

Hayo, Bernd; Mierzwa, Sascha

**Working Paper**

## The Effect of Legislated Tax Changes on the Trade Balance: Empirical Evidence for the United States, Germany, and the United Kingdom

MAGKS Joint Discussion Paper Series in Economics, No. 03-2021

**Provided in Cooperation with:**

Faculty of Business Administration and Economics, University of Marburg

*Suggested Citation:* Hayo, Bernd; Mierzwa, Sascha (2021) : The Effect of Legislated Tax Changes on the Trade Balance: Empirical Evidence for the United States, Germany, and the United Kingdom, MAGKS Joint Discussion Paper Series in Economics, No. 03-2021, Philipps-University Marburg, School of Business and Economics, Marburg

This Version is available at:

<https://hdl.handle.net/10419/234857>

**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.*

**MAGKS**



**Joint Discussion Paper  
Series in Economics**

by the Universities of  
**Aachen · Gießen · Göttingen  
Kassel · Marburg · Siegen**

ISSN 1867-3678

**No. 03-2021**

**Bernd Hayo and Sascha Mierzwa**

**The Effect of Legislated Tax Changes on the Trade  
Balance: Empirical Evidence for the United States,  
Germany, and the United Kingdom**

This paper can be downloaded from  
<http://www.uni-marburg.de/fb02/makro/forschung/magkspapers>

Coordination: Bernd Hayo • Philipps-University Marburg  
School of Business and Economics • Universitätsstraße 24, D-35032 Marburg  
Tel: +49-6421-2823091, Fax: +49-6421-2823088, e-mail: [hayo@wiwi.uni-marburg.de](mailto:hayo@wiwi.uni-marburg.de)

**The Effect of Legislated Tax Changes on the Trade Balance:  
Empirical Evidence for the United States, Germany, and the  
United Kingdom**

**Bernd Hayo and Sascha Mierzwa  
(University of Marburg)**

This version: 27 January 2021

Corresponding author:  
Bernd Hayo  
Marburg Centre for Institutional Economics (MACIE)  
School of Business and Economics  
University of Marburg  
D-35032 Marburg  
Germany  
Phone: +49-6421-2823091  
Email: hayo@wiwi.uni-marburg.de

# **The Effect of Legislated Tax Changes on the Trade Balance: Empirical Evidence for the United States, Germany, and the United Kingdom**

## **Abstract**

Using a narrative account of quarterly discretionary changes in tax liabilities from 1974Q4 to 2018Q2 in a VAR setting, we study whether legislative tax changes affect the trade balance in the United States, Germany, and the United Kingdom. As legislative tax changes we consider (i) all changes, (ii) personal income tax changes, (iii) business tax changes, (iv) indirect tax changes in Germany and the UK, (v) spillovers of US tax changes into Germany and the UK, and (vi) asymmetric reactions after tax hikes and cuts. Generally, we find that after a reduction in aggregated tax liabilities, imports and exports in the US and Germany react quite similarly: imports tend to rise; exports do not change much. Consequently—and fostered by growing output—the net-exports-to-GDP ratio decreases. We find no clear net effect in the UK. Instead, UK imports only increase after cuts to indirect taxes. However, employing normal variations of the tax changes as a yardstick, the economic magnitude of the estimated effects on the trade variables is not particularly large. Thus, there remain doubts as to whether tax policy is an effective instrument for addressing trade imbalances.

JEL code: E62, F41, H30, K34

Keywords: Fiscal policy, tax policy, legislated tax changes, trade balance, exports, imports, Germany, United Kingdom, United States, VAR, narrative approach

## 1. Introduction

Politicians and economists have long been interested in the German trade surplus and the US trade deficit. In mid-2017, a series of very critical Twitter comments by Donald Trump returned the topic to the limelight. Some economists (Krugman, 2017; Frankel, 2018) believe that the 2017 Trump-initiated tax cuts in the form of the Tax Cuts and Jobs Act (TCJA) worsened the US trade deficit. A number of economists have suggested measures to reduce the German surplus, with fiscal policy playing a prominent role. The ifo Institute recommends a corporate tax reform to boost private investment, which should result in more imports. A similar point is made by Marcel Fratzscher from the DIW Institute, who advocates a change in the tax system in order to incentivise private investment (Fratzscher, 2017). Carl-Christian von Weizsäcker suggests a ‘German current account break’ (Von Weizsäcker, 2017) and expects that a cut in VAT would boost domestic demand and, thereby, reduce the German trade surplus. This position stands in clear contrast to that of the ifo Institute, which argues that a permanent cut in VAT or personal income tax might lead only to higher savings and, therefore, would not address the German trade surplus (Felbermayr et al., 2017). However, all these recommendations seem to be largely based on theoretical rather than empirical evidence, as the empirical relationship between fiscal policy and trade flows has not been studied extensively. The question of whether fiscal policy in the form of legislative tax changes affects the trade balance is the focus of the present study.

A related literature on the ‘twin deficit hypothesis’ identifies a positive correlation between the US budget deficit and the US current account deficit (Enders & Lee, 1990; Bachman, 1992). However, in a panel of 21 OECD countries, Bussière et al. (2005) find that it is productivity shocks, not the budget balance, that have the dominate effect on the current account. Moreover, in the case of the United States, Kim and Roubini (2008) find that an expansionary fiscal policy shock or a government budget deficit shock depreciates the real exchange rate and, thereby, might even improve the current account. In a panel of 10 OECD countries, Corsetti and Müller (2008) find a similar relationship.

As the current account is a noisy measure for the trade balance, other authors look explicitly at trade and its components. When investigating the effects of public spending in the European Union, Beetsma et al. (2008) study both the trade-balance-to-GDP ratio as well as imports and exports separately. Tax policies are not considered, as ‘the effects of the former [public spending shocks] have been investigated in more detail both in theory and in empirical work’ (Beetsma et al., 2008, p. 415). In these authors’ six-variable panel vector autoregression (VAR), a public spending shock equal to 1% of GDP raises imports and reduces exports, resulting in a worsening of the trade balance by 0.8% of GDP after two years.

Investigating the effect of taxes in a panel of 17 OECD countries over the period 1960–1995, Lane and Perotti (1998) find neither an effect of labour taxes on the trade balance nor on exports and imports individually. They consider this outcome counterintuitive, as they expected that higher labour costs would depress the level of output in the traded goods sector. The authors conjecture that this finding

could be due to the poor quality of their tax data (Lane & Perotti, 1998, p. 890). An expansion in government wage consumption, in contrast, leads to a deterioration of the trade balance, mainly driven by a crowding-out of exports.

In a structural VAR (SVAR) model using Greek quarterly data from 2000 to 2013, Tagkalakis (2015) investigates the influence of direct and indirect taxes on exports and imports. He finds that an unexpected household tax hike reduces output, which in turn lowers import demand, whereas exports increase on impact, before declining persistently. The author argues that firms facing a declining demand after the tax shock immediately try to sell their products abroad. A hike in business taxes boosts exports for about four to five quarters, after which they turn negative. Finally, an increase in VAT decreases net exports.

For their analysis of the determinants of the German current account, Kollmann et al. (2014) use a multi-country dynamic stochastic general equilibrium (DSGE) model, which includes Germany, the euro area, and the rest of the world. The authors identify positive shocks to the German saving rate and external demand shocks, as well as the German labour market reform in the early 2000s, to be the main factors driving the German surplus. Modelling fiscal policy shocks by government spending, they find that a 1 euro hike in government expenditures lowers German net exports by about 0.35 euros. While the impact of tax shocks is not explicitly modelled, the authors mention the importance of tax incentives introduced in the context of pension reforms as an explanation for the surge in German private saving.

Also employing a DSGE model, the German Federal Ministry for Economic Affairs and Energy (BMWi) simulates the effects of an indirect tax shock on exports and imports. After a decrease in indirect taxes equal to 1.8% of GDP, real imports increase by about 0.5%, while real exports decrease by about 0.25% (BMWi, 2017, p. 14). Reasons for that decline are an increase in domestic consumption and a loss in external competitiveness. The authors discover that the total effect is a rather moderate decrease in net-exports-to-GDP ratio of 0.25%. Given the small magnitude of the effect and the notable loss in government revenues, they do not recommend such a policy (BMWi, 2017, p. 14).

Belke et al. (2020) argue that the German trade surplus is a problem of potential output growth. They find that measures increasing domestic demand are typically short-lived, whereas productivity-enhancing changes in technology can lower the trade surplus. As expectations about long-run growth improve, investment becomes more attractive, domestic demand increases and, thereby, imports also increase.

Our contribution to the literature is a systematic analysis of the effect of legislative tax changes on trade in the United States, Germany, and the United Kingdom. Studying these three countries will be interesting and informative, as the US trade balance is characterised by a persistent deficit, the German one by a persistent surplus, and the UK one is in between these extremes.

In a VAR framework, we use narratively identified tax shocks and quarterly data spanning the period 1974Q4 to 2018Q2. We study the development of real exports and imports as well as that of the

net-exports-to-GDP ratio, which is usually more important in policy discussions than the absolute trade balance. As legislative tax changes we consider (i) all changes, (ii) personal income tax changes, (iii) business tax changes, (iv) indirect tax changes in Germany and the United Kingdom, (v) spillovers of US tax changes into Germany and the United Kingdom, and (vi) asymmetric reactions after tax hikes and cuts.

Generally, we find that after a reduction in aggregated tax liabilities, imports and exports in the United States and Germany react quite similarly: imports tend to rise; exports do not change much. Consequently—and fostered by growing output—the net-exports-to-GDP ratio decreases. We find no clear net effect in the United Kingdom. Instead, UK imports increase only after cuts to indirect taxes. However, employing normal variations of the trade variables as a yardstick, the economic magnitude of the estimated effects is not particularly large and, thus, there remain doubts as to whether tax policy is an effective instrument for addressing trade imbalances.

The rest of the paper is organised as follows. Section 2 introduces the dataset and the empirical research methodology and Section 3 the aggregate empirical analysis. In Section 4, the tax shocks are disaggregated, Section 5 allows for asymmetric reactions, and Section 6 considers international spillovers. We present some robustness checks in Section 7; Section 8 concludes.

## **2. Data and Methodology**

We identify tax shocks based on the narrative approach developed by Romer and Romer (2009). Using the same methodology, Cloyne (2012) and Uhl (2013) systematically coded tax legislation in the United Kingdom and Germany, respectively. We extend Romer and Romer's (2009) data by more than 50 quarters and Cloyne's (2012) and Uhl's (2013) data by almost 30 quarters, so that our samples now cover the period from 1974Q4 until 2018Q2. Following Hussain and Malik (2016), we focus on permanent tax changes and thus omit temporary ones. We use the narrative account to break down the tax changes into personal income tax liabilities, corporate income tax liabilities, and German indirect tax liabilities. Comparing the United States, Germany, and the United Kingdom will be interesting, as they have different legislative processes (US and Germany processes fairly similar; the UK one very different; see below), dissimilar degrees of openness (United States rather closed, United Kingdom quite open, Germany very open), and opposite trade balances (persistent deficits in the United States, persistent surpluses in Germany, the United Kingdom in between).

The narrative account uses changes in expected tax revenues after implementation of tax laws and, thus, provides information about discretionary tax legislation. Instead of employing the aggregated numbers of the full tax bill, as is done, for example, by Romer and Romer (2010) and Mertens and Ravn (2013), we follow Cloyne (2012) and Uhl (2013), who disaggregated the tax bills into their individual components. This allows us to consider asymmetric effects, as in Jones et al. (2015) and Hussain and

Malik (2016), as well as spill-over effects, as in Clancy (2019) and Metelli and Natoli (2019). In addition, we can study changes in different types of taxes and obtain a precise timing of the shocks, as we identify the implementation dates of every single measure. In total, our analysis is based on more than 1,400 US tax changes, more than 1,800 German tax changes, and more than 2,500 UK tax changes. Note that disaggregating tax shocks has at least three drawbacks. First, we have to assume that the estimated revenues of tax changes are exogenous, as it becomes all but impossible to implement instrumental variable estimation (see Mertens & Ravn, 2013; Stock & Watson, 2018) for all the various types of taxes changes. Second, disaggregation reduces the number of available observations for specific tax changes, potentially decreasing external reliability by allowing outliers to influence statistical inference. Third, estimating a more general specification containing more parameters results in a loss of estimation efficiency.

Eliminating potential endogeneity with respect to income should not be important, as we focus on international trade. Instead, identification is based on excluding tax shocks that are endogenous with regard to trade performance. However, in practice, tax legislation rarely reacts to the trade balance. In fact, for the US and Germany, we only find one tax measure in each country.<sup>1</sup> In the case of the UK, all tax measures between November 1974 to July 1976 and three measures announced on 15 July 1977 were motivated by severe balance of payment deficits (see Cloyne, 2012). Moreover, we drop the reduction of the car tax from 11 March 1992, which was motivated by the high export share of the motor industry (Cloyne, 2012). To avoid endogeneity concerns, we exclude these instances from the analysis, but including them would not affect the results. In line with the extant literature, we scale our tax shocks to 1% of nominal GDP at the time of implementation. However, we believe the interpretation of the magnitude of typical economic policy measures is better approximated by rescaling the effects in terms of a one standard deviation change in tax revenues. Regarding the timing of the shocks, we shift them to the next quarter when implementation was in the second half of the respective quarter.

Following Beetsma et al. (2008) and Tagkalakis (2015), our macroeconomic variables are the logarithms of real exports and imports, real GDP, and the real effective exchange, all seasonally adjusted (see Table A1 in the Online Appendix for details). GDP, exports, and imports are deflated by their respective deflators. The real effective exchange rate reflects unit labour cost. An increase in the real effective exchange rate implies an appreciation and, hence, a decrease in international competitiveness.

---

<sup>1</sup> The US measure was a relief for start-ups included in ‘The Small Business Jobs Act of 2010’ and introduced with the aim of promoting exports. The German ‘Gesetz zur Änderung des Einkommensteuergesetzes’ (StSenkErwG 1988) was supposed to strengthen domestic demand and contribute to an equalisation of the trade balance (see Uhl, 2013).



We add the exogenous tax shock series to the reduced form of a standard VAR:

$$y_t = Cv_t + A(L)y + B(L)\Delta\tau + u_t, \quad (1)$$

where  $y_t$  is the vector of endogenous variables, that is, real exports, real imports, real GDP, and the effective exchange rate, and  $\Delta\tau$  is the series of exogenous tax shocks. Due to stationarity concerns, we take first differences of the logged variables, thereby transforming them into growth rates. Alternatively, we study a parsimonious specification that only includes the net-exports-to-GDP ratio instead of the three variables separately. Typically, this ratio is more relevant in policy discussions about persistent trade balances than is absolute trade development. The ratio enters as its first difference as well, as suggested by unit root tests and Lane and Perotti (1998).<sup>2</sup>  $A(L)$  and  $B(L)$  are lag-polynomials.  $v_t$  contains deterministic terms, namely, the intercept and a step-dummy for the global financial crisis, which takes the value 1 between 2007Q4 and 2009Q4. In the case of Germany, we also include an impulse-dummy for reunification, which takes the value 1 in 1991Q1.<sup>3</sup> Most information criteria point toward adding only one lag of the endogenous variables. Including one lag, however, does not remove autocorrelation from the error terms in the German VAR. Therefore, we estimate a VAR with five lags, which removes autocorrelation up to order 10. For the sake of estimation efficiency, we stick to one lag for both the United States and the United Kingdom, which is supported by FPE, BIC, and AIC. This specification removes autocorrelation up to order 5 and also corresponds to the number of endogenous lags used in Mertens and Ravn (2012) and Hussain and Liu (2018).

### 3. The Effect of Aggregated Tax Shocks on Trade

We commence our analysis by estimating a VAR as set out in Equation (1). The shocks underlying the impulse-response functions (IRFs) reflect a *decrease* in tax liabilities equal to 1% of nominal current GDP. The one-standard-error confidence bands based on a parametric bootstrap with 1,000 repetitions are plotted in grey. Note that, by definition, the net-exports-to-GDP ratio depends on development of the real trade balance and that of real GDP. For the United States and Germany, we generally find that GDP responds to taxes in a qualitatively symmetric way, that is, it becomes significantly positive (negative) after a tax cut (hike). In the United Kingdom, however, we observe asymmetric behaviour in the GDP response, as tax increases affect GDP negatively, whereas tax decreases have no significant effect.

Starting with the United States, Panel (1) of Figure 1 shows that exports decrease by up to 4% within the first six quarters after the shock. Panel (2) demonstrates that imports react quickly after the tax cut and then converge towards an increase of about 8% roughly two and a half years after the event.

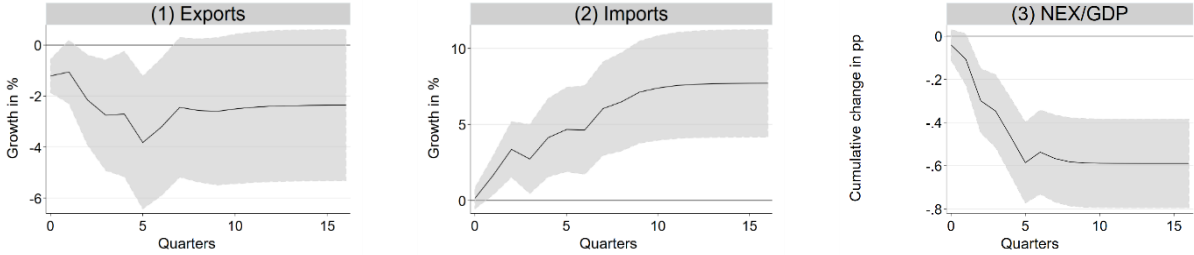
---

<sup>2</sup> The number of lags was determined by the Schwert criterion. Neither the Dickey-Fuller test nor the KPSS test excludes the possibility of stochastic non-stationarity.

<sup>3</sup> A step-dummy controlling for the European debt crisis was not significant and we do not include it in the presented model.

The effects on imports and exports are similar in size and duration to those reported by Romer and Romer (2010).

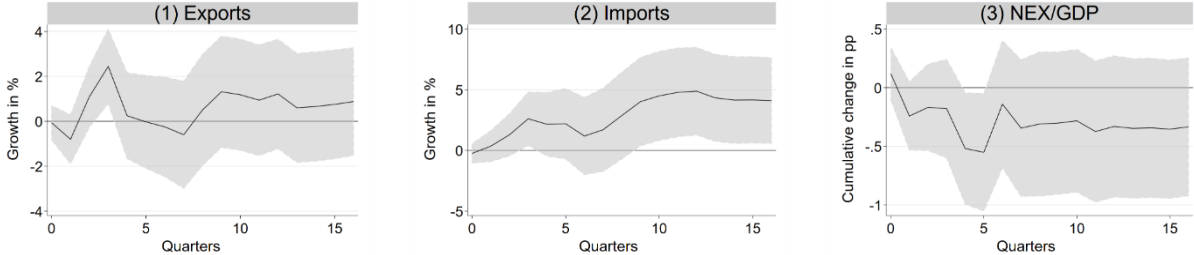
**Figure 1: US: Aggregated Tax Shocks**



*Notes:* The figure shows the response of (1) real exports, (2) real imports, and (3) NEX/GDP to a tax cut corresponding to 1% of GDP over 16 quarters following the shock. The shaded area represents the 68% confidence bands retrieved from a parametric bootstrap with 1,000 repetitions. The cumulative response in Panels (1) and (2) is in per cent and in percentage points in Panel (3).

Our estimate of the effect of a tax cut on GDP is similar to the one reported by Romer and Romer (2010) when all legislated tax shocks and no controls were included (1.86 and 2.02, respectively). The net-exports-to-GDP ratio in Panel (3) depicts a straightforward deterioration of the US trade balance after a tax cut, which converges to roughly 0.6 percentage points (pp) (about 0.4 standard deviations).

**Figure 2: Germany—Aggregated Tax Shocks**



*Notes:* See Figure 1.

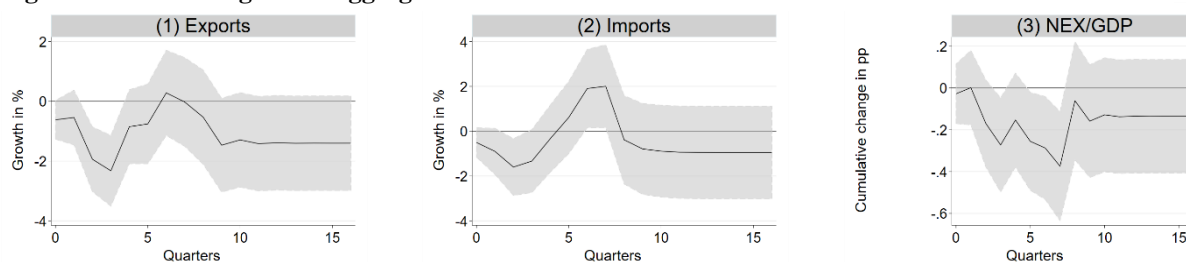
Switching our focus to Germany, Panel (2) of Figure 2 shows that over a time horizon of 16 quarters, German imports increase by about 5%, which is similar to Cloyne’s (2013) estimate for the United Kingdom. The peak effect occurs after 12 quarters. The effect of the tax reduction on GDP is positive, with an increase of about 2.2%, which is similar to the 2.4% reported in Hayo and Uhl (2014). Panel (1) shows that exports are barely affected. While there is an initial increase of about 2.5% after three quarters, the effect becomes insignificant thereafter. This increase is likely driven by the roughly 2% depreciation of the real exchange rate within the first three quarters after the shock.<sup>4</sup> The net-exports-to-GDP ratio drops by about 0.5 pp, but the effect is not consistently significant over the full observation window.

To assess whether a movement of that size is noteworthy, we compare it in terms of the ratio’s normal volatility measured in standard deviations, which, in this case, is equivalent to about 0.1 standard

<sup>4</sup> All omitted results are available on request.

deviations. Hence, the movement in the net-exports-to-GDP ratio after a notable tax change of 1% of GDP is relatively small when compared to its normal variation.

**Figure 3: United Kingdom—Aggregated Tax Shocks**



*Notes:* See Figure 1.

Turning now to the United Kingdom (see Figure 3), we observe a drop in exports, a response similar to that found for the United States. The peak effect two quarters after the tax cut is a bit smaller than that in the United States, though, reaching only 2%. Note that Cloyne (2013), who only considers tax shocks exogenous to the business cycle, reports no significant effect on exports. The decrease in exports here could be explained by the reaction of the real exchange rate, which appreciates up to 5% over the forecast horizon, the same reaction Cloyne (2013) reports.

The hump-shaped response of imports in Figure 3 resembles the results in Cloyne (2013) but is of lower magnitude. The positive peak effect coincides with the one in GDP, which increases by 1.3% six quarters after the shock. This effect lies in between Cloyne’s (2013) baseline estimation of 2.5% and his robustness exercise using all tax shocks (below 1%). Similar to the other two countries, the net-export-to-GDP ratio drops by about 0.4 after seven quarters (about 0.2 standard deviations). Thus, the worsening of the net-exports-to-GDP ratio after a tax cut is remarkably similar across the three countries.

A useful way of assessing whether the estimated movements in the trade variables imply effectiveness of tax cuts as a fiscal policy in a real-world situation is to consider them in millions of nominal local currency and then obtain a ‘normal’ tax change by multiplying the peak effect by the standard deviation (in nominal euros, US dollars, or British pounds) of the respective shock. Doing so reveals that the increase in German and US imports shrinks to 1.6% and 1.7%, respectively. The effect on the net-export-to-GDP ratio becomes roughly  $-0.2$  pp in all three economies, which is one-third the size of the effect of a 1% of GDP shock.

#### **4. The Effect of Disaggregated Tax Shocks on Trade**

Mertens and Ravn (2013) demonstrate the importance of differentiating between types of taxes, which is why we disaggregate our tax shocks series. Theoretically, the narrative approach allows analysing the effect of any kind of tax legislation, but, in practice, disaggregation often results in too few observations per specific tax change. We focus on three broad categories: personal income tax liabilities, corporate

income tax liabilities, and indirect taxes.<sup>5</sup> In the United States, sales tax is collected at the state level and is not part of our dataset. Therefore, we can study indirect taxes only in the case of Germany and the United Kingdom; these make up about 30% of German federal tax revenues and about 20% of total UK revenues.

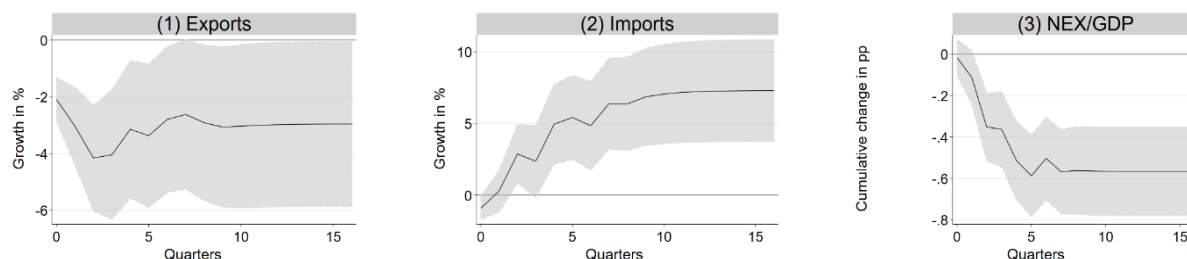
As mentioned in Mertens and Ravn (2013) and Hussain and Malik (2016), a characteristic of the narrative framework is that different types of taxes are highly correlated, as tax legislation typically changes several types of tax measures at the same time. We control for this by simultaneously including the respective other tax shock series. The model becomes:

$$y_t = C v_t + A(L)y + B(L)\Delta\tau^{\text{PI}} + D(L)\Delta\tau^{\text{CI}} + E(L)\Delta\tau^{\text{ID}} + u_t, \quad (2)$$

where  $C$ ,  $v_t$ ,  $A(L)$ ,  $y$ , and  $u_t$  are defined as before and  $B(L)$ ,  $D(L)$ , and  $E(L)$  are lag polynomials of order 8. The tax shock series is now decomposed into shocks to personal income tax liabilities,  $\Delta\tau^{\text{PI}}$ , corporate income tax liabilities,  $\Delta\tau^{\text{CI}}$ , and, in the case of Germany and the United Kingdom, indirect taxes,  $\Delta\tau^{\text{ID}}$ .

Starting with a personal income tax cut, the IRFs for the US trade variables in Figure 4 look quite similar to the ones based on aggregated tax shocks in Figure 1. As was the case for the aggregated tax shocks, exports decrease by about 4%, which is likely due to the accompanying real exchange rate appreciation.

