



Fiscal structural reforms: The effect of card payments on VAT revenue in the Euro Area

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Disclaimer: The views expressed are those of the authors and should not be interpreted as those of their respective institutions

Presentation plan



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- 1. Motivation**
- 2. Preliminary analysis**
 - Data and definition of main concepts
 - Insights from a basic model
- 3. Main empirical analysis**
 - Two-step approach
 - Step 1 and main findings
 - Step 2 and main findings
- 4. Robustness**
 - The role of self-employment
- 5. Conclusions**
 - Policy proposal

1. Motivation (1/2)



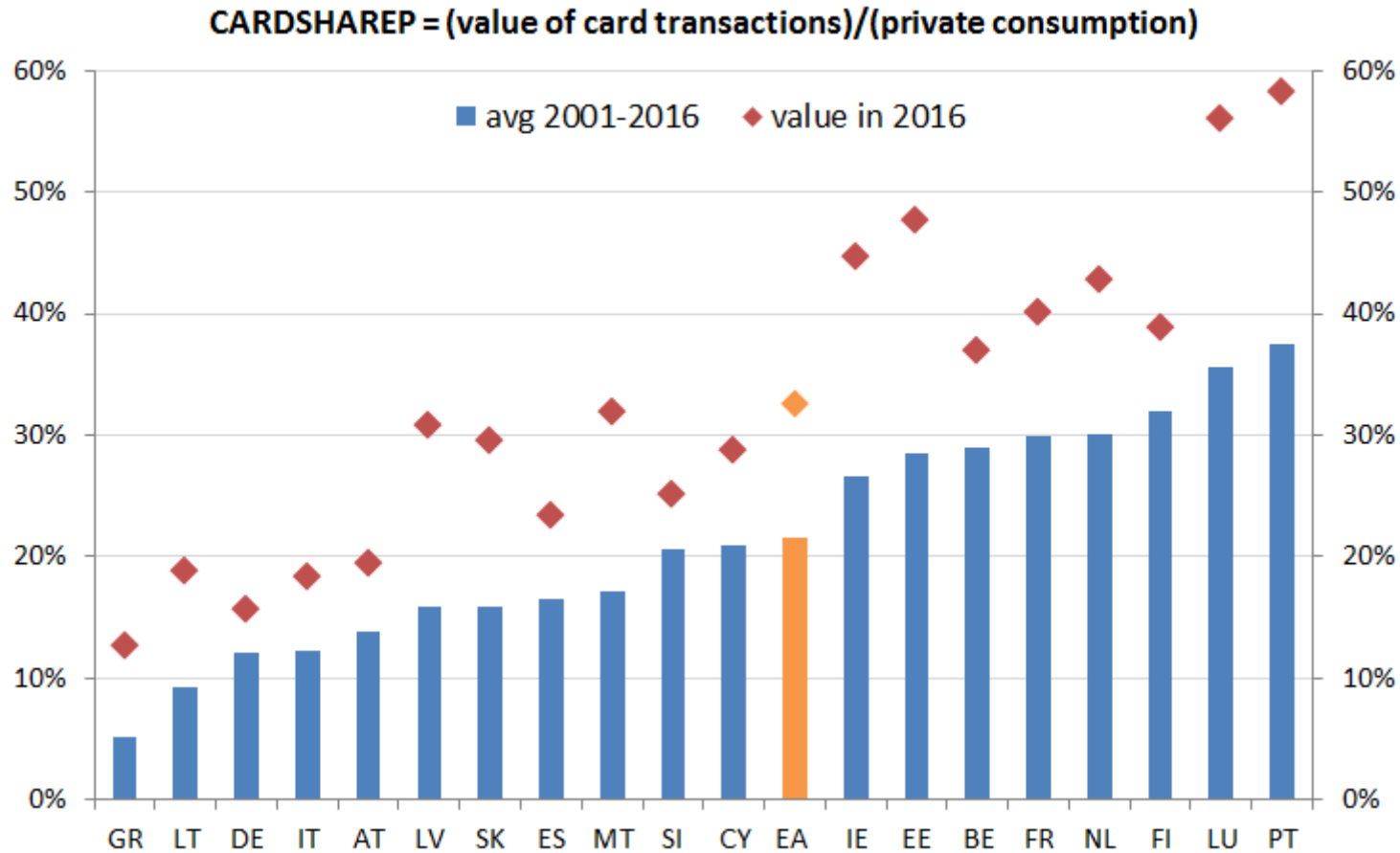
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“The implementation of structural reforms needs to be substantially stepped up”

(Mario Draghi, Introductory statement, 7/9/2017)

- Absorbing cyclical fluctuations in euro area member states relies crucially on the capacity to accumulate fiscal buffers during economic good times.
- Fiscal structural reforms that improve the efficiency of tax collection can increase the capacity of governments to accumulate fiscal buffers.
- Curtailing tax-evasion and improving compliance is not only an issue of enforcement, but is related also to payment preferences.

Card use in the Euro Area



Source: ECB Payment Statistics and Eurostat National Accounts ESA 2010.

1. Motivation (2/2)



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“[...] there is a significant body of evidence that a large percentage of currency in most countries, generally well over 50%, is used precisely to hide transactions.” Rogoff (2014)

- **The use of traceable, non-cash payments can be expected to increase the perceived probability of detection, leading to greater tax compliance.**
- **Card payments remain the dominant alternative to cash in the euro area, as far as retail purchases are concerned.**
 - ≈ 85% of the value of non-cash purchases in 2016 (Esselink and Hernández, 2017)
- **However, the anticipated positive effect of card payments on VAT revenue performance has eluded empirical confirmation.**
 - While cash transactions undermine revenue performance, card payments are not found to have a significantly positive influence (Madzharova, 2014).
- **The recent experience of Greece has revealed a positive effect of card payments on VAT tax compliance.**
 - a 1pp increase in the share of card payments in private consumption results in 1% higher revenue through increased compliance (Hondroyiannis and Papaoikonomou, 2017).

2. Preliminary analysis

Data and definition of main concepts



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- What might explain the lack of evidence for the anticipated positive relation between revenue efficiency and card payments?

Main concepts

$$\text{Efficiency} = (\text{VAT}) / (\text{BASE} * \text{RATE})$$

$$\text{CARDSHAREP} = (\text{card payments}) / (\text{private consumption})$$

Data

Quarterly series on the 19 EA economies (common sample 2002q1-2016q4)

VAT = VAT revenue

BASE (2 definitions):

- post-tax concept = (Private consumption) + (Government intermediate consumption)
- pre-tax concept = (post-tax concept) – (VAT)

RATE = standard VAT rate

card payments = value of payments with credit/debit cards

2. Preliminary analysis

Efficiency $\neq f(\text{Card payments})$?



Dependent Variable: DLOG(EFFICIENCY,0,4)

Method: Panel Least Squares

Sample: 2001Q1 2016Q4

Cross-sections included: 19

Cross-section dummy variables

Period dummy variables

Variable	Coefficient	t-Statistic	Prob.
C	-0.001816	-0.531169	0.5954
DLOG(CARDSHAREP,0,4)	-0.012785	-0.289507	0.7722
DLOG(CARDSHAREP,0,4)^2	0.041092	0.585352	0.5584
Adjusted R-squared	0.111586		

- The empirical literature on VAT performance typically defines some measure of efficiency as the dependent variable and explores the effects of various independent variables.
- Simple OLS regression indicates no significant positive effect of CARDSHAREP on EFFICIENCY.
- This is in line with the general findings reported in the literature (Madzharova, 2014)

Question: What might be driving this result?

- Distinguish between the effect of the numerator (VAT) and the denominator (BASE*RATE)



2. Preliminary analysis – VAR

2-equation panel VAR for the 19 Euro Area economies with cross-section i given by:

$$\Delta_4 \mathbf{y}_{i,t} = \mathbf{a}_{0i} + \Gamma(L) \Delta_4 \mathbf{y}_{i,t} + \mathbf{A}(L) \Delta_4 \mathbf{x}_{i,t} + \mathbf{e}_{i,t} \quad (1)$$

, where Δ_4 denotes year-on-year difference (i.e. $\Delta_4 \mathbf{z}_t = \mathbf{z}_t - \mathbf{z}_{t-4}$)

$$\mathbf{y}_{i,t} = [\ln(VAT_{i,t}), \ln(BASE_{i,t})]'$$

$$\mathbf{x}_{i,t} = [\ln(RATE_{i,t}), \ln(RATE_{i,t})^2, \ln(CARDSHAREP_{i,t})]'$$

$$\Gamma(L) = \Gamma_1 L + \Gamma_2 L^2 + \dots + \Gamma_p L^p$$

$$\mathbf{A}(L) = \mathbf{A}_0 + \mathbf{A}_1 L^1 + \dots + \mathbf{A}_p L^p$$

and \mathbf{a}_{0i} is a cross-section fixed effect.

Estimation period: 2003q1-2016q4

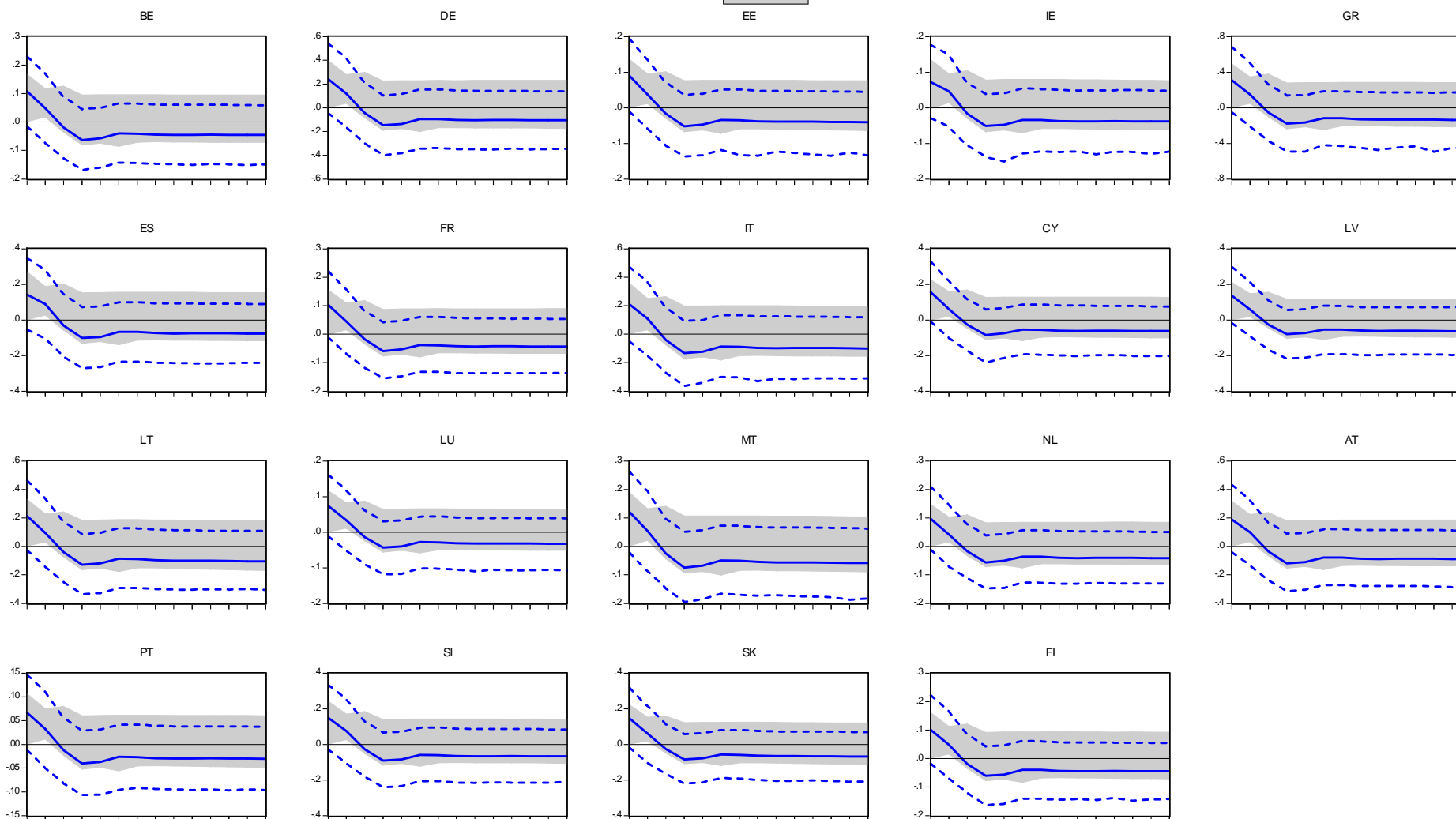
Exogenous $CARDSHAREP$ => driven by exogenous factors, such as preferences, technology penetration and/or administrative restrictions to cash withdrawals (e.g. Greece since 15q3).



2. Preliminary analysis - VAR

Response of EFFICIENCY to +1pp CARDSHAREP

--- 68% (baseline) — baseline ■ range across different specifications

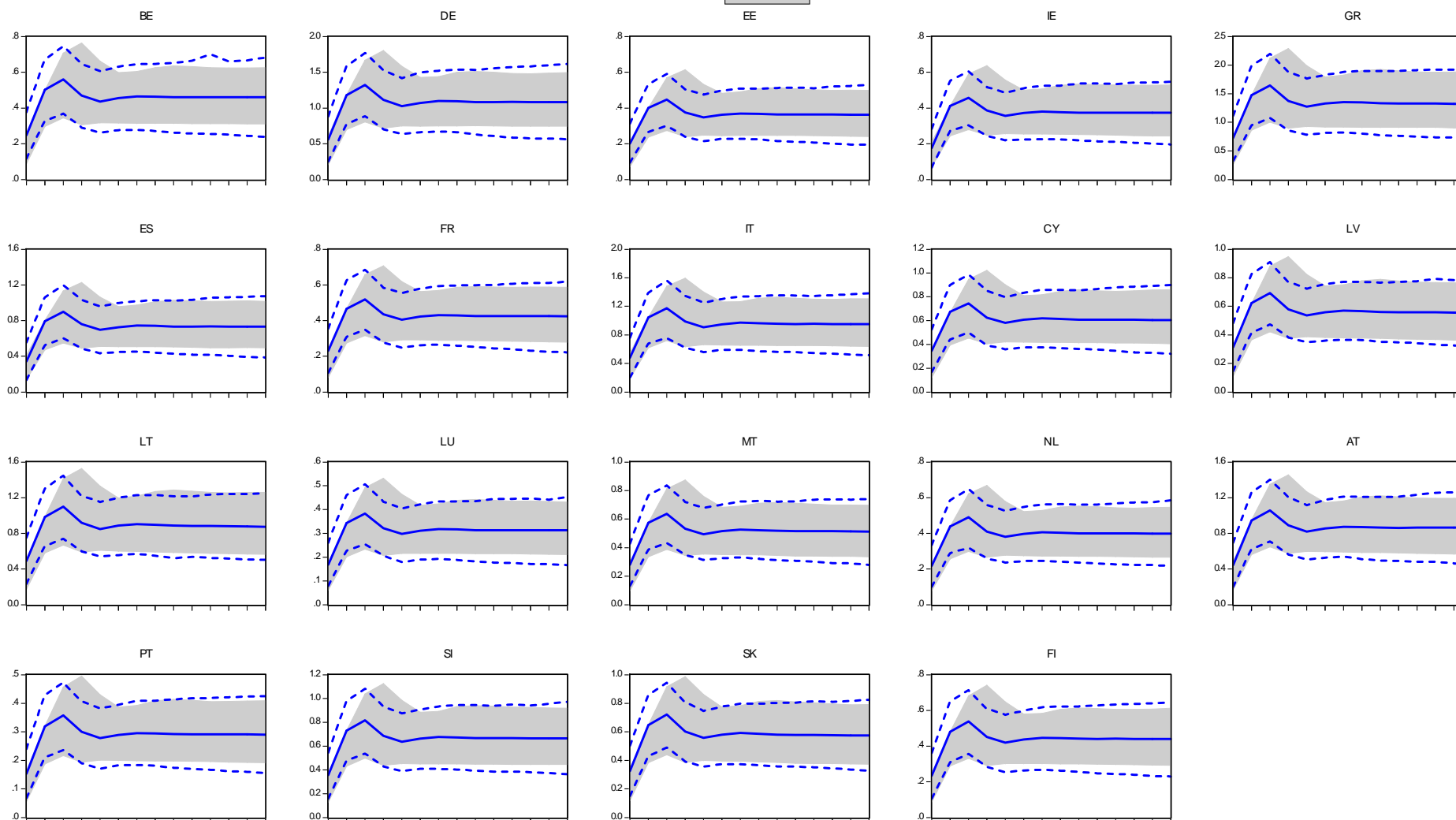




2. Preliminary analysis - VAR

Response of VAT to +1pp CARDSHAREP

--- 68% (baseline) — baseline ■ range across different specifications

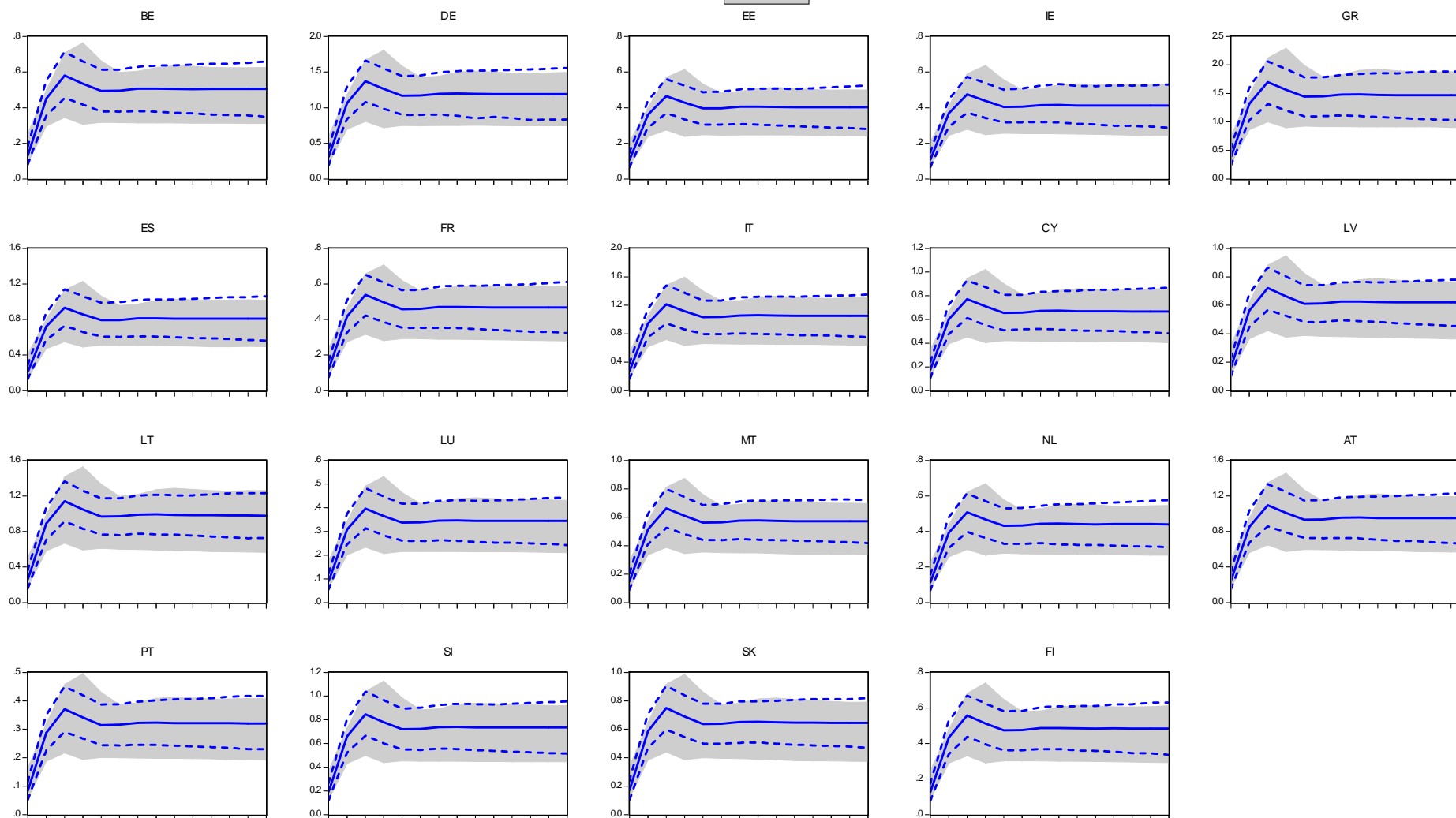




2. Preliminary analysis - VAR

Response of BASE to +1pp CARDSHAREP

--- 68% (baseline) — baseline ■ range across different specifications



2. Preliminary analysis

Insights and way forward



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- While CARDSHAREP increases VAT, it also causes BASE to rise, eventually eliminating any increases in EFFICIENCY.
- The positive influence of card use on the tax base reflects the strong positive correlation between these variables in our sample.
 - This could arise, for example, if the technological advances facilitating card use also have positive macroeconomic effects.
 - Naïve model for BASE is unable to isolate the ‘compliance effect’ of CARDSHAREP.
- Need to identify the effect of card use on compliance.



3. Main empirical analysis

Two-step approach

The effect of card use on revenue efficiency is studied using a two-step procedure.

- **Step 1:** A Time-Varying Coefficients (TVC) model is used in order to obtain a measure of compliance as a function of card payments.

- **Step 2:**
 - The estimate of compliance from step 1 is included as an exogenous regressor in a VAR model.
 - Obtain the dynamic responses of the endogenous variables to an increase in card use, where the latter is propagated through the TVC measure of compliance.



3. Main empirical analysis

Step 1: TVC model

Adaptation of the Time-Varying Coefficients (TVC) model in Hondroyiannis and Papaoikonomou (2017) as a panel for the 19 EA economies with cross-section i given by:

$$\Delta_4 \ln(VAT_{i,t}) = b_{0i,t} + b_{1i,t} \Delta_4 \ln(RATE_{i,t}) + b_{2i,t} \Delta_4 \ln(BASE_{i,t}) \quad (2)$$

, where Δ_4 denotes year-on-year difference (i.e. $\Delta_4 x_t = x_t - x_{t-4}$) and $b_{ji,t}, j = 0, 1, 2$ are continuously time-varying parameters.

$b_{0i,t}$ captures all influences on VAT revenue other than through the tax rate and the tax base and may therefore be interpreted as a proxy for *tax compliance*. It is estimated as a function of CARDSHAREP:

$$b_{0i,t} = c_0 + c_1 \Delta_4 \ln(CARDSHAREP_{i,t}) + c_2 \Delta_4 \ln(CARDSHAREP_{i,t})^2 + e_{i,t} \quad (3)$$

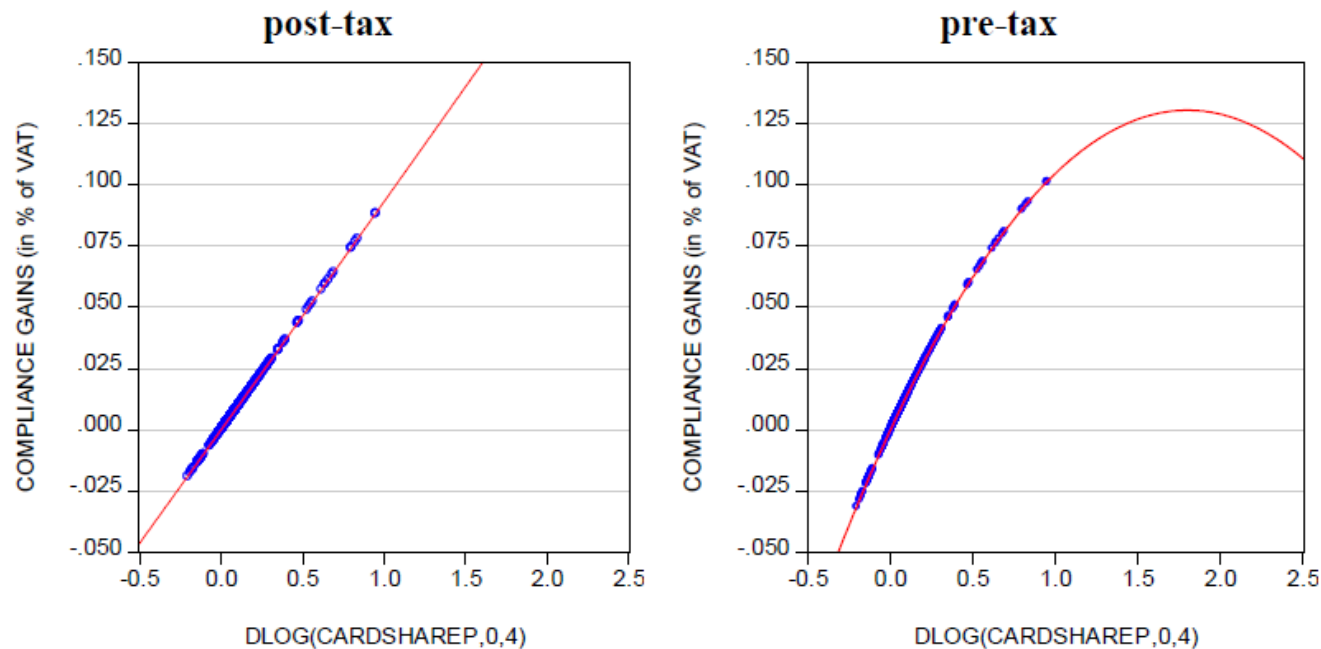
, where c_0, c_1, c_2 are estimated, time-invariant coefficients, common across cross-sections and $e_{i,t} \sim N(0, \sigma_i^2)$, assuming $E(e_{i,t} e'_{j,t}) = 0$, for $i \neq j$.

