öffentlicher Unternehmen 02/2015
Nr. 136	Gunther Schnabl	Japans Lehren für das Schweizer Wechselkursdilemma 02/2015
Nr. 137	Ulf Papenfuß / Christian Schmidt	Determinants of Manager Pay in German State-Owned Enterprises and International Public Policy Implications: 3-Year Study for Sectors, Performance and Gender 02/2015
Nr. 138	Philipp Mandel / Bernd Süßmuth	Public education, accountability, and yardstick competition in a federal system 05/2015
Nr. 139	Gunther Schnabl	Wege zu einer stabilitäts- und wachstumsorientierten Geldpolitik aus österreichischer Perspektive 06/2015
Nr. 140	Ulf Papenfuß / Matthias Redlich / Lars Steinhauer / Benjamin Friedländer	Forschend und engagiert lernen im Public Management: Befunde und Gestaltungsanregungen eines Service Learning Lehrforschungsprojektes – 2. aktualisierte Auflage 08/2015
Nr. 141	Friedrun Quaas / Georg Quaas	Hayeks Überinvestitionstheorie 10/2015
Nr. 142	Bastian Gawellek / Marco Sunder	The German Excellence Initiative and Efficiency Change among Universities, 2001-2011 01/2016
Nr. 143	Benjamin Larin	Bubble-Driven Business Cycles 02/2016
Nr. 144	Friedrun Quaas / Georg Quaas	Effekte des Kapitalmarktzins auf die Preis- und Produktivitätsentwicklung Eine Analyse der deutschen Volkswirtschaft 1970-2014 02/2016
Nr. 145	Thomas Lenk / Matthias Redlich / Philipp Glinka	Nachhaltige Stadtfinanzen - Akzeptanzsteigerung der bürgerschaftlichen Beteiligung an der Haushaltsplanung 02/2016
Nr. 146	Michael von Prollius / Gunther Schnabl	Geldpolitik, Arabellion, Flüchtlingskrise 10/2016
Nr. 147	David Leuwer / Bernd Süßmuth	The Exchange Rate Susceptibility of European Core Industries, 1995-2010 05/2017