**Figure 4: United States—Personal Income Tax Shock**



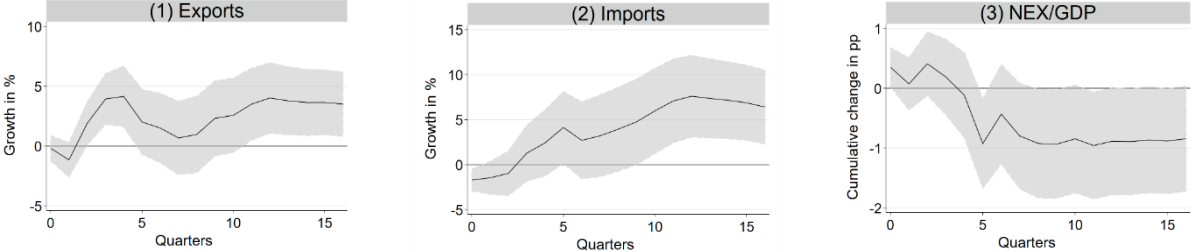
Notes: See Figure 1.

Panel (3) of Figure 4 illustrates that a permanent personal income tax reduction causes a permanent decrease in the net-exports-to-GDP ratio of approximately 0.6 pp after about one year, which translates into 0.4 standard deviations of this ratio.

<sup>5</sup> Similar to Mertens and Olea (2018), we use a broad measure of personal income. We classify taxes borne by non-corporations as ‘personal income tax’ (e.g., wage tax, allowances, self-assessed income tax, employee share of SSC contributions, and capital income) and taxes borne by corporations as ‘corporation tax’ (e.g., corporate tax rates, changes in depreciation schedules, employer share of SSC contributions). German and UK indirect taxes comprise all indirect tax liabilities, for example, VAT, sales tax, and excise duties. Following Mertens and Ravn (2013), we do not consider US excise duties.

Panel (1) of Figure 5 shows a significant increase in German exports, with a maximum hike of about 4%. As can be seen in Panel (2), imports increase too, by roughly 8% over the course of three years.

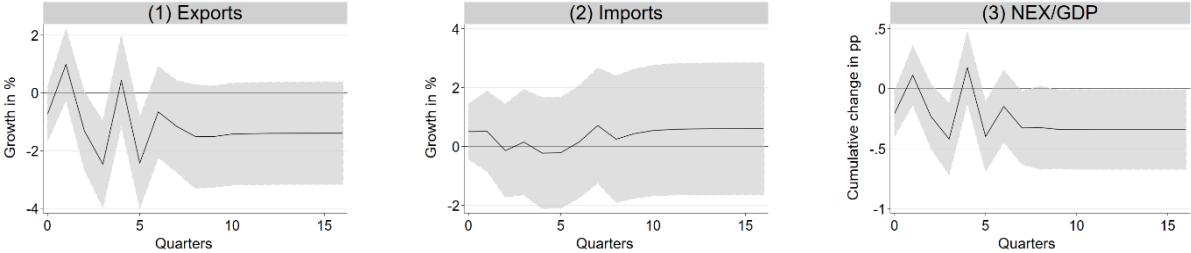
**Figure 5: Germany—Personal Income Tax Shocks**



Notes: See Figure 1.

Panel (3) of Figure 5 considers the net-exports-to-GDP ratio and generally shows a deterioration of Germany’s trade balance after a decrease in personal income taxes. The peak effect is somewhat higher than at the aggregate level, namely, around 1 pp (or 0.2 standard deviations). Thus, in contrast to what Felbermayr et al. (2017) predict, our estimations suggest that permanent cuts in personal income taxation do seem to affect German trade variables. Contrary to Lane and Perotti (1998), we find significant reactions of trade variables to personal income taxes in both Germany and the United States.

**Figure 6: United Kingdom—Personal Tax Shocks**

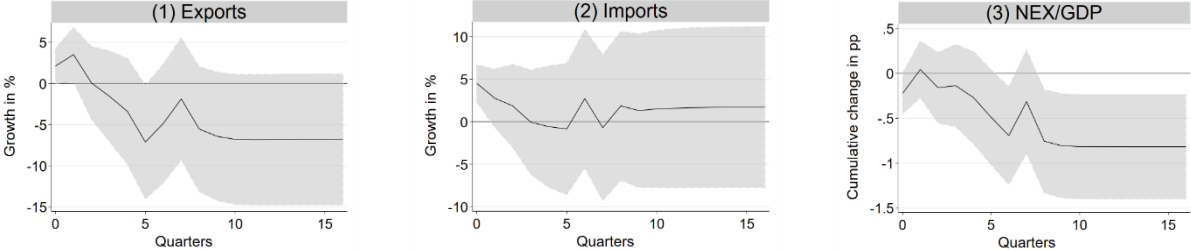


Notes: See Figure 1.

After a cut in personal income taxes, UK exports have a reaction similar to that of US exports, as was the case for aggregated taxes (see Panel (1) in Figure 6). The peak effect, however, is more erratic in the first 1.5 years after the shock, short-lived, and only about half the size. Imports are not influenced by a cut in personal income taxes, which is in contrast to our findings for the United States and Germany. The effect on GDP, not shown here, is even negative on impact, before turning insignificant after one quarter. While this outcome seems counterintuitive, it is in line with Hussain and Liu’s (2018) report of a negative effect of personal income tax cuts on GDP. Hence, the net-export-to-GDP ratio follows the path of real exports and decreases, although hardly significantly, by about 0.5 pp (or 0.24 standard deviations).

Figure 7 shows how US trade variables react to business tax shocks. Panel (1) illustrates that exports increase significantly on impact, by roughly 4%. They then begin to fall, undershooting the baseline by roughly 7%. However, this effect is barely significant.

**Figure 7: United States—Corporate Income Tax Shock**

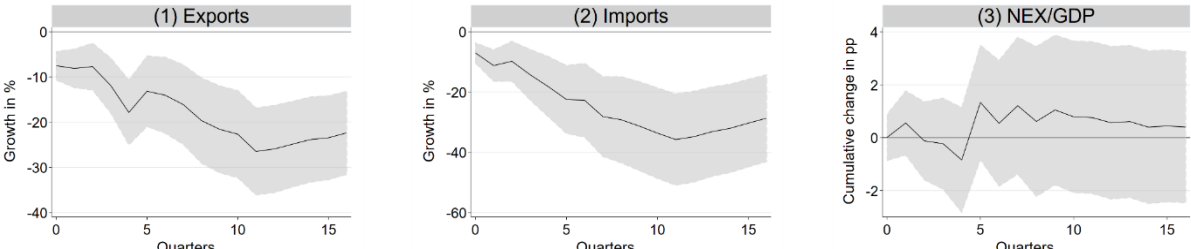


Notes: See Figure 1.

Panel (2) of Figure 7 shows that imports jump upward during the first year, but then the effect becomes insignificant. Panel (3) makes the net effect clear: a cut in business taxes has a negative effect on the US net-exports-to-GDP ratio, which declines by roughly 1 percentage point (0.6 standard deviations).

In the case of Germany, trade reacts differently to a reduction in business taxes. Panel (2) of Figure 8 shows that imports drop immediately upon impact and that the peak effect is a massive reduction of more than 30%.

**Figure 8: Germany—Corporate Income Tax Shock**



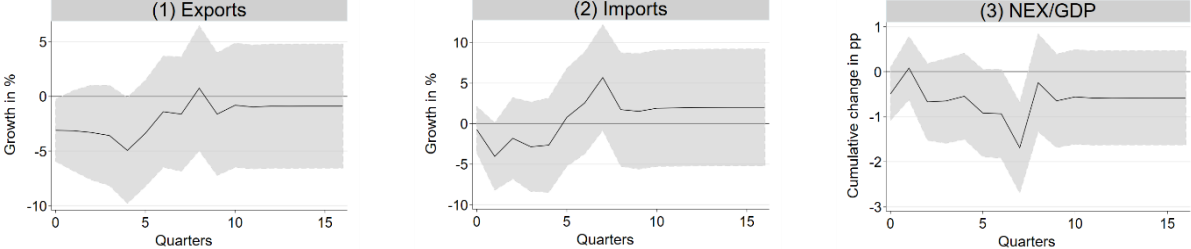
Notes: See Figure 1.

Panel (1) of Figure 8 shows that exports decrease similarly to imports, albeit not quite as strongly. Given that both trade series move in the same direction, we would not expect to see much change in the net-exports-to-GDP ratio. Indeed, as Panel (3) of Figure 8 demonstrates, after a cut in corporate income taxes, we find no significant change.

Turning now to the United Kingdom (see Figure 9), the error bands of the responses after a cut in corporation taxes are quite large. As a result, neither imports or exports have a significant reaction. We do, however, measure an increase in real GDP of about 2% after two years, which is similar to that reported by Hussain and Liu (2018). As a result, the net-export-to-GDP ratio drops by almost 2 pp (about

one standard deviation). Again, the US and UK effects are similar, whereas the German trade variables behave quite differently.

**Figure 9: United Kingdom—Corporate Income Tax Shock**

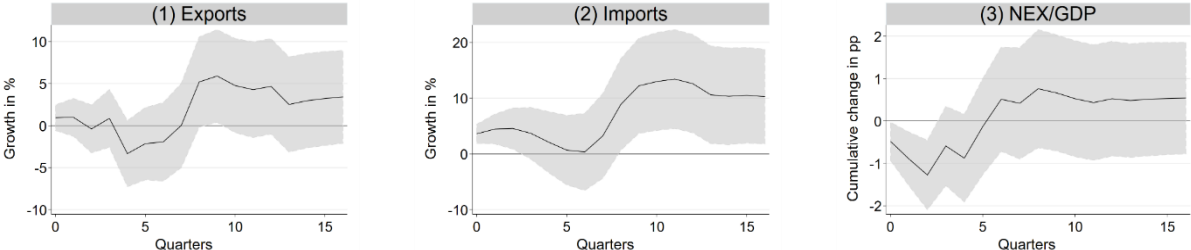


Notes: See Figure 1.

Keen and Syed (2006) argue that an increase in business taxation should be associated with an increase in net exports in the short run, as domestic investment decreases and, consequently, capital outflows increase, which leads to an exchange rate depreciation, before the effect turns negative in the second year. Thus, they predict a decrease in net exports in the first year after a business tax cut. However, in none of the three economies studied here do we observe this predicted change in the direction of the effect on net exports.

As mentioned earlier, we are only able to construct a series for indirect tax shocks for Germany and the United Kingdom. To study the reaction of trade to an indirect tax shock, we also include direct tax liabilities (personal and corporate income tax liability changes) as controls. Panel (2) of Figure 10 shows an increase in German imports on impact, which really jump upward after about two years, with a peak effect of 13%.

**Figure 10: Germany—Indirect Tax Shock**



Notes: See Figure 1.

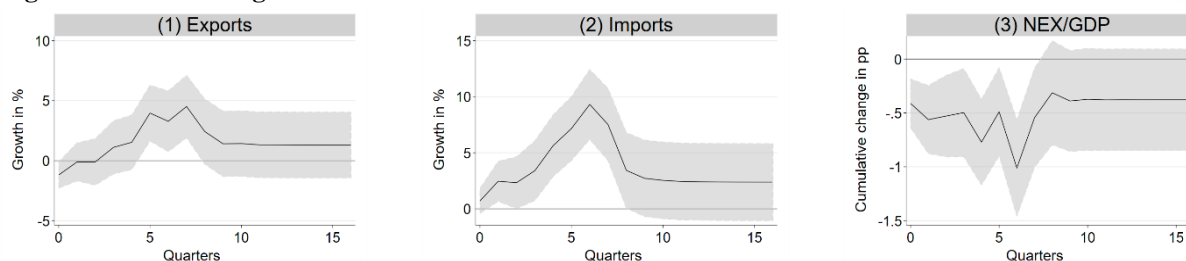
In Panel (1) of Figure 10, we see that the reaction of exports is more muted, but they also show an almost significant increase after around two years, with a maximum reaction of 6%. Studying the reaction of the net-exports-to-GDP ratio in Panel (3), we find that the overall trade effect is negative, with the ratio decreasing by more than 1 pp, which corresponds to a decline equal to 0.2 standard deviations.

Comparing our results to the DSGE-derived predictions by the German Ministry of Finance (BMWi, 2017) shows that our estimates are qualitatively similar but larger in magnitude. However, the

Ministry argues that a cut in indirect taxes could help reduce the German trade surplus by increasing domestic demand and crowding-out exports. We find empirical support for this claim only with regard to the import reaction; we obtain the reverse outcome for exports. Our result thus supports the intuition expressed by von Weizsäcker (2017) and casts doubt on Felbermayr et al.'s (2017) view.

The UK results are similar to those obtained for Germany. As can be seen in Panel (1) of Figure 11, exports increase in this country too, but the reaction occurs a bit earlier than in Germany. Overall, UK exports increase by almost 5% after one and a half years. The positive effect on imports kicks in right after one quarter and reaches its maximum of roughly 9% one and a half years after the shock. Mirroring the outcome for Germany, the UK net-export-to-GDP ratio drops by about 1 pp (0.5 standard deviations). Although we find very different trade reactions by the two European countries after business and personal income tax changes, both adjust similarly in the case of indirect tax changes.

**Figure 11: United Kingdom—Indirect Tax Shock**



Notes: See Figure 1.

Again, we scale the peak effects by the standard deviation of the tax shocks to obtain an indication of the effects of a normal tax change. A typical personal income tax cut yields an increase in US (German) imports of about 3% (1.2%), whereas the net-export-to-GDP ratio drops by 0.3 pp (0.1 pp). The scaled effect on the UK trade balance translates to less than 0.1 pp. Even when considering the typical size of changes in the various types of taxes, legislative adjustments in German indirect taxes appear to be roughly twice as influential for the trade balance: imports rise by about 2.5% and the drop in the net-export ratio equals 0.3 pp. In the United Kingdom, personal income taxes are the least influential type of tax for the trade balance; the effects of typical business and indirect tax cuts are three times the size. In all cases, the trade balance deteriorates.

## 5. Asymmetric Effect of Tax Shocks on Trade Variables

Jones et al. (2015) and Hussain and Malik (2016) provide evidence of asymmetric reactions by macroeconomic variables using the narrative tax shocks for the United States and the United Kingdom, respectively. They identify tax increases (decreases) by positive (negative) expected government revenues. Jones et al. (2015) argue that the coefficients are unbiased as long as the positive and negative tax



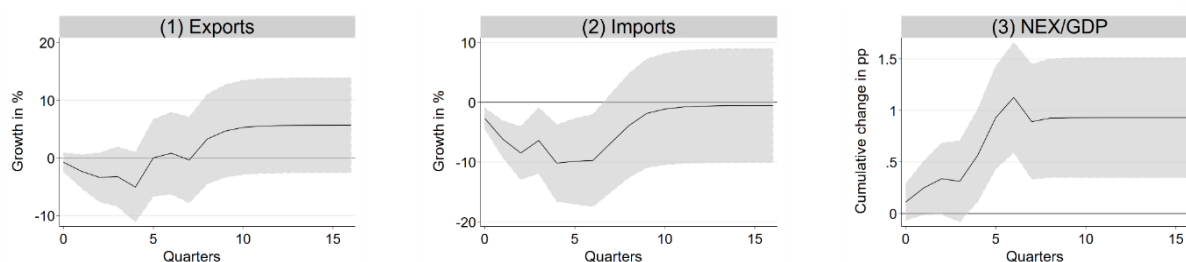
shocks are included contemporaneously. Hence, based on the following VAR model, we can derive linear IRFs for our asymmetric tax shocks:<sup>6</sup>

$$y_t = Cv_t + A(L)y + B^+(L)\Delta\tau^+ + B^-(L)\Delta\tau^- + u_t, \quad (3)$$

As before, the vector of endogenous variables contains the growth rates of real exports, real GDP, real imports, and the real effective exchange rate, which enter with five lags for Germany and one lag for the United States and the United Kingdom. The tax shock series is now separated into increases,  $\Delta\tau^+$ , and decreases,  $\Delta\tau^-$ .

Commencing our asymmetric analysis with tax increases in the United States, Panel (1) of Figure 12 shows that a tax hike causes a decrease in US exports, which, however, is not significant. We also observe a reduction in US imports, as can be seen from Panel (2). The reaction is instantaneous, lasts for almost two years, and reaches a maximum decline of about 10%. This reaction also reminds us that changing a sample period may overturn previous results. Comparing our results for the reactions of US real GDP with those reported by Jones et al. (2015), we obtain the standard result of falling GDP after a tax hike, whereas they do not observe significant output effects.

**Figure 12: United States—Only Increase in Aggregated Tax Shocks**



Notes: See Figure 1.

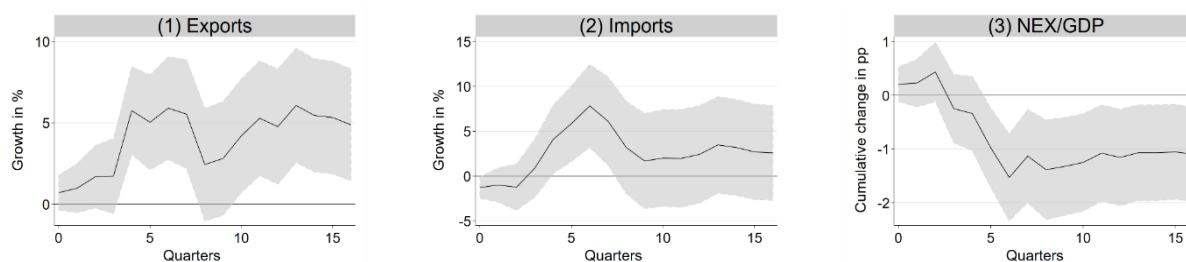
Adjustment of the US net-exports-to-GDP ratio is demonstrated in Panel (3) of Figure 12. The graph shows the development of exports and imports, becoming significantly positive after about one year and continuing to be significant throughout the observation window. The total effect on the US net-exports-to-GDP ratio amounts to almost 1 pp (0.6 standard deviations).

Figure 13 demonstrates that the reaction is very different in Germany. Panel (2) shows an initial drop in German imports, which quickly gives way to a substantial increase, going up to 8% after six quarters and then becoming insignificant soon after.

As displayed in Panel (1) of Figure 13, German exports react positively too. The magnitude is lower than that for imports, only reaching a bit more than 6%, but the effect is significant for a much longer time.

<sup>6</sup> See Kilian and Vigfusson (2011) and Hussain and Malik (2016) for a discussion of linear and nonlinear IRFs.

**Figure 13: Germany—Only Increase in Aggregated Tax Shocks**

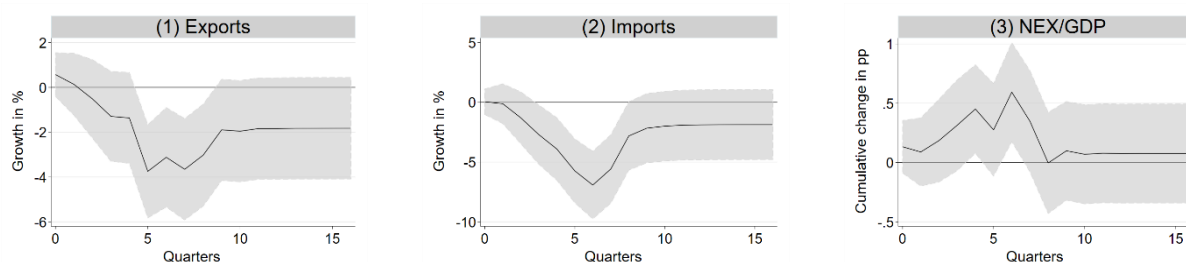


Notes: See Figure 1.

Panel (3) of Figure 13 shows that the German net-exports-to-GDP ratio is dominated by the import reaction, as the ratio becomes negative after about five quarters. The maximum negative impact of a tax hike reaches almost 1.5 pp (or 0.26 standard deviation) of the net-exports-to-GDP ratio. Thus, the reaction to a tax increase in the United States is the reverse of the reaction in Germany. This illustrates that it may be unwise to focus too much on US data, as conclusions may have little external validity.

In Figure 14, we study an increase in aggregated taxes in the United Kingdom. We observe that this country's imports have a reaction similar to that of US imports, with a trough of 6% after six quarters. This magnitude is only about half what we estimated in the case of US imports and appears to be driven by the decrease in UK GDP of about 2.5% after six quarters. Comparing this reaction with the extant literature on exogenous tax increases in the United Kingdom, Jones et al. (2015) and Hussain and Liu (2018) report even steeper drops of about  $-6\%$ .<sup>7</sup> We further discover that exports decrease too, by about 4%. Overall, the import adjustment dominates and the net-export-to-GDP ratio increases by about 0.5 pp (0.25 standard deviations) after six quarters. Statistically, the effect is barely significant.

**Figure 14: United Kingdom—Only Increase in Aggregated Tax Shocks**



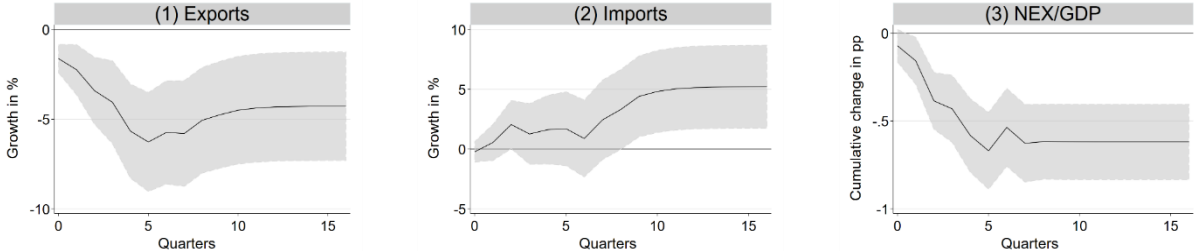
Notes: See Figure 1.

Next, we investigate the reaction to tax decreases, starting with the United States (see Figure 15). The IRF in Panel (1) shows that US exports react negatively, as they also did to a tax increase, but now

<sup>7</sup> However, both papers note that the effect is likely driven by outliers, namely, an income tax cut in 1979Q4, which was financed by a VAT hike in 1979Q3. When excluding these two tax changes, we no longer find a negative tax hike multiplier in the United Kingdom. Furthermore, the signs of both trade variables flip, with exports increasing by about 2% (barely significant) and imports by about 5%. The net effect on the trade balance, however, is zero.

the effect is significant over the whole forecast horizon. Panel (2) shows a different reaction: imports soar upward after two years, stay significantly positive throughout our observation window, and reach a peak increase of 5%.

**Figure 15: United States—Only Decreasing Aggregated Tax Shocks**

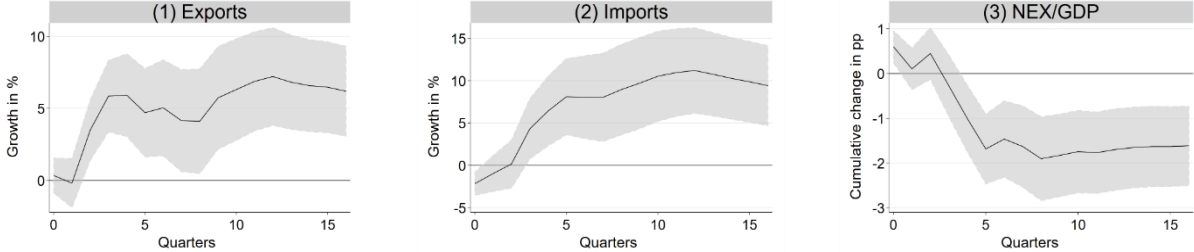


Notes: See Figure 1.

Panel (3) of Figure 15 demonstrates how the US net-exports-to-GDP ratio reacts to a reduction in taxes. After one quarter, the ratio becomes significantly negative and continues downward until it reaches a decline of 0.7 pp (about 0.4 standard deviations). It remains significant at that level for the remainder of the four-year observation period.

In Figure 16, we study the reaction of German trade to a domestic tax decrease. The left-hand side of Figure 16 shows that exports also increase after a tax reduction, even with a similar time profile and magnitude.

**Figure 16: Germany—Only Decreasing Aggregated Tax Shocks**



Notes: See Figure 1.

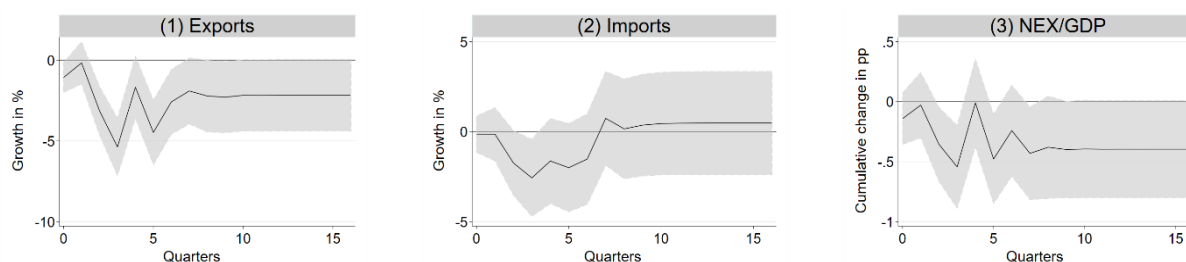
Panel (2) of Figure 16 shows a clear hike in German imports. While this is qualitatively similar to what we found for tax hikes, the magnitude is now much more pronounced, up to 11%, and the effect is clearly significant over the whole observation window. Panel (3) presents how the German net-exports-to-GDP ratio reacts to a reduction in taxes. Initially, the reaction is positive, but after about a year’s time, the effect turns significantly negative and stays that way for the entire four years displayed in the graph. Quantitatively, the positive part of the reaction reaches about 0.6 pp, whereas the negative one reaches a loss of roughly 2 pp, corresponding to 0.3 standard deviations. Thus, while the qualitative reaction of the German net-exports-to-GDP ratio is similar when comparing tax increases and decreases, its deterioration is much more pronounced in the latter case. Hence, in the case of tax cuts, we conclude

that the German and US reactions are qualitatively comparable, with a larger magnitude observed in the former case.

As before, we compare these results with those from a normal tax shock scenario, where the shock is defined by one standard deviation. Under this scenario, the German net-exports-to-GDP ratio drops by  $-0.44$  pp after an increase in German aggregated taxes, which is two times larger in absolute terms than the about  $0.2$  pp decrease after a normal tax cut. This asymmetry is even more pronounced in the case of the United States and the United Kingdom, where the drop in this ratio is about two times and five times larger ( $-0.2$  pp and  $-0.2$  pp) after a tax cut than the rise after a hike ( $0.1$  pp and  $0.05$ , respectively).