$b_{1i,t}$ and $b_{2i,t}$ are modelled as driftless random walks:

$$\begin{aligned} b_{1i,t} &= b_{1i,t-1} + e_{i,t} \\ b_{2i,t} &= b_{2i,t-1} + e_{i,t} \end{aligned}$$

3. Main empirical analysis

Step 1: TVC model – Compliance and card use



Dependent variable: $b_{0i,t}$

Sample: 2003q1-2016q4; Periods: 56; Cross-sections: 19

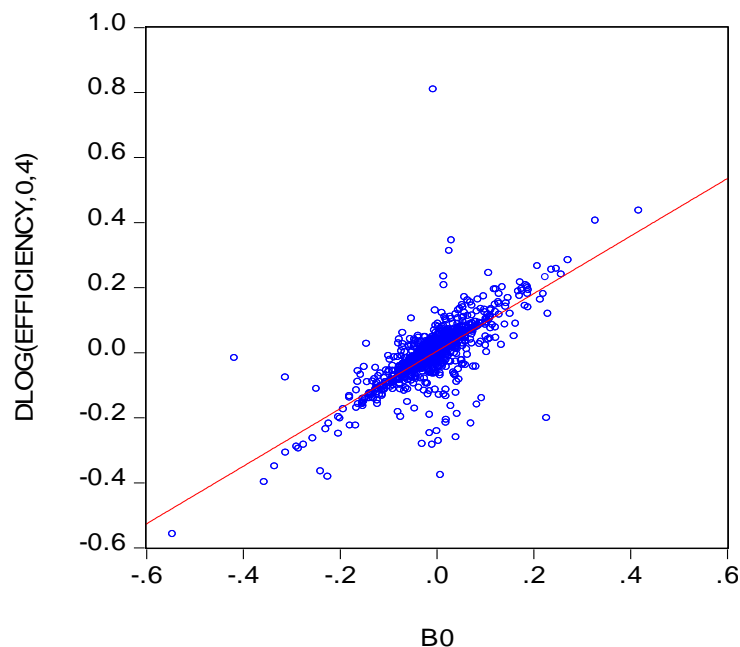
	post-tax	pre-tax
$\Delta_4 \ln(CARDSHAREP_{i,t})$	0.09* [1.67]	0.15** [2.41]
$\Delta_4 \ln(CARDSHAREP_{i,t})^2$	0.0005 [0.004]	-0.04 [-0.31]

Notes: z-statistic in square brackets. “*” and “**” denote significance at the 10% and 5% levels, respectively. The post-tax definition of the tax base is given by the sum of private consumption and government intermediate consumption. The pre-tax definition subtracts VAT revenue from the post-tax measure.



3. Main empirical analysis

Step 1: TVC model – Compliance and efficiency



Dependent Variable: DLOG(EFFICIENCY,0,4)

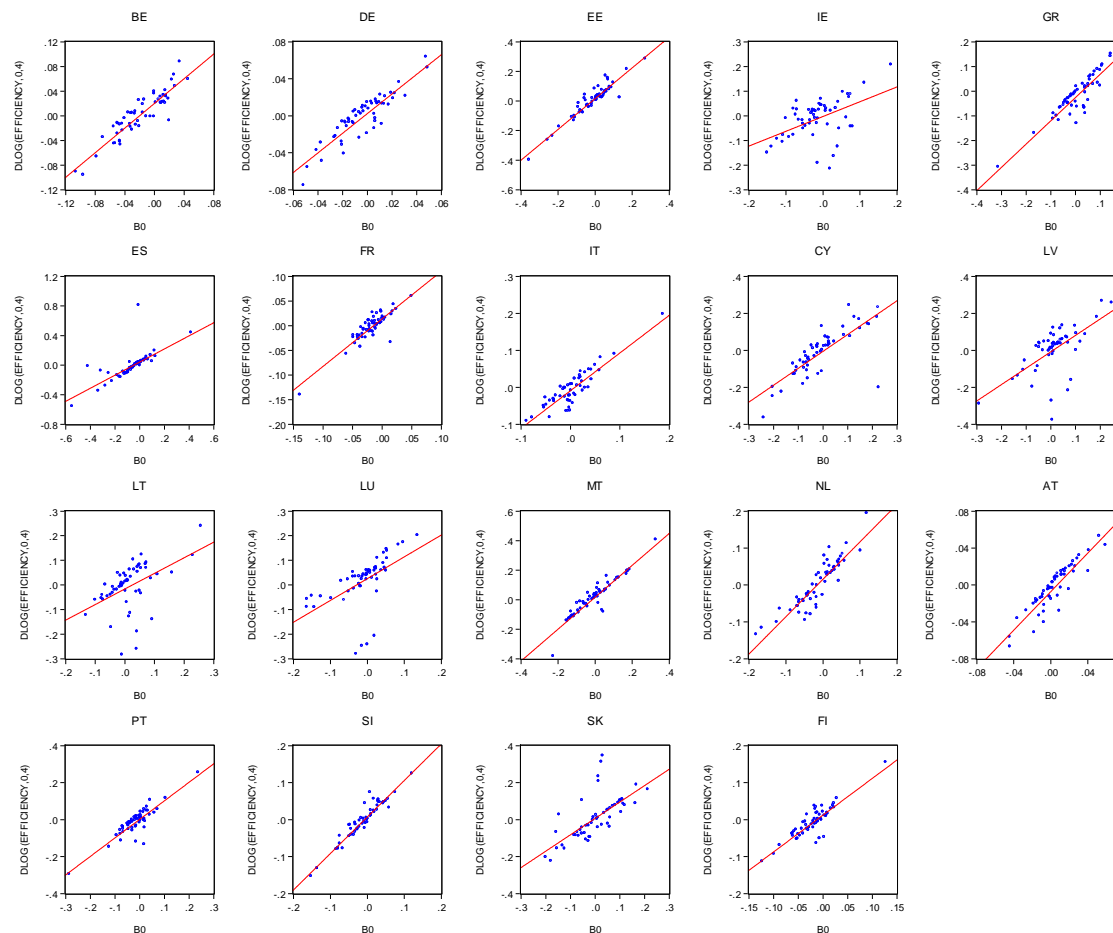
Method: Panel Least Squares

Sample (adjusted): 2003Q1 2016Q4

Cross-sections included: 19

Cross-section fixed (dummy variables)

Period fixed (dummy variables)



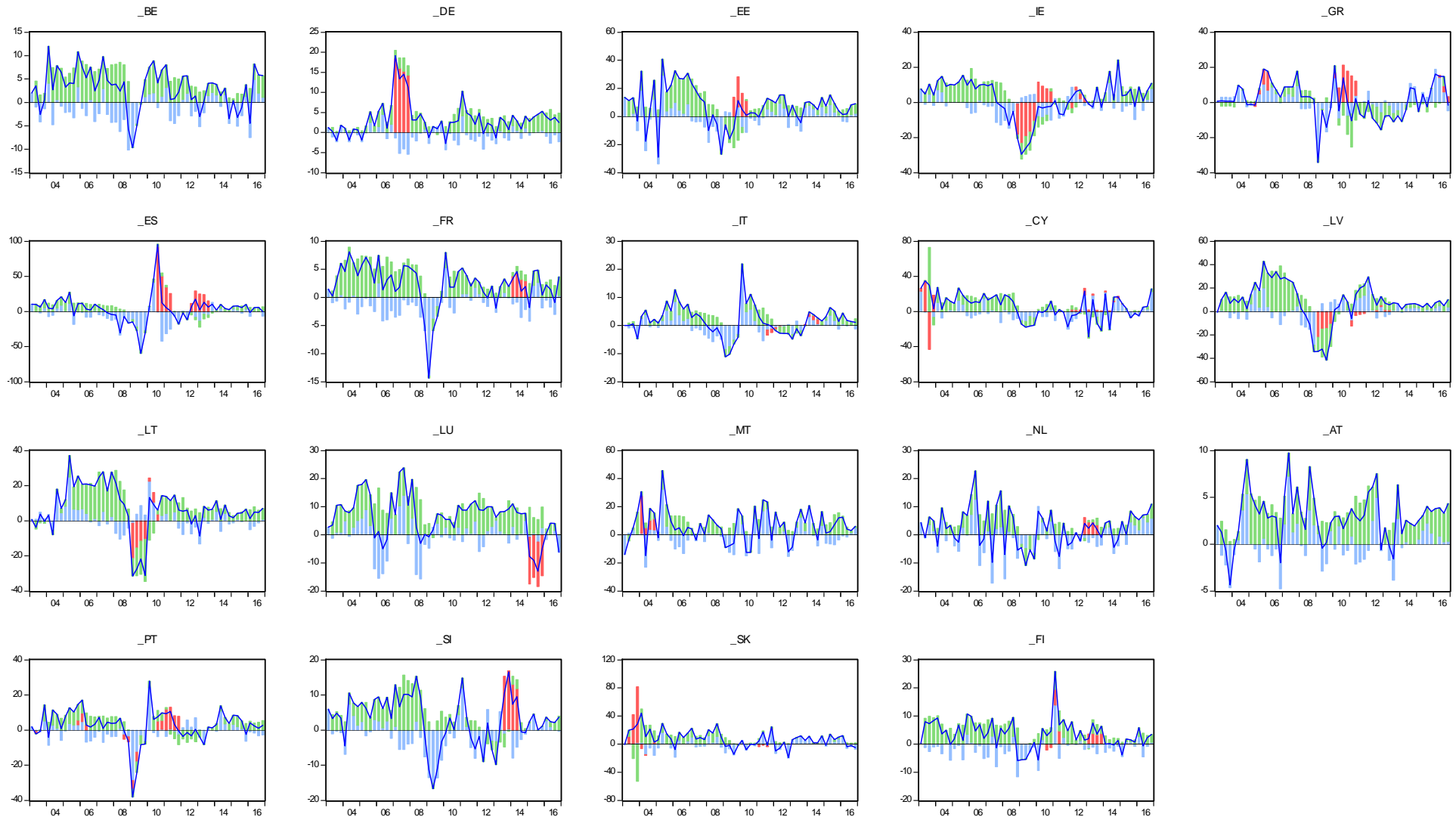
Variable	Coefficient	t-Statistic	Prob.
C	0.004760	2.779090	0.0056
B0	0.885945	35.27674	0.0000
Adjusted R-squared		0.611654	

3. Main empirical analysis

Step 1: TVC model – Decomposition of VAT growth



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3. Main empirical analysis

Step 2: VAR model

The preliminary VAR model is reformulated by:

- replacing $\Delta_4 \ln(CARDSHAREP_{i,t})$ with $\widehat{b_{0i,t}}$ as exogenous regressor:

$$\Delta_4 \mathbf{y}_{i,t} = \mathbf{a}_{0i} + \Gamma(L) \Delta_4 \mathbf{y}_{i,t} + A(L) \Delta_4 \mathbf{x}_{i,t} + \mathbf{B}(L) \widehat{b_{0i,t}} + \mathbf{e}_{i,t} \quad (4)$$

- allowing CARDSHAREP to influence the endogenous variables through its estimated effect on $\widehat{b_{0i,t}}$ obtained from the TVC model:

$$\widehat{b_{0i,t}} = \widehat{c}_0 + \widehat{c}_1 \Delta_4 \ln(CARDSHAREP_{i,t}) + \widehat{c}_2 \Delta_4 \ln(CARDSHAREP_{i,t})^2 + \widehat{e}_{i,t} \quad (5)$$

$$\mathbf{y}_{i,t} = [\ln(VAT_{i,t}), \ln(BASE_{i,t})]'$$

$$\mathbf{x}_{i,t} = [\ln(RATE_{i,t}), \ln(RATE_{i,t})^2, \ln(CARDSHAREP_{i,t})]'$$

$$\Gamma(L) = \Gamma_1 L + \Gamma_2 L^2 + \dots + \Gamma_p L^p$$

$$A(L) = A_0 + A_1 L^1 + \dots + A_p L^p$$

$$\mathbf{B}(L) = B_0 + B_1 L^1 + \dots + B_p L^p$$

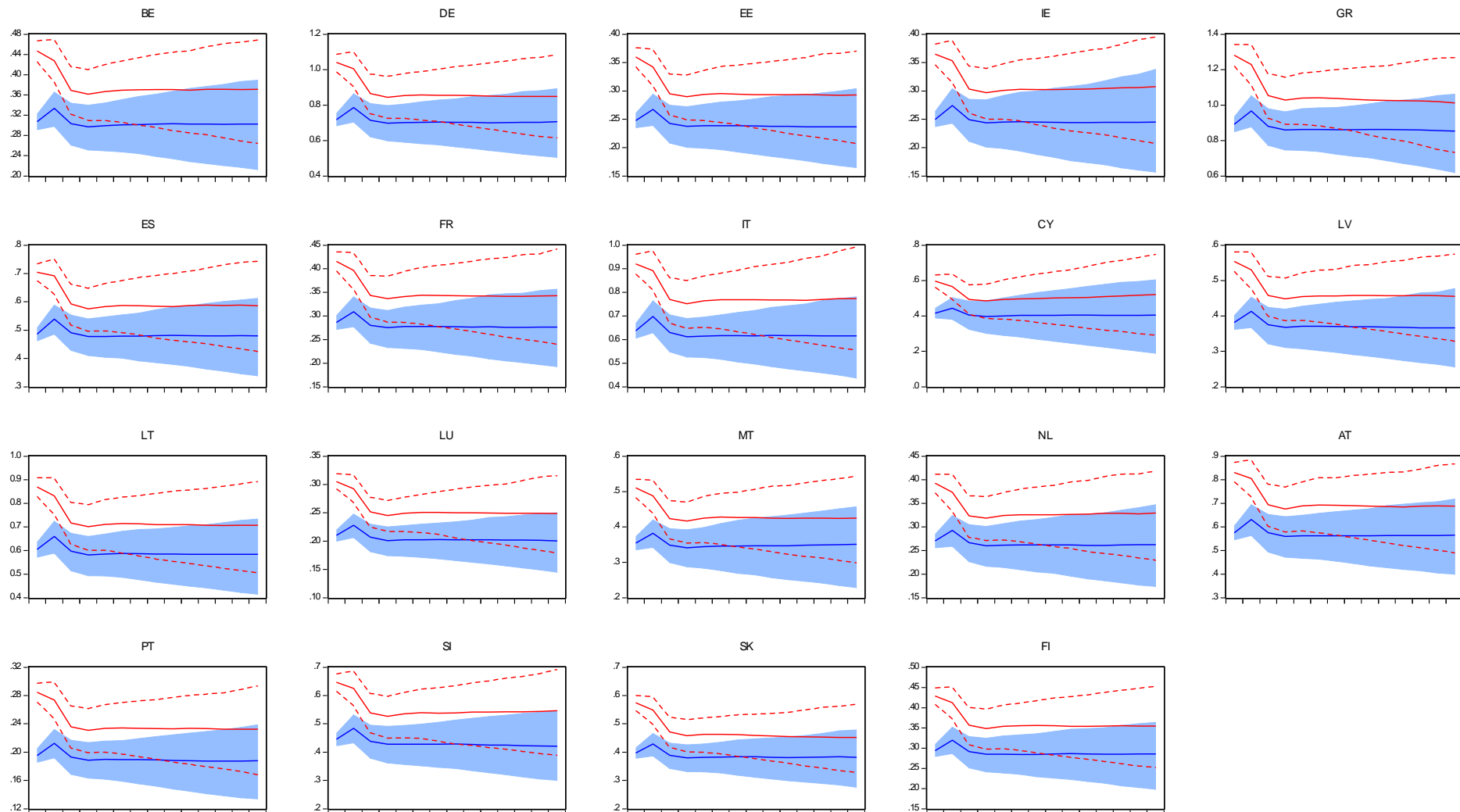
and \mathbf{a}_{0i} is a cross-section fixed effect.

3. Main empirical analysis – Step 2

Response of EFFICIENCY to +1pp in CARDSHAREP



— response (post-tax) - - - 68% — response (pre-tax) ■ 68%

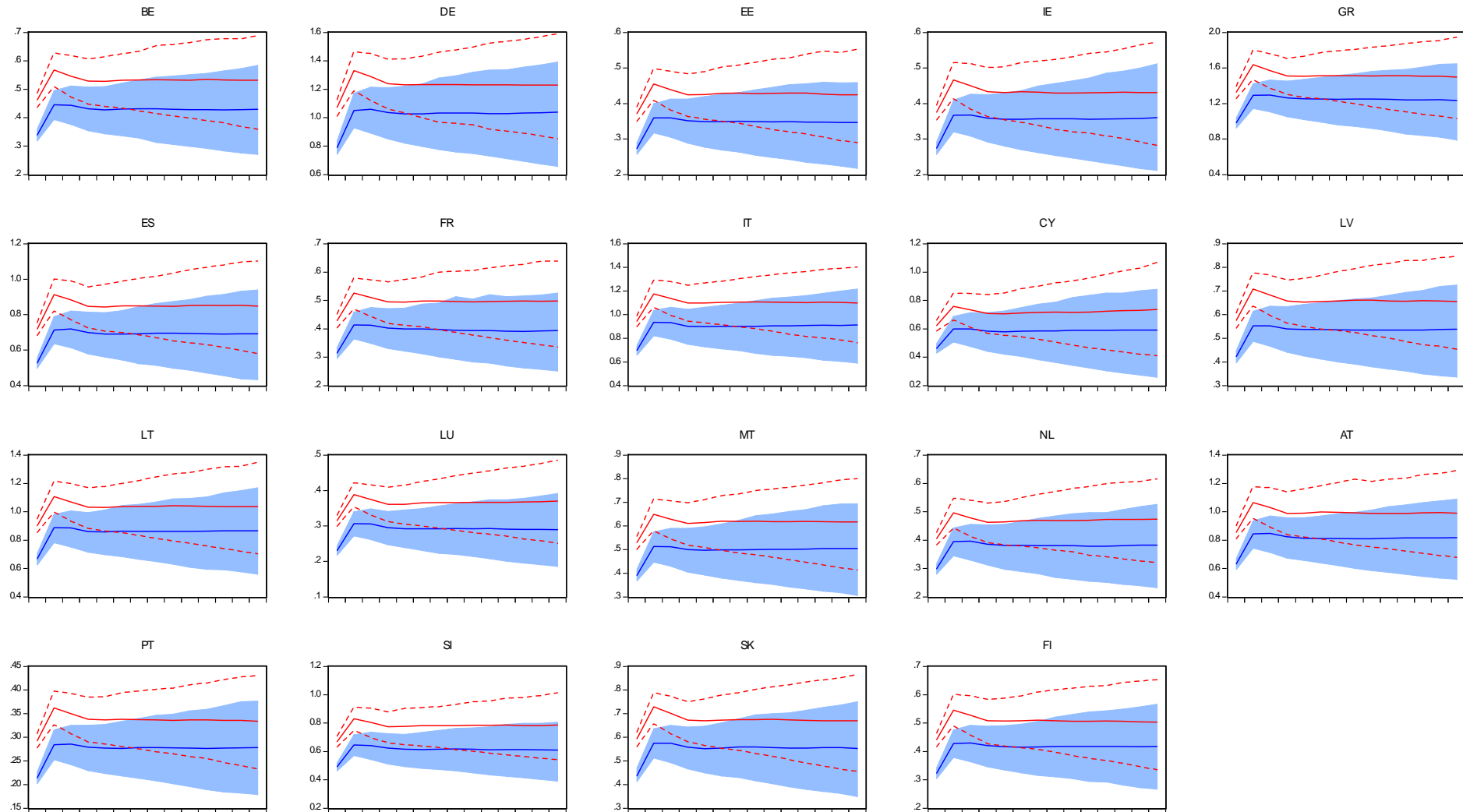


3. Main empirical analysis – Step 2

Response of VAT to +1pp in CARDSHAREP

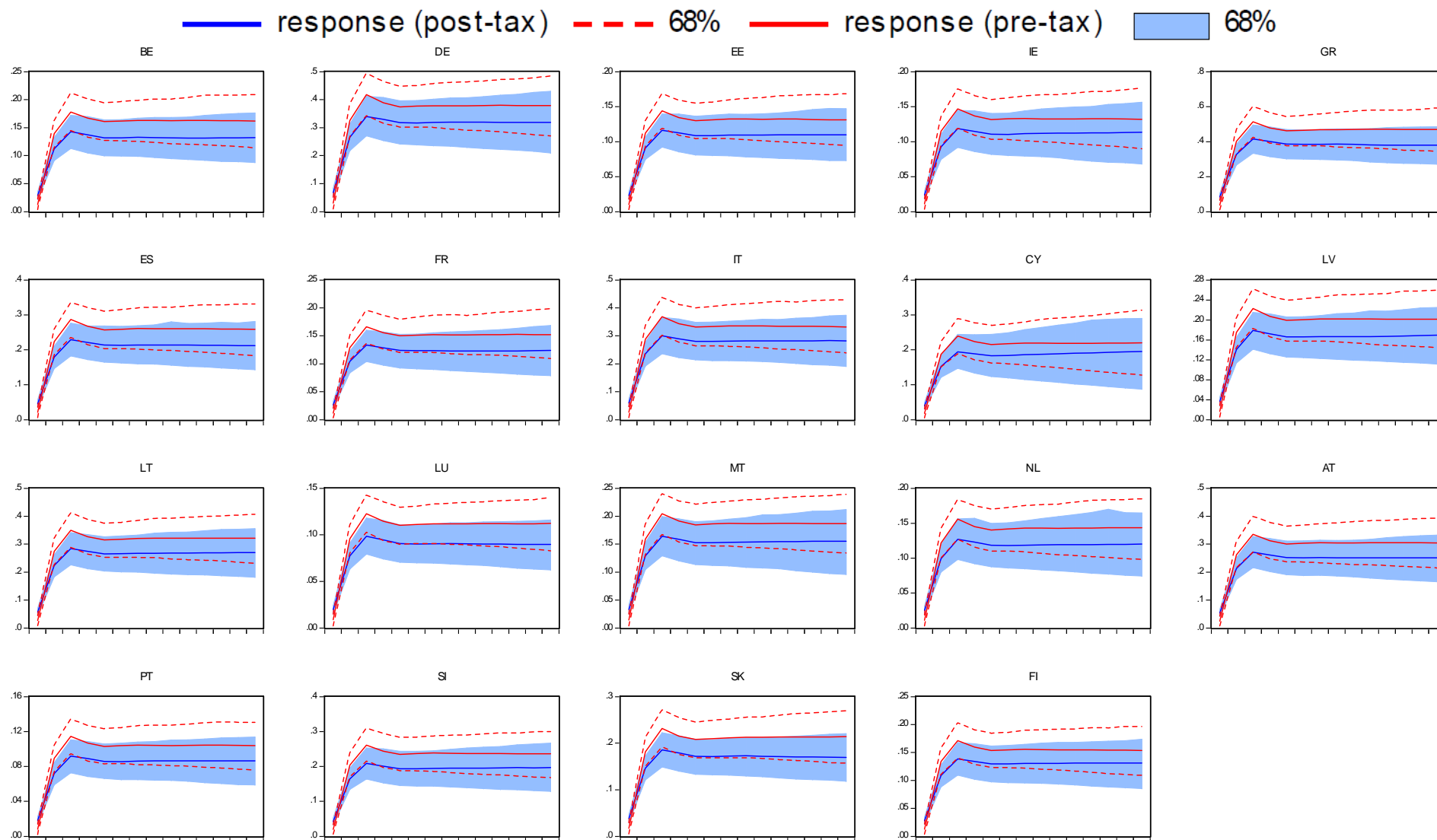


— response (post-tax) - - - 68% — response (pre-tax) ■ 68%



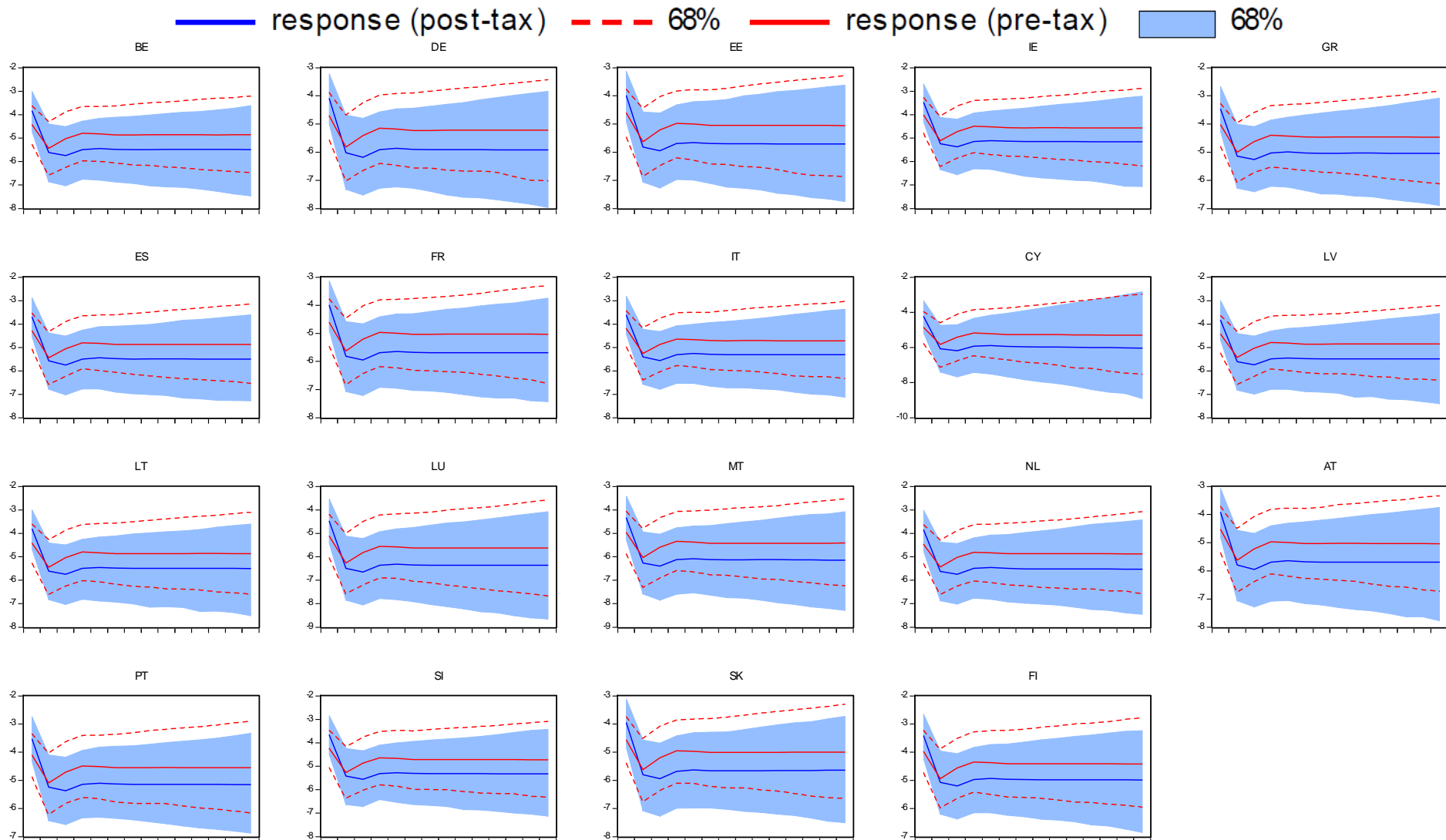
3. Main empirical analysis – Step 2

Response of BASE to +1pp in CARDSHAREP



3. Main empirical analysis – Step 2

Response of EFFICIENCY to +1pp in RATE

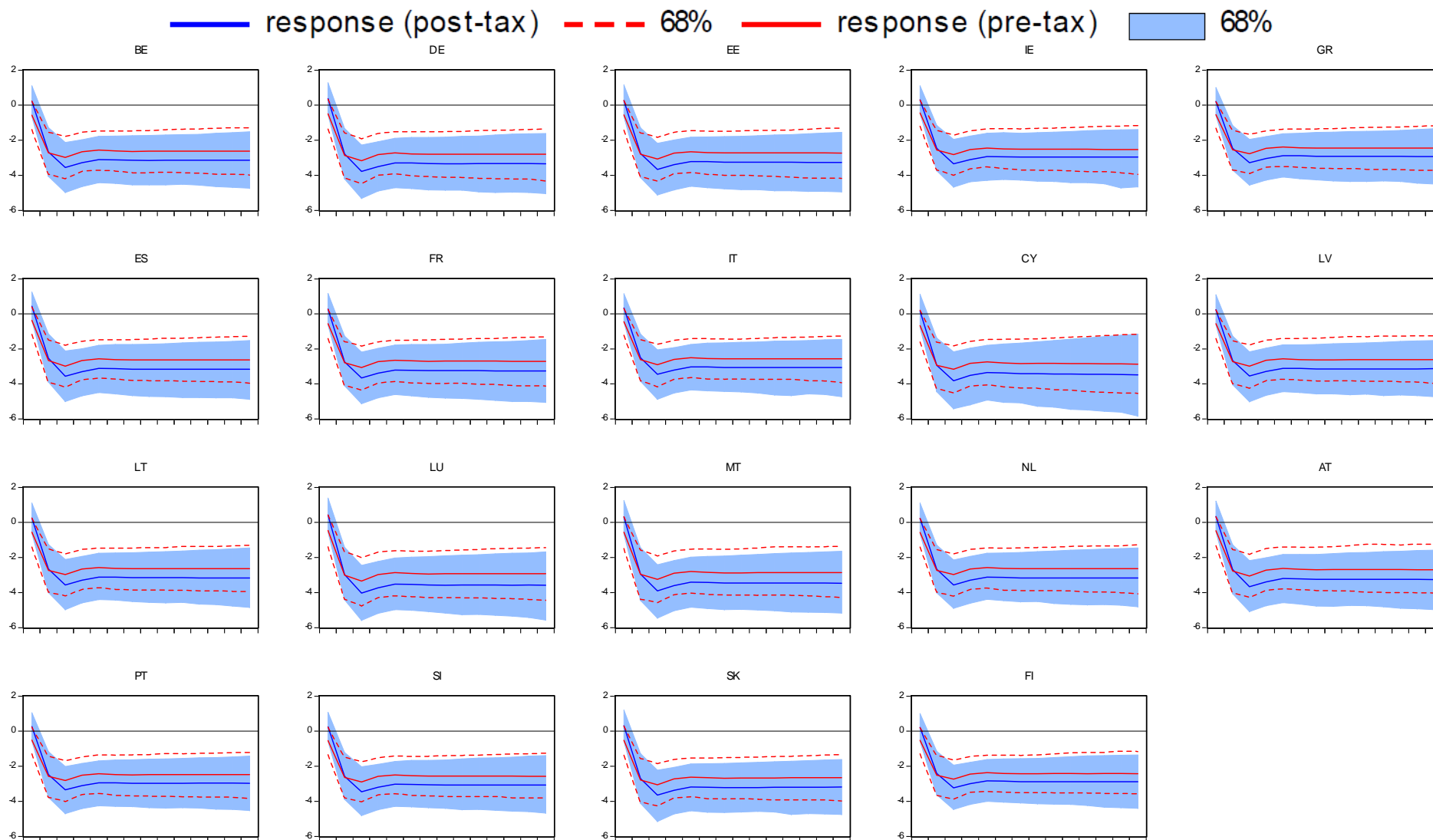


3. Main empirical analysis – Step 2

Response of VAT to +1pp in RATE

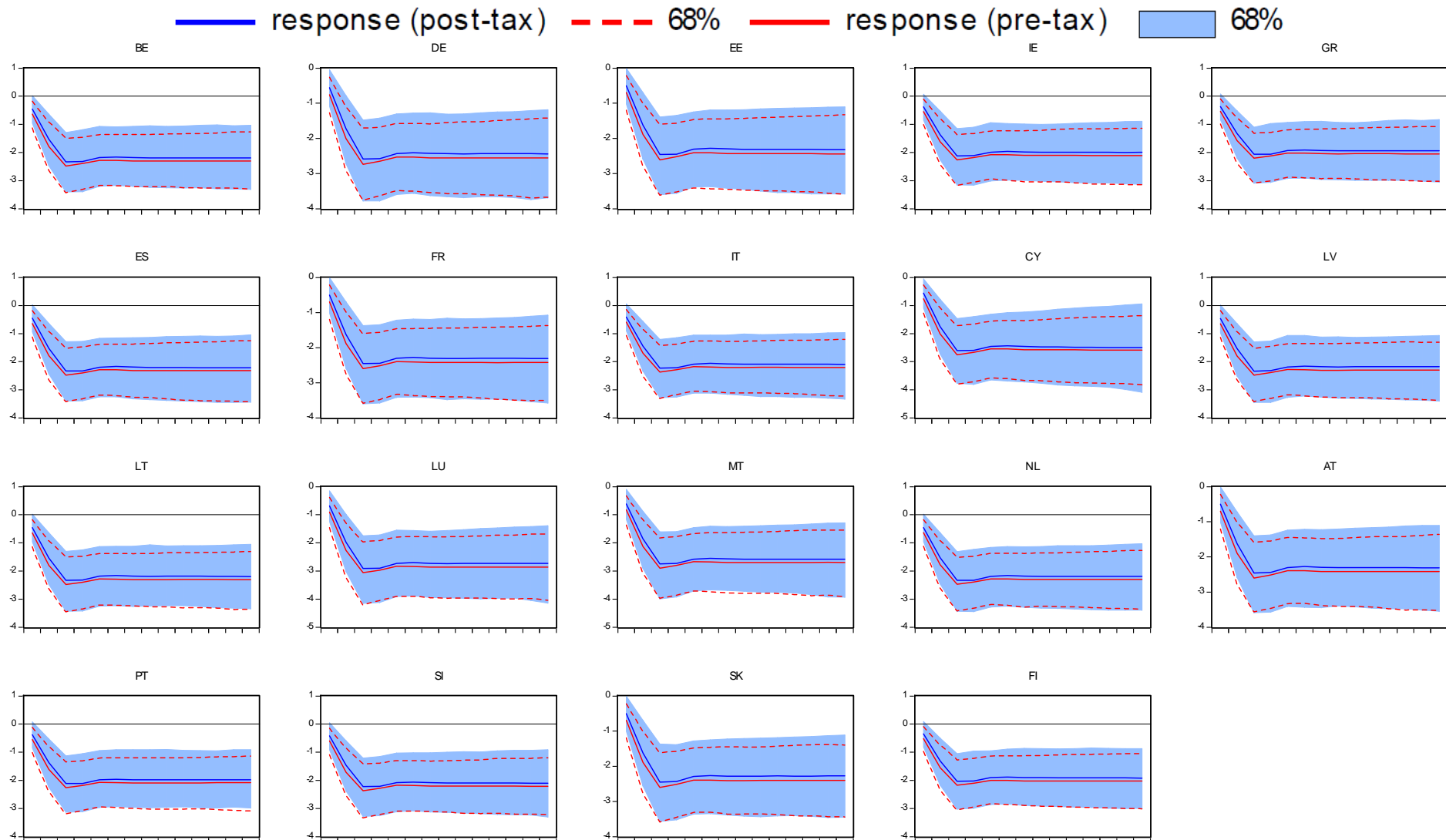


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3. Main empirical analysis – Step 2

Response of BASE to +1pp in RATE





4. Robustness

Overview of robustness checks

In addition to generating estimates using both, the post-and pre-tax concepts of the tax base in the main analysis, we check the robustness of the results to:

- i. Allowing for heterogeneity between countries with above and below average card use.
 - Compliance and efficiency gains from higher card use are more sizeable in countries with lower card use.
 - Lower efficiency losses from rate hikes in countries with higher card use.
- ii. Excluding individual cross-sections.
 - No single country is driving the main results.
- iii. Including per capita GDP as an additional exogenous variable in the VAR.
 - Eliminates the increase in BASE in response to higher card use.
 - Confirms the efficiency gains from higher card use.
- iv. Using Bayesian estimation and applying dynamic panel bias correction in the VAR.
 - No significant difference.
- v. Accounting for the effect of self-employment.
 - Compliance and efficiency gains from higher card use increase in countries with high self-employment (GR, IT).

Conclusions – Summary of main results



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1. Increasing the use of payment cards is found to:
 - a. improve tax compliance and collection efficiency
 - b. increase VAT revenue
 - c. contain efficiency losses after rate hikes

2. The gains from increasing card use are higher in countries with:
 - a. low use of cards (GR, DE, IT)
 - b. high self-employment (GR, IT)

Conclusions – Policy proposal (1/2)



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➤ Incentives to consumers for non-cash payments in professional services.

Example

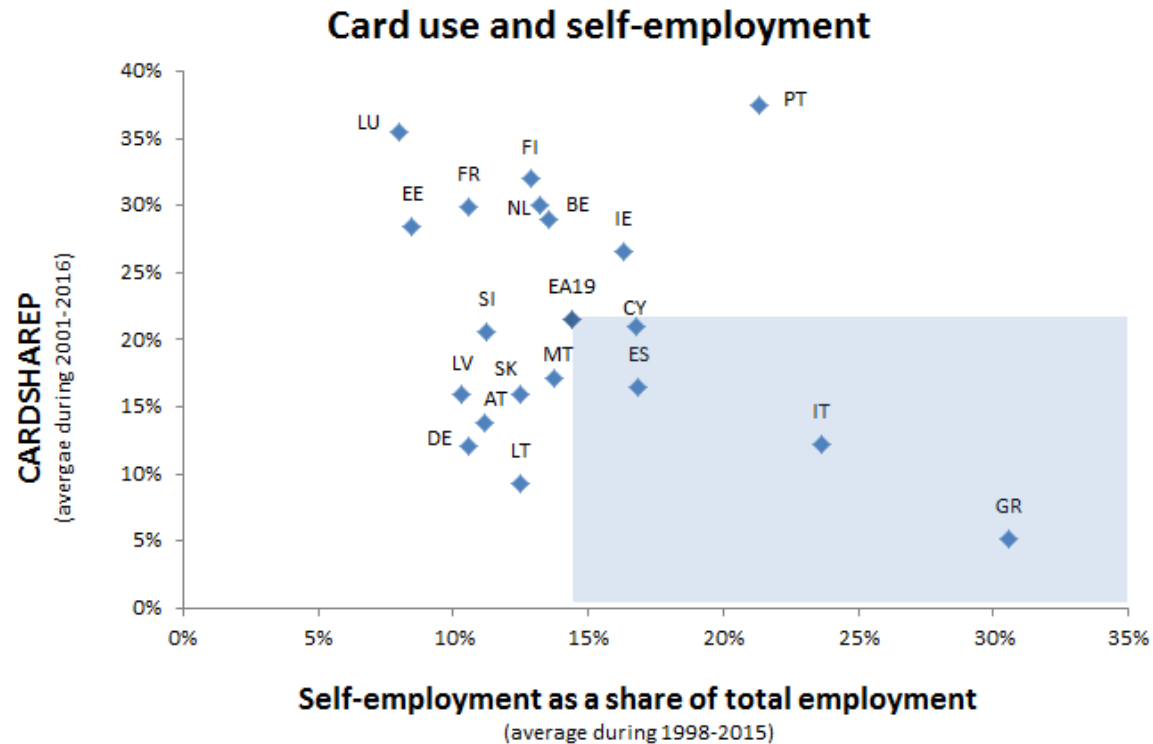
- Denmark: Personal Income Tax deductions of up to 15,000 DKK spent on renovation services via card or bank.

Recent evidence

- Naritomi, J. (2016), “Consumers as tax auditors” (revise and resubmit, *AER*)
 - Microdata on the effect of tax rebates and lottery prizes for requesting receipts in Brazil.

Conclusions – Policy proposal (2/2)

- Particularly relevant to Euro Area countries with low use of cards *and* a high share of self-employment, such as GR and IT.





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Thank you



Supplementary slides



4. Robustness

i. Heterogeneity in TVC model

Allow for different effects of CARDSHAREP on compliance ($b_{0i,t}$) between economies with above and below-average CARDSHAREP:

$$b_{0i,t} = high * [c_0^h + c_1^h \Delta_4 \ln(CARDSHAREP_{i,t}) + c_2^h \Delta_4 \ln(CARDSHAREP_{i,t})^2] + \\ low * [c_0^l + c_1^l \Delta_4 \ln(CARDSHAREP_{i,t}) + c_2^l \Delta_4 \ln(CARDSHAREP_{i,t})^2] + e_{i,t} \quad (3b)$$

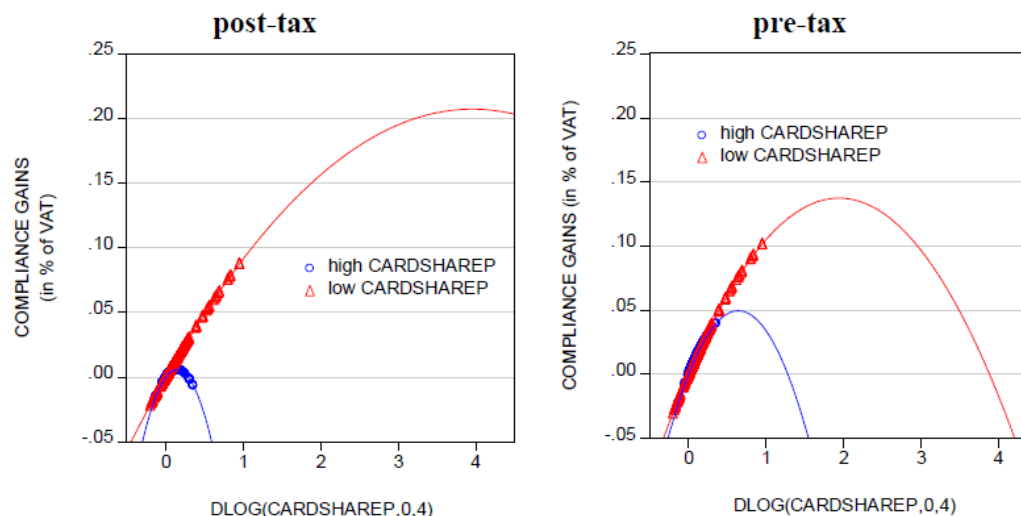
$$high = \begin{cases} 1, & \text{for countries with above average CARDSHAREP} \\ 0, & \text{otherwise} \end{cases}$$

$$low = 1 - high.$$



4. Robustness

i. Heterogeneity in TVC model



Dependent variable: $b_{0i,t}$
Sample: 2003q1-2016q4; Periods: 56

	post-tax	pre-tax
High card use		
$\Delta_4 \ln(CARDSHAREP_{i,t})$	0.08 [0.96]	0.15 [1.60]
$\Delta_4 \ln(CARDSHAREP_{i,t})^2$	-0.28 [-0.44]	-0.12 [-0.17]
Low card use		
$\Delta_4 \ln(CARDSHAREP_{i,t})$	0.10* [1.87]	0.14** [2.55]
$\Delta_4 \ln(CARDSHAREP_{i,t})^2$	-0.01 [-0.13]	-0.04 [-0.30]

Notes: z-statistic in square brackets. “*” and “**” denote significance at the 10% and 5% levels, respectively. High/low card use is defined as above/below average CARDSHAREP during 2000q1-2016q4. Countries with high card use are BE, EE, IE, FR, LU, NL, PT and FI. The post-tax definition of the tax base is given by the sum of private consumption and government intermediate consumption. The pre-tax definition subtracts VAT revenue from the post-tax measure.



4. Robustness

i. Heterogeneity in VAR model

Allow for different dynamics between economies with above and below-average CARDSHAREP:

$$\begin{aligned} \Delta_4 \mathbf{y}_{i,t} = & \text{high} * [\mathbf{a}_{0i}^h + \mathbf{\Gamma}^h(L)\Delta_4 \mathbf{y}_{i,t} + \mathbf{A}^h(L)\Delta_4 \mathbf{x}_{i,t} + \mathbf{B}^h(L)\widehat{b}_{0i,t}] + \\ & \text{low} * [\mathbf{a}_{0i}^l + \mathbf{\Gamma}^l(L)\Delta_4 \mathbf{y}_{i,t} + \mathbf{A}^l(L)\Delta_4 \mathbf{x}_{i,t} + \mathbf{B}^l(L)\widehat{b}_{0i,t}] + \mathbf{e}_{i,t} \end{aligned} \quad (4b)$$

$$\begin{aligned} \widehat{b}_{0i,t} = & \text{high} * [\widehat{c}_0^h + \widehat{c}_1^h \Delta_4 \ln(\text{CARDSHAREP}_{i,t}) + \widehat{c}_2^h \Delta_4 \ln(\text{CARDSHAREP}_{i,t})^2] + \\ & \text{low} * [\widehat{c}_0^l + \widehat{c}_1^l \Delta_4 \ln(\text{CARDSHAREP}_{i,t}) + \widehat{c}_2^l \Delta_4 \ln(\text{CARDSHAREP}_{i,t})^2] + e_{i,t} \end{aligned} \quad (5b)$$

$$\text{high} = \begin{cases} 1, & \text{for countries with above average CARDSHAREP} \\ 0, & \text{otherwise} \end{cases}$$