Finally, in Figure 17, we look at how the UK trade variables respond to aggregated tax decreases only. In Panel (1), exports show an erratic pattern, likely driven by the adjustment to personal income tax changes. In total, exports decline by about 5% within the first six quarters after the shock. Imports drop too, but the effect is barely significant. As a result, the net-export-to-GDP ratio decreases by about 0.5 pp (about 0.25 standard deviations), which is the same magnitude as the reaction of the US trade balance and about four times less than the one in Germany.<sup>8</sup>

**Figure 17: United Kingdom—Only Decreasing Aggregated Tax Shocks**



Notes: See Figure 1.

## 6. Spill-Over Effects from US Tax Legislation

With up to 10% and 14% of exports from Germany and the United Kingdom, respectively, over the period 1988 to 2018, the United States is an important trading partner for the two European countries.<sup>9</sup> Thus, there could be spillovers from US tax legislation to European trade variables. Feyrer and Shambaugh (2012) find spill-over effects of US tax shocks via the current account, as changes in US savings affect investment in the rest of the world. Auerbach and Gorodnichenko (2013) show that spill-over effects can occur through trade, with increasing US demand stimulating foreign exports and, hence, output. Metelli and Natoli (2019) argue that US tax shocks could also have spill-over effects via changes

<sup>8</sup> When excluding the two aforementioned tax outliers, the effect on exports remains, whereas we observe increasing GDP and imports (but only significant for one quarter). Still, the negative effect on the trade balance remains at 0.5 pp.

<sup>9</sup> World Bank. Germany Product Exports by Country and Region. Trade Flow. <https://wits.worldbank.org/CountryProfile/en/Country/DEU/Year/1988/TradeFlow/Export/Partner/all/Product/Total>. Retrieved 16 July 2019.

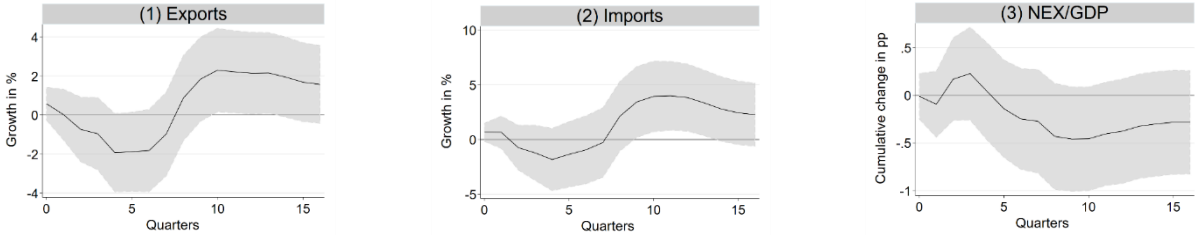
in interest rates, the real exchange rate, and equity prices. Clancy (2019) shows that US corporate tax shocks spill over into the Irish economy: Irish output increases after a US business tax cut. However, there could be an identification issue, as Clancy neither controls for changes in US personal income taxation nor for Irish tax changes occurring during the sample period. Therefore, we include both US corporate income and US personal income tax shocks as well as all domestic tax shocks in our model, which is now:

$$y_t = Cv_t + A(L)y + B(L)\Delta\tau^d + D(L)\Delta\tau^f + u_t, \tag{4}$$

where  $y_t$ ,  $v_t$ ,  $u_t$ ,  $C$ ,  $A(L)$ , and  $B(L)$  are defined as before in Equation (1).  $D(L)$  is a lag-polynomial and  $\Delta\tau^d$  describes eight lags of the aggregated domestic tax shocks series.  $\Delta\tau^f$  is the aggregated US tax shock series, which also enters with eight lags.

Panels (1) and (2) of Figure 18 show that a decrease in US taxes has an offsetting influence on German exports and imports. As demonstrated in Panel (3), the net effect on the net-export-to-GDP ratio is zero.

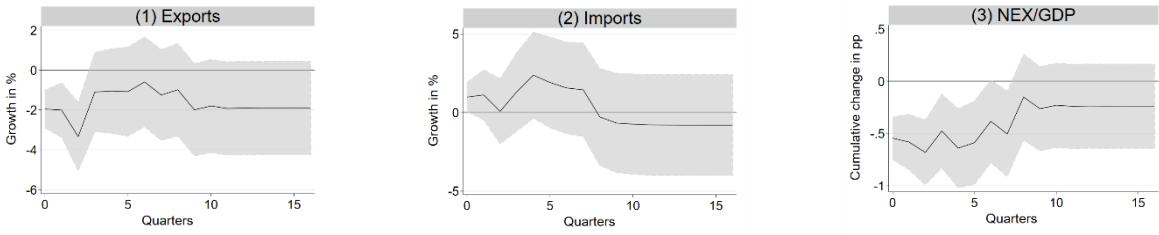
**Figure 18: Germany—Spill-Over Effects of Aggregated US Tax Liabilities**



Notes: See Figure 1.

The effect of US tax legislation on UK trade variables is shown in Figure 19. The effect occurs earlier in the United Kingdom than in the case of Germany, as UK exports drop on impact and by about 3% after three quarters, whereas imports have an (insignificant) upward tendency. The drop in exports could be explained by an appreciation of about 2% after two quarters. Unlike Clancy (2019) for the case Ireland, we find no increase in GDP, which likely reflects the fact that the United Kingdom is relatively less dependent on US trade than is Ireland. Still, the net-export-to-GDP ratio drops by about 0.6 pp after three quarters, which is a notable spillover, as it is comparable to the reaction after a domestic personal income tax cut.

**Figure 19: United Kingdom—Spill-Over Effects of Aggregated US Tax Liabilities**



Notes: See Figure 1.

To economise on space, we only briefly report the results when allowing for asymmetric tax responses and a disaggregation of the tax shocks.

#### *Allowing for Asymmetric Effects Aggregated US Tax Shock*

We discover a symmetric pattern, with German exports and imports increasing (decreasing) after a US tax cut (hike). In either case, the German net-export-to-GDP ratio tends to increase within one to three quarters after the shock. For the United Kingdom, we find imports (exports) to increase (to be not affected) after US tax *hikes*, whereas imports (exports) are not affected (negatively affected) by US tax *cuts*. Although US tax *hikes* do not significantly affect the UK trade balance, a US tax *cut* leads to a deterioration of about 0.7 pp over a period of two years.

#### *US Personal Income Tax Change*

##### *Assumption of symmetric effects of US personal income tax shock*

After a decrease in US personal income tax, we discover an increase in German imports of about 4% after roughly three years. This increase, however, does not significantly reduce the net-export-to-GDP ratio. On impact, UK exports drop by about 2%, whereas about one year after the shock, imports rise by about 5%. The net effect on the trade balance is a trough of more than 0.6 pp. Like Metelli and Natoli (2019), we find that UK GDP has a positive reaction to US personal income tax shocks but, when not allowing for asymmetries, we obtain the opposite result of falling real exports.

##### *Assumption of asymmetric effects of US personal income tax shock*

*Increases* in US personal income tax do not influence the German net-export-to-GDP ratio, whereas *cuts* increase the trade-balance-to-GDP ratio three quarters after the shock. We find a qualitatively symmetric response of UK imports to US personal income tax shocks, which increase by 5% after US personal income tax *cuts* and decrease by as much as 20% after an *increase*. Exports do not react to *hikes* but do decrease after a tax *cut*. As a result, the UK net-export-to-GDP ratio increases (decreases) by 3 pp (1 pp) after an *increase* (*decrease*) in US personal income taxes.

#### *US Business Tax Change*

##### *Assumption of symmetric effects of US business tax shock*

Around two years after a cut in US business taxes, both German exports and imports increase by roughly 10% and the net effect on the trade balance is zero. The effect of a *cut* in US business taxes on the UK's GDP is similar to the German case and amounts to a drop of about 3%. In contrast to Germany, however, both UK imports and exports drop by 10% and 13%, respectively. The drop in exports occurs first, resulting in a decrease of the trade balance of more than 1 pp in the first three month after the shock.

This result differs from that of Metelli and Natoli (2019), who report no effect on UK GDP after a US business tax cut, but an increase in exports.

*Assumption of asymmetric effects of US business tax shock*

Business tax *hikes* do not appear to influence the German net-export-to-GDP ratio, whereas *cuts* tend to decrease the ratio somewhat. The effect, however, is barely significant and short-lived. What is more interesting is the effect on the German GDP components. While a US business tax cut increases German exports by almost 20%, GDP drops by more than 5%. Feyrer and Shambaugh (2012) argue that an increase in US savings through higher tax revenues results in more investment in the rest of the world as interest rates fall. Flipping their argument around, a tax *cut* would crowd out investment through higher interest rates. Augmenting Equation (4) with the three-month interest rate and replacing German GDP by real consumption and investment confirms this reasoning. The short-term interest rate increases by more than 6 pp, crowding out investment by about 20%. In the United Kingdom, we find symmetric behaviour of exports, imports, and the trade-balance-to-GDP ratio. UK imports and exports surge after a US business tax *hike*, with the former increasing up to 30% and the latter up to 10%, whereas they both drop within the first year after a US business tax *cut* by about 10% and 20%, respectively. As a result, the net-exports-to-GDP ratio first rises by almost 2 pp after a business tax *hike* before decreasing by about 3pp by the end of the forecast horizon. The effect of business tax *cuts* on the trade balance is barely significant and negative, reducing the ratio by about 2.5 pp half a year after the shock.

## 7. Robustness

Following Hayo and Uhl (2014), we chose 8 lags for the tax shocks, whereas Romer and Romer (2010) and Cloyne (2013) used 12 lags. To ensure that our results are not driven by the choice of lags, we experiment with 1 to 6 lags for the vector of endogenous variables and 4, 6, 8, 10, and 12 lags for the exogenous tax shocks. The results for various endogenous lags can be found in the Online Appendix, Figures A1–A27, and for various exogenous lags in Figures A28–A54. In almost all cases, the IRFs lie within the confidence bounds of the above estimations.

Due to concerns about non-stationarity of the variables, we estimated Equation (1) in first differences. However, following Sims et al. (1990), we also estimated it in (log) levels, utilising the long-run information in the data, which is lost when differencing the variables. As can be seen in Figures A55–A81 in the Online Appendix, overall, all results discussed above hold up remarkably well.

We also estimate the model as a standard VAR using a Cholesky identification, with the legislative tax changes included as endogenous variables and ordered first. The model reduces to the following reduced-form VAR:

$$y_t = C v_t + A(L)y + u_t. \quad (6)$$

For the US and UK VAR, we now include 5 lags of the endogenous variables (including taxes), reflecting the case of Germany. Otherwise, the dynamics would be extremely restricted. The corresponding

output is presented in Figures A82–A108 of the Online Appendix. Overall, the results are less pronounced but qualitatively the same.

Kollmann et al. (2014) argue that external demand shocks are a main driver of the German current account surplus. To check whether our identification scheme based on legislated tax changes holds up, we construct a control variable measuring external demand. We use World Bank data to identify the most important export destinations for the three countries during our sample period. Since we do not have import data at a quarterly frequency for all the major trading partners, we proxy their demand by real GDP. Hence, we construct an external demand index as the real GDP of the trading partners weighted by their average export share. From this index, we compute the log growth rate and include it as an exogenous variable in our various specifications.<sup>10</sup> The IRFs in Figures A109–A135 of the Online Appendix demonstrate that our results do not change in a noteworthy way.

## 8. Conclusion

Using a narrative account of quarterly discretionary changes in tax liabilities from 1974Q4 to 2018Q2 in a VAR setting, we study whether legislative tax changes affect the trade balance in the United States, Germany, and the United Kingdom. We find a number of significant results, the most important of which are summarised in Table 1.

*Table 1: Adjustment of Net-Exports-to-GDP Ratio (Shock: Cut in Taxes, Except for ‘Only Increasing Aggregated Tax Shocks’)*

	US	Germany	UK
Aggregated Tax Shocks	–	–	–
Personal Income Tax Shocks	–	–	–
Corporate Income Tax Shocks	–	0	–
Indirect Tax Shocks	n.a.	–	–
Only <i>Increase</i> in Aggregated Tax Shocks	+	–	+
Only <i>Decrease</i> in Aggregated Tax Shocks	–	–	–
Spill-Over Effects of Aggregated US Tax Shocks	n.a.	–	–

First, after a reduction in aggregated tax liabilities and personal income taxes, as well as when focussing entirely on tax reductions, the US, German, and UK reactions are quite similar: imports tend to rise and, in conjunction, with higher output, the net-exports-to-GDP ratio decreases. Hence, our estimation results provide empirical evidence supporting claims by Krugman (2017) and Frankel (2018) that Trump’s 2017 ‘Tax Cuts and Jobs Act’ has worsened the US trade deficit.

<sup>10</sup> At a quarterly frequency, Chinese GDP is available only from 1991Q1 onward. To account for this jump in the external demand index, we include an impulse dummy.



Second, exports frequently move in the same general direction as imports, which is likely due to corresponding changes in the real exchange rate. This makes it more difficult to design tax changes that will have a notable impact on net trade.

Third, when studying corporate income tax shocks and the asymmetric case of increasing aggregated tax shocks only, we obtain different outcomes for the three countries. In the former case, there is no significant reaction in Germany after a tax cut, whereas we observe a deteriorating net-exports-to-GDP ratio in the United States and the United Kingdom. In the latter case, a tax hike worsens the German net-exports-to-GDP ratio, whereas it improves the US and UK ones. The counterintuitive result for Germany suggests that this type of tax policy may not be a reliable instrument for manipulating the trade balance.

Fourth, in the case of Germany and the United Kingdom, we were able to investigate the impact of changes in indirect taxes. In both economies, a reduction in indirect taxes decreases the net-exports-to-GDP ratios, which is qualitatively consistent with previous findings derived from a DSGE model (BMW<sub>i</sub>, 2017). Note that our results cannot be directly applied to the temporary reduction in German VAT as part of the COVID-19 fiscal policy package (a 3 pp rate reduction from 1 July to 31 December 2020), as we study only permanent tax changes.

Fifth, we observe significant spill-over effects from US tax legislation to German and UK imports and exports. A reduction in US aggregated tax liabilities does not alter the German trade balance but does reduce the UK net-export-to-GDP ratio. Qualitatively, our results deviate from those reported by Clancy (2019) with regard to spillovers of US business tax cuts into Ireland.

In light of these key results, can we conclude that fiscal policy in the form of tax changes is suitable for addressing trade imbalances? As Table 1 sets out, in terms of qualitative effects, the answer is ‘yes’. But when we consider the effectiveness of tax policy with regard to trade, the answer is less clear-cut. Although we are studying large tax changes of a magnitude of 1% of GDP, the resulting reactions of the trade balance range from roughly zero in the case of lower German corporate income taxes to a peak effect of a 2 pp lower net-export-to-GDP ratio in the case of lower aggregated taxes in Germany. Estimated effects for the United States and the United Kingdom are of a roughly similar magnitude. Moreover, our estimated impact of a decrease in indirect taxes is much higher than the value found by the German Federal Ministry for Economic Affairs and Energy based on a DSGE model (BMW<sub>i</sub>, 2017). Thus, at least some tax changes appear able to impact trade in a notable way. Still, when we shift our attention to the net-exports-to-GDP ratio, we discover only moderate changes, usually around 0.5 pp. The largest estimated impact was found for decreasing aggregated taxes, causing a deterioration of the German net-exports-to-GDP ratio of 1.9 pp.

Arguably, a proper assessment of the effectiveness of fiscal policy with respect to the trade balance requires additional information. We think it is informative to compare the estimated trade effects in terms of the standard deviations of the trade variables, as a one standard deviation change can be considered a normal fluctuation in the variable of interest. Interpreting the magnitude of our estimated results in this light suggests that normal changes in taxes are unlikely to make a notable difference in the development of the trade variables. For instance, the estimated reduction in the net-exports-to-GDP ratio after an aggregated tax cut is 0.3 standard deviations in the case of Germany and the United Kingdom and 0.4 standard deviations in the case of the United States. Put differently, normal fluctuations in this ratio are about three times higher than the outcome of a massive fiscal policy change.

This also puts the claim by Krugman (2017) and Frankel (2018) that the ‘Tax Cuts and Jobs Act’ contributes to worsening the US trade situation into perspective: yes, it likely does, but, no, it is unlikely that the actual impact is particularly visible. This also applies, for instance, to potential spillovers from the United States to Germany (and probably to other countries). Hence, based on an economic assessment, we conclude that the magnitude of tax spillovers on trade is quite limited. More generally, reflecting these considerations, we hesitate to recommend tax policy as a means of addressing trade imbalances.

Finally, applying this alternative yardstick of measuring estimated effects against the typical fluctuation in the variable of interest can affect the outcome of our country comparison. For instance, although the effect on the net-exports-to-GDP ratio after an aggregated tax cut is approximately similar across the three countries in terms of estimated percentage points, when we measure it against the ratio’s normal volatility, we discover using tax policy to address trade variables is a more effective strategy in the United States and the United Kingdom than it is in Germany.

To conclude, qualitatively, we find that most legislated tax changes can affect trade variables, especially imports and the net-exports-to-GDP ratio. Adopting a quantitative perspective, however, raises doubts that tax policies are an effective means of addressing trade imbalances.

## References

- Auerbach, A.J. & Gorodnichenko, Y. (2013). Output Spillovers from Fiscal Policy. *American Economic Review*, 103(3), 141–146.
- Bachman, D.D. (1992). Why is the U.S. Current Account Deficit so Large? Evidence from Vector Autoregressions. *Southern Economic Journal*, 59(2), 232–240.
- Beetsma, R., Giuliodori, M., & Klaassen, F. (2008). The Effects of Public Spending Shocks on Trade Balances and Budget Deficits in the European Union. *Journal of the European Economic Association*, 6(2–3), 414–423.
- Belke, A., Elstner, S., & Rujin, S. (2020). Growth Prospects and the Trade Balance in Advanced Economies. *Ruhr Economic Papers*, No. 827.
- BMWi. (2017). Monatsbericht. *Schlaglichter Der Wirtschaftspolitik*, July, 13–14.
- Bussière, M., Fratzscher, M., & Müller, G.J. (2005). Productivity Shocks, Budget Deficits and the Current Account. *ECB Working Paper Series*, No. 509.
- Clancy, D. (2019). US Corporate Tax Rate Cuts: Spillovers to the Irish Economy. *European Stability Mechanism Working Paper Series*, 38, 1–44.
- Cloyne, J. (2012). Discretionary Tax Shocks in the United Kingdom 1945-2009: A Narrative Account and Dataset. *MPRA Paper*, No. 37739.
- Cloyne, J. (2013). Discretionary Tax Changes and the Macroeconomy: New Narrative Evidence from the United Kingdom. *American Economic Review*, 103(4), 1507–1528.
- Corsetti, G. & Müller, G.J. (2008). Twin Deficits, Openness, and the Business Cycle. *Journal of the European Economic Association*, 6(2–3), 404–413.
- Enders, W. & Lee, B.-S. (1990). Current Account and Budget Deficits: Twins or Cousins? *The Review of Economics and Statistics*, 72(3), 373–381.
- Felbermayr, G., Fuest, C., & Wollmerhäuser, T. (2017). The German Current Account Surplus: Where does it come from, is it harmful and should Germany do something about it? *EconPol Policy Report*, 1(July).
- Feyrer, J. & Shambaugh, J. (2012). Global Savings and Global Investment: The Transmission of Identified Fiscal Shocks. *American Economic Journal: Economic Policy*, 4(2), 95–114.
- Frankel, J. (2018, January 15). Donald Trump is Making America's Deficits Great Again. *The Guardian*.
- Fratzscher, M. (2017, July 3). How to Understand Germany's Trade Surplus: Is it Exploiting the Weak Euro? *Euronews*.
- Hayo, B. & Uhl, M. (2014). The Macroeconomic Effects of Legislated Tax Changes in Germany. *Oxford Economic Papers*, 66(2), 397–418.
- Hussain, S.M. & Liu, L. (2018). Comparing the Effects of Discretionary Tax Changes between the US and the UK. *B.E. Journal of Macroeconomics*, 18(1), 1–17.
- Hussain, S.M. & Malik, S. (2016). Asymmetric Effects of Exogenous Tax Changes. *Journal of Economic Dynamics and Control*, 69, 268–300.
- Jones, P.M., Olson, E., & Wohar, M.E. (2015). Asymmetric Tax Multipliers. *Journal of Macroeconomics*, 43, 38–48.
- Keen, M. & Syed, M.H. (2006). Domestic Taxes and International Trade: Some Evidence. *IMF Working Paper*, 06/47.
- Kilian, L. & Vigfusson, R.J. (2011). Nonlinearities in the Oil Price-Output Relationship. *Macroeconomic Dynamics*, 15, 337–363.
- Kim, S. & Roubini, N. (2008). Twin Deficit or Twin Divergence? Fiscal Policy, Current Account, and Real Exchange Rate in the U.S. *Journal of International Economics*, 74(2), 362–383.
- Kollmann, R., Ratto, M., Roeger, W., in't Veld, J., & Vogel, L. (2014). What Drives the German Current Account? And How Does it Affect Other EU Member States? *European Commission Economic Papers*, 516(April), 47–93.
- Krugman, P. (2017, October 5). The Transfer Problem and Tax Incidence. *New York Times*.
- Lane, P.R. & Perotti, R. (1998). The Trade Balance and Fiscal Policy in the OECD. *European Economic Review*, 42(3–5), 887–895.
- Mertens, K. & Olea, J.L.M. (2018). Marginal Tax Rates and Income: New Time Series Evidence. *Quarterly Journal of Economics*, 133(4), 1803–1884.
- Mertens, K. & Ravn, M.O. (2012). Empirical Evidence on the Aggregate Effects of Anticipated and

- Unanticipated US Tax Policy Shocks. *American Economic Journal: Economic Policy*, 4(2), 145–181.
- Mertens, K. & Ravn, M.O. (2013). The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States. *American Economic Review*, 103(4), 1212–1247.
- Metelli, L. & Natoli, F. (2019). The International Transmission of US Tax Shocks: a Proxy-SVAR Approach. *Banca D'Italia Working Papers*, 1223(June 2019).
- Romer, C. & Romer, D. (2009). A Narrative Analysis of Postwar Tax Changes. *Mimeo, University of California, Berkeley, June*, 1–93.
- Romer, C. & Romer, D. (2010). The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. *The American Economic Review*, 100(3), 763–801.
- Sims, C.A., Stock, J.H., & Watson, M.W. (1990). Inference in Linear Time Series Models with some Unit Roots. *Econometrica*, 58(1), 113–144.
- Stock, J.H. & Watson, M.W. (2018). Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments. *Economic Journal*, 128(610), 917–948.
- Tagkalakis, A. (2015). Fiscal Policy, Net Exports, and the Sectoral Composition of Output in Greece. *International Economics and Economic Policy*, 12(4), 521–539.
- Uhl, M. (2013). A History of Tax Legislation in the Federal Republic of Germany. *MAGKS Joint Discussion Paper Series in Economics*, No.11-2013.
- Von Weizsäcker, C.C. (2017, January 8). Trumps Wirtschaftspläne: Nächstes Opfer Deutschland. *Frankfurter Allgemeine Zeitung*.