$$\text{low} = 1 - \text{high}.$$

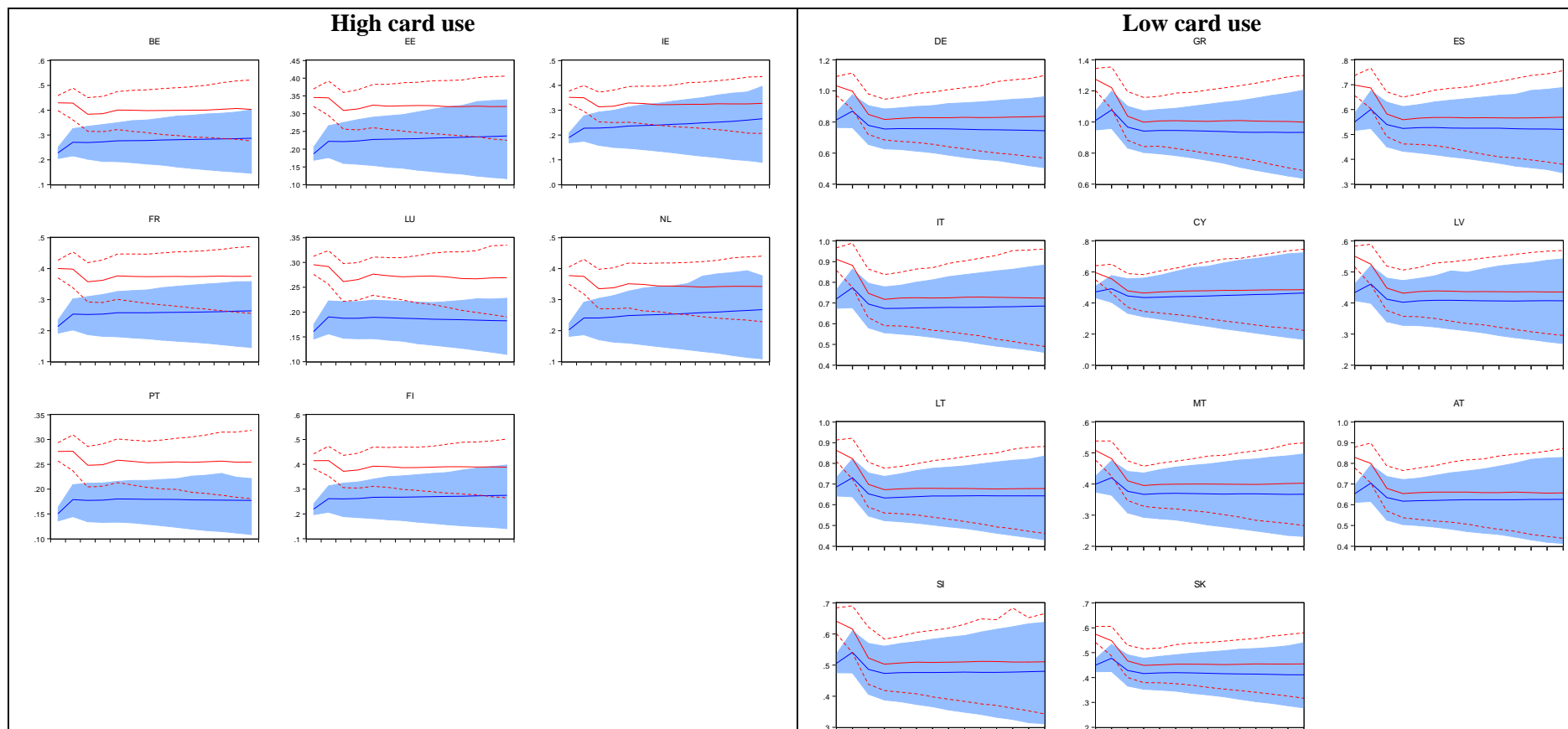


4. Robustness

i. Heterogeneity in VAR model

Response of EFFICIENCY to +1pp in CARDSHAREP

— response (post-tax) - - - 68% — response (pre-tax) ■ 68%



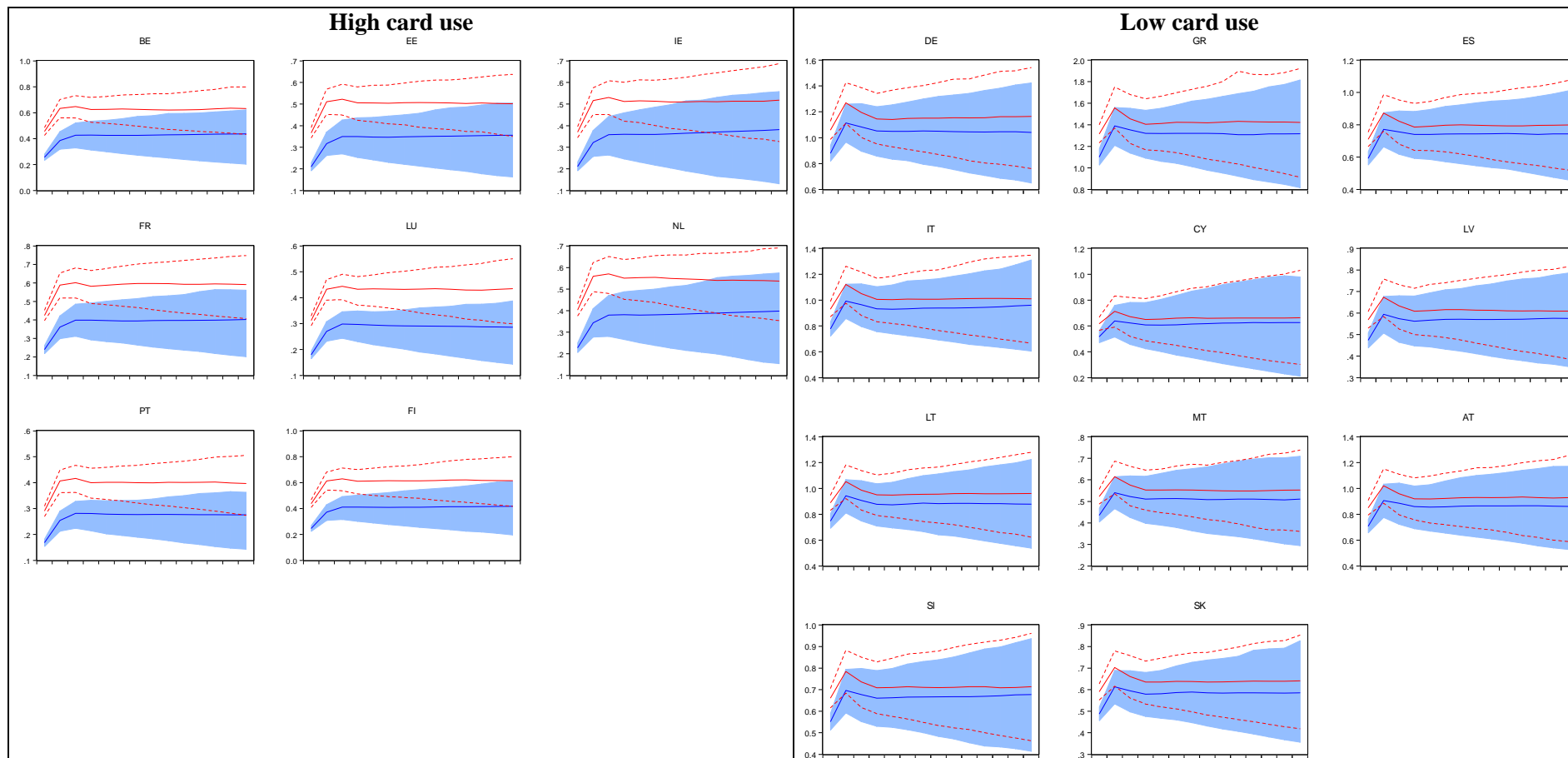
4. Robustness

i. Heterogeneity in VAR model

Response of VAT to +1pp in CARDSHAREP



— response (post-tax) - - - 68% — response (pre-tax) ■ 68%



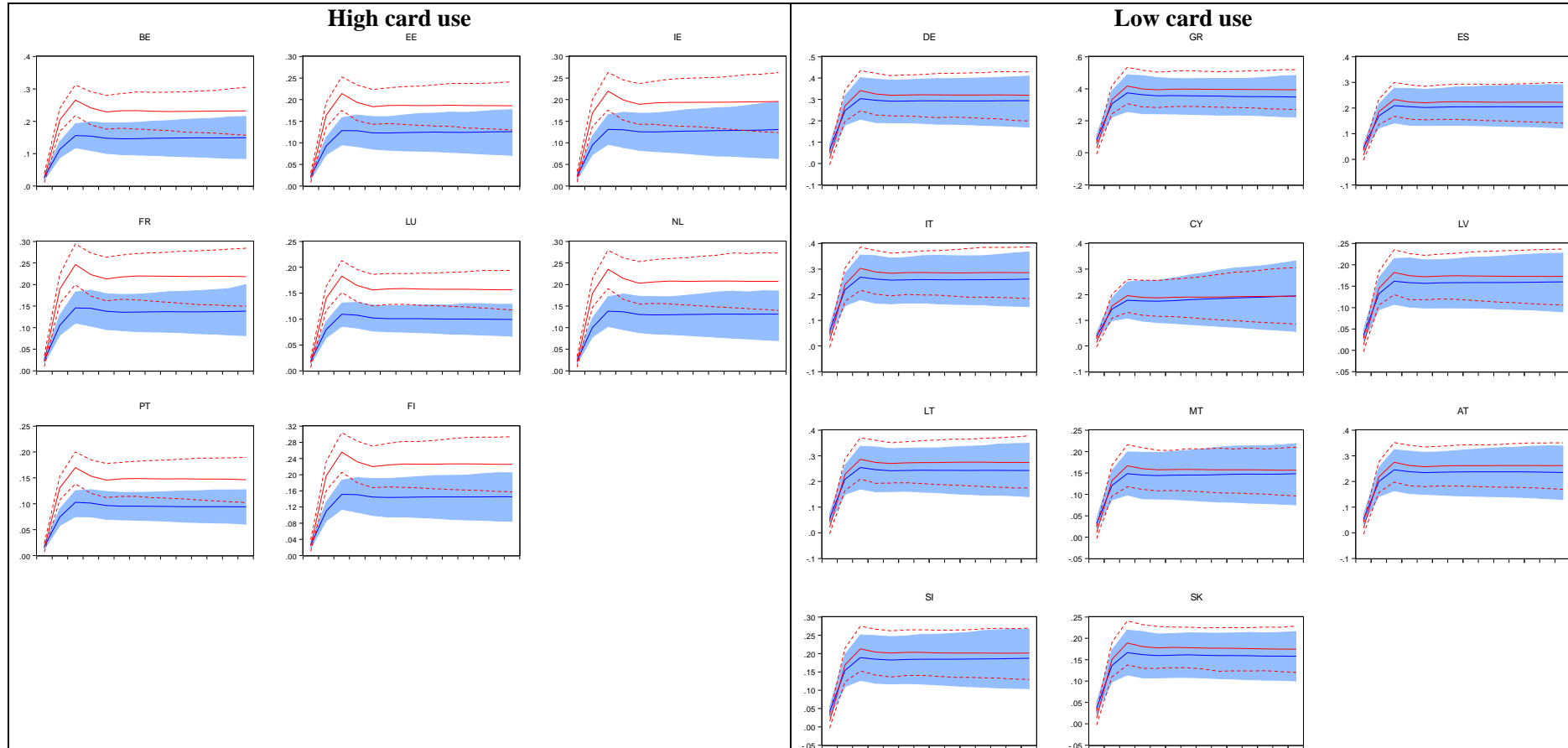
4. Robustness

i. Heterogeneity in VAR model

Response of BASE to +1pp in CARDSHAREP



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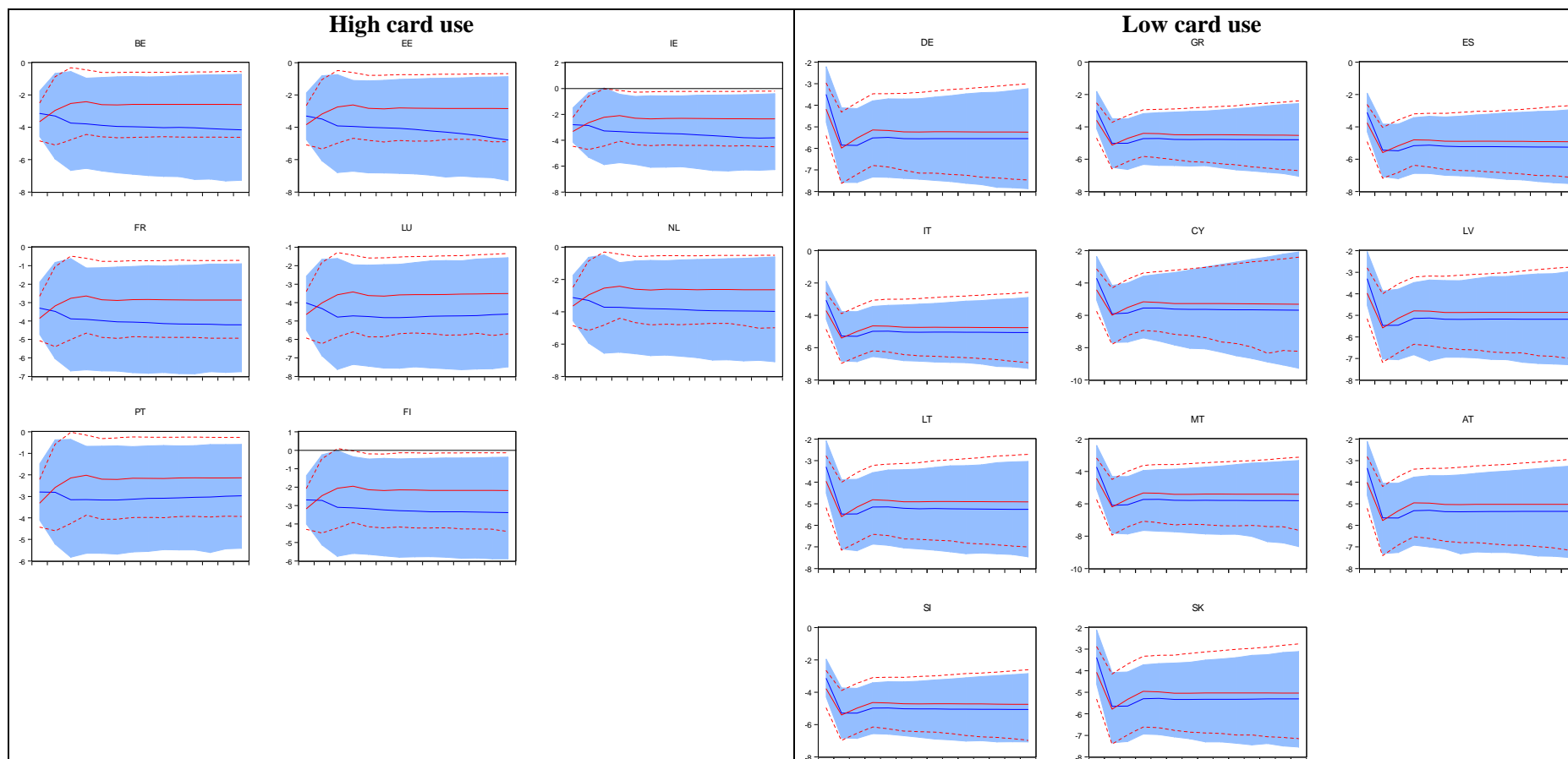


4. Robustness

i. Heterogeneity in VAR model

Response of EFFICIENCY to +1pp in RATE

— response (post-tax) - - - 68% — response (pre-tax) ■ 68%



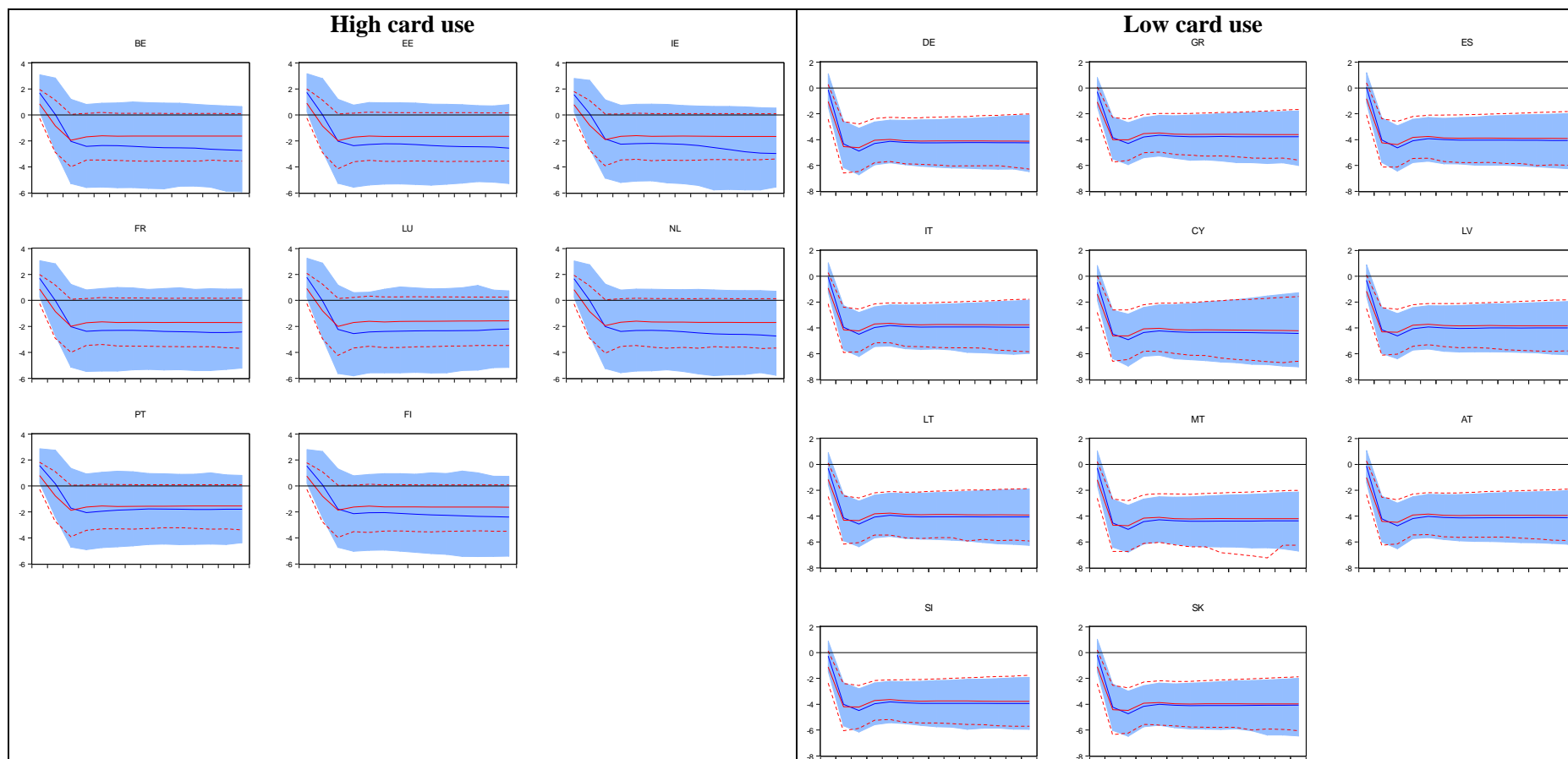


4. Robustness

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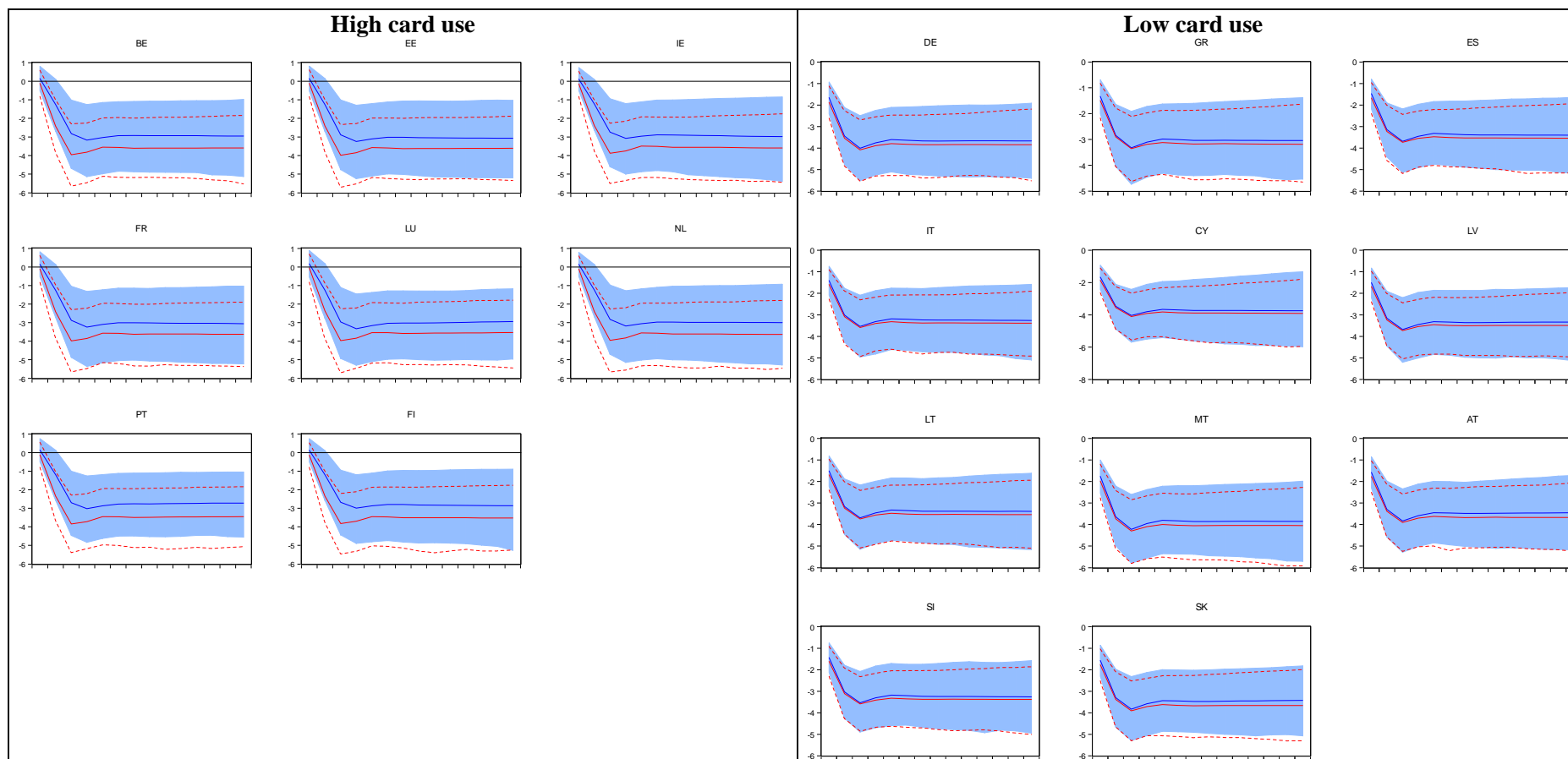


4. Robustness

i. Heterogeneity in VAR model

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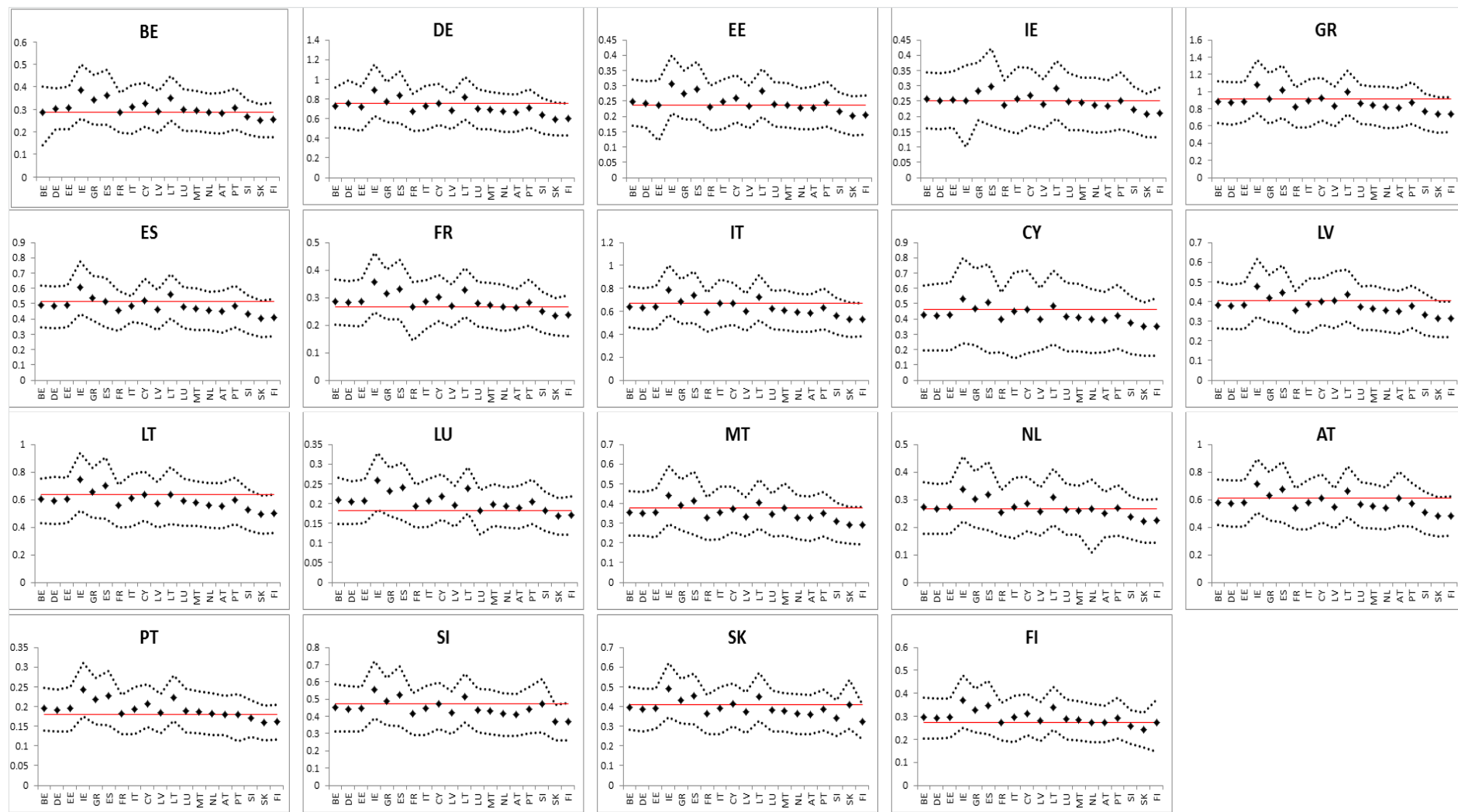
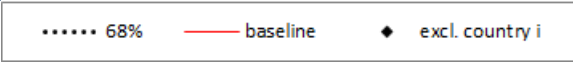


4. Robustness

ii. Excluding individual cross-sections

Long-term (60qrts) response of EFFICIENCY to +1pp CARDSHAREP (vertical)

Robustness to exclusion of individual cross-sections (horizontal)



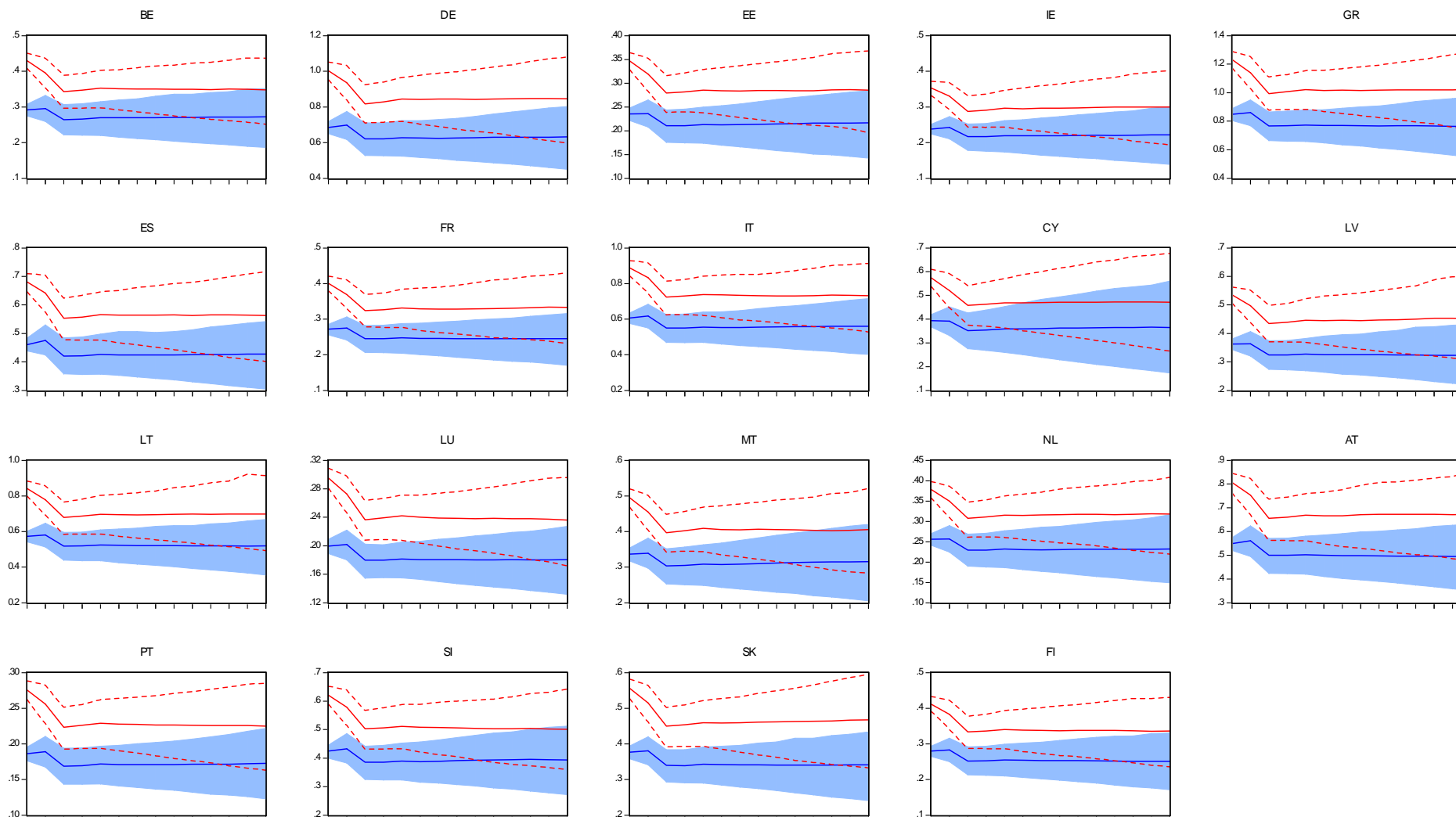
4. Robustness

iii. Including GDP per capita in VAR

Response of EFFICIENCY to +1pp in CARDSHAREP



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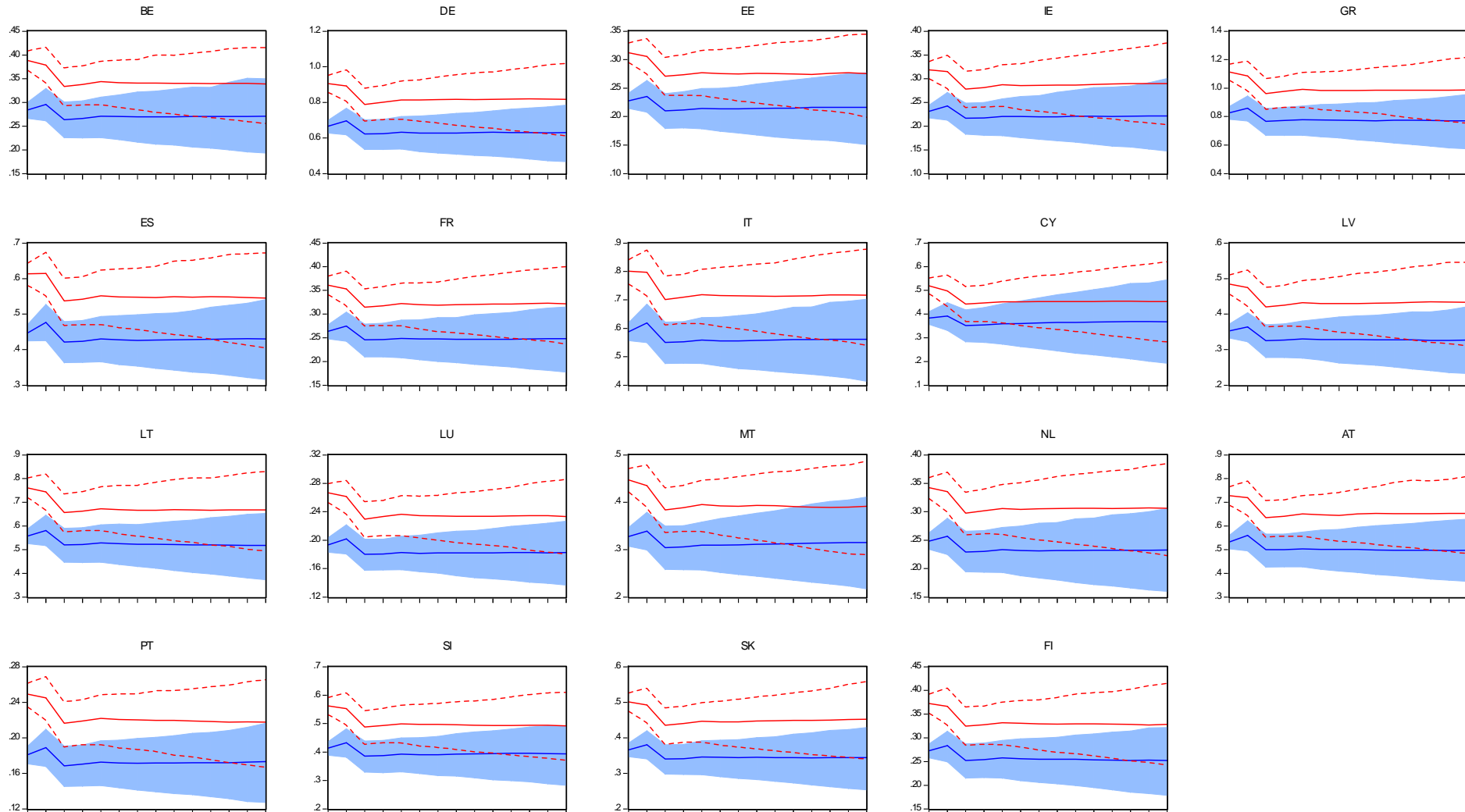


4. Robustness

iii. Including GDP per capita in VAR Response of VAT to +1pp in CARDSHAREP



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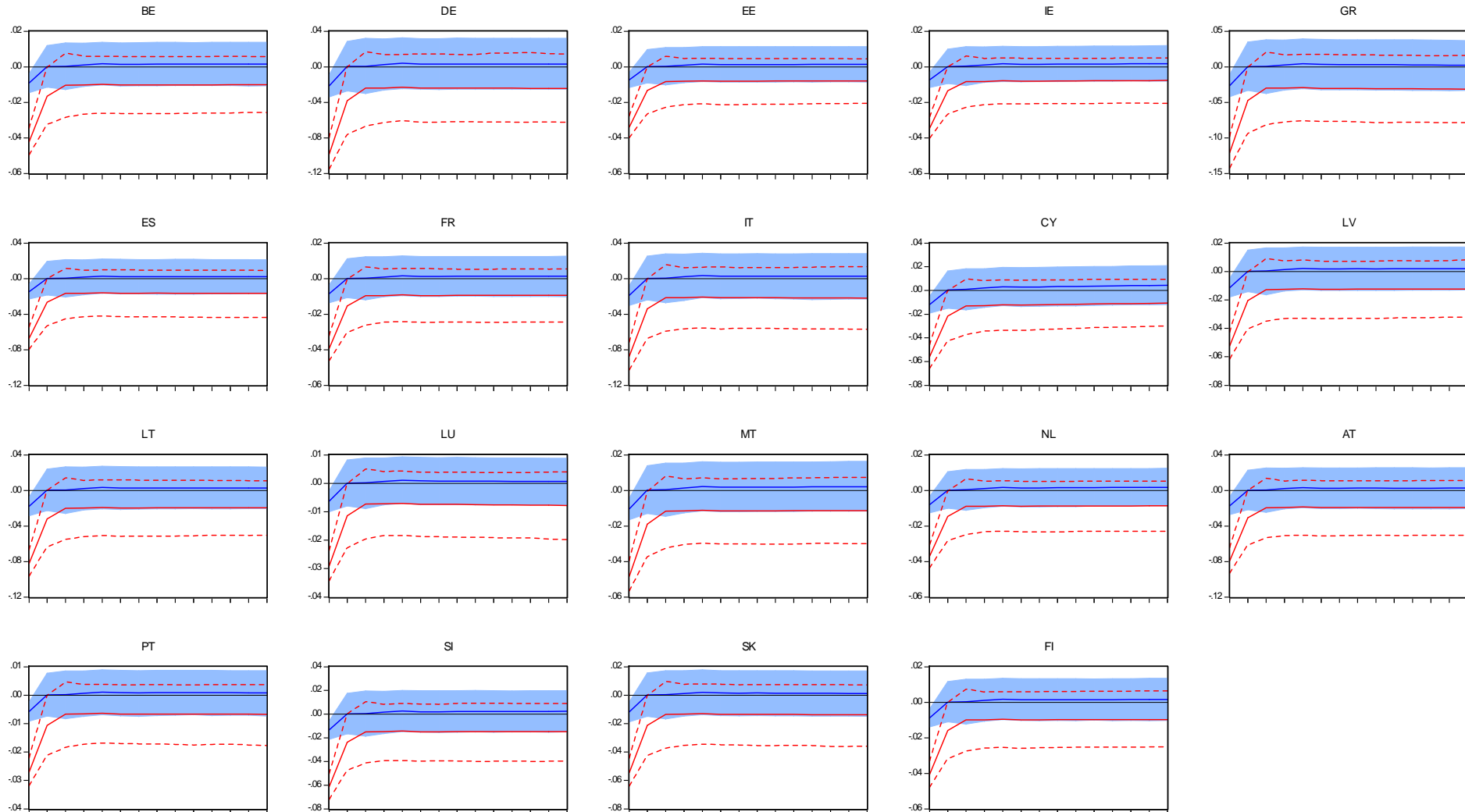
4. Robustness

iii. Including GDP per capita in VAR
Response of BASE to +1pp in CARDSHAREP



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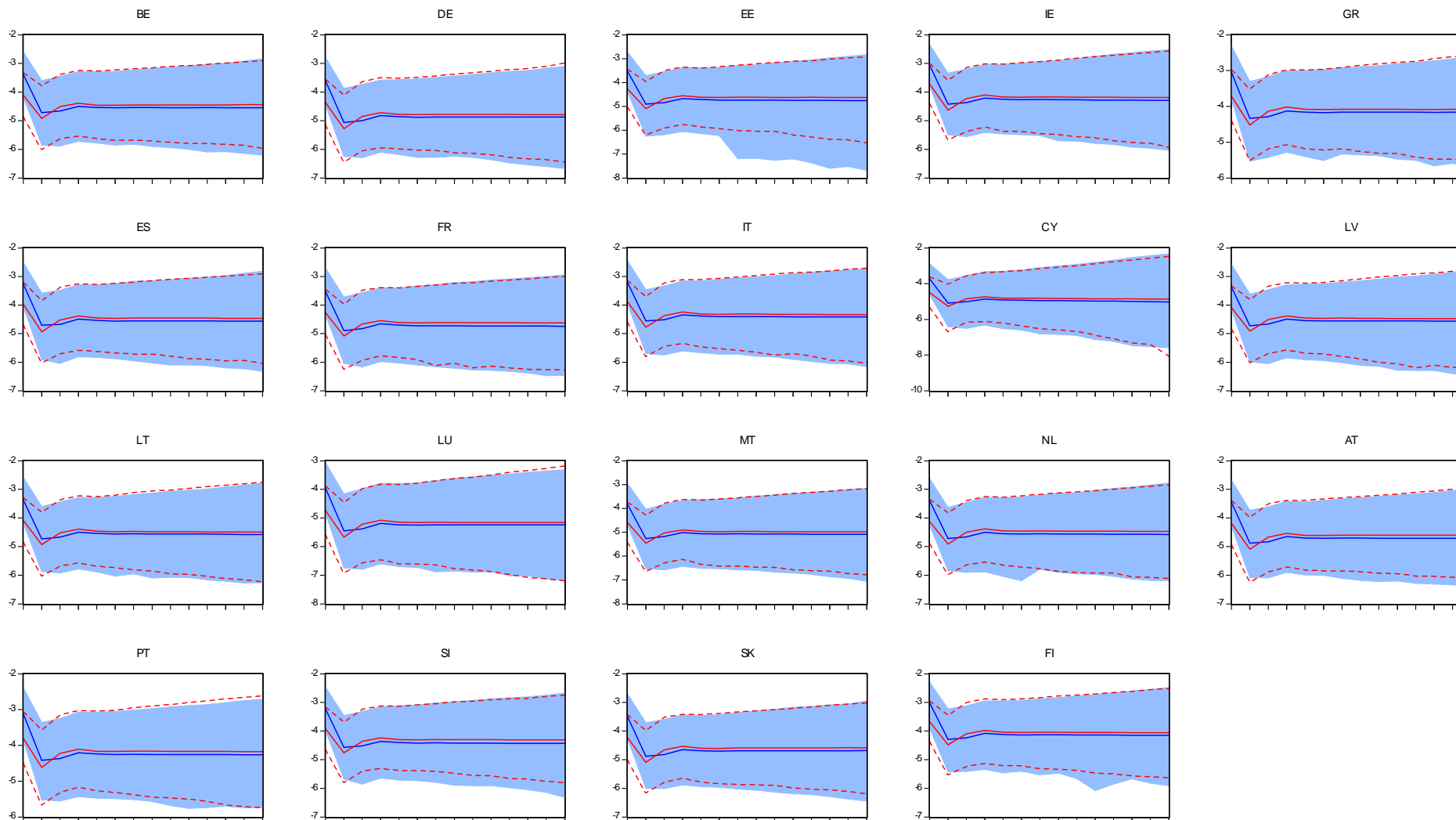
4. Robustness

iii. Including GDP per capita in VAR
Response of EFFICIENCY to +1pp in RATE



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— response (post-tax) - - - 68% — response (pre-tax) ■ 68%

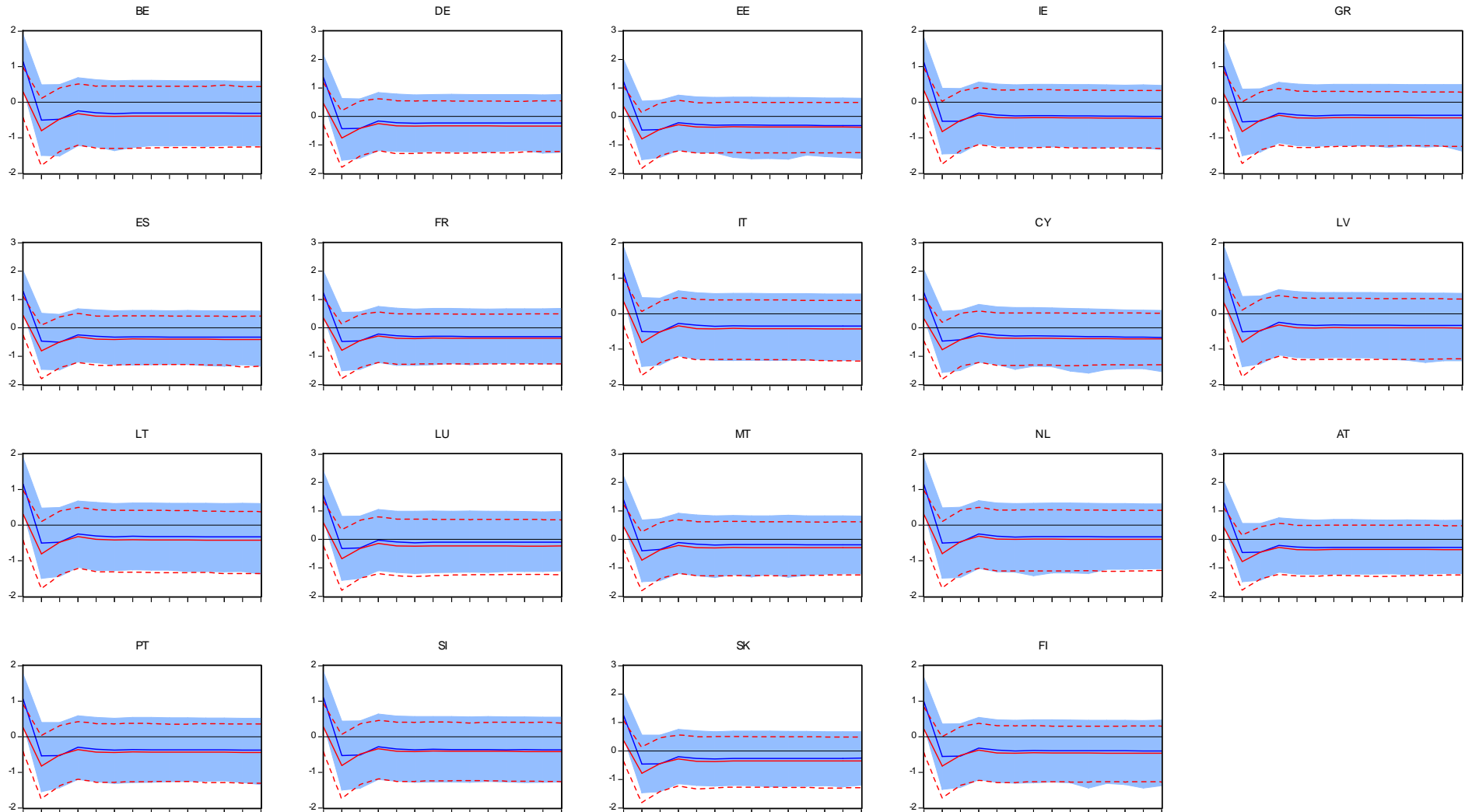


4. Robustness

iii. Including GDP per capita in VAR Response of VAT to +1pp in RATE



— response (post-tax) - - - 68% — response (pre-tax) ■ 68%



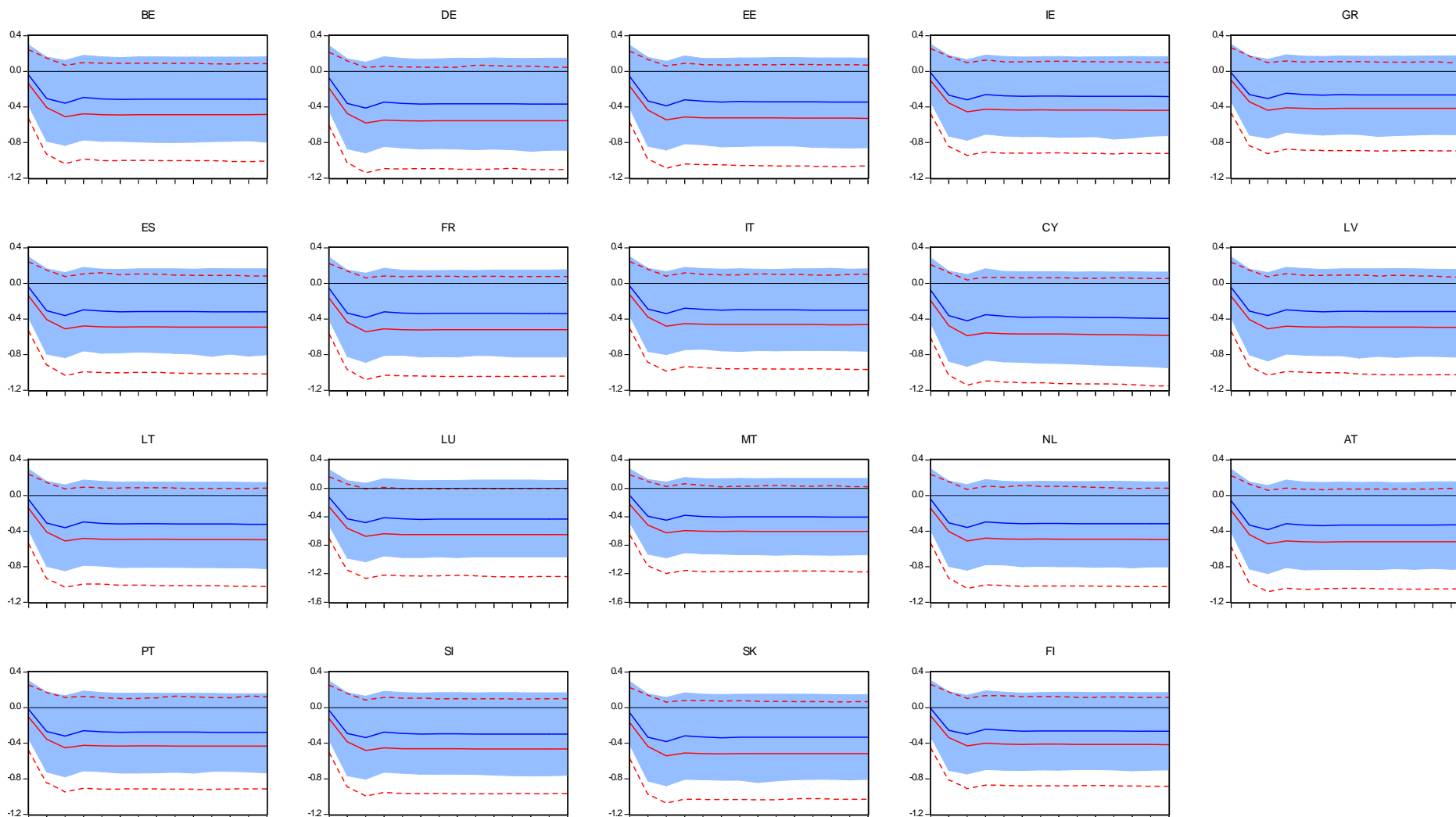
4. Robustness

iii. Including GDP per capita in VAR
Response of BASE to +1pp in RATE



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— response (post-tax) - - - 68% — response (pre-tax) ■ 68%