## Online Appendix

**Table A1: Data Description**

<b>Variable</b>	<b>Description</b>	<b>Source</b>
GDP	Real values, deflated with respective GDP-deflator, base year 2010, annual levels, seasonally adjusted. From 1991-Q1 onward, data for unified Germany.	St. Louis Fred
Exports and Imports	Real values, deflated with their respective deflators, base year 2010, annual levels, seasonally adjusted. From 1991-Q1 onward, data for unified Germany.	St. Louis Fred
Exchange Rate	Real effective exchange rate, based on unit labour costs, seasonally adjusted, base year 2010.	St. Louis Fred
GDP Deflator	Seasonally adjusted with X12-Arima filter, base year 2010.	St. Louis Fred
Export & Import Deflator	Price index of exported and imported goods and services, seasonally adjusted with X12-Arima filter, base year 2010.	St. Louis Fred, Federal Statistical Office of Germany, ONS

**Table A2: Tax Shocks, expressed as cuts**

Date \ Type	USA			Germany				UK			
	All	PI	CI	All	PI	CI	Indirect	All	PI	CI	Indirect
1974q4	0	0	0	0	0	0	0	0	0	0	0
1975q1	0	0	0	6.9	7.1	-0.2	0	0	0	0	0
1975q2	0	0	0	0	0	0	0	0	0	0	0
1975q3	0	0	0	0	0	0	0	0	0	0	0
1975q4	0	0	0	0	0	0	0	0	0	0	0
1976q1	0	0	0	-0.9	-0.6	-0.3	-0.1	0	0	0	0
1976q2	0	0	0	0	0	0	0	0	0	0	0
1976q3	0	0	0	0	0	0	0	0	0	0	0
1976q4	-2.1	-1.4	-0.7	0	0	0	0	0	0	0	0
1977q1	0.9	0.8	0	0.2	1.1	0	-0.9	-0.3	0	0	-0.3
1977q2	0	0	0	0	0	0	0	1.6	2.3	0	-0.7
1977q3	1.5	1.5	0	0.4	0.4	0	0	-0.1	0	0	-0.1
1977q4	0	0	0	2.8	2.8	0	0	1.3	1.3	0	0
1978q1	1.7	0	1.7	3.7	3.8	0	-0.1	0	0	0	0
1978q2	0	0	0	0	0	0	0	2.9	2.8	0.1	0
1978q3	0	0	0	0	0	0	0	0	0	0	0
1978q4	2.5	2.3	0.2	0	0	0	0	-0.2	0	-0.2	0
1979q1	10.2	10.2	0.1	5.7	5.8	0	-0.1	-0.1	0	-0.1	0
1979q2	0	0	0	0	0	0	0	0.1	0.1	0	0
1979q3	0	0	0	-3.3	0	0	-3.3	-3.8	1	-0.1	-4.7
1979q4	0	0	0	0	0	0	0	2.5	2.5	0	0
1980q1	-1.2	-0.3	-0.9	2.6	0.7	2	-0.1	0	0	0	0
1980q2	0.2	0	0.2	0	0	0	0	-1.6	-0.3	-0.1	-1.2
1980q3	0	0	0	0	0	0	0	-0.2	0	-0.2	0
1980q4	0	0	0	1.8	1.8	0	0	0	0	0	0
1981q1	-16.9	-8.6	-8.3	3.4	3.3	0.2	-0.1	0	0	0	0
1981q2	0	0	0	-1.8	0	0	-1.8	-4.8	-2.7	0.3	-2.4
1981q3	28.7	25.8	2.8	0	0	0	0	0	0	0	0
1981q4	-17.8	-17.8	0	0	0	0	0	0	0	0	0
1982q1	50.1	50.6	-0.5	1.6	1.7	0.1	-0.2	0	0	0	0
1982q2	0	0	0	-0.4	0	0	-0.4	-0.3	0.6	0	-0.9
1982q3	0.5	0	0.5	-1.3	0	0	-1.3	1.2	0	1.2	0
1982q4	-6.6	0	-6.6	0	0	0	0	0.1	0	0	0.1
1983q1	45	53.6	-8.6	0.3	-0.6	0.9	0	0.2	0	0.2	0
1983q2	0	0	0	0	0	0	0	2.2	1.6	1.2	-0.6
1983q3	0	0	0	-4.1	0	0	-4.1	0.4	0	0.4	0
1983q4	-0.4	0	-0.4	0	0	0	0	0	0	0	0
1984q1	24	30	-6.1	1.8	0.8	0.9	0	-0.1	0	-0.1	0
1984q2	0	0	0	-0.1	0	0	0	0.3	1.2	0.1	-1
1984q3	-7.4	-4.3	-3.1	0	0	0	0	0	0	0	0
1984q4	0	0	0	0	0	0	0	0.9	0	0.9	0
1985q1	3.6	8.7	-5.1	-0.2	0.2	0	-0.3	0	0	0	0
1985q2	0	0	0	0	0	0	0	0.7	1.5	0.1	-0.9
1985q3	0	0	0	0	0	0	0	-0.1	0	0	-0.1
1985q4	0	0	0	0	0	0	0	0.1	0.1	0	0
1986q1	-4.2	-2.1	-2.1	7.2	6.2	1	0	0	0	0	0
1986q2	0	0	0	0	0	0	0	-0.2	0.5	0.1	-0.9
1986q3	0	0	0	0	0	0	0	0	0	0	0
1986q4	-23.1	-0.8	-22.3	0	0	0	0	0	0	0	0
1987q1	6.7	19.3	-12.7	0.2	0.2	0	0	0	0	0	0
1987q2	0	0	0	0	0	0	0	2.6	2.6	-0.1	0.2
1987q3	6.7	0	6.7	0	0	0	0	0	0	0	0
1987q4	0	0	0	0	0	0	0	0	0	0	0
1988q1	-24.3	-10	-14.3	4.5	4.5	0	0	0	0	0	0
1988q2	0	0	0	0	0	0	0	5.9	5.5	0.3	0.2
1988q3	0	0	0	-0.1	-0.1	0	0	0	0	0	0
1988q4	0	0	0	0	0	0	0	0	0	0	0
1989q1	0	0	0	-7.3	-2.7	-0.6	-4	0	0	0	0
1989q2	0	0	0	-0.3	0	0	-0.3	0.8	-0.2	0	1
1989q3	0	0	0	2.5	2.4	0.1	0	0	0	0	0
1989q4	0	0	0	0	0	0	0	2.8	2.8	0	0
1990q1	-10.3	-5.2	-5.2	14.9	15.3	-0.2	-0.2	-0.2	0	-0.2	0
1990q2	0	0	0	0	0	0	0	-0.7	-0.5	-0.2	0
1990q3	0	0	0	0	0	0	0	-0.1	0	0	-0.1
1990q4	-4.2	0	-4.2	0	0	0	0	0	0	0	0
1991q1	-11.8	-5.2	-6.6	-0.5	0	0	-0.5	0.2	0.2	0	0

1991q2	0	0	0	0	0	0	0	-2.6	3.1	0.3	-5.9
1991q3	-1.9	-0.9	-0.9	-7.7	0.8	0.8	-9.3	0	0	0	0
1991q4	0	0	0	-0.4	-0.4	0	0	0	0	0	0
1992q1	0	0	0	-1.5	0	-0.4	-1.1	0.9	0	0.1	0.8
1992q2	0	0	0	1	3.2	-1.6	-0.5	1.1	1.8	-0.1	-0.5
1992q3	0	0	0	0	0	0	0	0.1	0	0	0.1
1992q4	0	0	0	0	0	0	0	0.9	0	0	0.9
1993q1	0	0	0	-5.8	-4.9	5.3	-6.1	0.3	0	0	0.3
1993q2	0	0	0	0	0	0	0	-3.3	-1.9	-0.8	-0.6
1993q3	-24.9	-23	-1.9	-1	-0.2	0	-0.8	0	0	0	0
1993q4	0	0	0	-0.2	0	-0.2	0	0	0	0	0
1994q1	-7.6	-7	-0.6	-7	-3	0.7	-4.5	-2.2	-0.3	-0.2	-1.7
1994q2	0	0	0	0.7	0.4	0.4	0	-6	-4.7	1	-2.3
1994q3	0.2	0	0.2	-0.1	0	0	-0.1	0.1	0	0.1	0
1994q4	0	0	0	0	0	0	0	-1.2	0	0	-1.2
1995q1	0	0	0	-17	-7.9	-7.8	-1.3	-1.8	0	-0.2	-1.6
1995q2	0	0	0	0	0	0	0	-1	-1.3	0.3	0
1995q3	0	0	0	0	0	0	0	0	0	0	0
1995q4	0	0	0	0.1	0.2	0	-0.1	0	0	0	0
1996q1	0	0	0	8.5	8.5	0	0	-0.9	0.1	0	-0.9
1996q2	0	0	0	0	0	0	0	4.4	4.1	0.2	0
1996q3	0	0	0	0	0	0	0	0.1	0	0	0.1
1996q4	0	0	0	0	0	0	0	-0.9	0	-0.4	-0.5
1997q1	0	0	0	2.8	0.5	2.3	0	-2.6	-0.2	-0.8	-1.6
1997q2	0	0	0	0	0	0	0	3.1	3.4	0.6	-0.9
1997q3	-7.7	-3.9	-3.7	0	0	0	0	-3.8	-4.1	1.5	-1.2
1997q4	-0.1	-0.1	0	0	0	0	0	0.1	0	0	0.1
1998q1	23.1	21.8	1.3	4.6	2.8	1.9	0	-2.1	-1.7	0	-0.4
1998q2	0	0	0	-5.8	0	0	-5.8	-3.3	-1.6	-0.1	-1.7
1998q3	0	0	0	0	0	0	0	0	0	0	0
1998q4	0	0	0	0	0	0	0	-0.4	0	0	-0.4
1999q1	0.7	0	0.7	5.9	5.9	0	0	0	0	0	0
1999q2	0	0	0	-19.3	-5.6	-5.7	-7.9	-4	0.2	-1.2	-3
1999q3	0	0	0	0	0	0	0	-0.4	-0.1	-0.1	-0.3
1999q4	0	0	0	0	0	0	0	-0.1	0	0	0
2000q1	0	0	0	7	8.8	0.8	-2.7	0	0	0	0
2000q2	0	0	0	0	0	0	0	-1.7	-0.2	-0.5	-0.9
2000q3	0	0	0	0	0	0	0	0.4	0.1	0.3	0
2000q4	0	0	0	0	0	0	0	0	0	0	0
2001q1	0	0	0	12	14.4	0.2	-2.7	-0.1	0	-0.1	0
2001q2	0	0	0	0	0	0	0	4.9	1.9	2	0.9
2001q3	70.4	70.4	0	0.1	0.1	0	0	0.3	0	-0.2	0.4
2001q4	0	0	0	0	0	0	0	-0.1	0	0	-0.1
2002q1	2.6	2.6	0	6.6	6.3	4.4	-4.2	0.4	0	0	0.4
2002q2	35.3	0	35.3	0	0	0	0	0.2	0.1	0.6	-0.5
2002q3	0	0	0	0	0	0	0	-0.6	0	0	-0.5
2002q4	0	0	0	0	0	0	0	-0.2	0	-0.4	0.1
2003q1	0.1	0	0	-3.7	1	0	-4.7	-1.3	-0.4	-0.7	-0.1
2003q2	0	0	0	0.6	0.6	0	0	-9.7	-5.1	-4.1	-0.6
2003q3	140.3	104.3	36	-2.4	-0.1	-2.3	0	0	0	0	0
2003q4	0	0	0	0	0	0	0	0	0	0	0
2004q1	0	0	0	6	8.4	-2.2	-0.1	0.1	0	0.1	0
2004q2	0	0	0	-0.8	0	0	-0.8	-0.7	-0.1	-0.6	0
2004q3	0	0	0	0	0	0	0	-0.1	0	0	-0.1
2004q4	0	0	0	0	0	0	0	-0.2	0	0	-0.2
2005q1	4.9	4.9	0	9.4	10.3	0	-0.8	-0.2	-0.7	-0.3	0.8
2005q2	0	0	0	0	0	0	0	-1.7	-0.7	-0.6	-0.3
2005q3	0	0	0	0	0	0	0	0	0	0	0
2005q4	0	0	0	-0.8	0	0	-0.8	0.1	-0.1	0	0.2
2006q1	1.7	1.7	0	1.1	0.6	0.5	0	-3.3	-0.2	-3	-0.1
2006q2	0	0	0	1.7	1.7	0	0	-0.2	-0.3	-0.1	0.2
2006q3	-0.7	-0.3	-0.4	0	0	0	0	-0.8	0	-0.8	-0.1
2006q4	0	0	0	0	0	0	0	-0.3	0	0	-0.3
2007q1	7.9	0.3	7.5	-29.4	-4.5	1.4	-26.2	-1.9	-0.1	-0.5	-1.3
2007q2	0	0	0	0	0	0	0	-1	-0.2	-0.3	-0.4
2007q3	0	0	0	0	0	0	0	-0.6	0	-0.2	-0.4
2007q4	0	0	0	-1.6	0	-1.6	0	1.3	1.1	-0.1	0.3
2008q1	0	0	0	12.2	5.4	6.8	0	0	0	0	0
2008q2	0	0	0	0	0	0	0	0.9	2.6	-0.5	-1.2
2008q3	0	0	0	0	0	0	0	0	0	0	0
2008q4	0	0	0	0	0	0	0	-0.1	0	0	-0.1
2009q1	0	0	0	6.5	6.2	0.3	0	0.2	0.2	0	0
2009q2	12.9	14.3	-1.4	3.1	3.1	0	0	-2	0.2	-1.2	-1
2009q3	0	0	0	1	0	0.9	0	0.4	0	0.3	0
2009q4	0	0	0	0	0	0	0	-0.5	0	0	-0.5
2010q1	-2.5	-2.5	0	19.7	17.7	1.1	0.9	-0.8	0	0.1	-1
2010q2	4.5	0.6	3.9	0	0	0	0	-4.1	-3.4	0.2	-0.8

2010q3	-0.2	0	-0.2	0	0	0	0	0.8	0.3	0.3	0.2
2010q4	0	0	0	0	0	0	0	-0.2	0	0	-0.1
2011q1	18	27.4	-9.4	-1.1	-1.1	0	0	-13.2	0	-0.6	-12.6
2011q2	0	0	0	0	0	0	0	-0.4	-0.9	-1.6	2.1
2011q3	0	0	0	0	0	0	0	0	0	0	0
2011q4	0	0	0	0	0	0	0	-1.2	0	-1.1	0
2012q1	0	0	0	-0.7	-0.7	0	0	1	0	0	1
2012q2	0	0	0	0	0	0	0	-1.6	-0.6	-0.5	-0.6
2012q3	0	0	0	0	0	0	0	0	0	0	0
2012q4	-0.3	0	-0.3	0	0	0	0	-0.1	0	-0.1	0
2013q1	-30.9	-26.1	-4.8	-0.7	-0.7	0	0	-0.5	0	-0.5	0
2013q2	0	0	0	6.1	6.1	0	0	4.6	2.3	2.9	-0.7
2013q3	0	0	0	0	0	0	0	0	0	0	0
2013q4	0	0	0	0	0	0	0	0.7	0	-0.1	0.8
2014q1	1.7	11	-9.3	0	0	0	0	-0.5	0	-0.5	0
2014q2	0	0	0	0	0	0	0	5.2	-0.5	5.1	0.6
2014q3	0	0	0	0	0	0	0	-1.1	-0.5	-0.6	0
2014q4	0	0	0	0	0	0	0	0.7	0	0	0.7
2015q1	-8	0	-8	0	0	0	0	0.4	-0.4	0.1	0.8
2015q2	0	0	0	0	0	0	0	1	2.3	-1.6	0.3
2015q3	0	0	0	2	2	0	0	-1.1	-0.3	-0.3	-0.5
2015q4	0	0	0	0	0	0	0	-1.2	0	0	-1.2
2016q1	0	0	0	3.3	3.3	0	0	-0.1	-0.1	0.1	0
2016q2	0	0	0	0	0	0	0	-7.5	-0.6	-5.9	-1
2016q3	0	0	0	0.1	0.1	0	0	0	0	0	0
2016q4	0	0	0	0	0	0	0	-0.2	0	0	-0.2
2017q1	0	0	0	2.3	2.6	-0.3	0	-0.5	-0.1	-0.4	0
2017q2	0	0	0	0	0	0	0	1.6	2.4	-1.3	0.5
2017q3	0	0	0	0	0	0	0	-0.8	0	0	-0.8
2017q4	0	0	0	0	0	0	0	0	0	0	0
2018q1	46	-14.1	60.2	3.6	3.6	0	0	0.3	-0.2	-0.2	0.8
2018q2	0	0	0	0	0	0	0	-0.9	-1.6	0.1	0.6

Notes: Tax shocks are expressed in billion nominal local currency and represent *tax cuts*.



# Varying Lag Lengths of Endogenous Tax Shocks

Figure A 1: Aggregated tax shocks, US Trade Variables, varying endogenous lag length

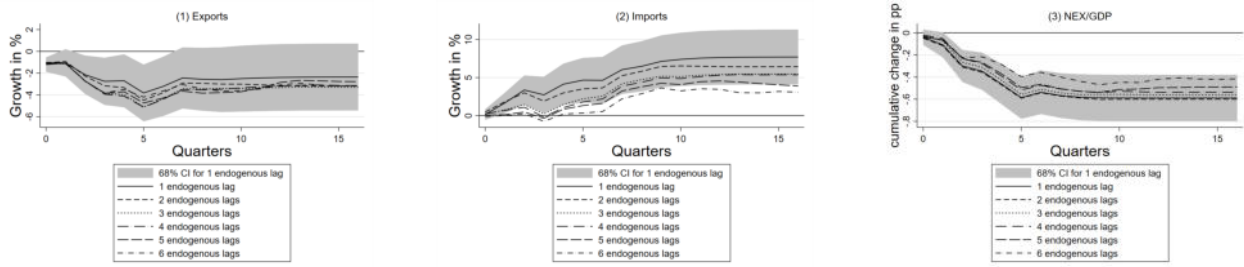


Figure A 2: Aggregated tax shocks, German Trade Variables, varying endogenous lag length

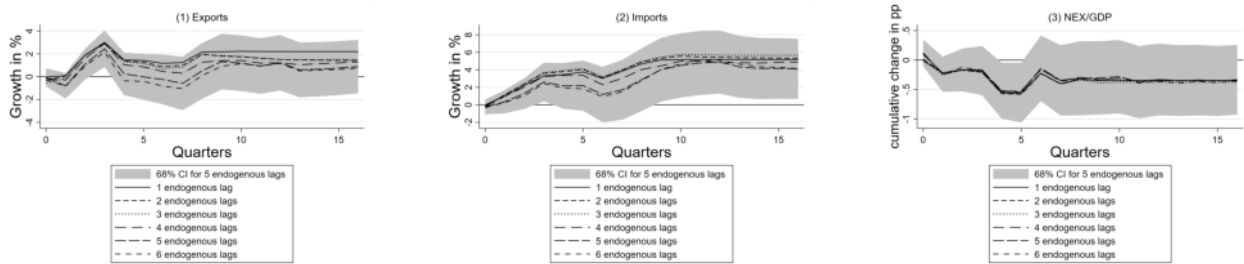


Figure A 3: Aggregated tax shocks, UK Trade Variables, varying endogenous lag length

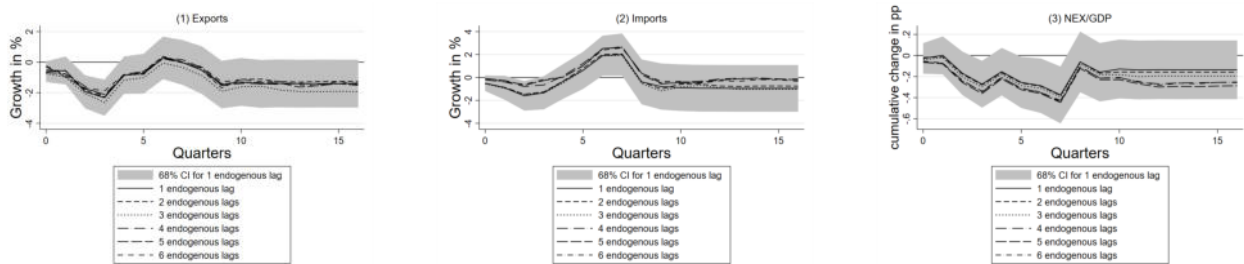


Figure A 4: Personal Income Tax Shock, US Trade Variables, varying endogenous lag length

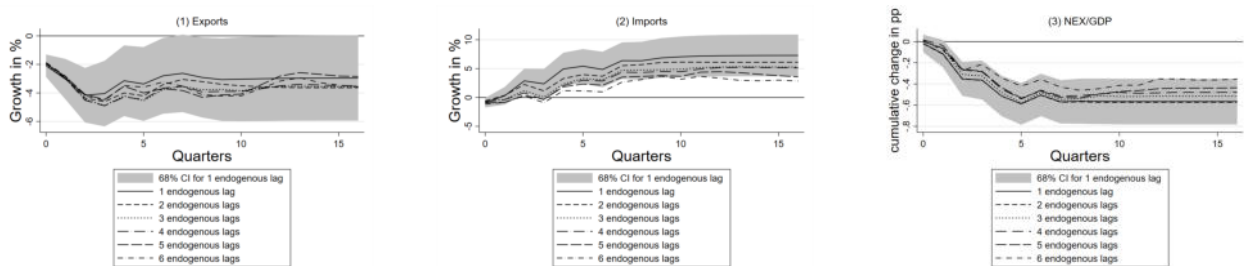


Figure A 5: Personal Income Tax Shocks, German Trade Variables, varying endogenous lag length

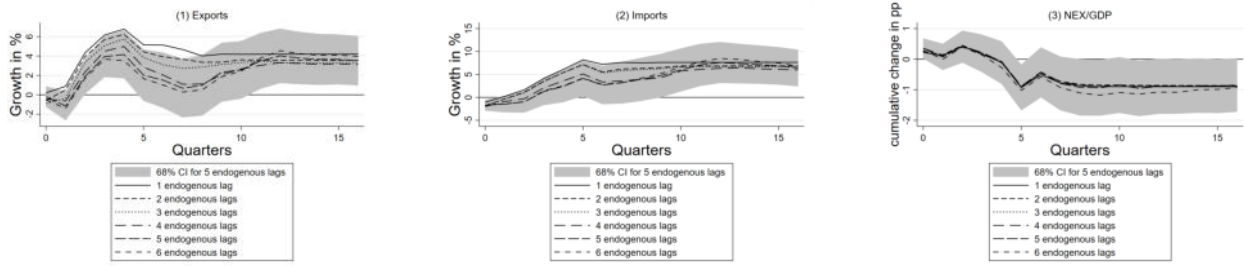


Figure A 6: Personal Income Tax Shocks, UK Trade Variables, varying endogenous lag length

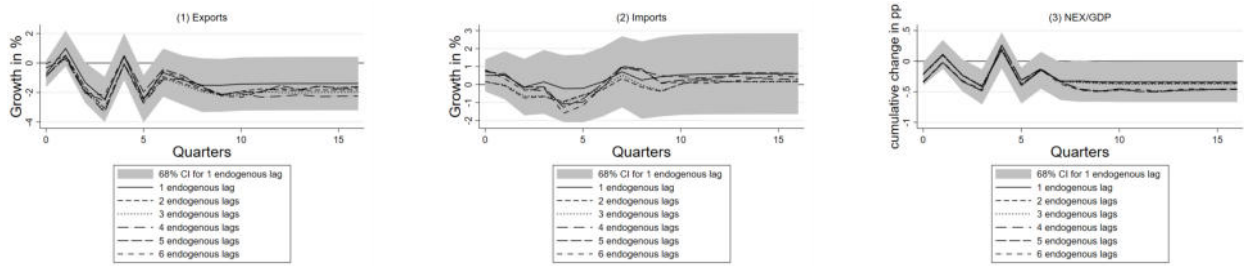


Figure A 7: Corporate Income Tax Shock, US Trade Variables, varying endogenous lag length

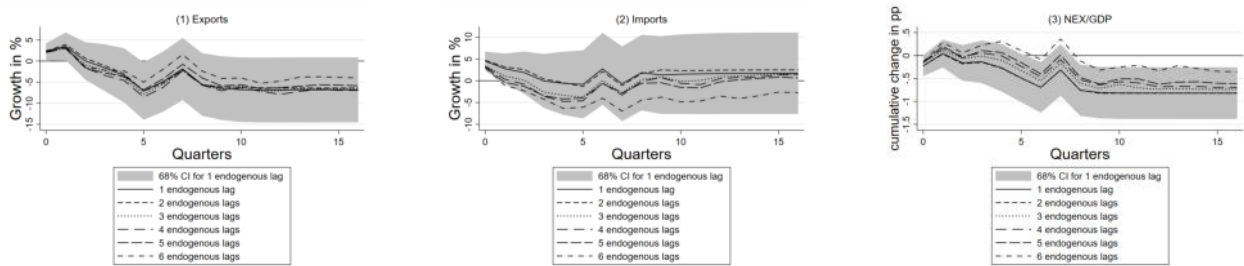


Figure A 8: Corporate Income Tax Shock, German Trade Variables, varying endogenous lag length

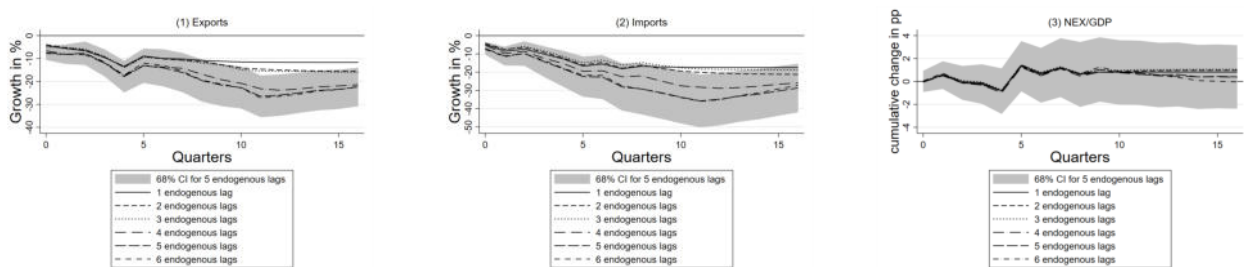


Figure A 9: Corporate Income Tax Shock, UK Trade Variables, varying endogenous lag length

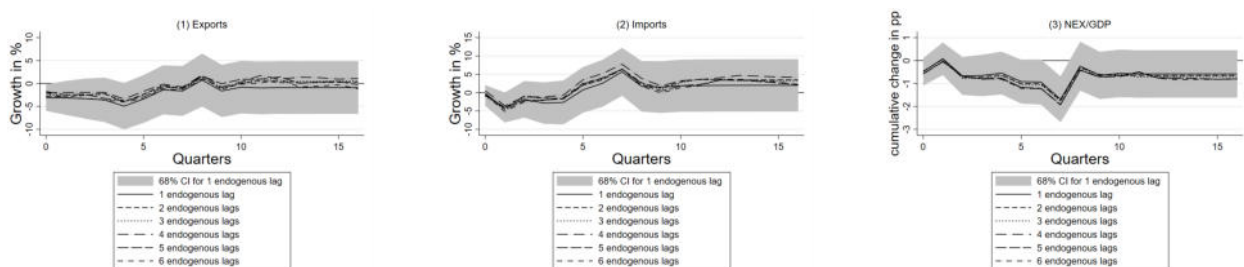


Figure A 10: Indirect Tax Shock, German Trade Variables, varying endogenous lag length

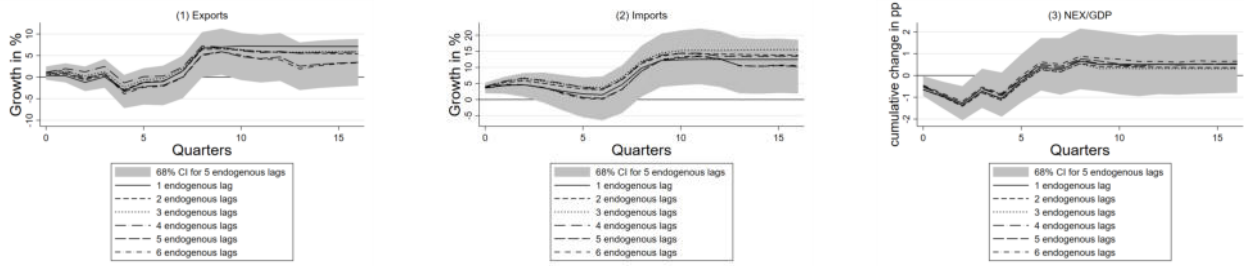


Figure A 11: Indirect Tax Shock, UK Trade Variables, varying endogenous lag length

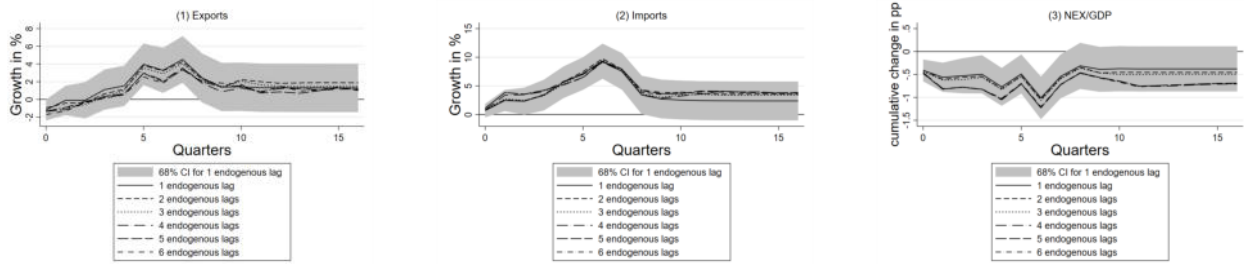


Figure A 12: Increase in Aggregated Tax Shocks, US Trade Variables, varying endogenous lag length

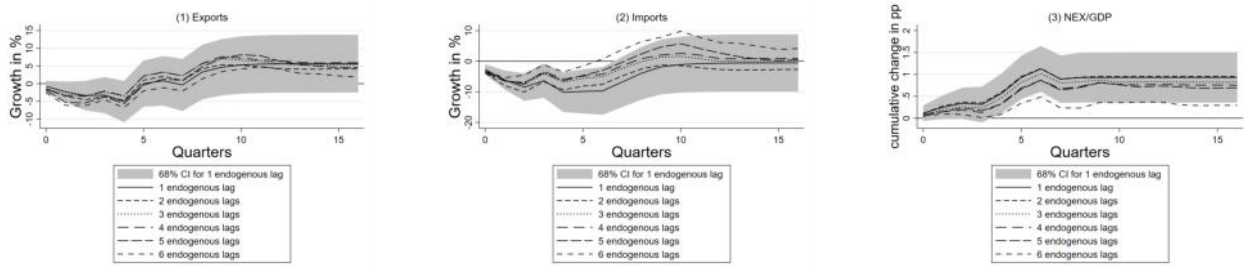


Figure A 13: Increase in Aggregated Tax Shocks, German Trade Variables, varying endogenous lag length

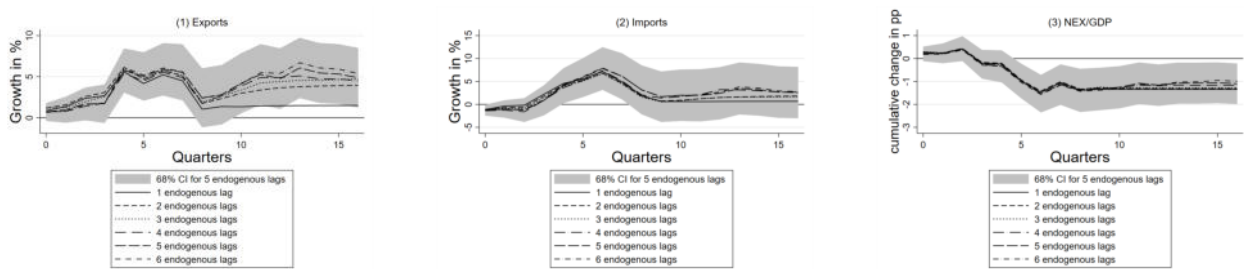


Figure A 14: Increase in Aggregated Tax Shocks, UK Trade Variables, varying endogenous lag length

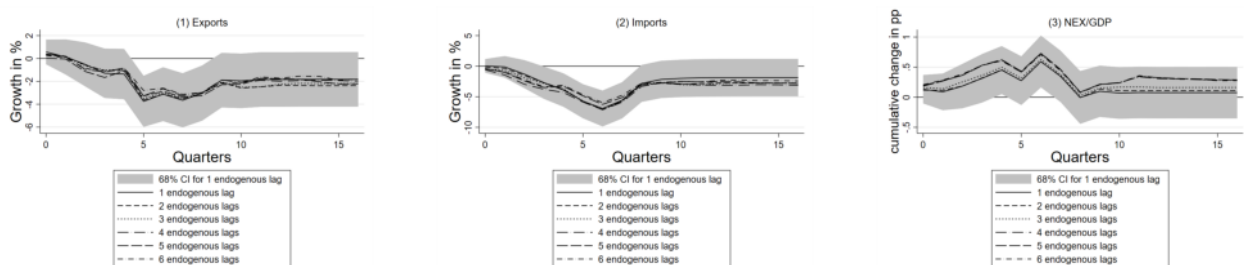


Figure A 15: Decrease in Aggregated Tax Shocks, US Trade Variables, varying endogenous lag length

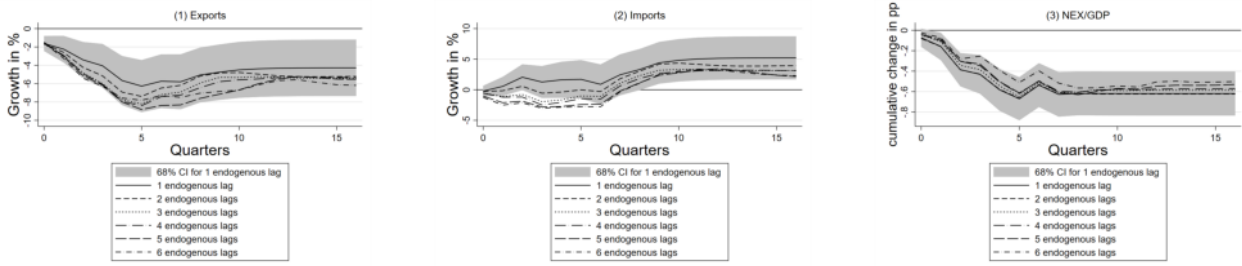


Figure A 16: Decrease in Aggregated Tax Shocks, German Trade Variables, varying endogenous lag length

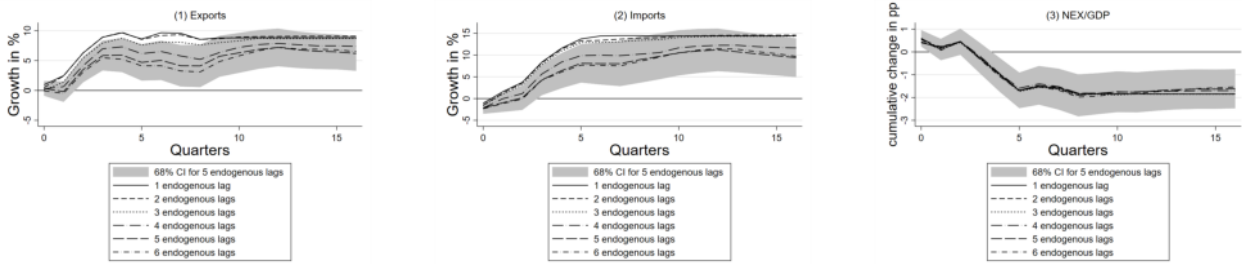


Figure A 17: Decrease in Aggregated Tax Shocks, UK Trade Variables, varying endogenous lag length

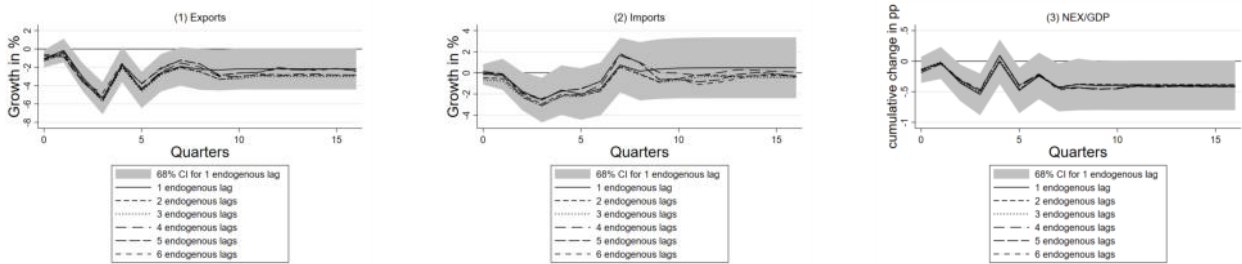


Figure A 18: Spill-over Effects, All US Tax Liabilities, German Trade Variables, varying endogenous lag length

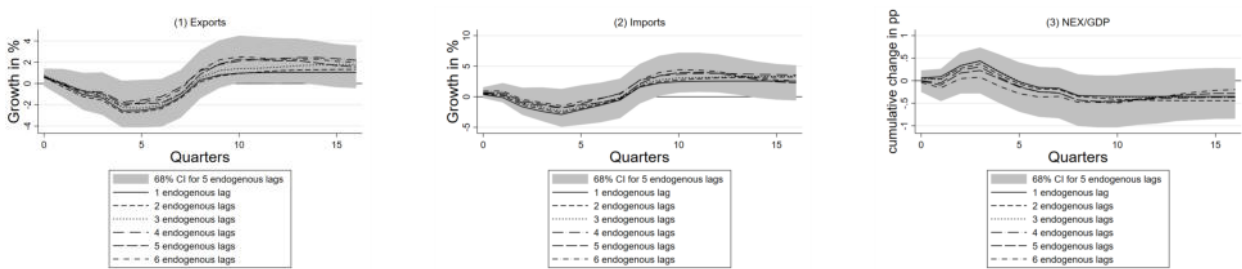


Figure A 19: Spill-over Effects, All US Tax Liabilities, UK Trade Variables, varying endogenous lag length

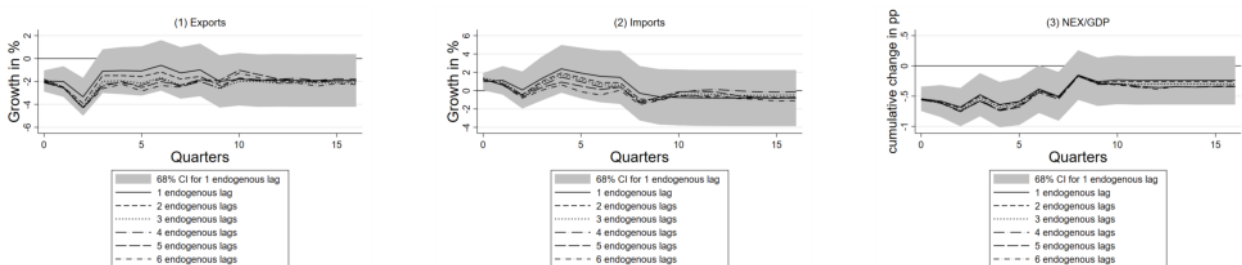


Figure A 20: Spill-over Effects, US Personal Income Tax Shock, German Trade Variables, varying endogenous lag length

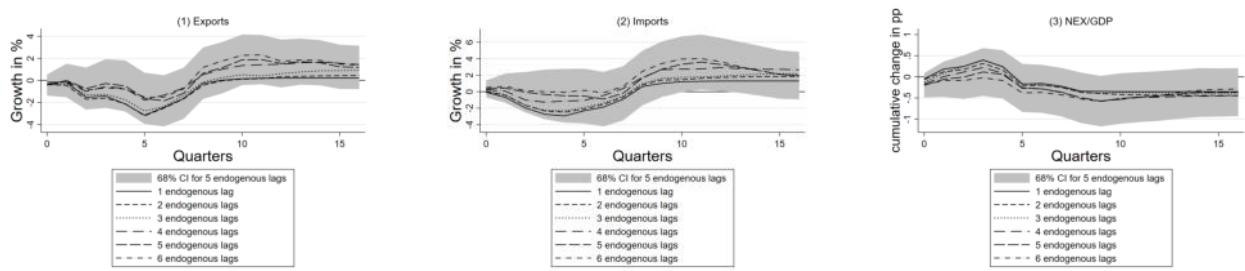


Figure A 21: Spill-over Effects, US Personal Income Tax Shock, UK Trade Variables, varying endogenous lag length

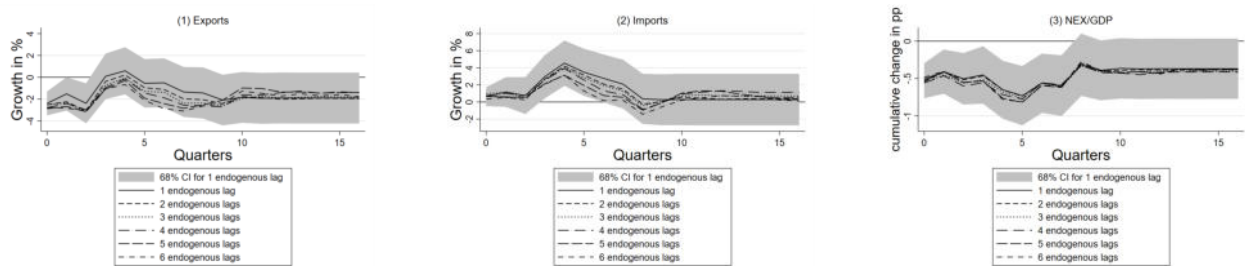


Figure A 22: Spill-over Effects, US Business Income Tax Shock, German Trade Variables, varying endogenous lag length

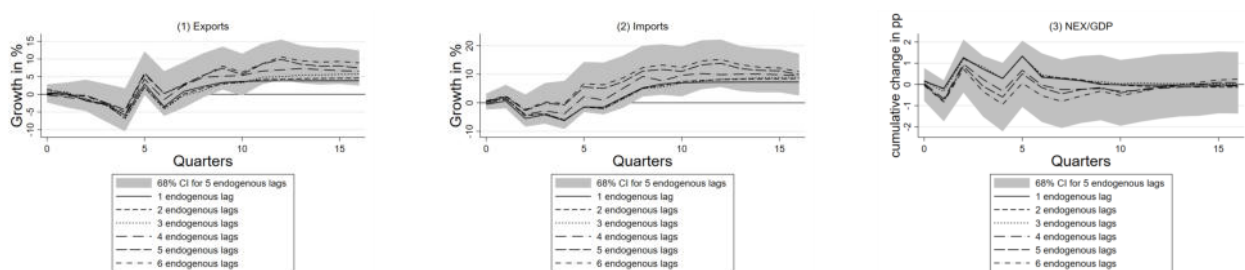


Figure A 23: Spill-over Effects, US Business Income Tax Shock, UK Trade Variables, varying endogenous lag length

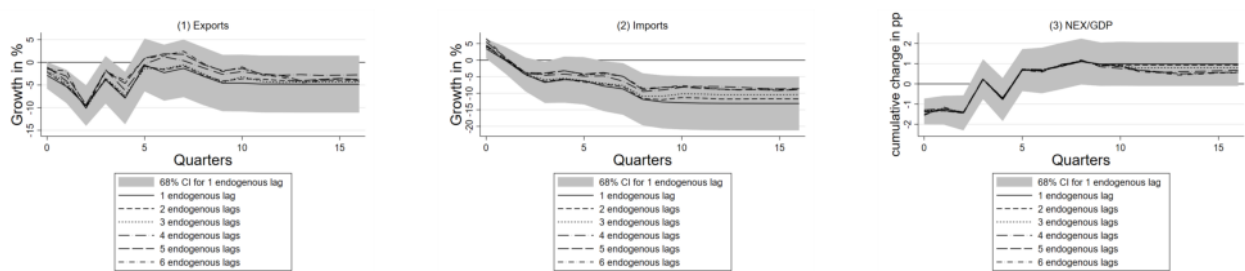


Figure A 24: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, German Trade Variables, varying endogenous lag length

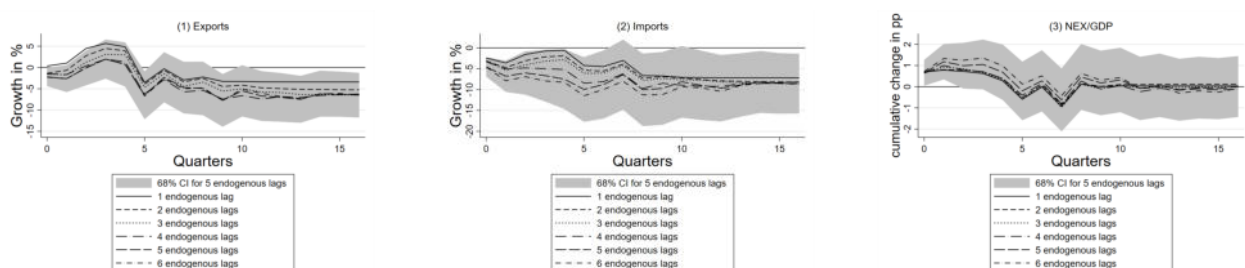




Figure A 25: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, UK Trade Variables, varying endogenous lag length

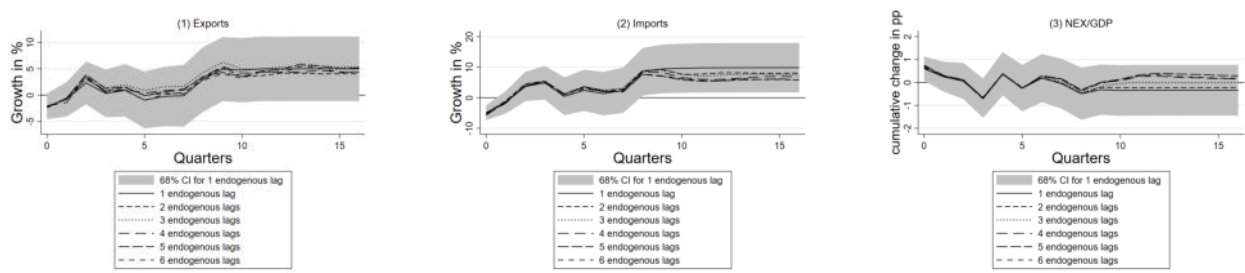


Figure A 26: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, German Trade Variables, varying endogenous lag length

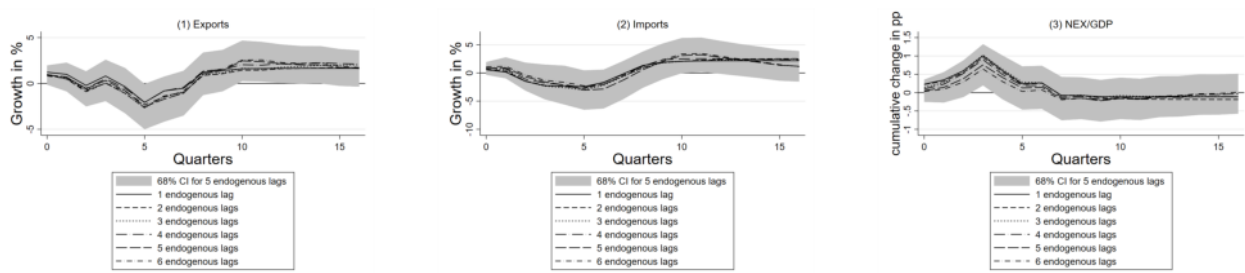
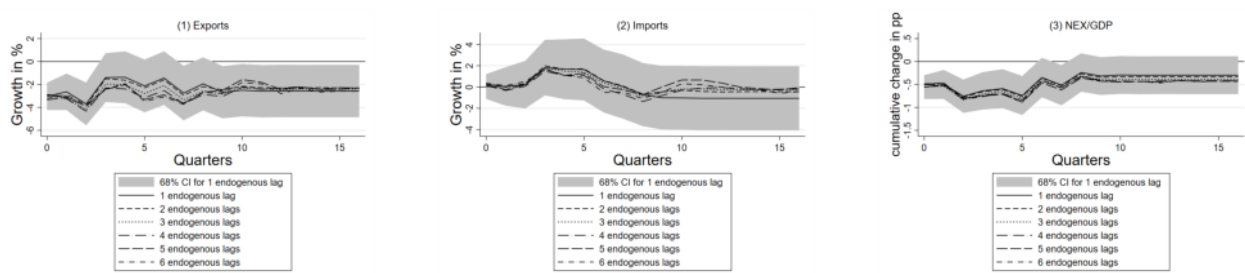


Figure A 27: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, UK Trade Variables, varying endogenous lag length



# Varying Lag Lengths of Exogenous Tax Shocks

Figure A 28: Aggregated tax shocks, US Trade Variables, varying exogenous lag length

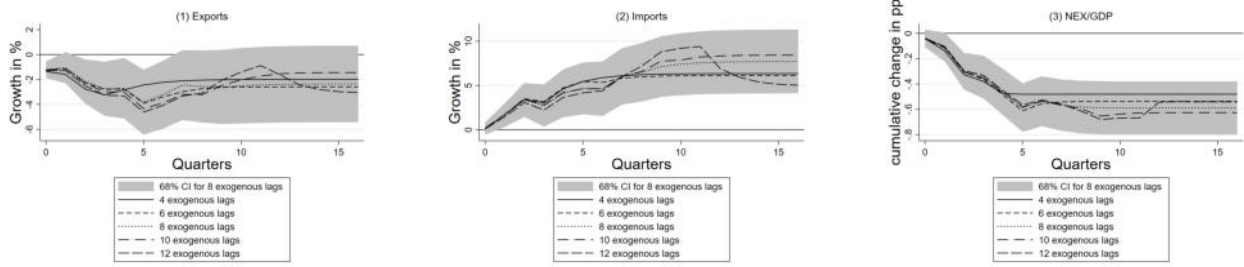


Figure A 29: Aggregated tax shocks, German Trade Variables, varying exogenous lag length

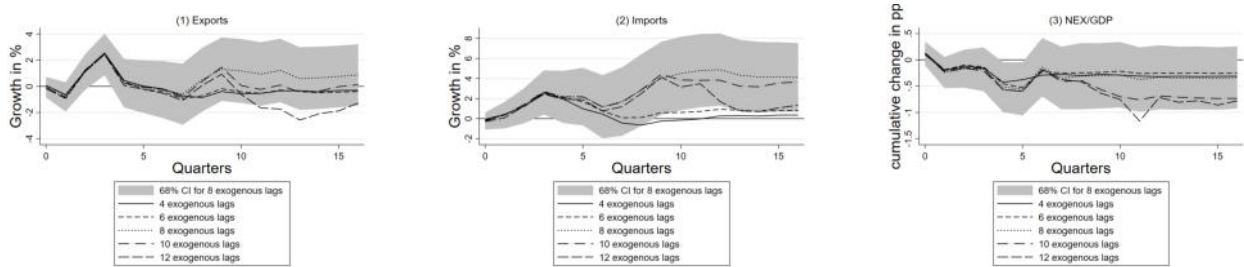


Figure A 30: Aggregated tax shocks, UK Trade Variables, varying exogenous lag length

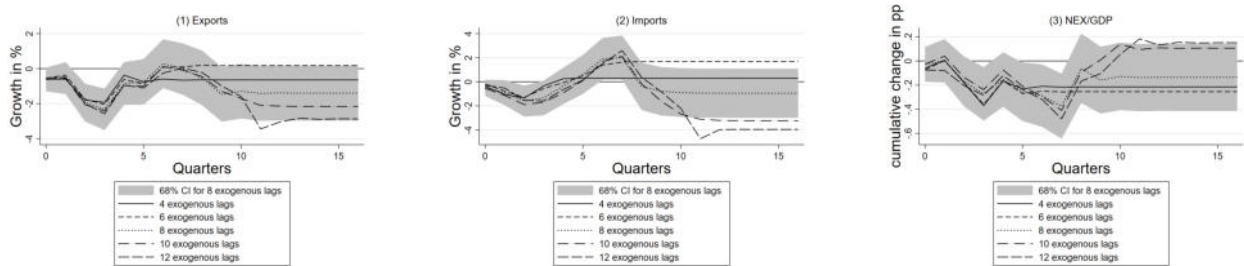


Figure A 31: Personal Income Tax Shock, US Trade Variables, varying exogenous lag length

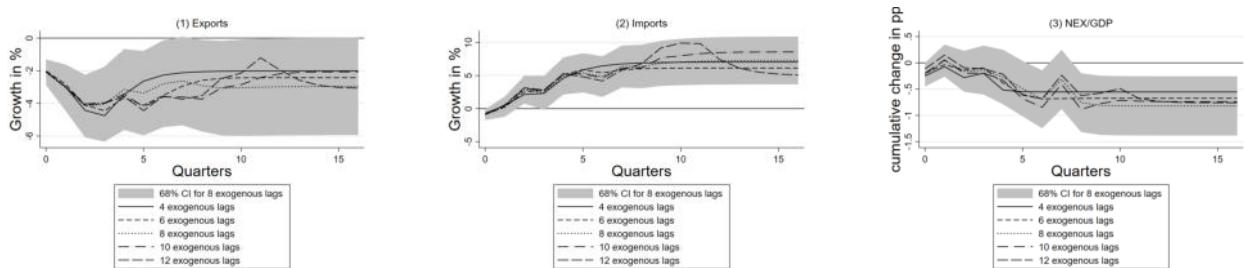


Figure A 32: Personal Income Tax Shocks, German Trade Variables, varying exogenous lag length

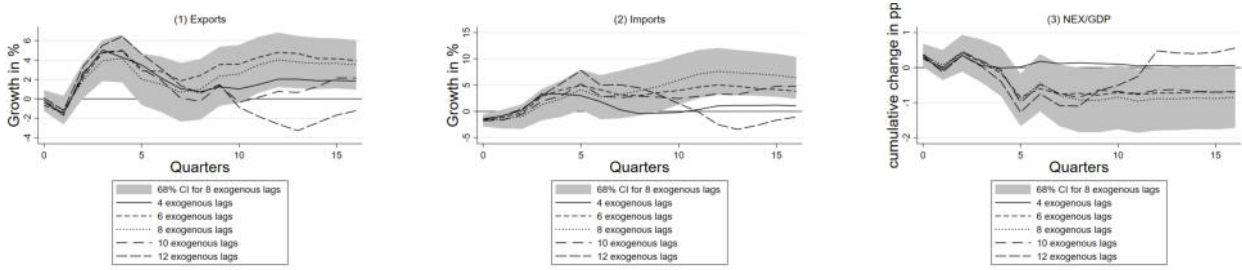


Figure A 33: Personal Income Tax Shocks, UK Trade Variables, varying exogenous lag length

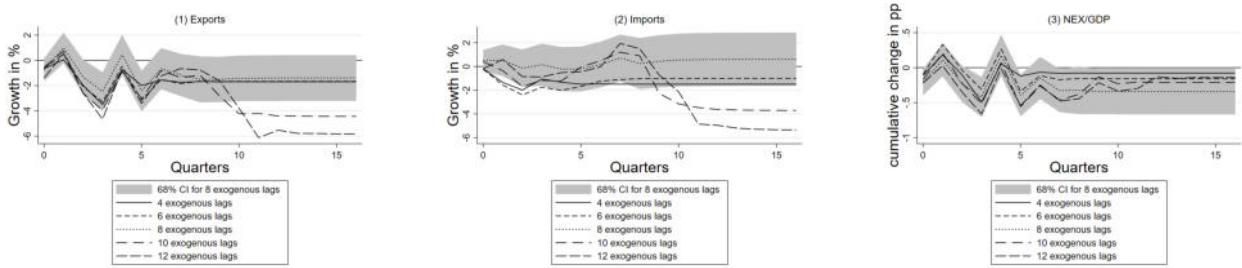


Figure A 34: Corporate Income Tax Shock, US Trade Variables, varying exogenous lag length