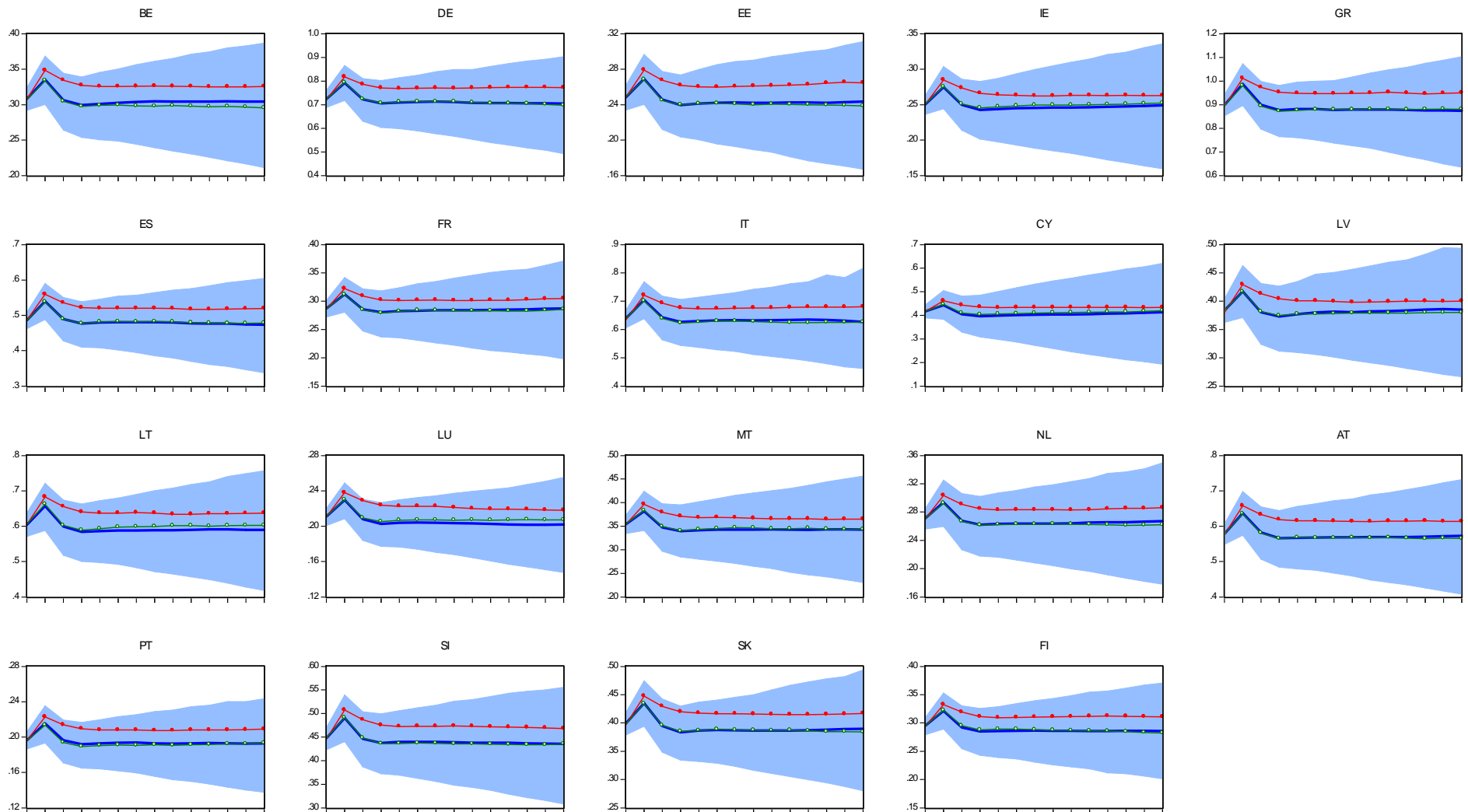
4. Robustness

iv. Alternative VAR estimators

Response of EFFICIENCY to +1pp in CARDSHAREP



— Baseline (OLS) —●— Bayesian —○— OLS bias-adjusted 68% around baseline



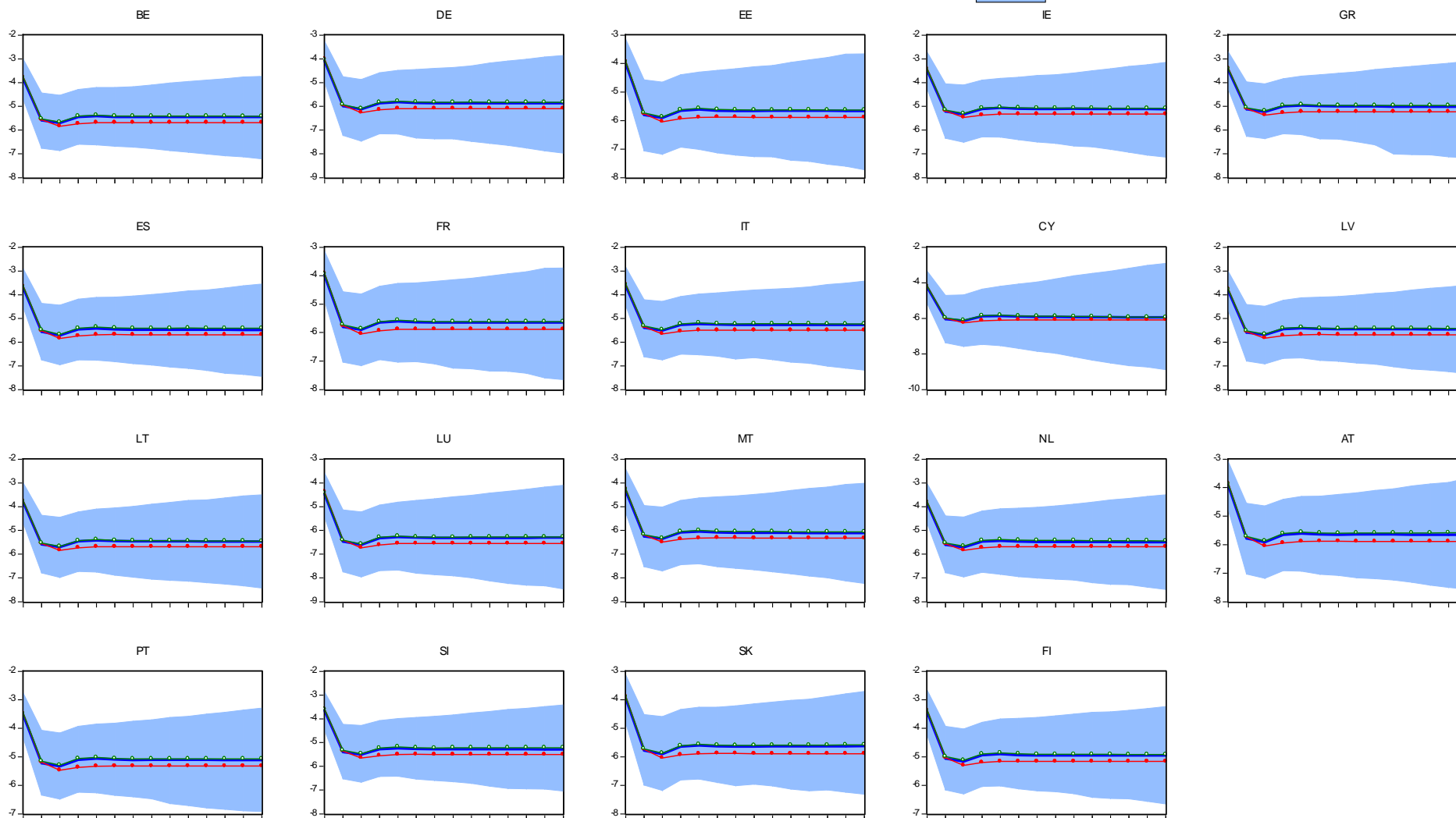


4. Robustness

iv. Alternative VAR estimators

Response of EFFICIENCY to +1pp in RATE

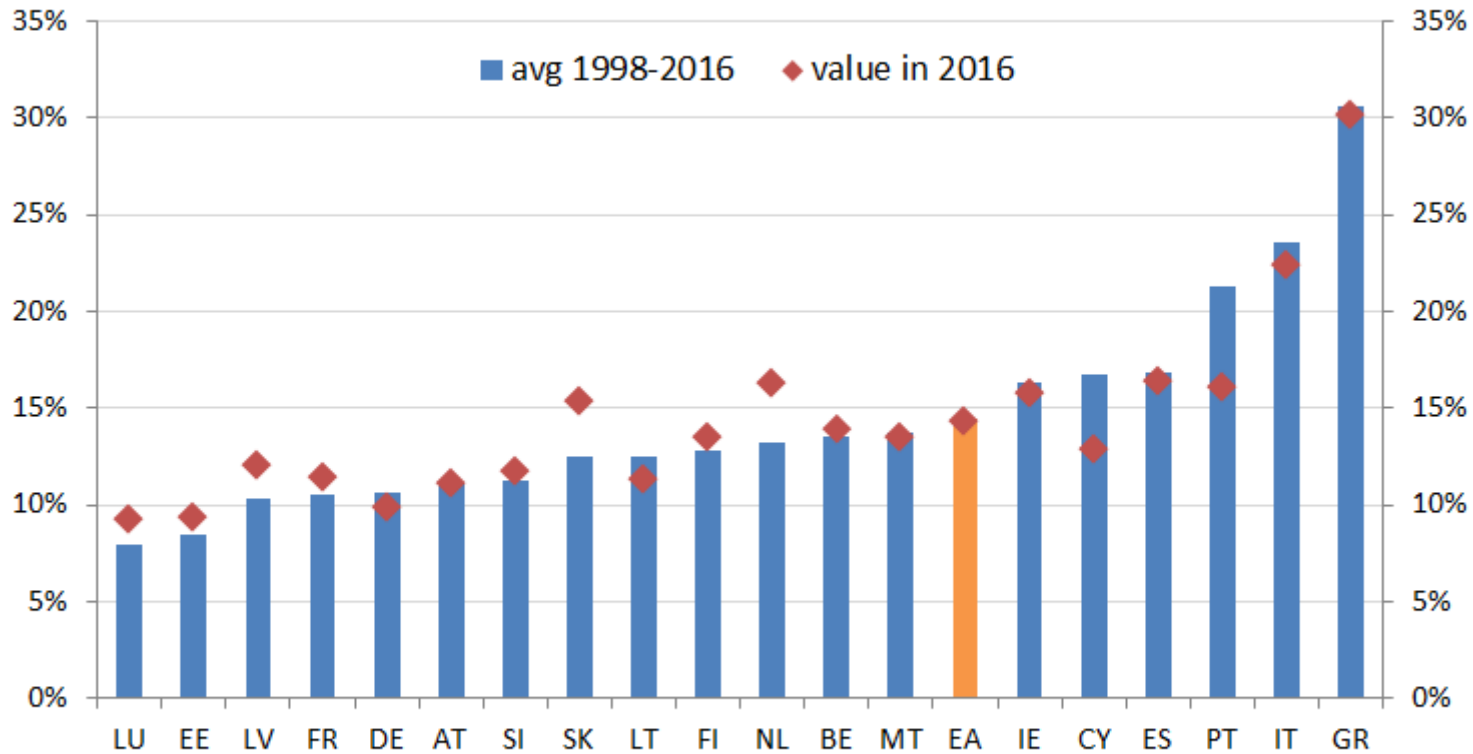
— Baseline (OLS) —●— Bayesian —○— OLS bias-adjusted 68% around baseline



Self-employment in the Euro Area



SELFEMP = (number of self-employed)/(total employment)



Source: Labour Force Survey



4. Robustness

v. Accounting for self-employment in TVC

Motivation

- In Greece around 45% of self-employed income is estimated to go unreported and thus untaxed (Artavanis et al. 2016).

Reformulation of TVC model

- Allow CARDSHAREP to interact with the share of self-employment (SELFEMP) in the TVC equation of compliance ($b_{0i,t}$):

$$b_{0i,t} = c_0 + \text{SELFEMP}_{i,t} (c_1 \Delta_4 \ln(\text{CARDSHAREP}_{i,t}) + c_2 \Delta_4 \ln(\text{CARDSHAREP}_{i,t})^2) + e_{i,t} \quad (3c)$$

- where SELFEMP = (number of self-employed)/(total employment). Source: quarterly LFS

Priors

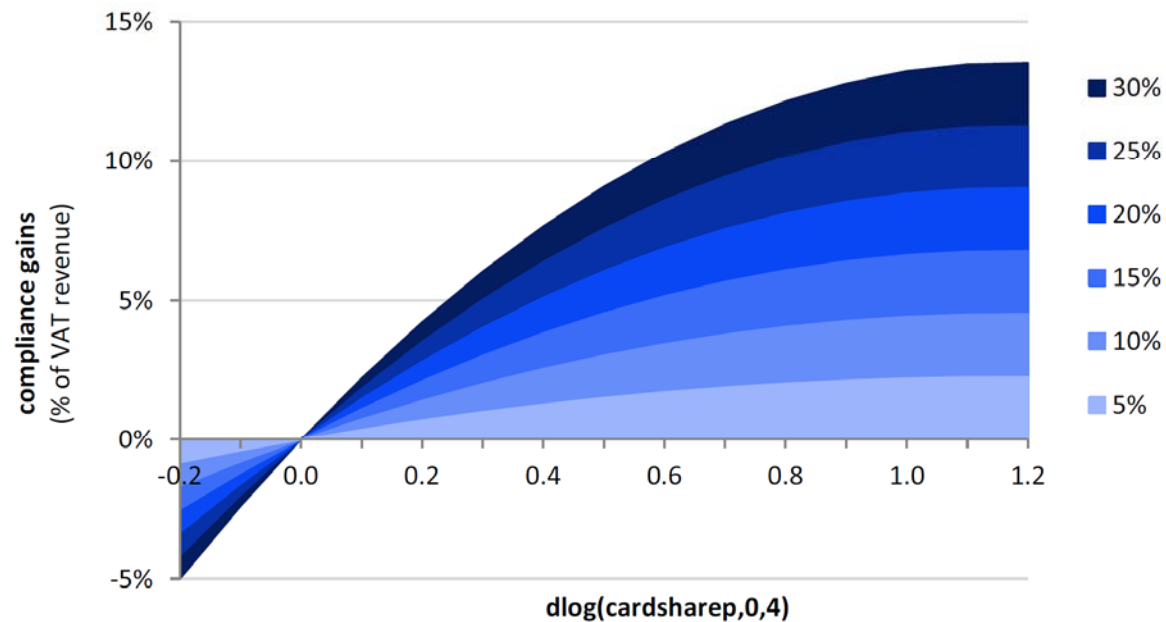
- We anticipate a positive c_1 , indicating that the compliance gains from higher card use increase with SELFEMP.

4. Robustness

v. Accounting for self-employment in TVC



Compliance gains (left) as a function of changes in card use (horizontal) for different levels of self-employment (right)



Dependent variable: $b_{0i,t}$

Sample: 2005q1-2016q4; Periods: 48; Cross-sections: 19

$\Delta_4 \ln(CARDSHAREP_{i,t}) * SELFEMP_{i,t}$	0.77** [2.10]
$\Delta_4 \ln(CARDSHAREP_{i,t})^2 * SELFEMP_{i,t}$	-0.33 [-0.61]

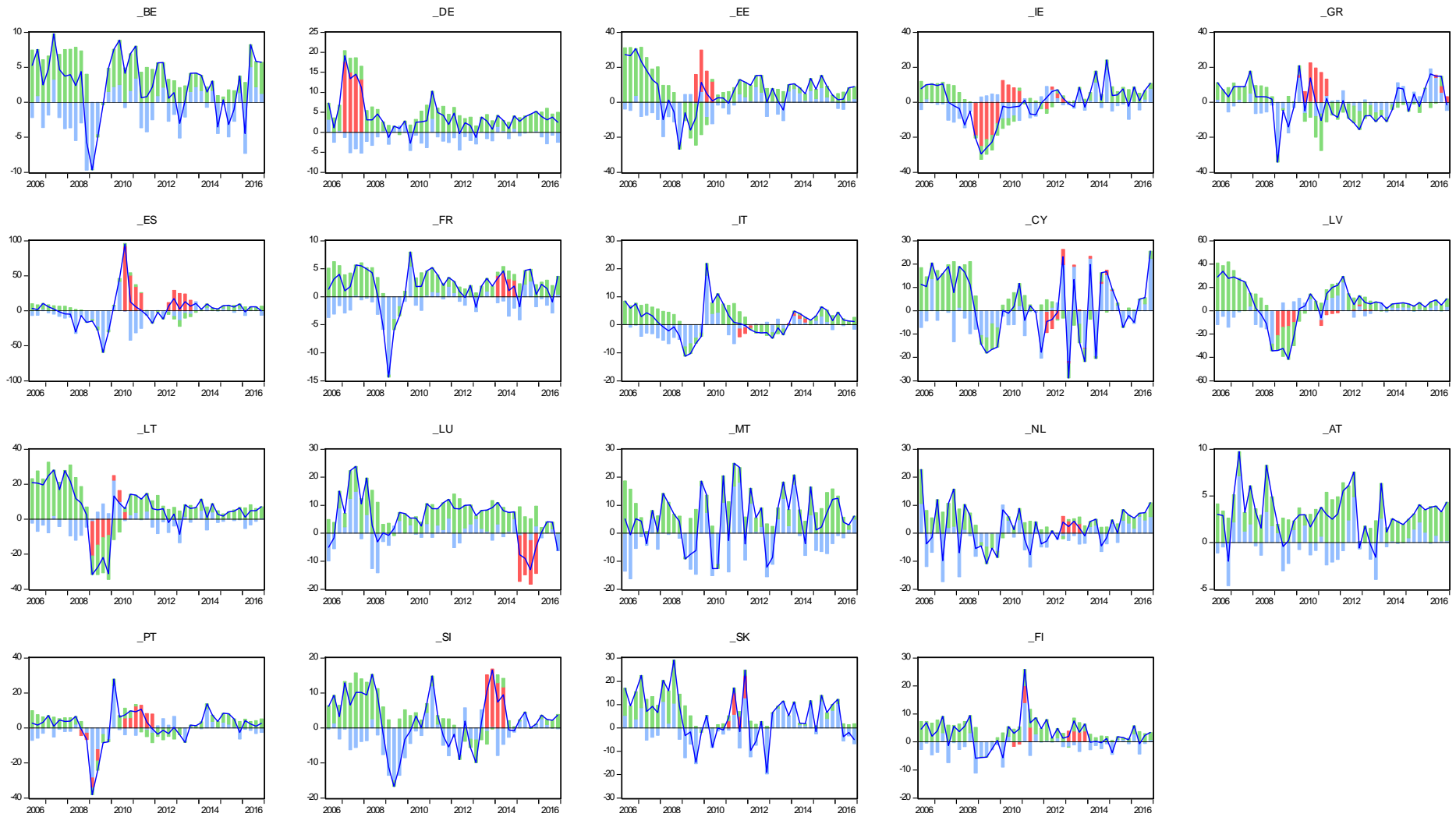
Notes: z-statistic in square brackets. “*” and “**” denote significance at the 10% and 5% levels, respectively. Based on the post-tax definition of the tax base, given by the sum of private consumption and government intermediate consumption.

4. Robustness

v. Accounting for self-employment in TVC Decomposition of VAT growth



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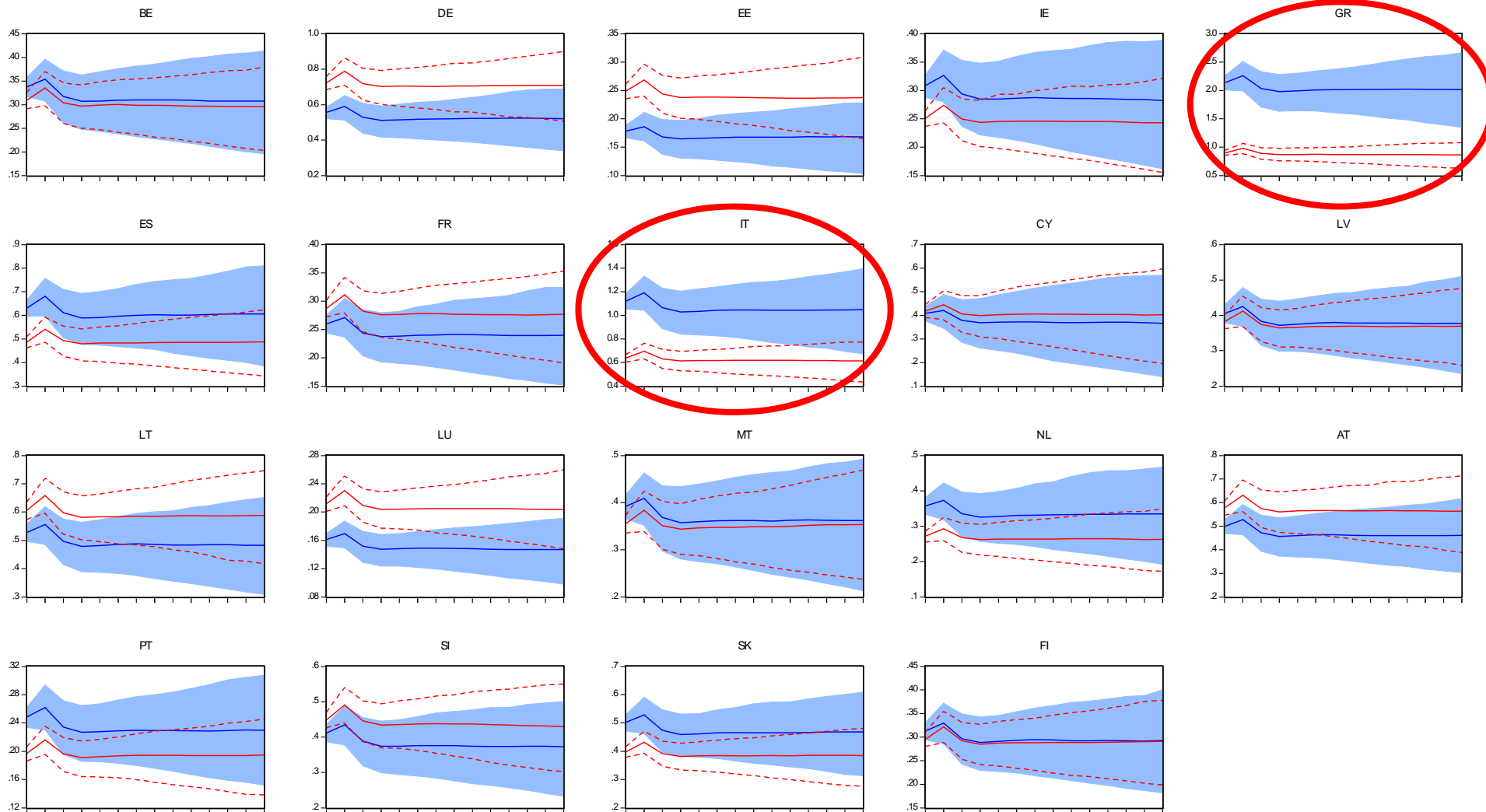
4. Robustness

v. Accounting for self-employment

Response of EFFICIENCY to +1pp in CARDSHAREP (Higher gains for GR, IT)



— response (self) - - - 68% (baseline) — response (baseline) ■ 68% (self)



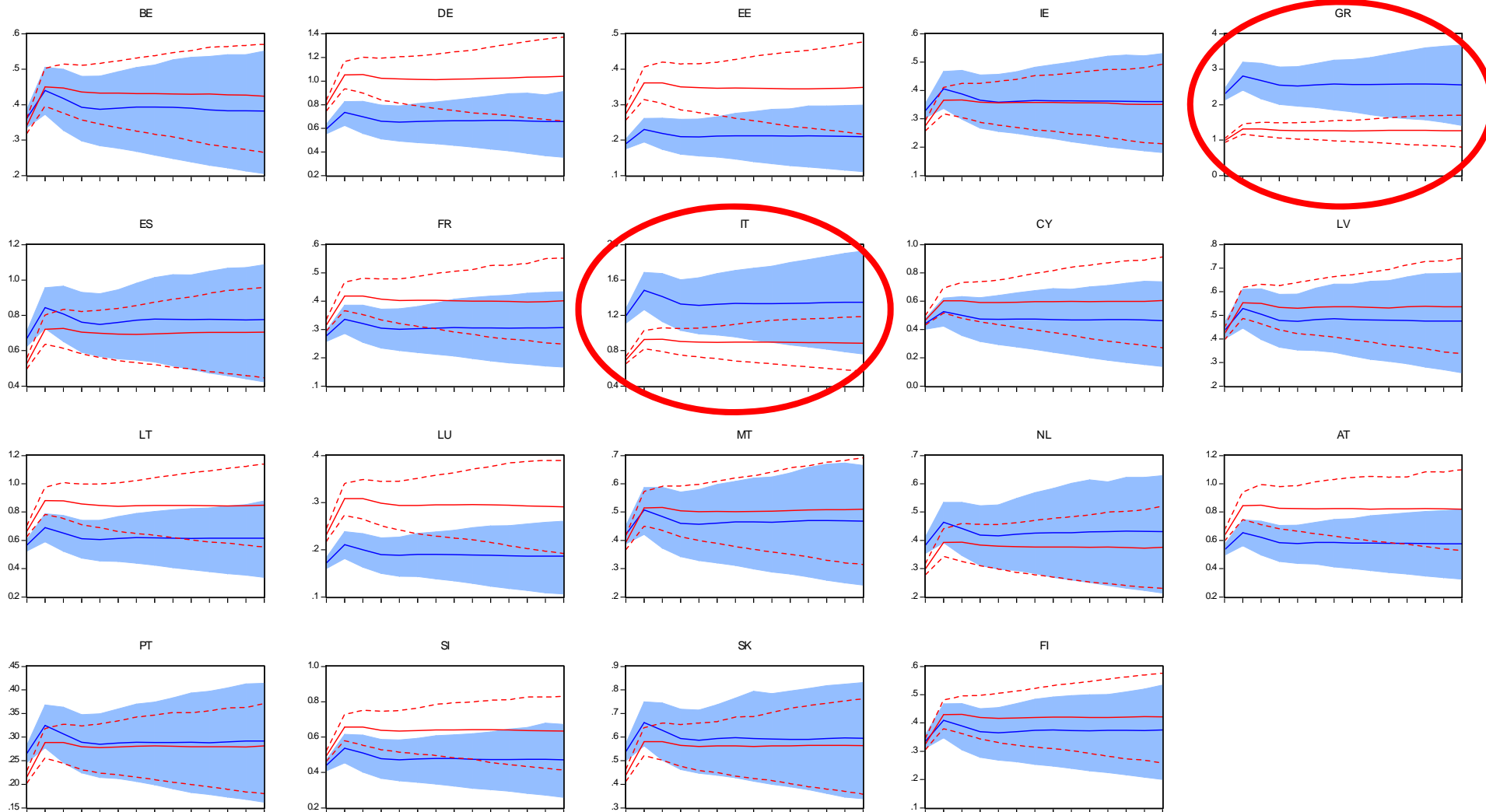
4. Robustness

v. Accounting for self-employment

Response of VAT to +1pp in CARDSHAREP (Higher gains for GR, IT)



— response (self) - - - 68% (baseline) — response (baseline) ■ 68% (self)

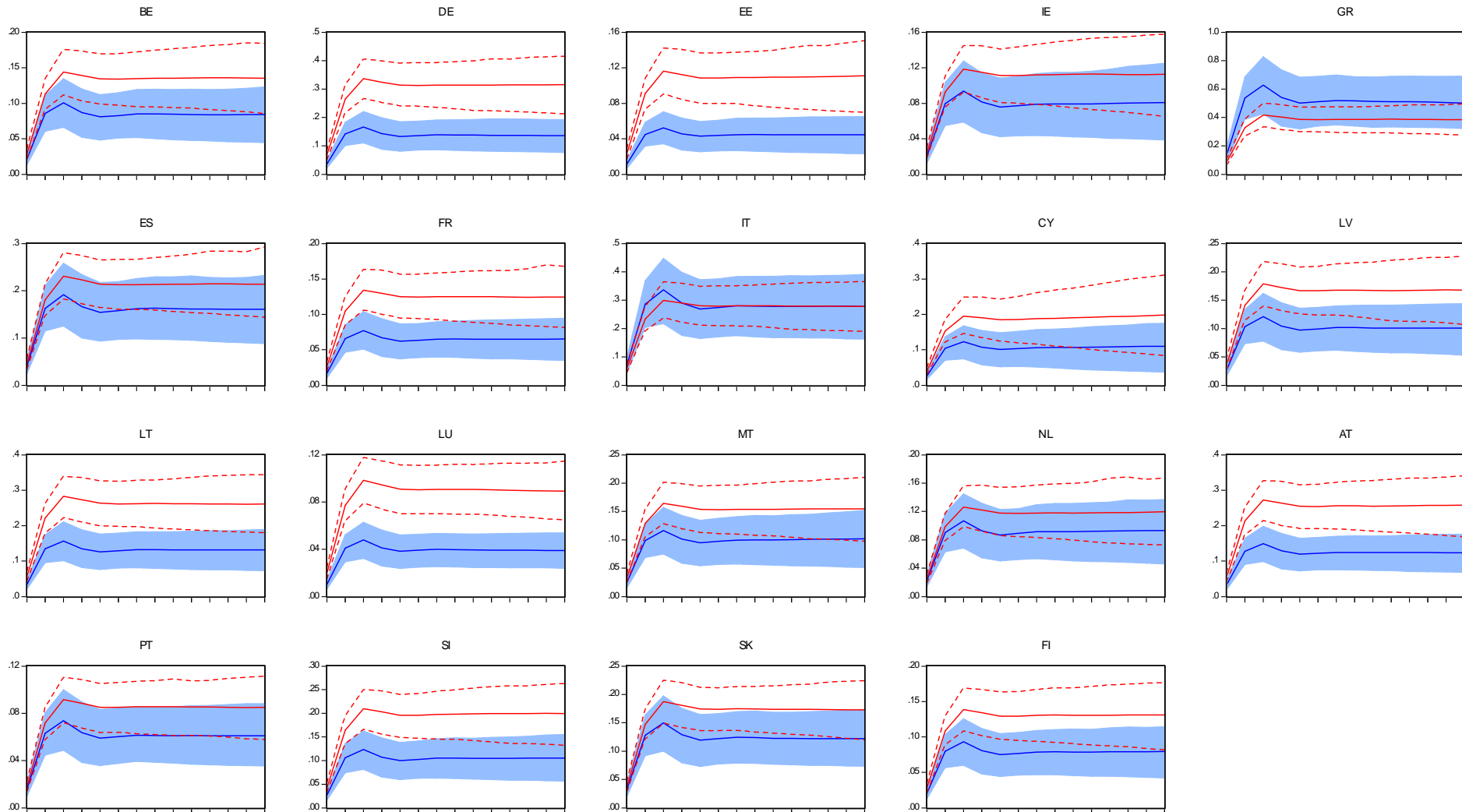


4. Robustness

v. Accounting for self-employment Response of BASE to +1pp in CARDSHAREP



— response (self) - - - 68% (baseline) — response (baseline) ■ 68% (self)

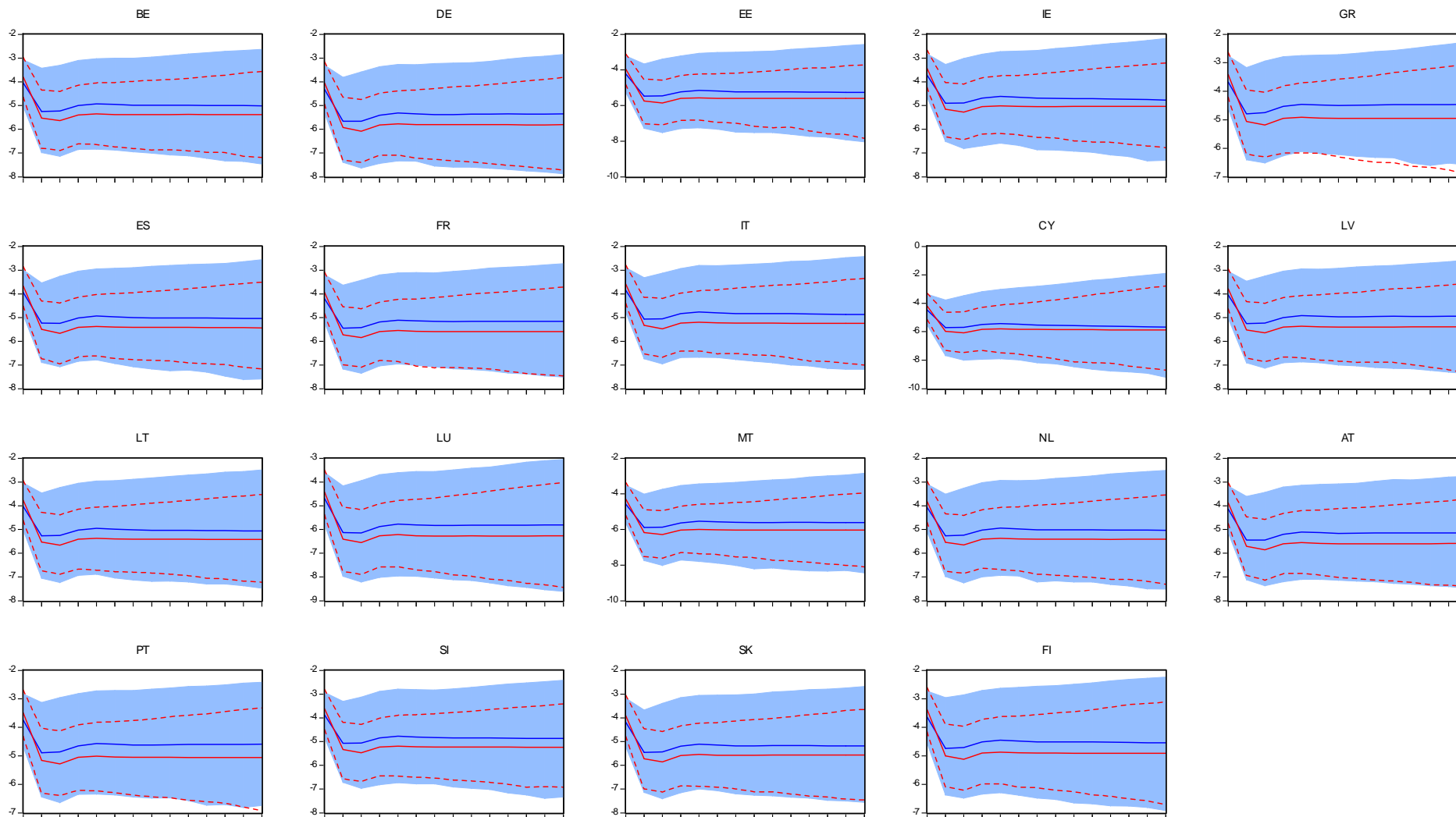


4. Robustness

v. Accounting for self-employment Response of EFFICIENCY to +1pp in RATE



— response (self) - - - 68% (baseline) — response (baseline) ■ 68% (self)

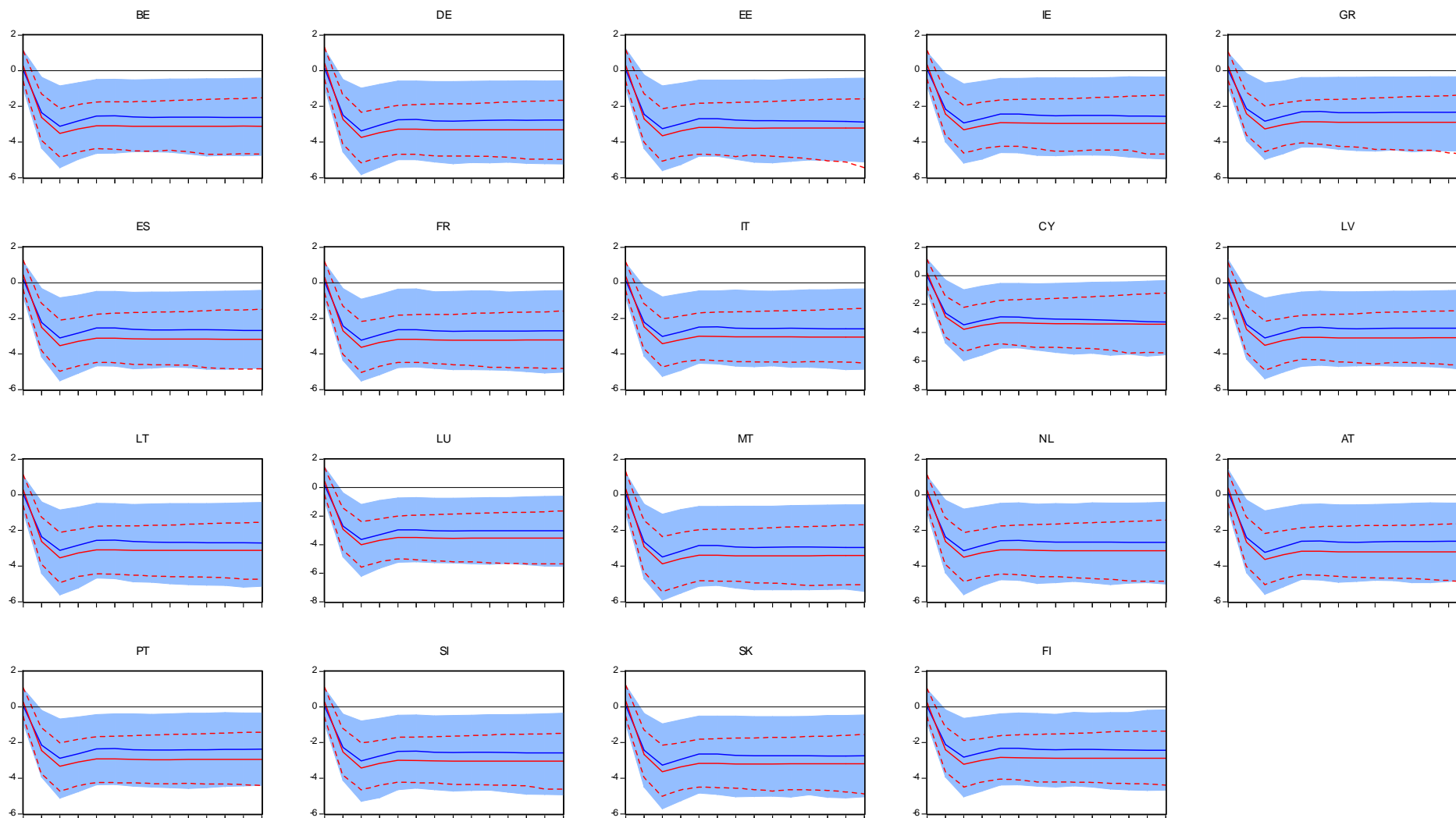




4. Robustness

v. Accounting for self-employment Response of VAT to +1pp in RATE

— response (self) - - - 68% (baseline) — response (baseline) ■ 68% (self)

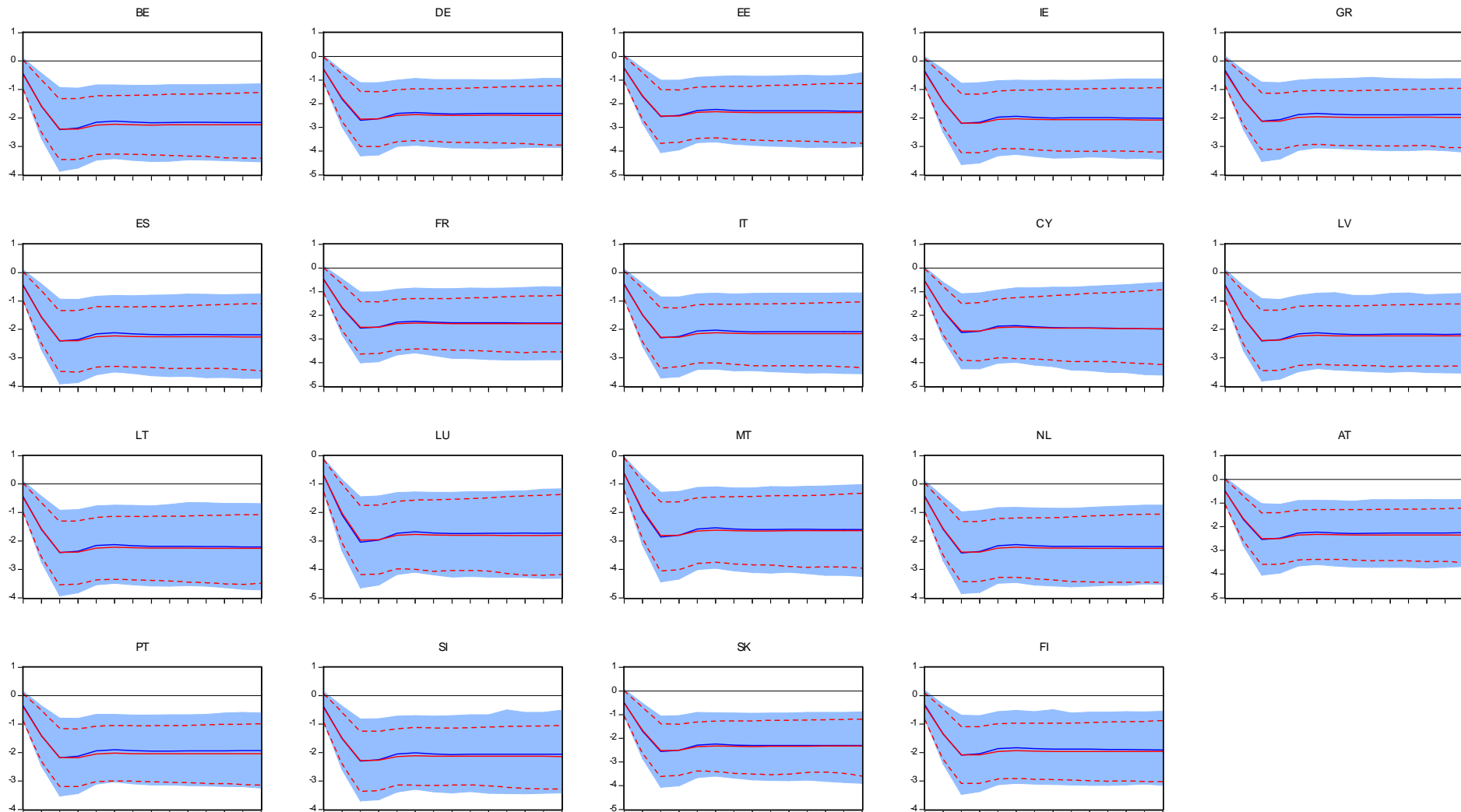


4. Robustness

v. Accounting for self-employment Response of BASE to +1pp in RATE



— response (self) - - - 68% (baseline) — response (baseline) ■ 68% (self)



Data appendix



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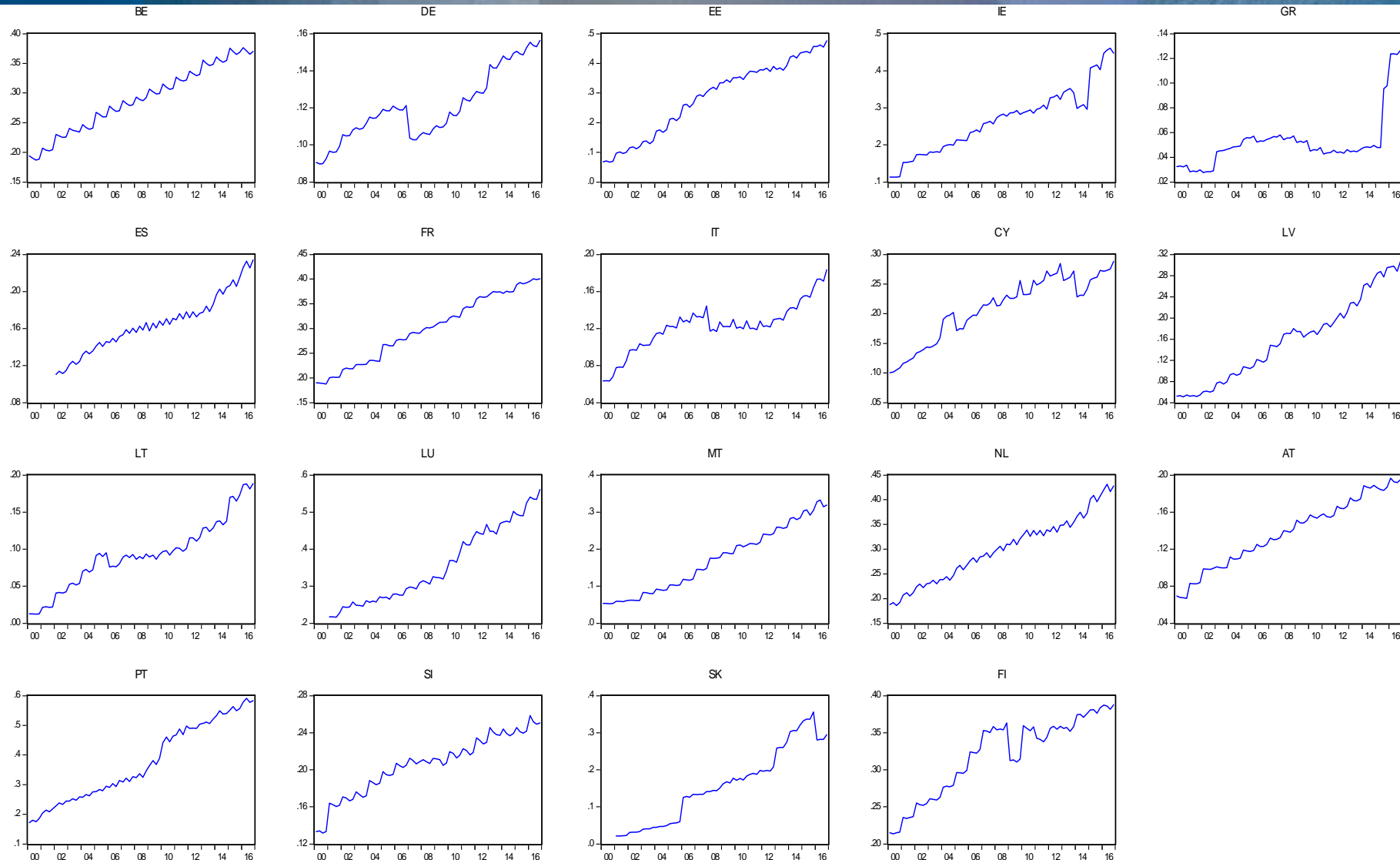
1. $CARDS_t$ = Value of payments with credit and debit cards issued by resident PSPs (except cards with an e-function only), available on an annual basis from the ECB SDW (common EA sample 2002-2016). Transformed into quarterly frequency using the seasonal pattern of $CONS_t$.
2. $CARDSHAREP_t = CARDS_t / CONSP_t$.
3. $CONS_t$ = Final consumption expenditure (nominal), National Accounts (ESA 2010), common EA sample 00q1-16q4.
4. $CONSG_t$ = Final consumption expenditure of the general government (nominal), National Accounts (ESA 2010), common EA sample 00q1-16q4.
5. $CONSP_t = CONS_t - CONSG_t$.
6. INC_t = Intermediate consumption of the general government (nominal), National Accounts (ESA 2010), common EA sample 02q1-16q4.
7. VAT_t = VAT revenue (nominal), National Accounts (ESA 2010), common EA sample 02q1-16q4.
8. $BASE_t = \begin{cases} CONS_t - CONSG_t + INC_t, & \text{post tax} \\ CONS_t - CONSG_t + INC_t - VAT_t, & \text{pre tax} \end{cases}$
9. $RATE_t$ = Standard VAT rate, European Commission (January 2017). Adjusted for the days the reported rates have been in force within a given quarter.
10. $EFFICIENCY_t = \frac{VAT_t}{BASE_t * RATE_t}$.
11. $SELF_t$ = Labour Force Survey quarterly observations on self-employed persons aged 15-74. Common EA sample 05q1-16q4.
12. EMP_t = Labour Force Survey quarterly observations on total number of employed persons aged 15-74. Common EA sample 05q1-16q4.
13. $SELFEMP_t = SELF_t / EMP_t$.

Data appendix

CARDSHAREP 2000q1-2016q4

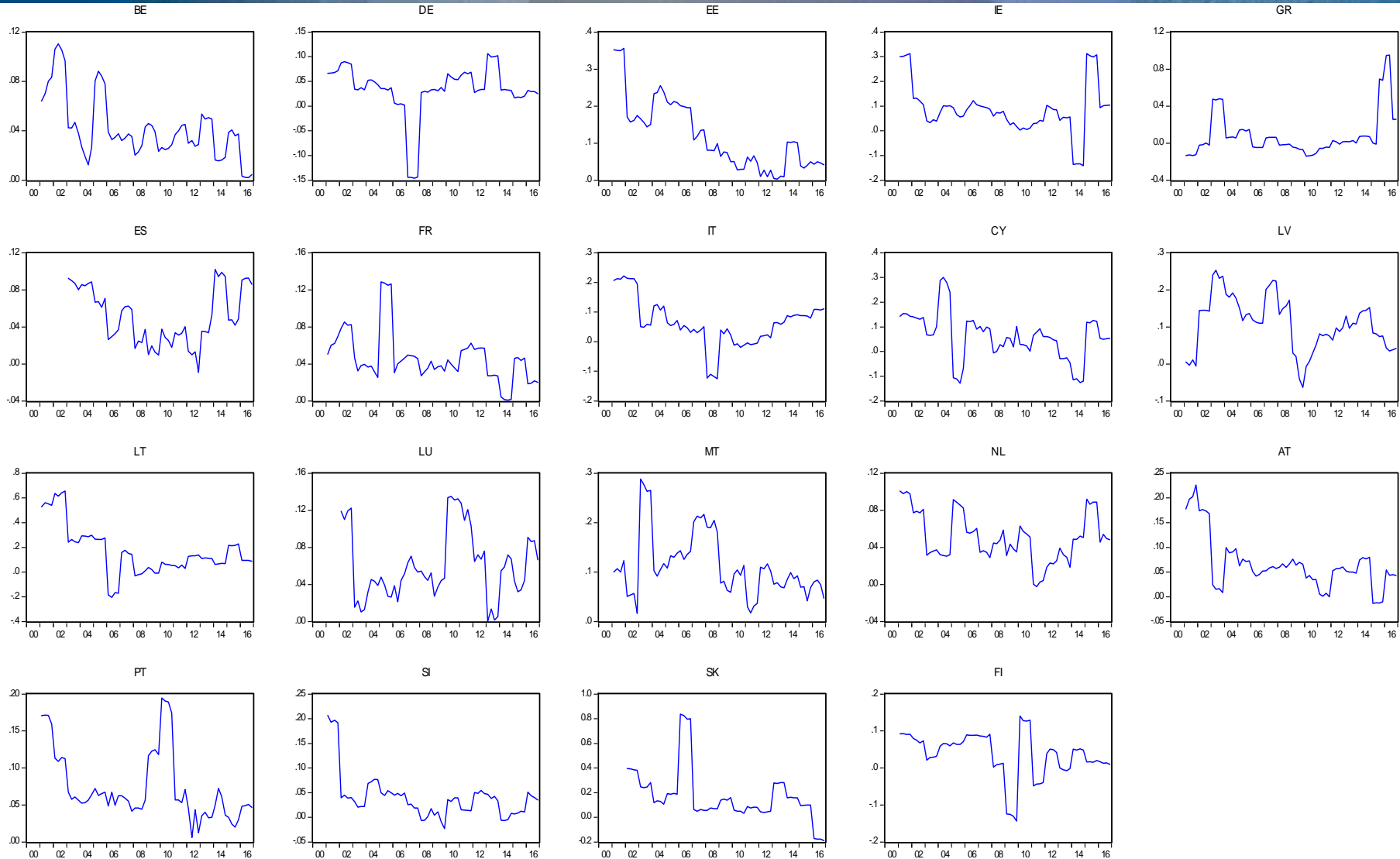


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Data appendix

dlog(CARDSHAREP,0,4) 2000q1-2016q4

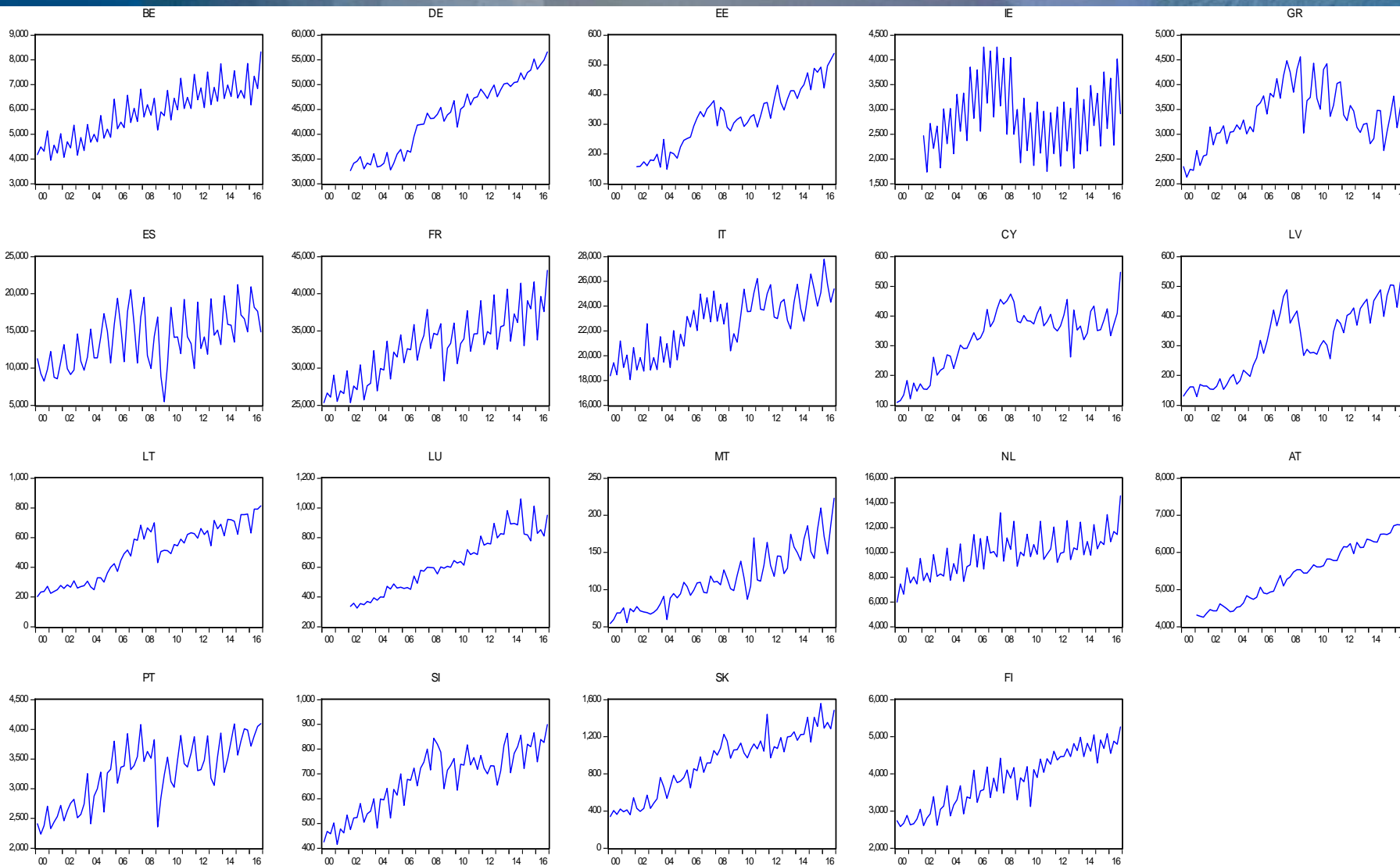


Data appendix

VAT (EUR million) 2000q1-2016q4



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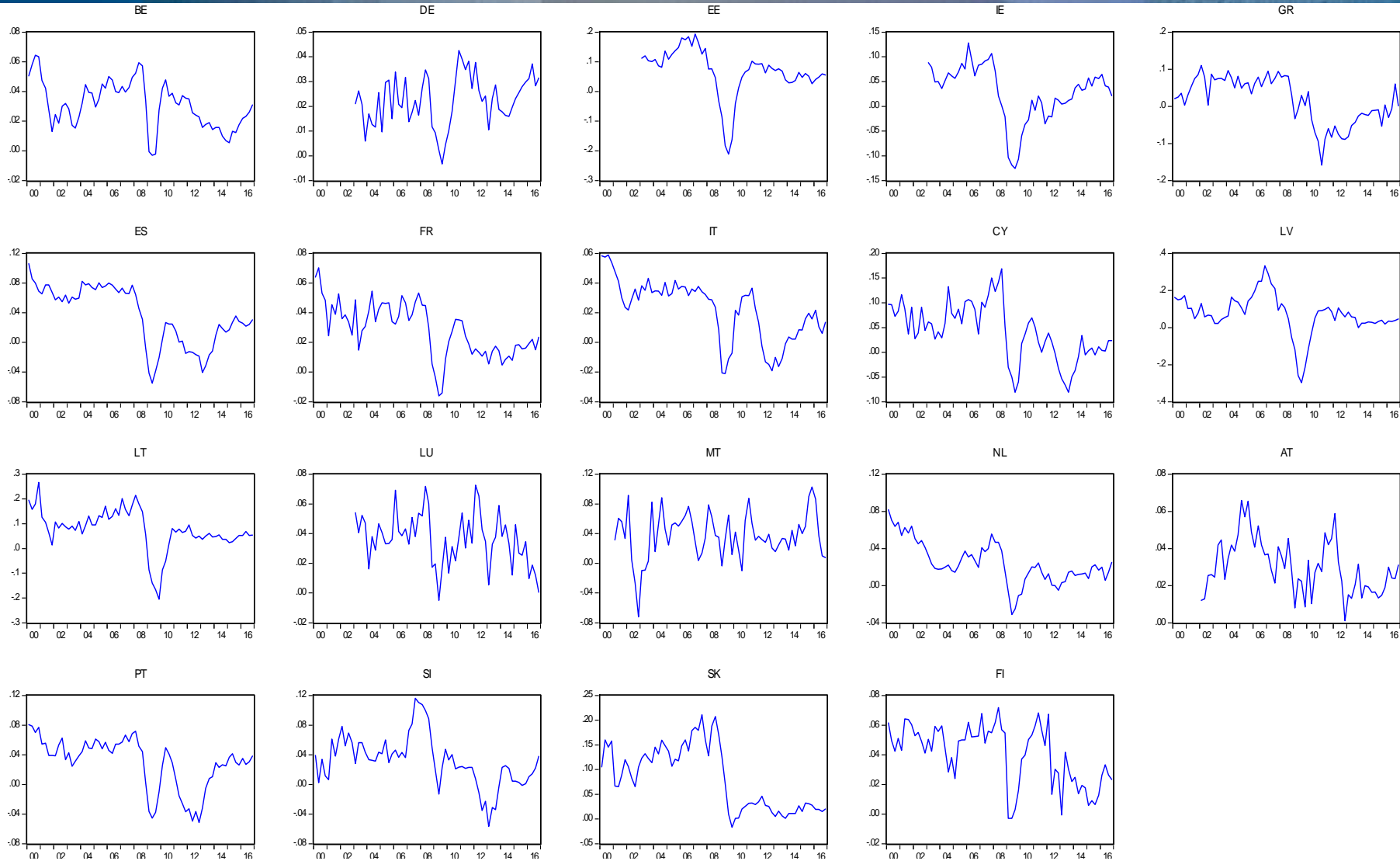