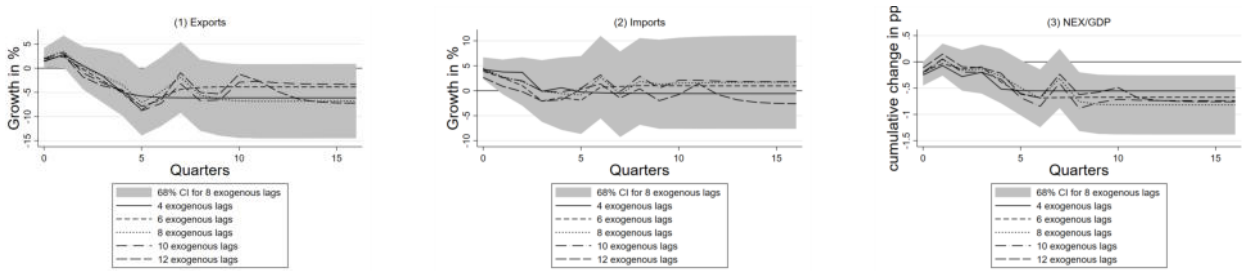


Figure A 35: Corporate Income Tax Shock, German Trade Variables, varying exogenous lag length

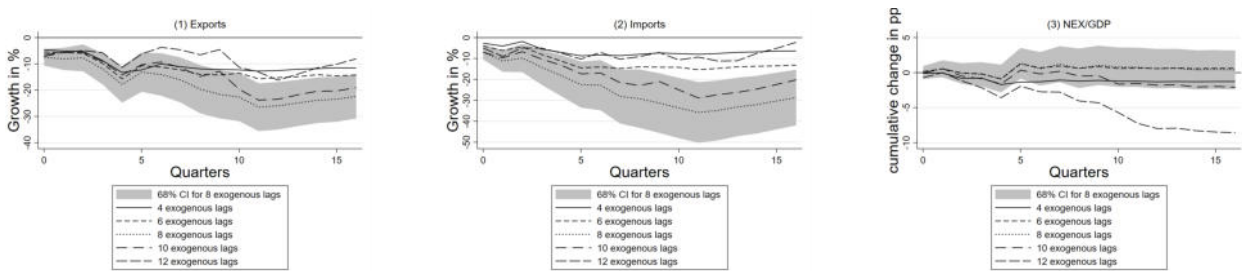


Figure A 36: Corporate Income Tax Shock, UK Trade Variables, varying exogenous lag length

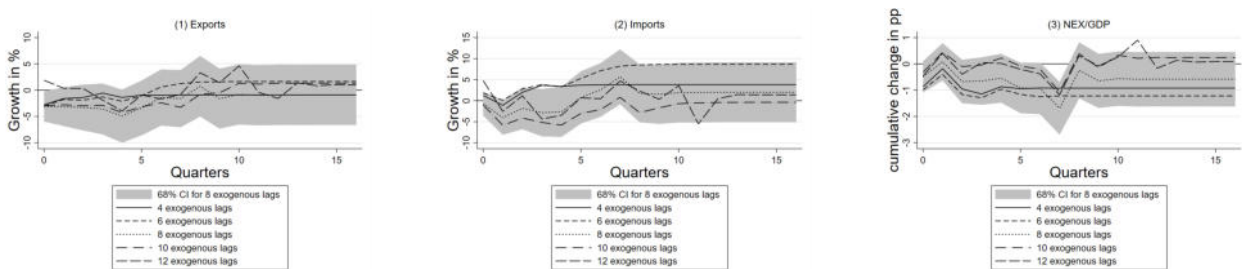




Figure A 37: Indirect Tax Shock, German Trade Variables, varying exogenous lag length

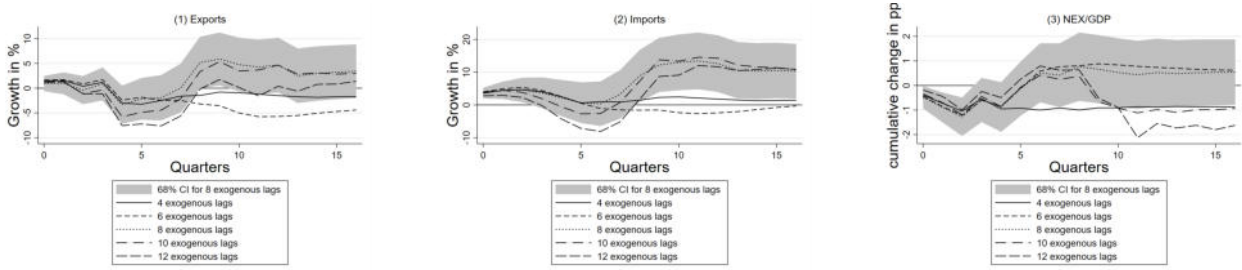


Figure A 38: Indirect Tax Shock, UK Trade Variables, varying exogenous lag length

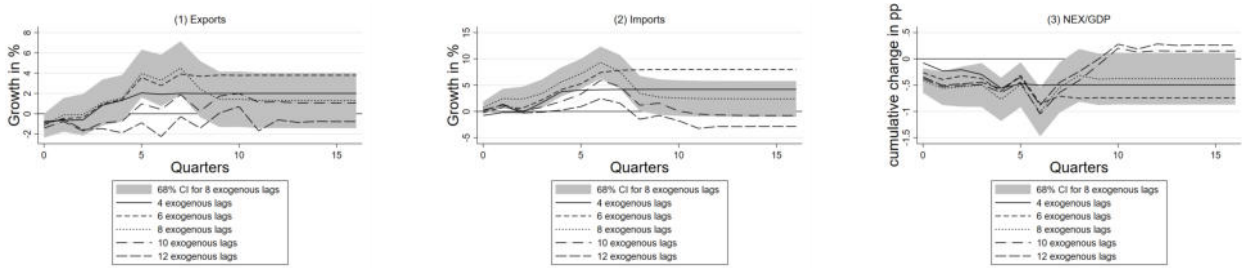


Figure A 39: Increase in Aggregated Tax Shocks, US Trade Variables, varying exogenous lag length

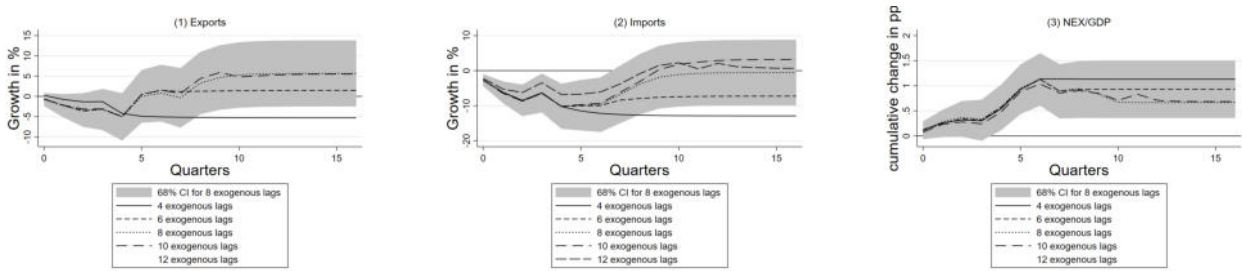


Figure A 40: Increase in Aggregated Tax Shocks, German Trade Variables, varying exogenous lag length

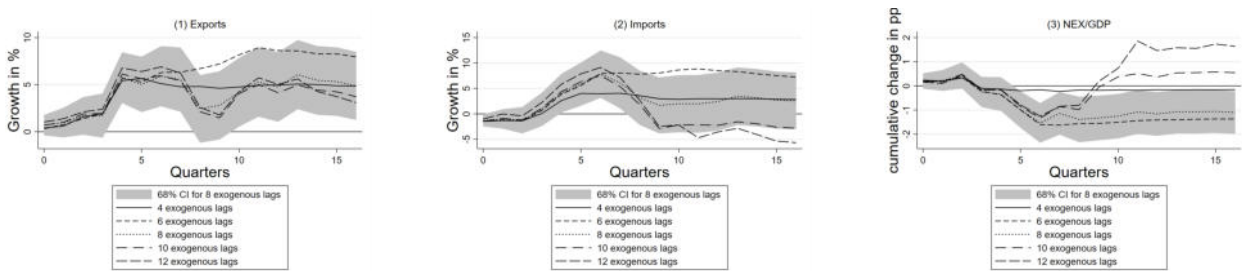


Figure A 41: Increase in Aggregated Tax Shocks, UK Trade Variables, varying exogenous lag length

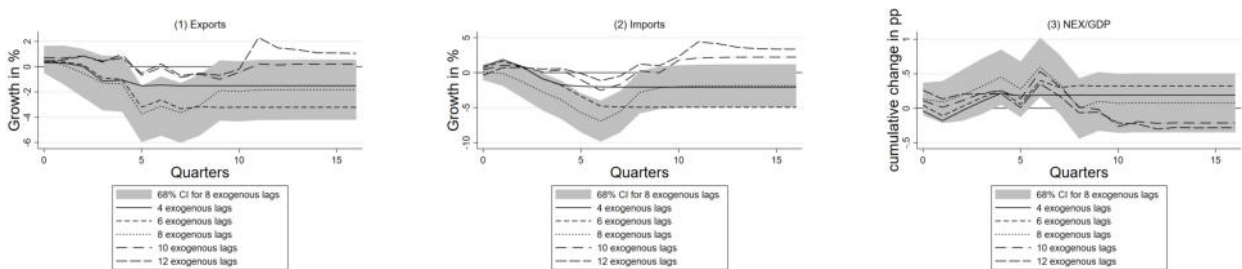


Figure A 42: Decrease in Aggregated Tax Shocks, US Trade Variables, varying exogenous lag length

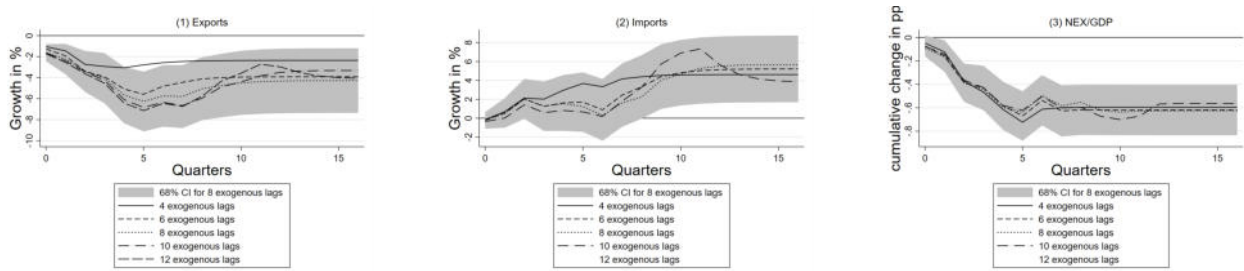


Figure A 43: Decrease in Aggregated Tax Shocks, German Trade Variables, varying exogenous lag length

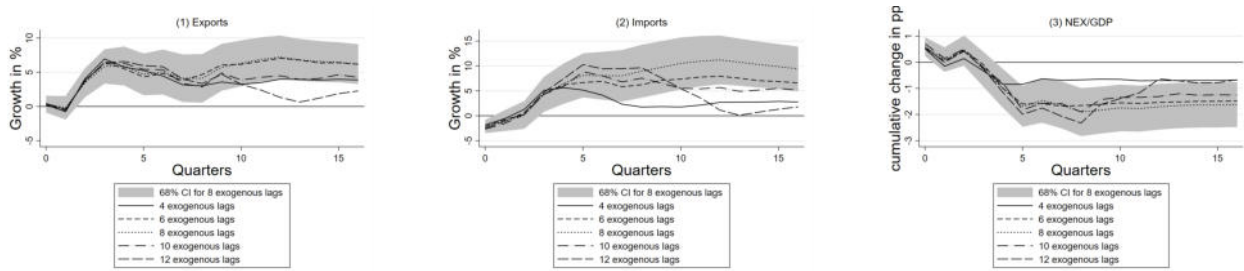


Figure A 44: Decrease in Aggregated Tax Shocks, UK Trade Variables, varying exogenous lag length

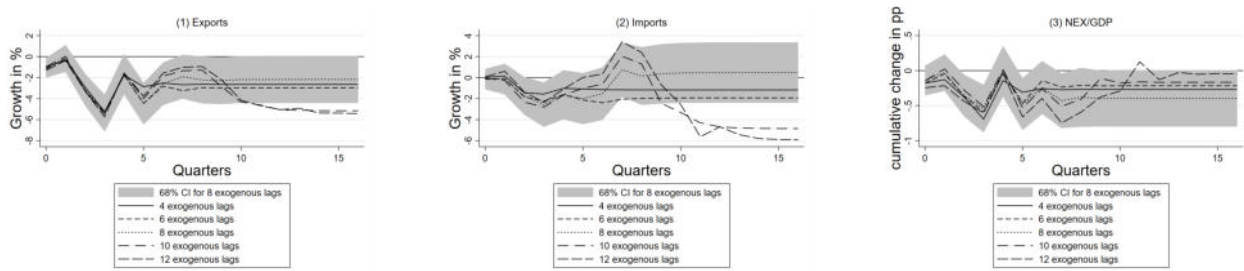


Figure A 45: Spill-over Effects, All US Tax Liabilities, German Trade Variables, varying exogenous lag length

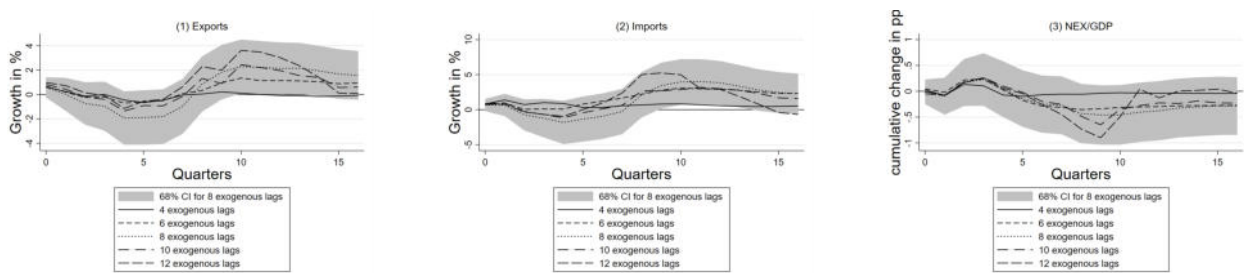


Figure A 46: Spill-over Effects, All US Tax Liabilities, UK Trade Variables, varying exogenous lag length

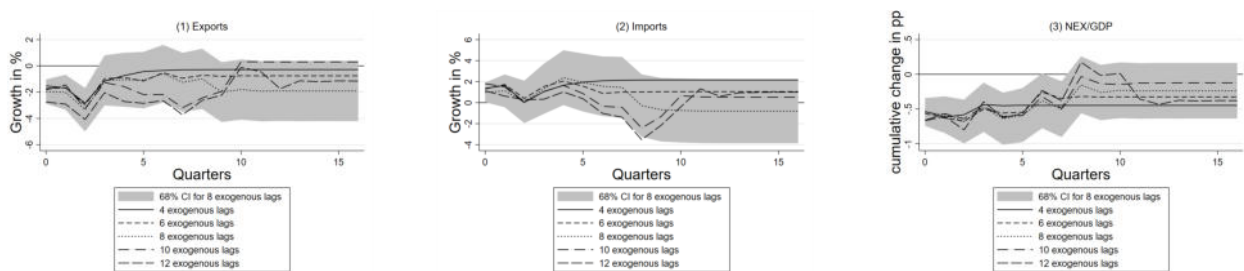


Figure A 47: Spill-over Effects, US Personal Income Tax Shock, German Trade Variables, varying exogenous lag length

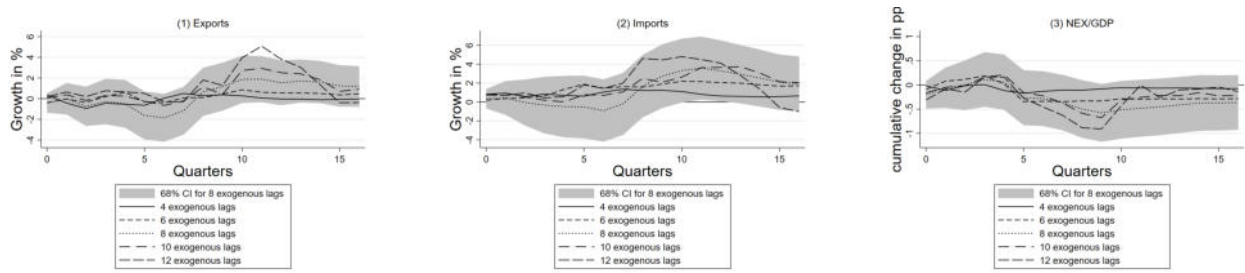


Figure A 48: Spill-over Effects, US Personal Income Tax Shock, UK Trade Variables, varying exogenous lag length

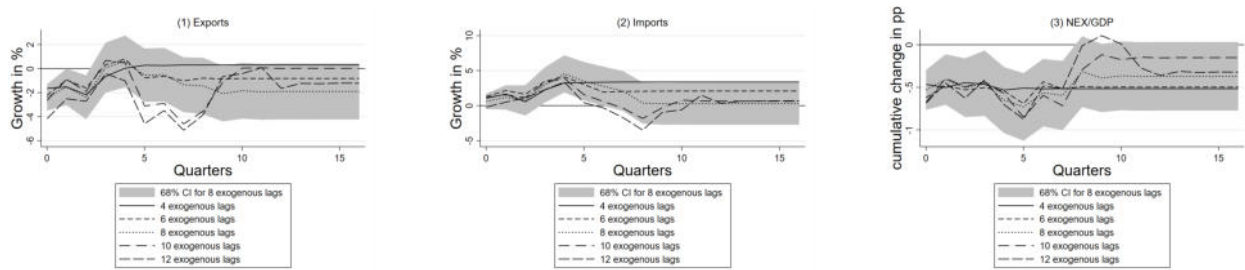


Figure A 49: Spill-over Effects, US Business Income Tax Shock, German Trade Variables, varying exogenous lag length

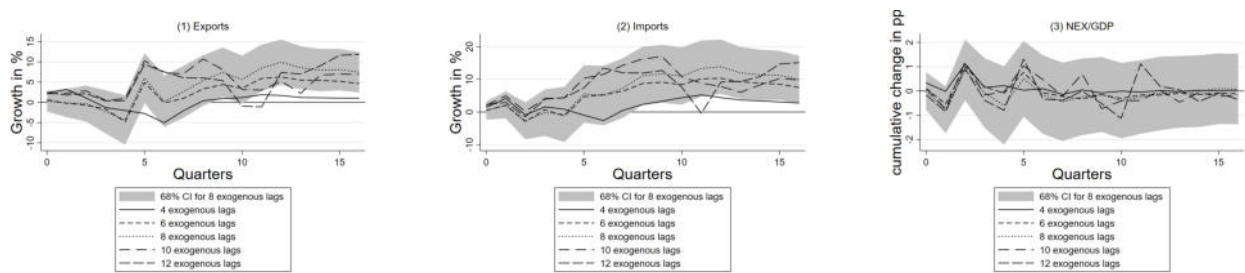


Figure A 50: Spill-over Effects, US Business Income Tax Shock, UK Trade Variables, varying exogenous lag length

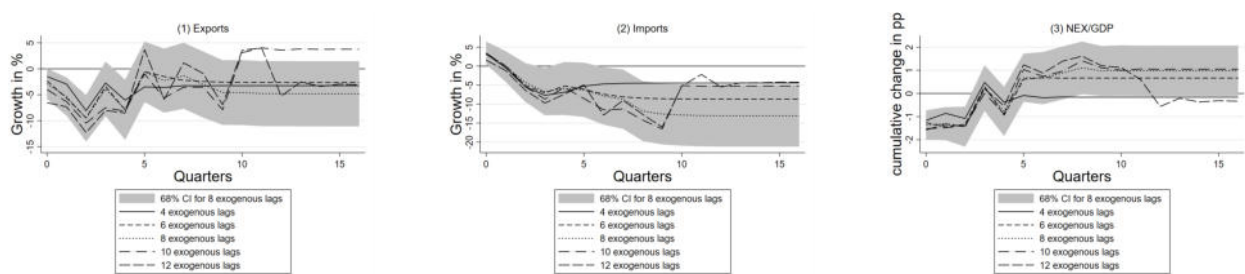


Figure A 51: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, German Trade Variables, varying exogenous lag length

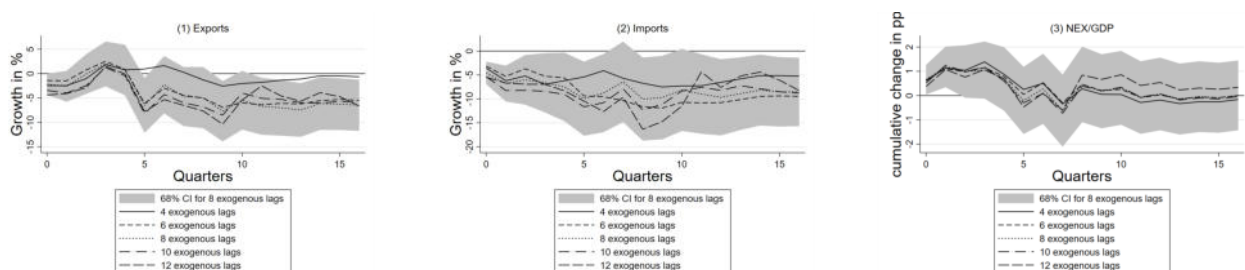


Figure A 52: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, UK Trade Variables, varying exogenous lag length

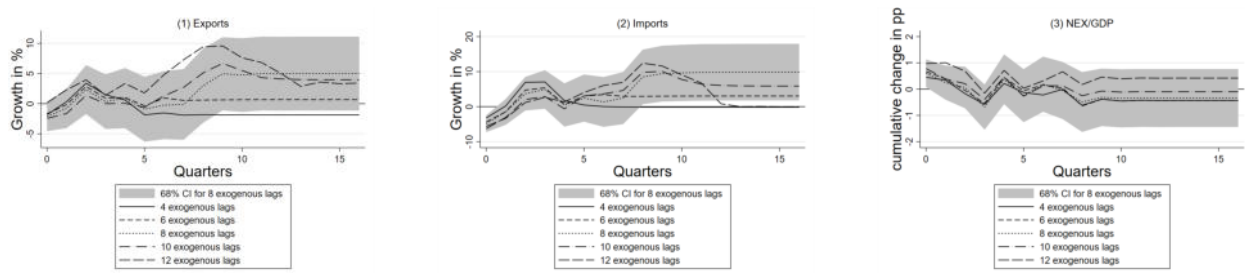


Figure A 53: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, German Trade Variables, varying exogenous lag length

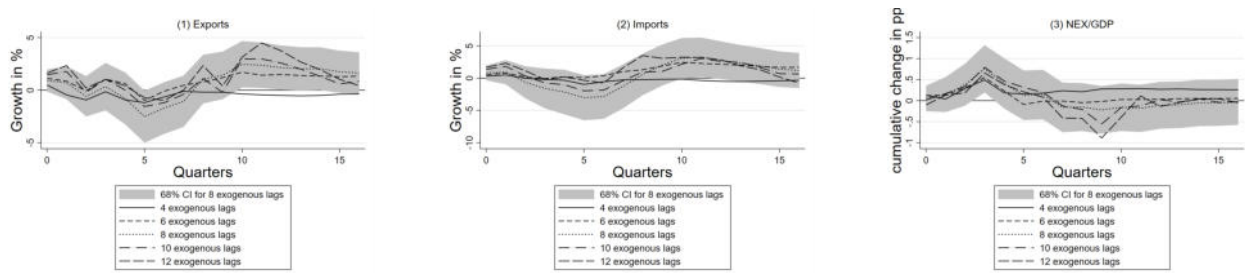
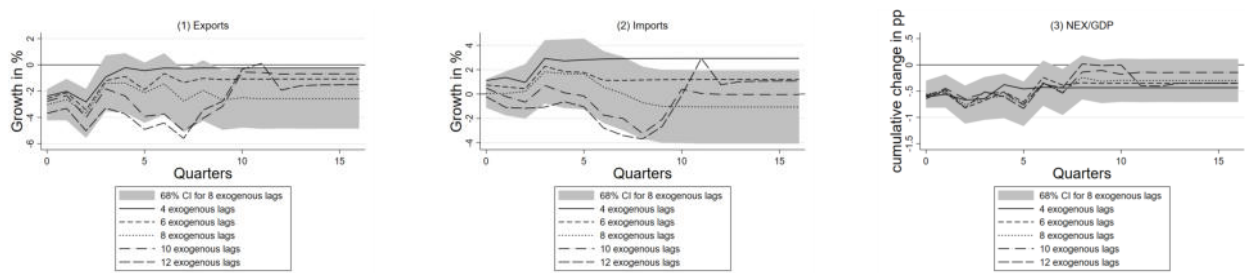


Figure A 54: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, UK Trade Variables, varying exogenous lag length



## In (log-)levels

Figure A 55: Aggregated tax shocks, US Trade Variables, in (log-) levels

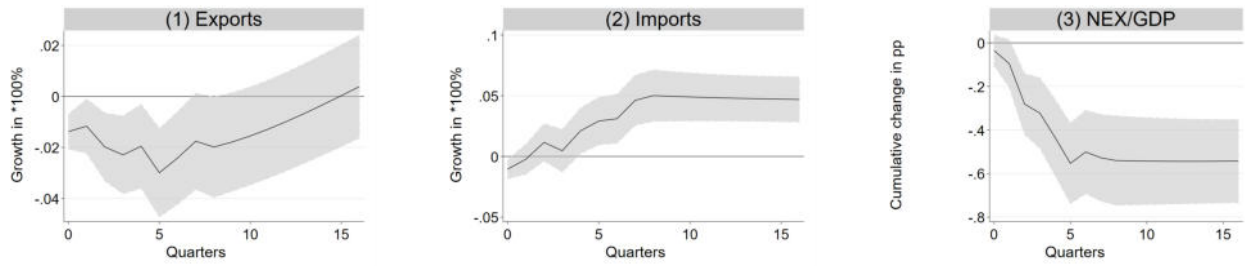


Figure A 56: Aggregated tax shocks, German Trade Variables, in (log-) levels

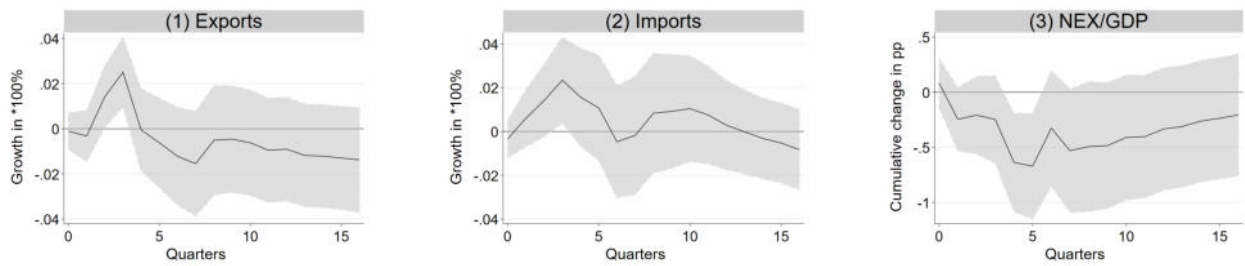


Figure A 57: Aggregated tax shocks, UK Trade Variables, in (log-) levels

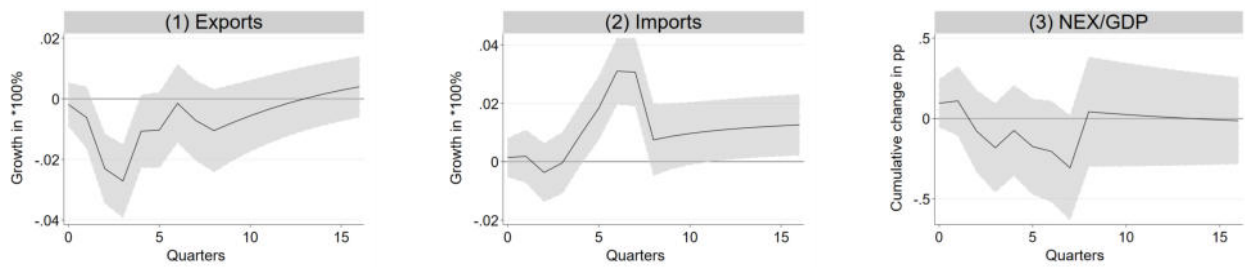


Figure A 58: Personal Income Tax Shock, US Trade Variables, in (log-) levels

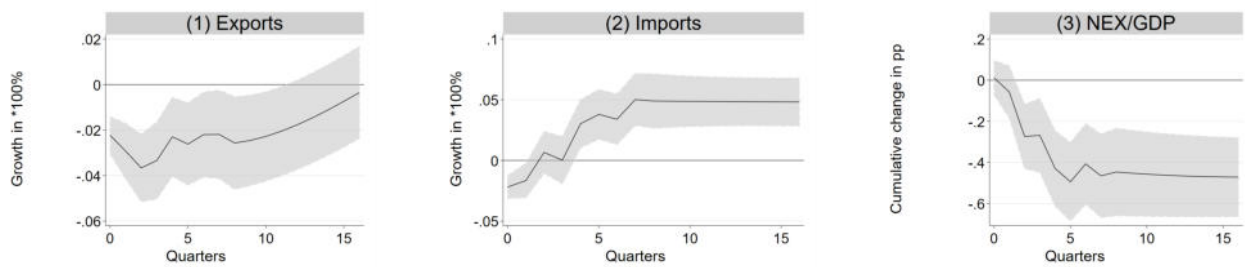




Figure A 59: Personal Income Tax Shocks, German Trade Variables, in (log-) levels

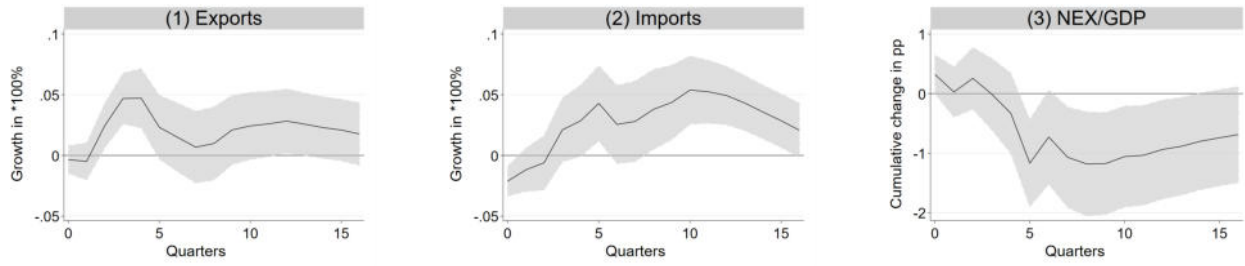


Figure A 60: Personal Income Tax Shock, UK Trade Variables, in (log-) levels

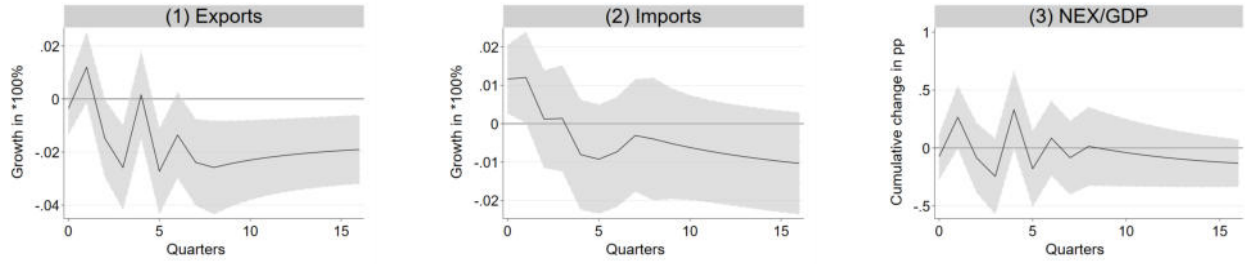


Figure A 61: Corporate Income Tax Shock, US Trade Variables, in (log-) levels

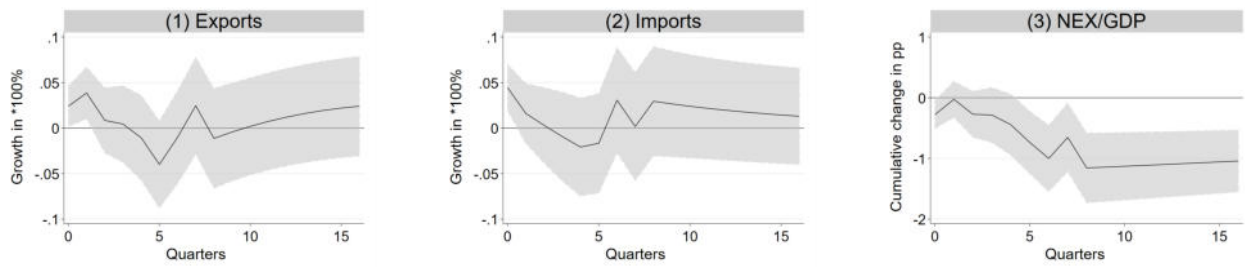


Figure A 62: Corporate Income Tax Shock, German Trade Variables, in (log-) levels

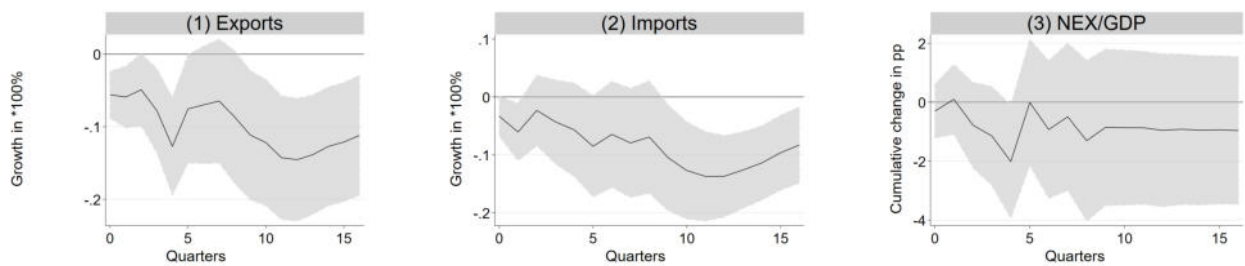


Figure A 63: Corporate Income Tax Shock, UK Trade Variables, in (log-) levels

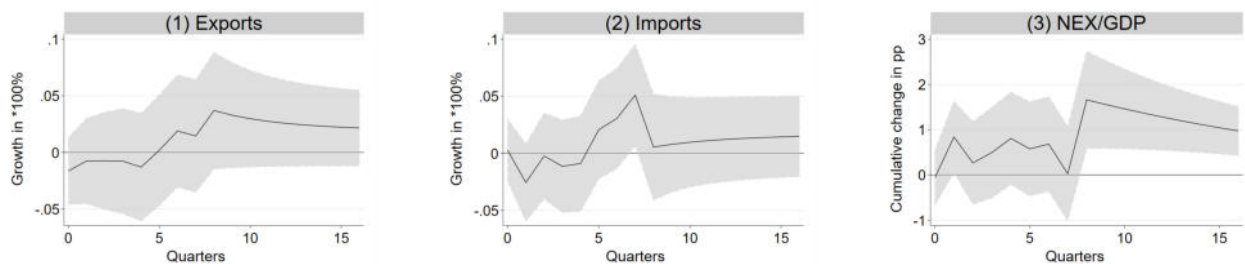


Figure A 64: Indirect Tax Shock, German Trade Variables, in (log-) levels

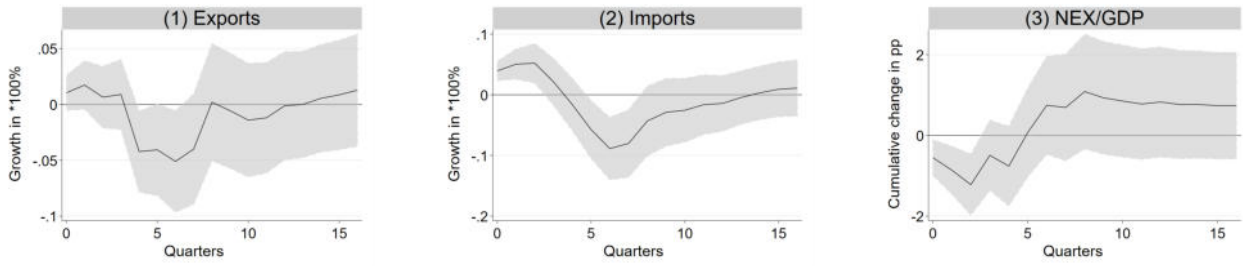


Figure A 65: Indirect Tax Shock, UK Trade Variables, in (log-) levels

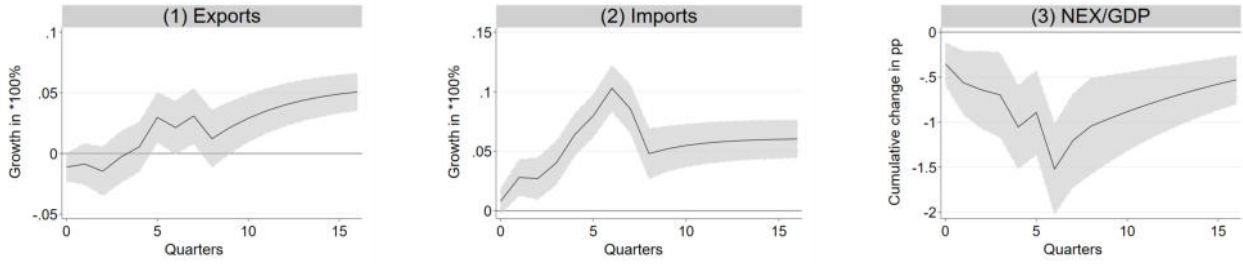


Figure A 66: Increase in Aggregated Tax Shocks, US Trade Variables, in (log-) levels

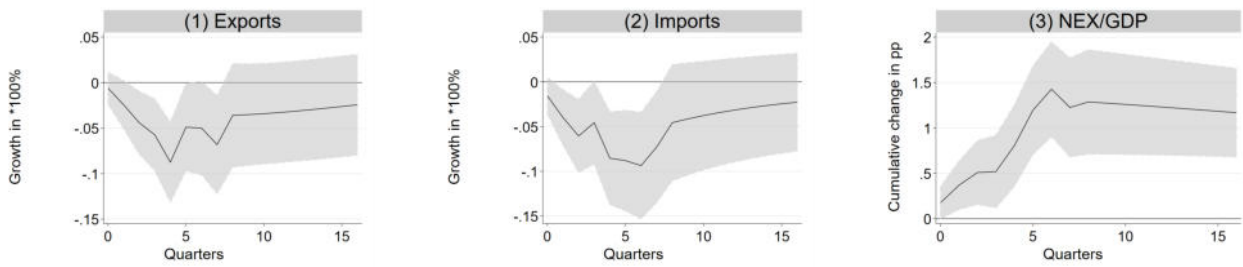


Figure A 67: Increase in Aggregated Tax Shocks, German Trade Variables, in (log-) levels

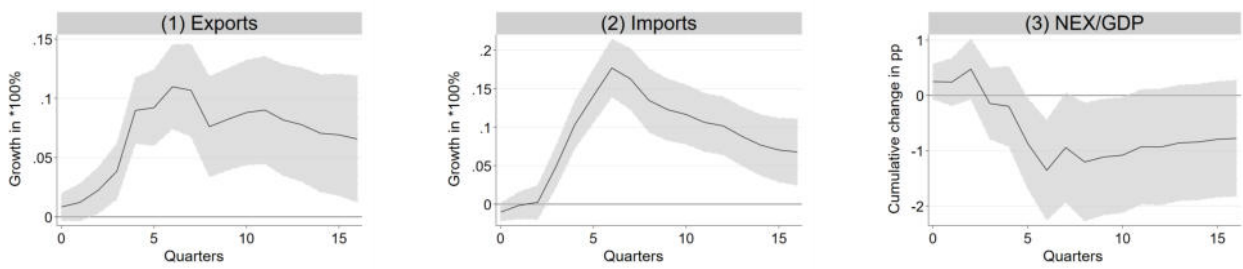


Figure A 68: Increase in Aggregated Tax Shocks, UK Trade Variables, in (log-) levels

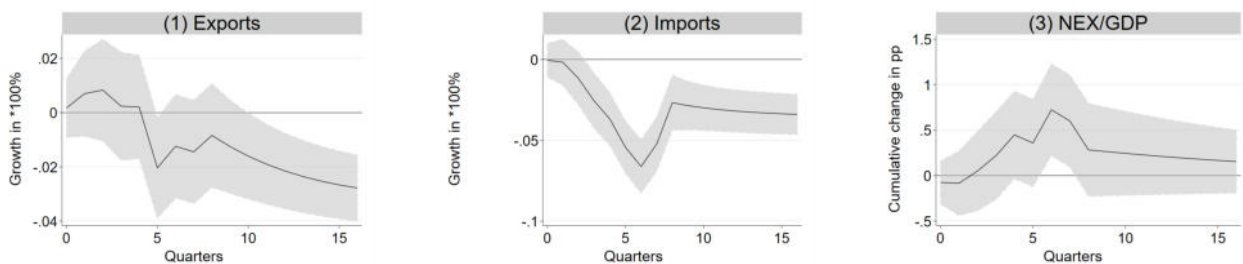


Figure A 69: Decrease in Aggregated Tax Shocks, US Trade Variables, in (log-) levels

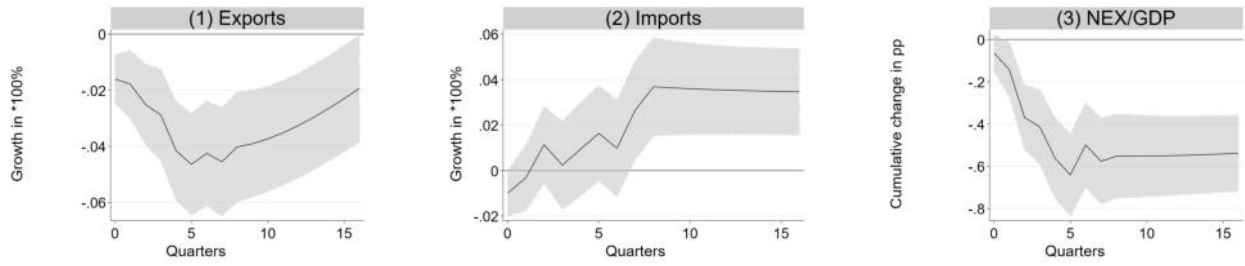


Figure A 70: Decrease in Aggregated Tax Shocks, German Trade Variables, in (log-) levels

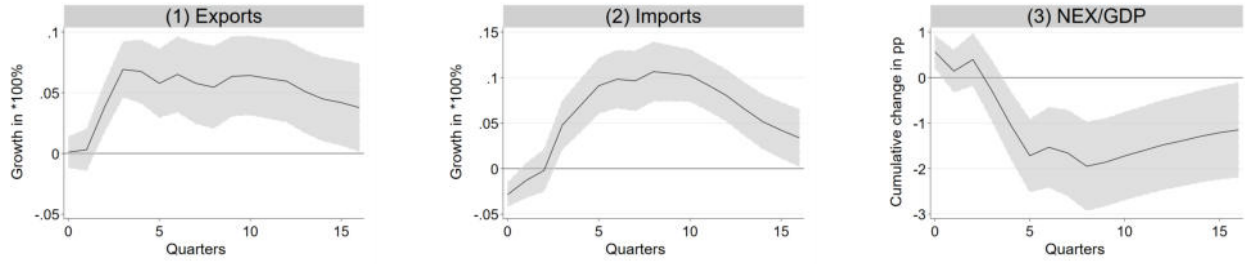


Figure A 71: Decrease in Aggregated Tax Shocks, UK Trade Variables, in (log-) levels

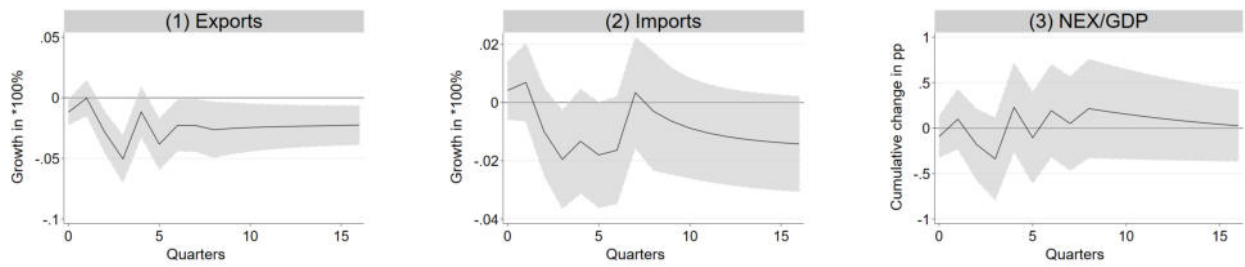


Figure A 72: Spill-over Effects, All US Tax Liabilities, German Trade Variables, in (log-) levels

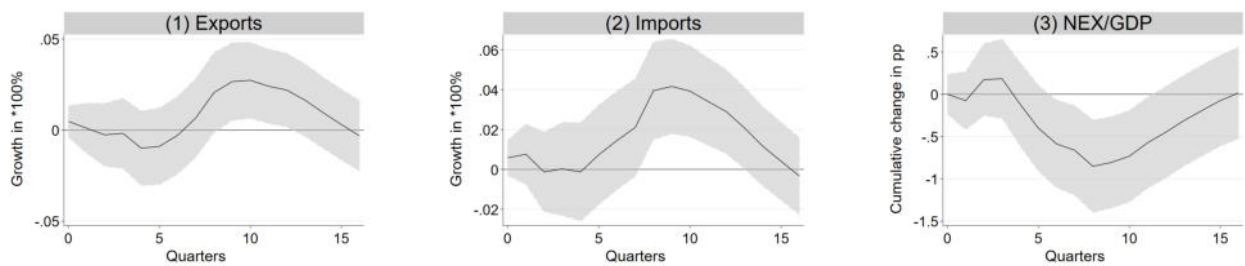


Figure A 73: Spill-over Effects, All US Tax Liabilities, UK Trade Variables, in (log-) levels

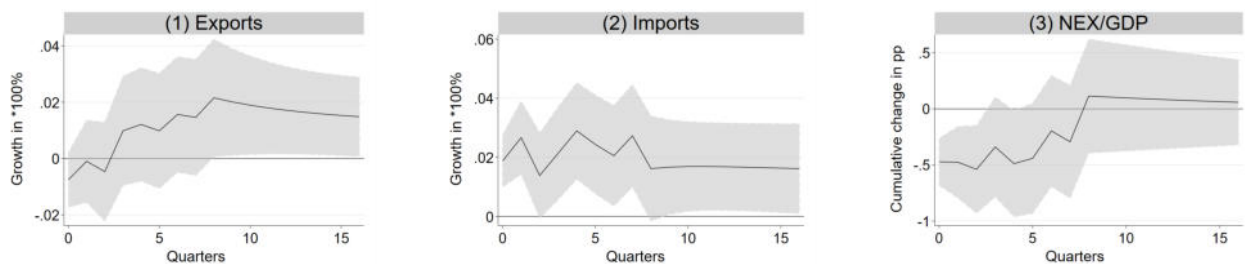




Figure A 74: Spill-over Effects, US Personal Income Tax Shock, German Trade Variables, in (log-) levels

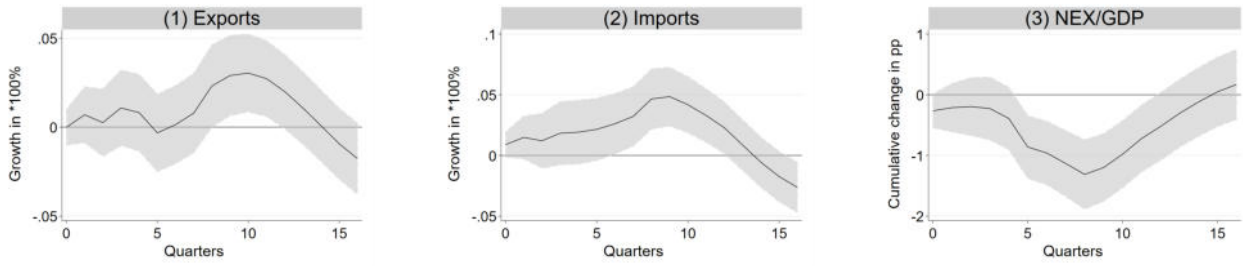


Figure A 75: Spill-over Effects, US Personal Income Tax Shock, UK Trade Variables, in (log-) levels

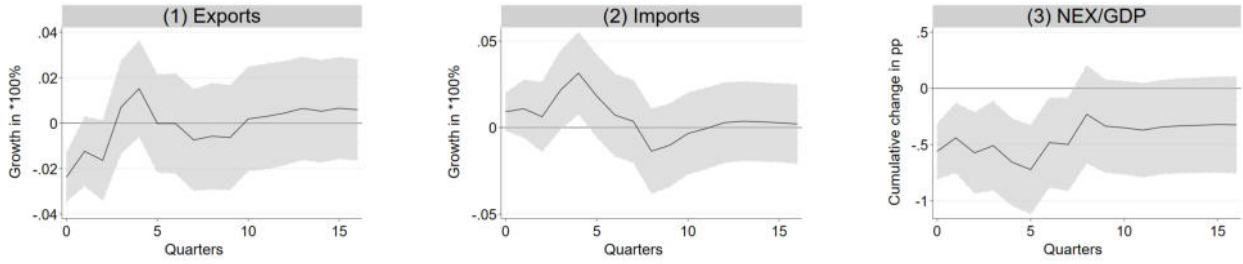


Figure A 76: Spill-over Effects, US Business Income Tax Shock, German Trade Variables, in (log-) levels

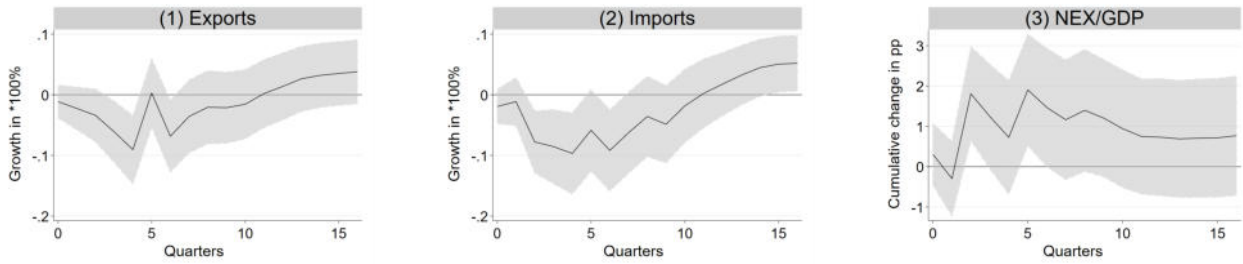


Figure A 77: Spill-over Effects, US Business Income Tax Shock, UK Trade Variables, in (log-) levels

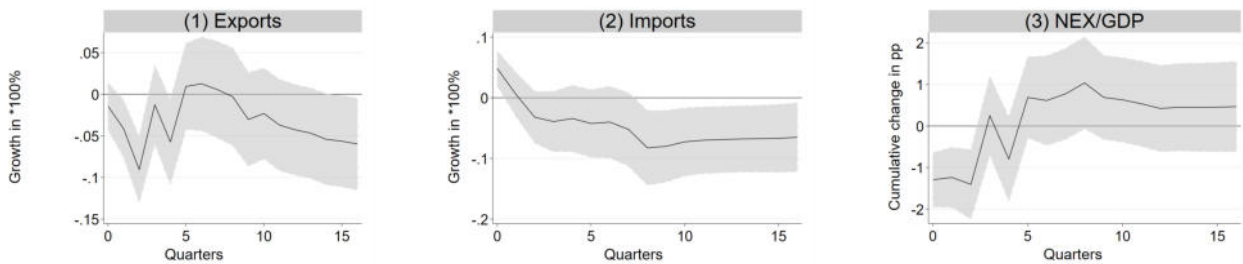


Figure A 78: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, German Trade Variables, in (log-) levels

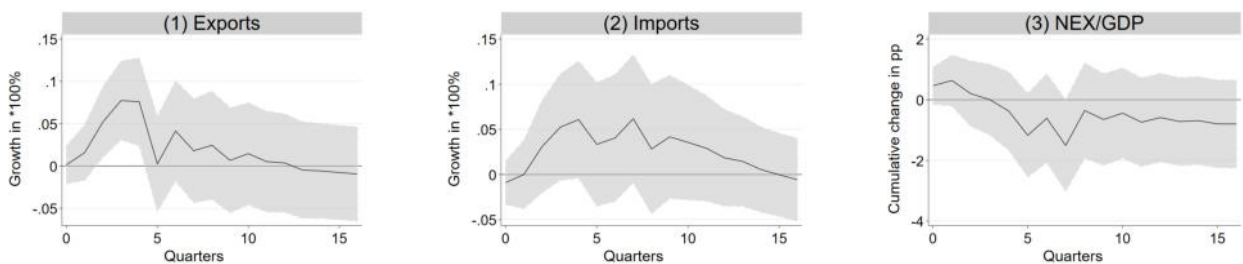


Figure A 79: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, UK Trade Variables, in (log-) levels