Data appendix

dlog(VAT,0,4) 2000q1-2016q4



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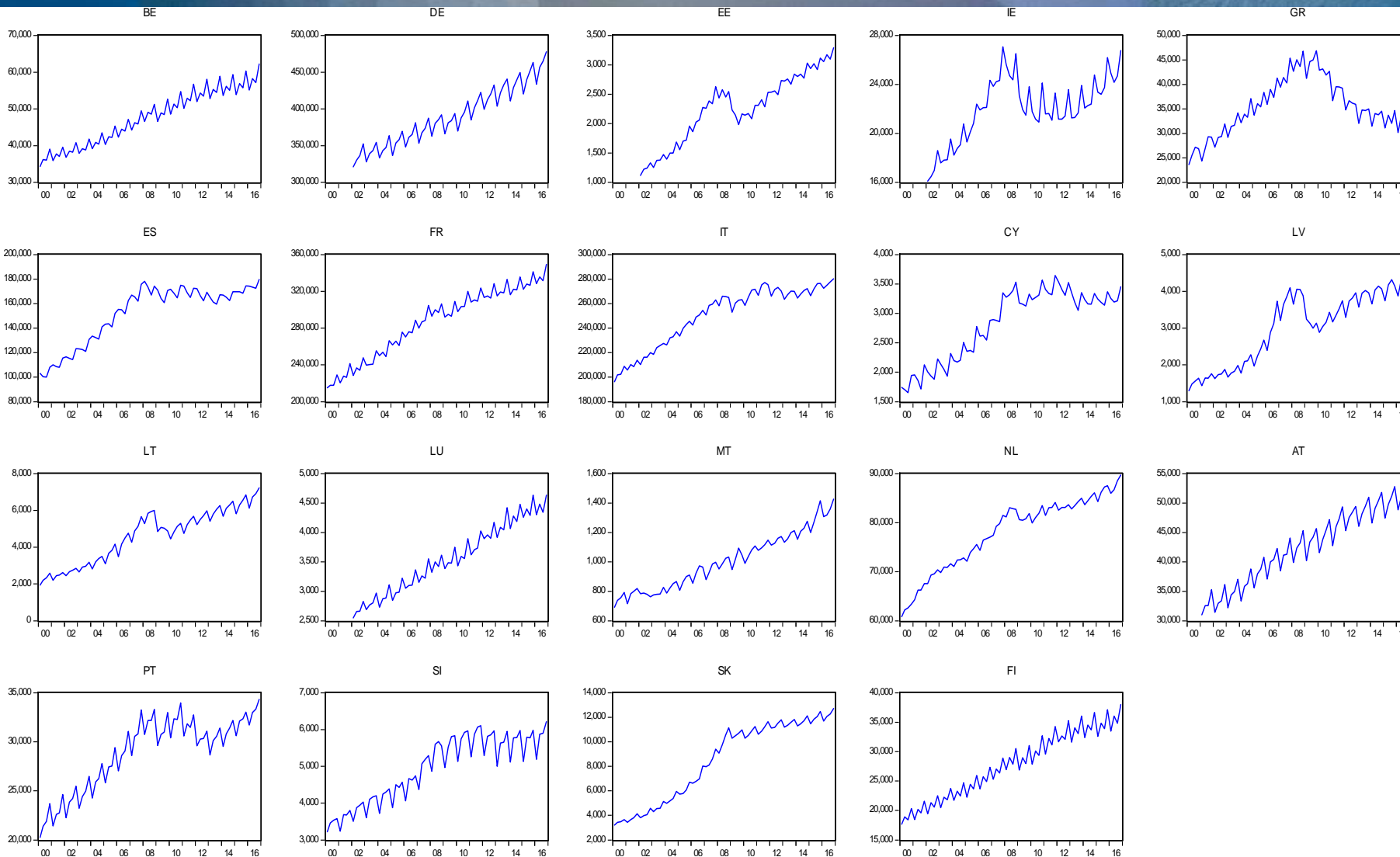


Data appendix

BASE (EUR million) 2000q1-2016q4

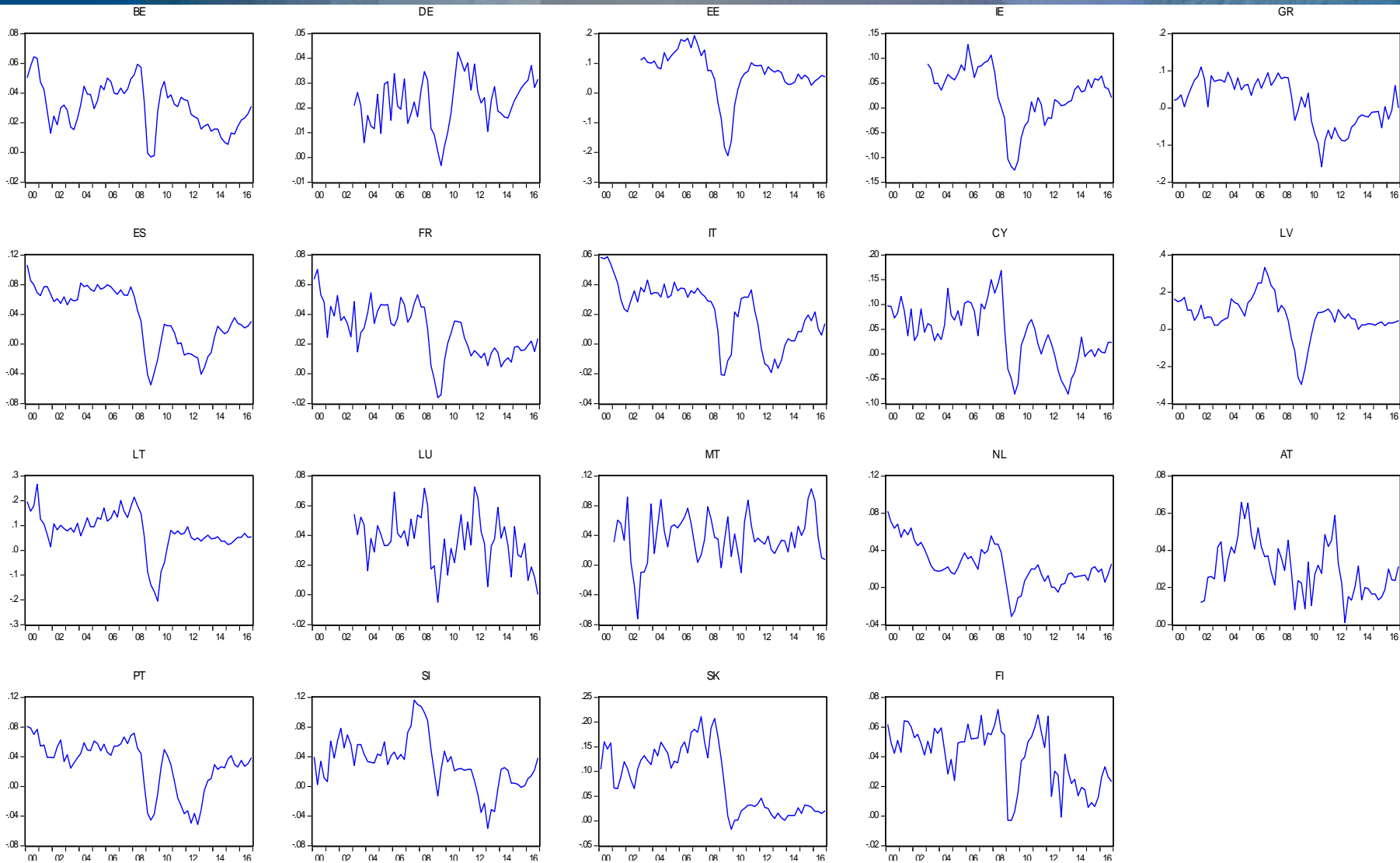


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Data appendix

dlog(BASE,0,4) 2000q1-2016q4

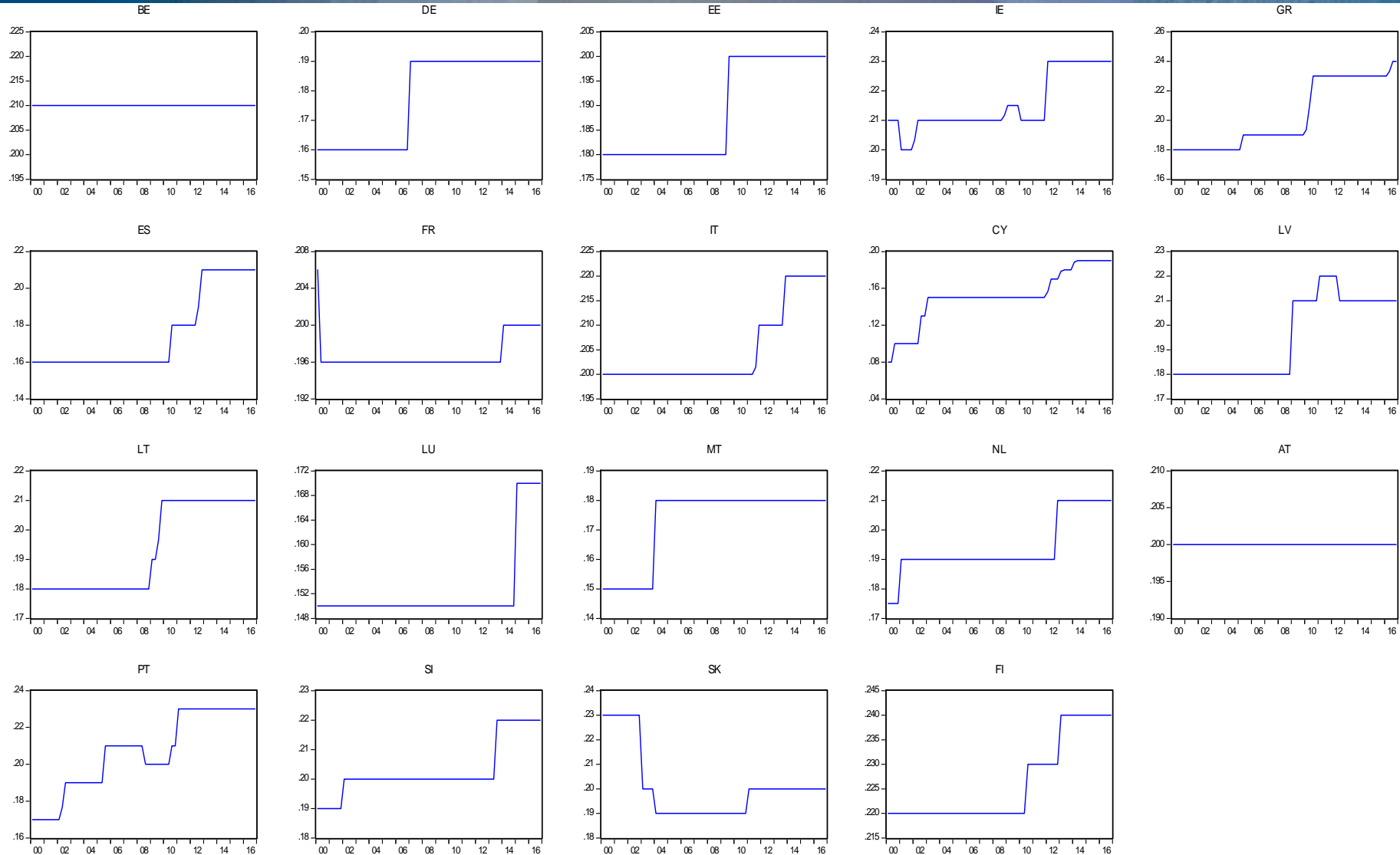


Data appendix

RATE 2000q1-2016q4

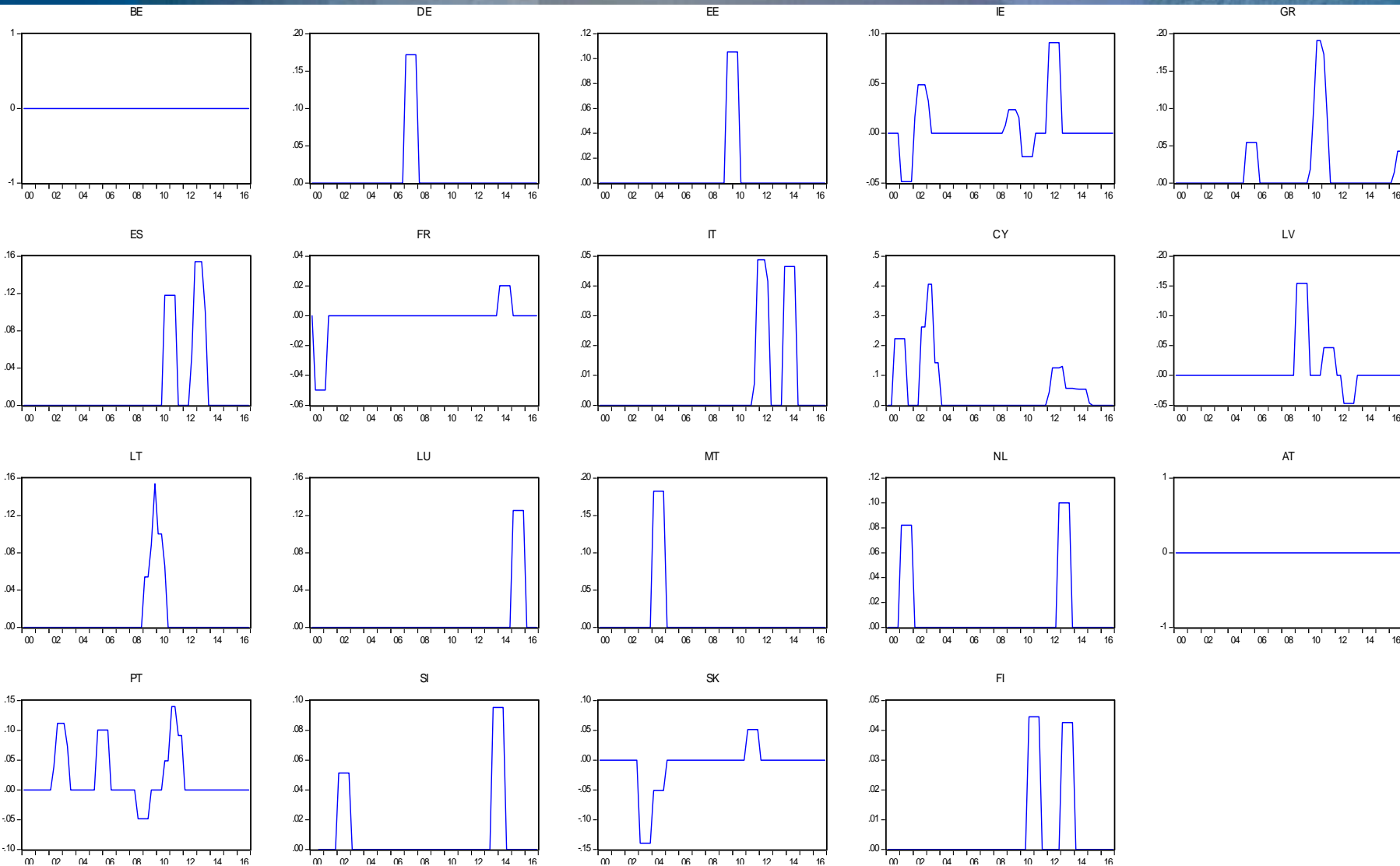


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Data appendix

dlog(RATE,0,4) 2000q1-2016q4

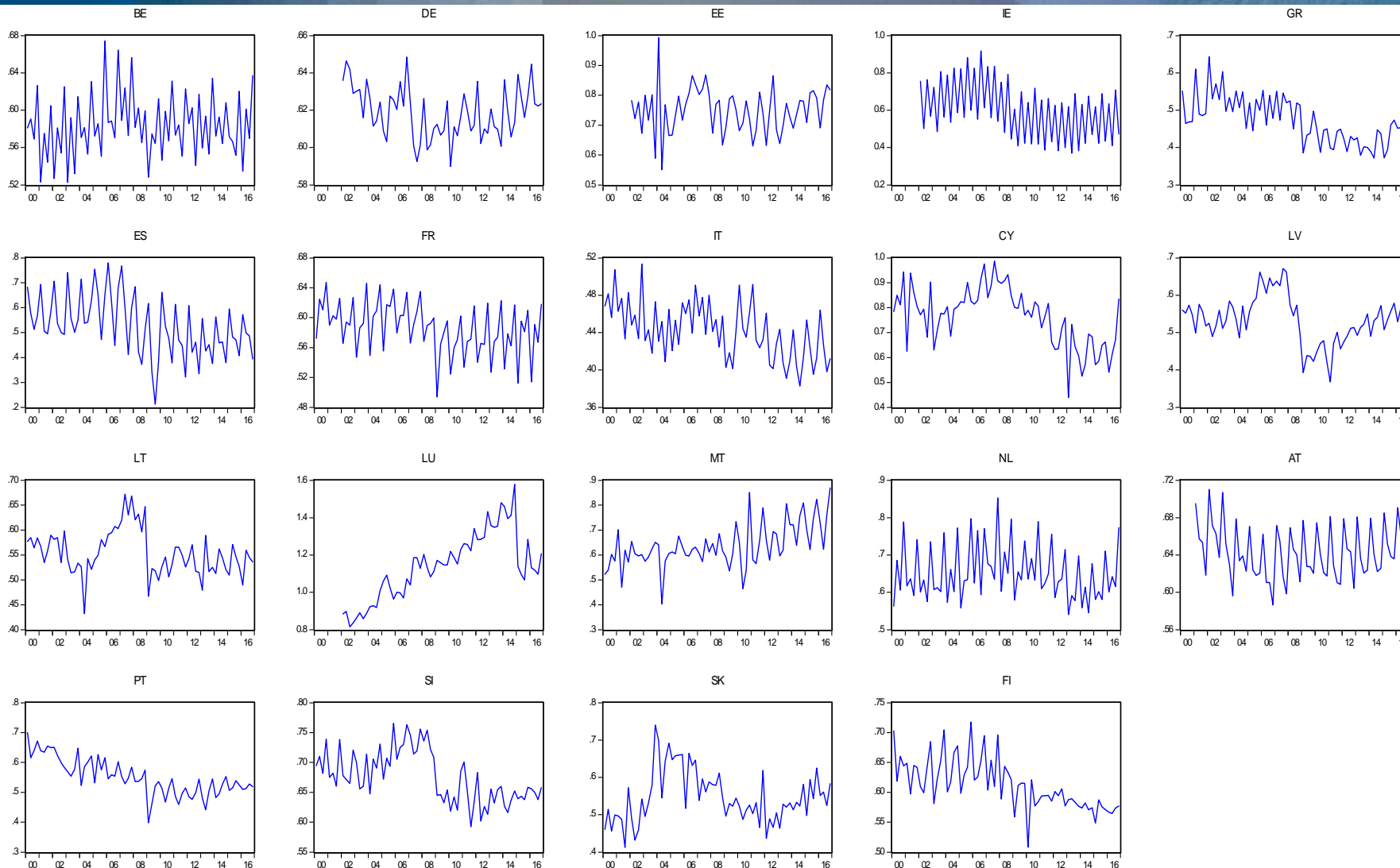


Data appendix

EFFICIENCY 2000q1-2016q4



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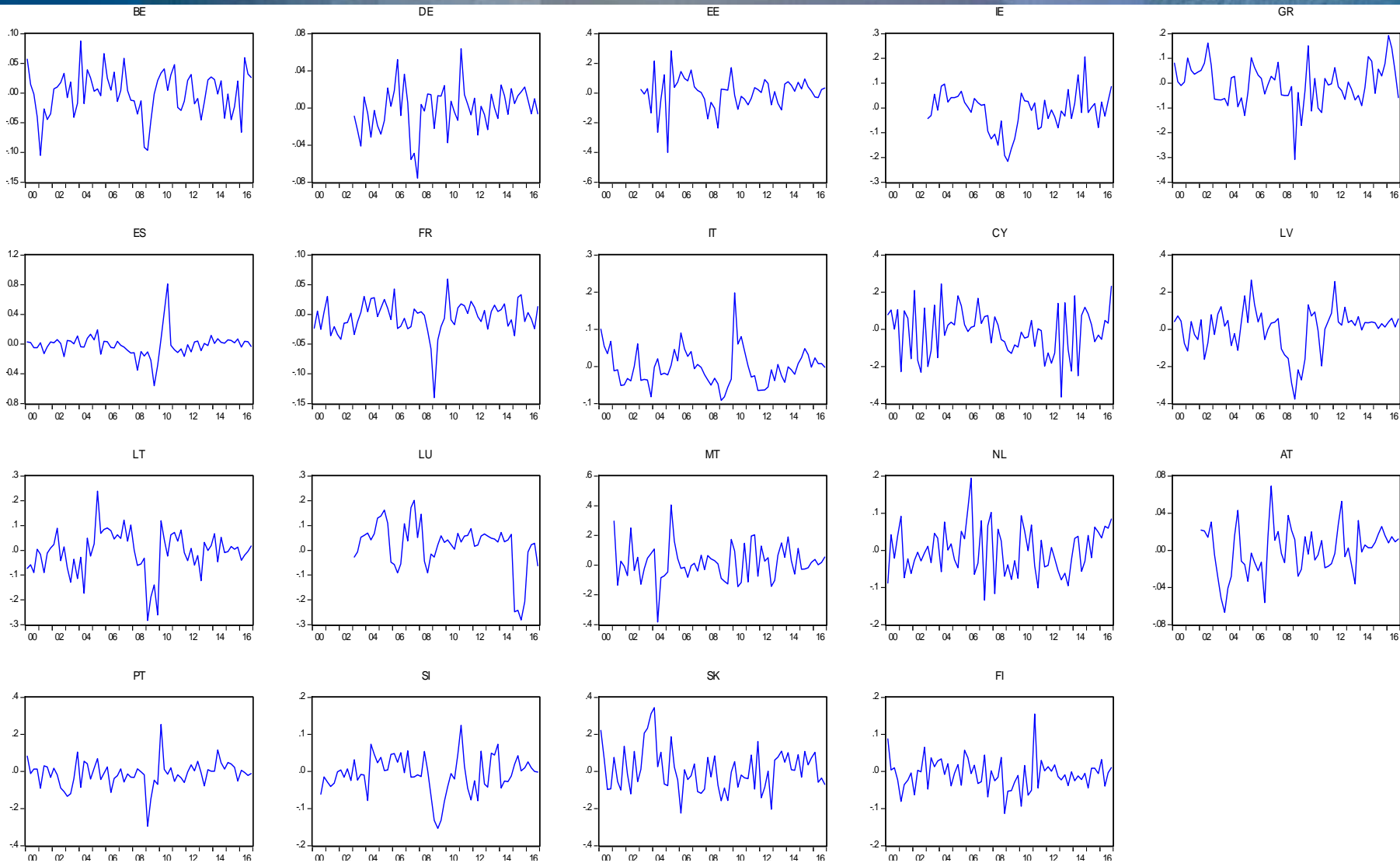


Data appendix

dlog(EFFICIENCY,0,4) 2000q1-2016q4



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Data appendix

SELFEMP 2000q1-2016q4



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