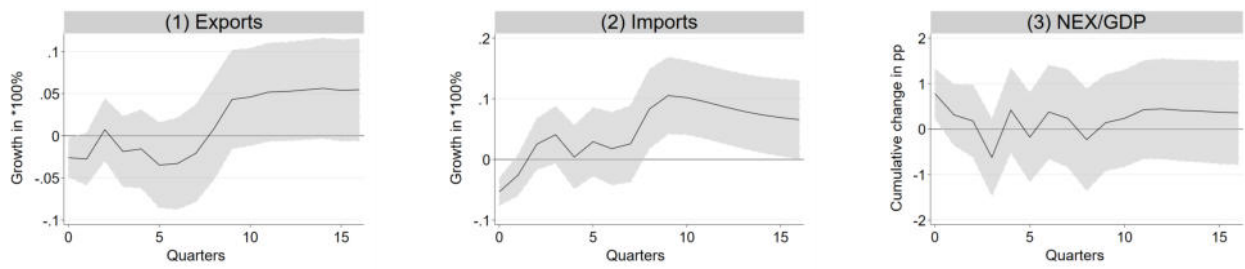


Figure A 80: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, German Trade Variables, in (log-) levels

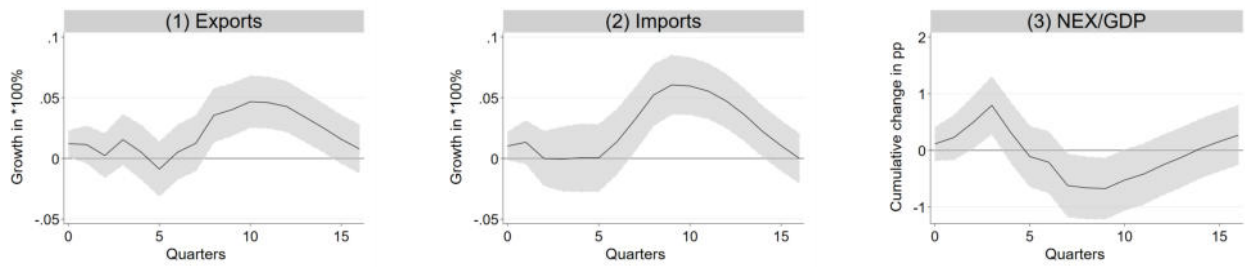
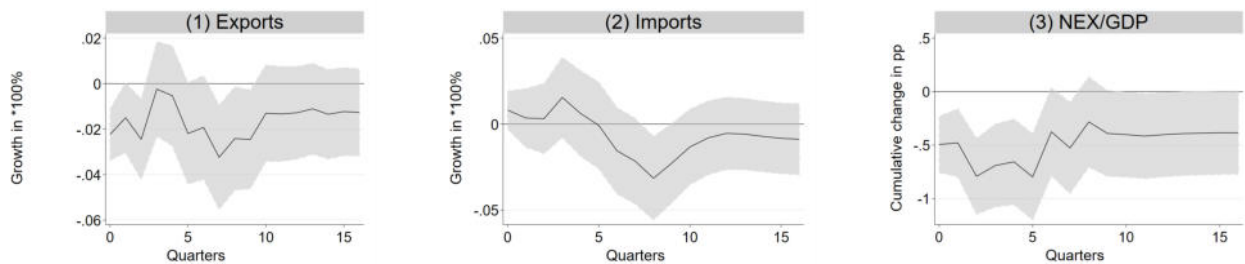


Figure A 81: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, UK Trade Variables, in (log-) levels



# Estimated as VAR

Figure A 82: Aggregated tax shocks, US Trade Variables, estimated as VAR

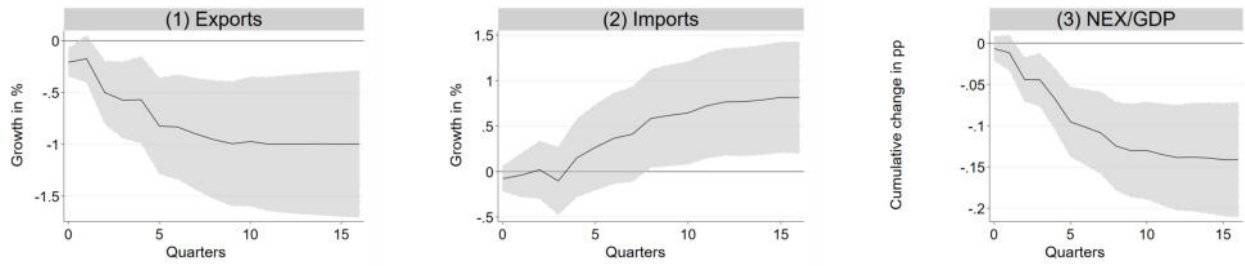


Figure A 83: Aggregated tax shocks, German Trade Variables, estimated as VAR

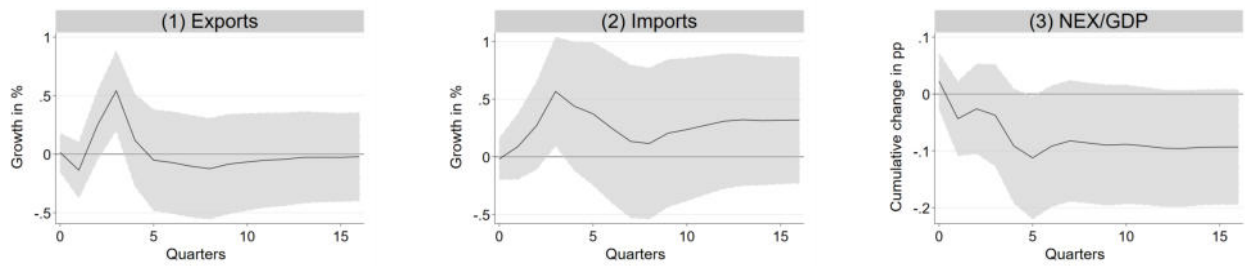


Figure A 84: Aggregated tax shocks, UK Trade Variables, estimated as VAR

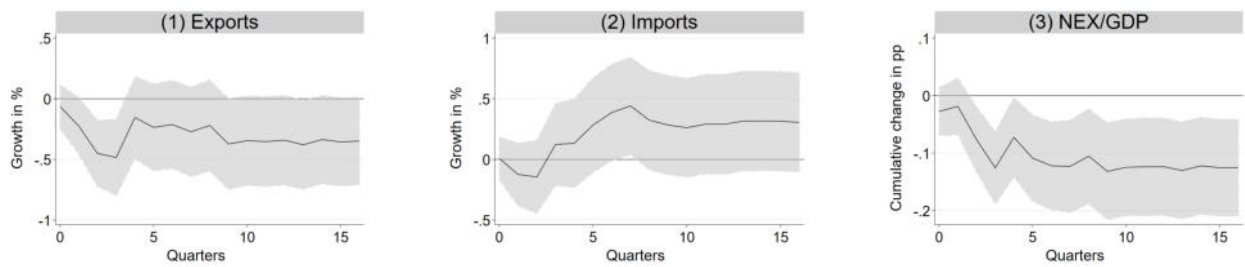


Figure A 85: Personal Income Tax Shock, US Trade Variables, estimated as VAR

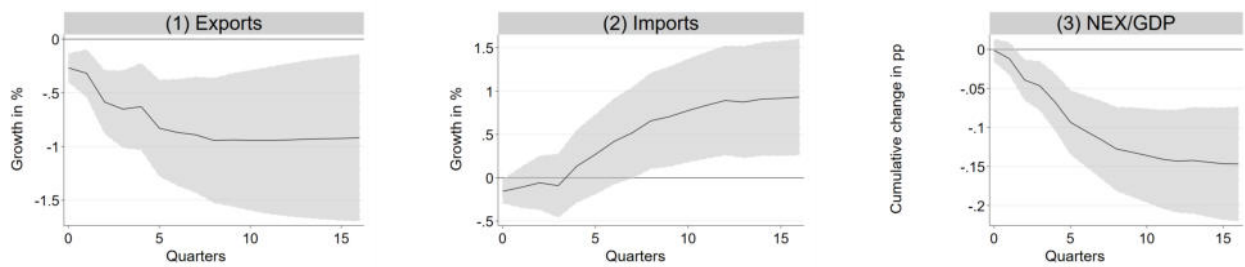


Figure A 86: Personal Income Tax Shocks, German Trade Variables, estimated as VAR

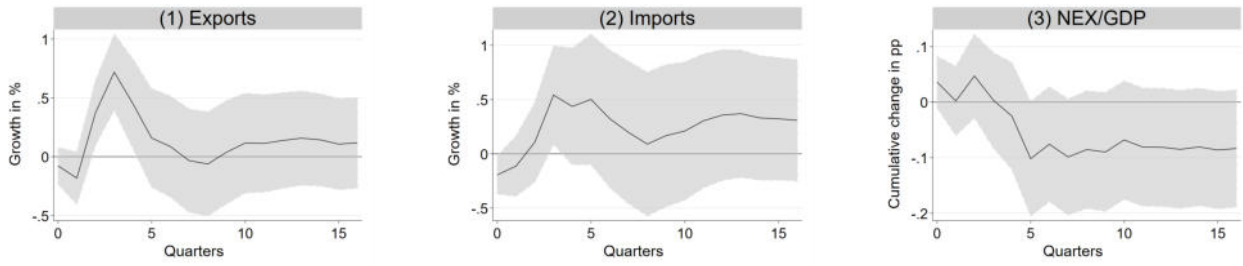


Figure A 87: Personal Income Tax Shocks, UK Trade Variables, estimated as VAR

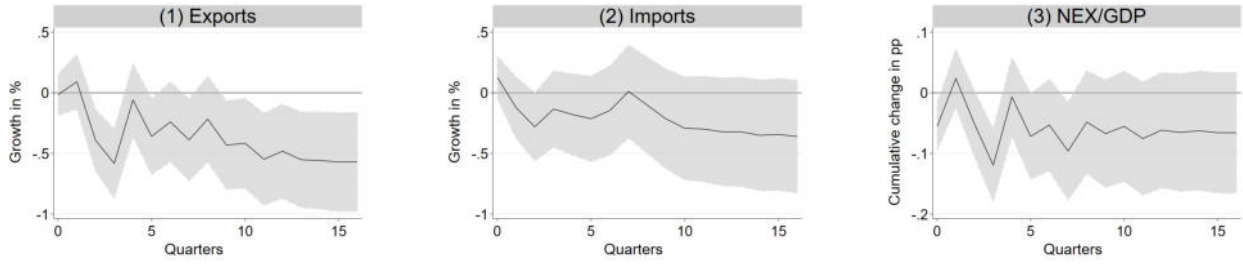


Figure A 88: Corporate Income Tax Shock, US Trade Variables, estimated as VAR

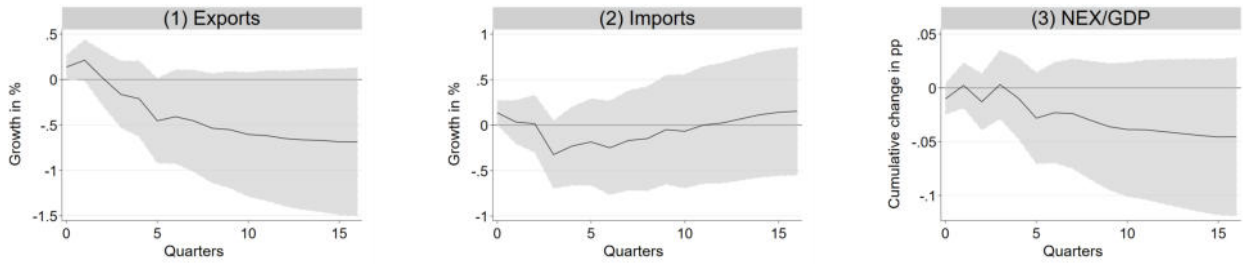


Figure A 89: Corporate Income Tax Shock, German Trade Variables, estimated as VAR

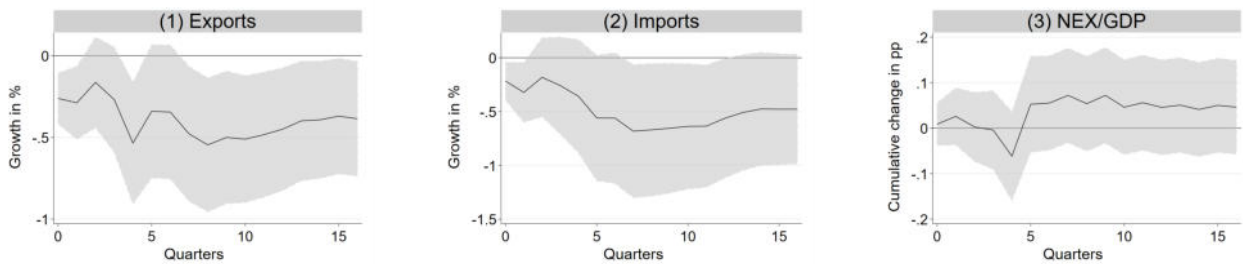


Figure A 90: Corporate Income Tax Shock, UK Trade Variables, estimated as VAR

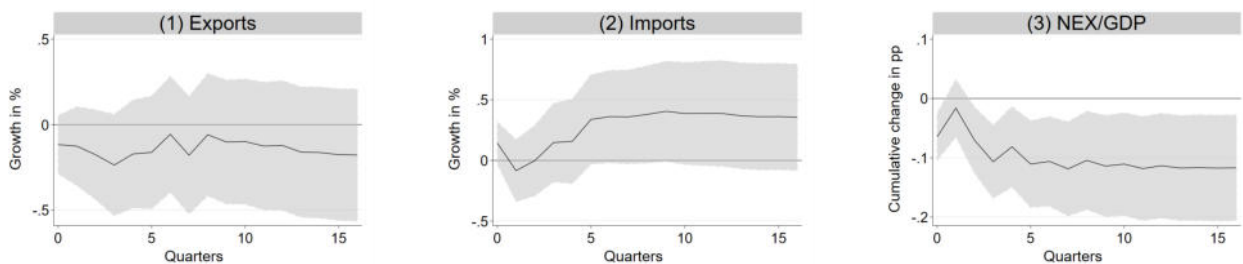


Figure A 91: Indirect Tax Shock, German Trade Variables, estimated as VAR

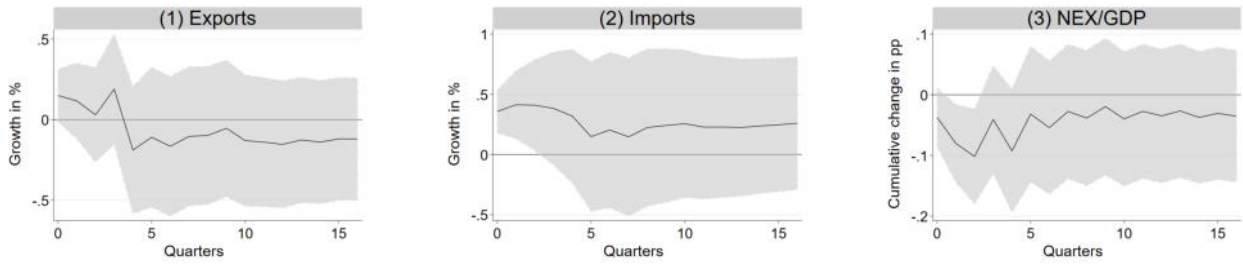


Figure A 92: Indirect Tax Shock, UK Trade Variables, estimated as VAR

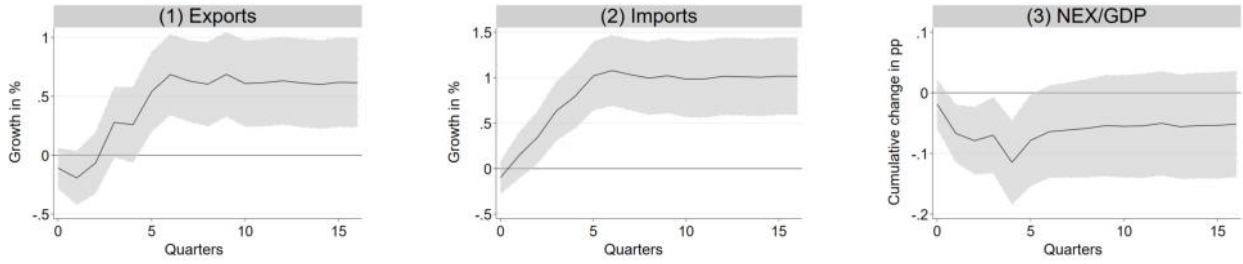


Figure A 93: Increase in Aggregated Tax Shocks, US Trade Variables, estimated as VAR

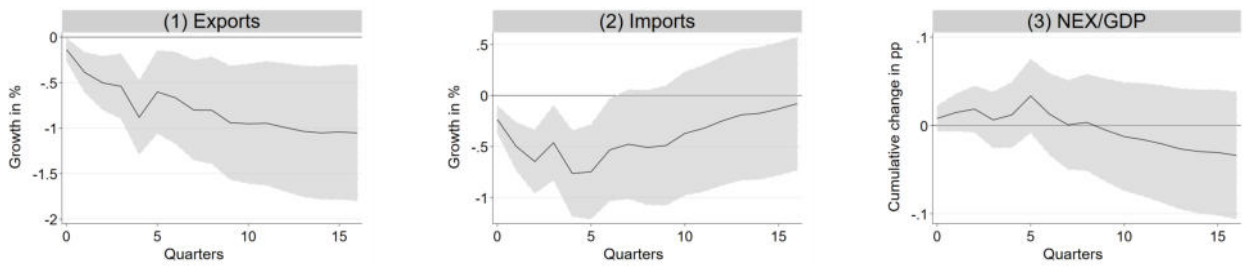


Figure A 94: Increase in Aggregated Tax Shocks, German Trade Variables, estimated as VAR

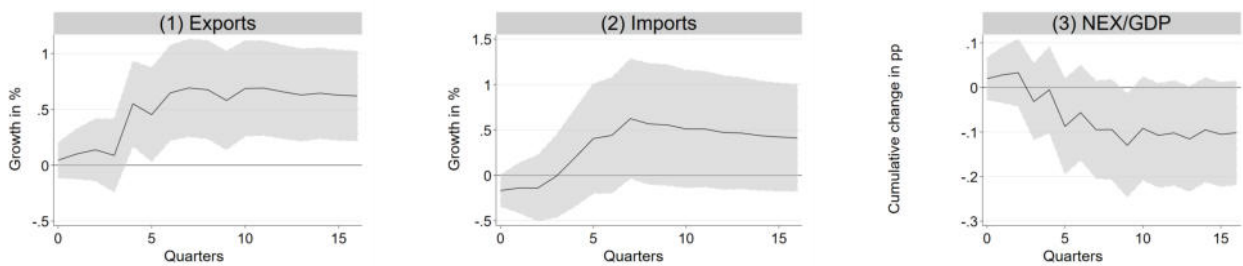


Figure A 95: Increase in Aggregated Tax Shocks, UK Trade Variables, estimated as VAR

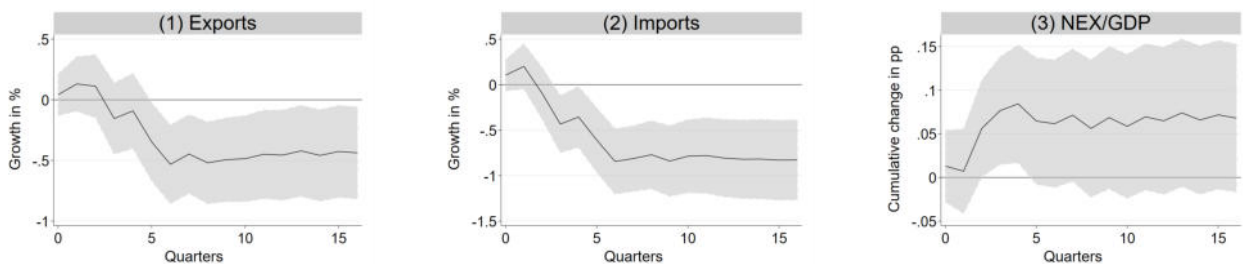


Figure A 96: Decrease in Aggregated Tax Shocks, US Trade Variables, estimated as VAR

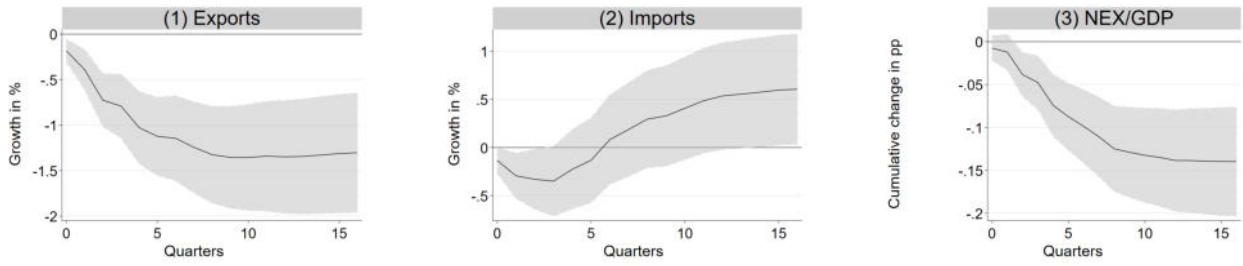


Figure A 97: Decrease in Aggregated Tax Shocks, German Trade Variables, estimated as VAR

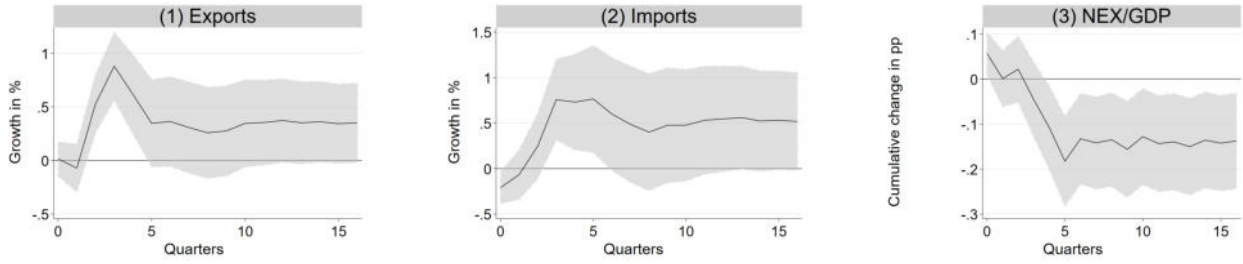


Figure A 98: Decrease in Aggregated Tax Shocks, UK Trade Variables, estimated as VAR

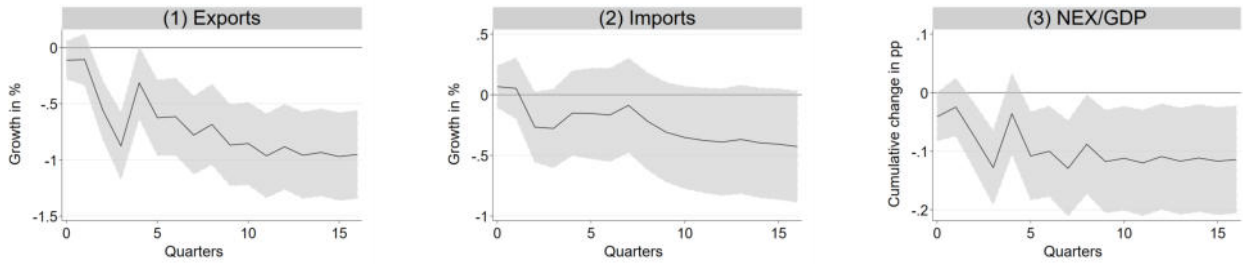


Figure A 99: Spill-over Effects, All US Tax Liabilities, German Trade Variables, estimated as VAR

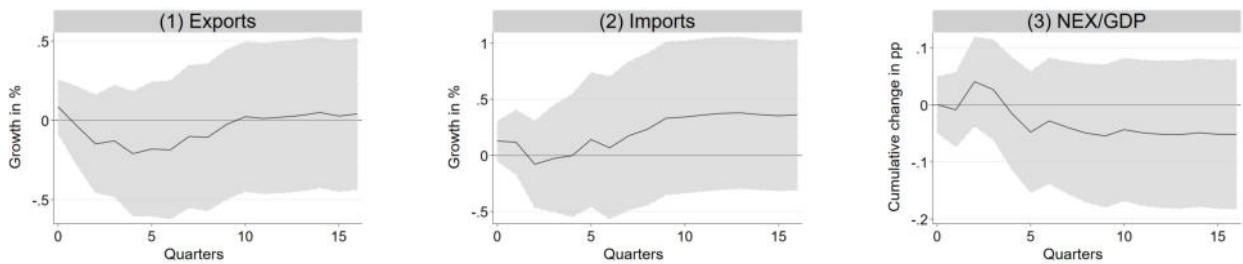


Figure A 100: Spill-over Effects, All US Tax Liabilities, UK Trade Variables, estimated as VAR

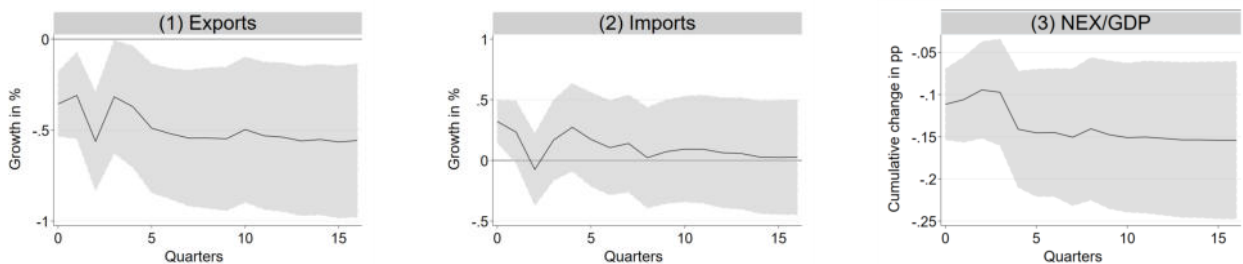




Figure A 101: Spill-over Effects, US Personal Income Tax Shock, German Trade Variables, estimated as VAR

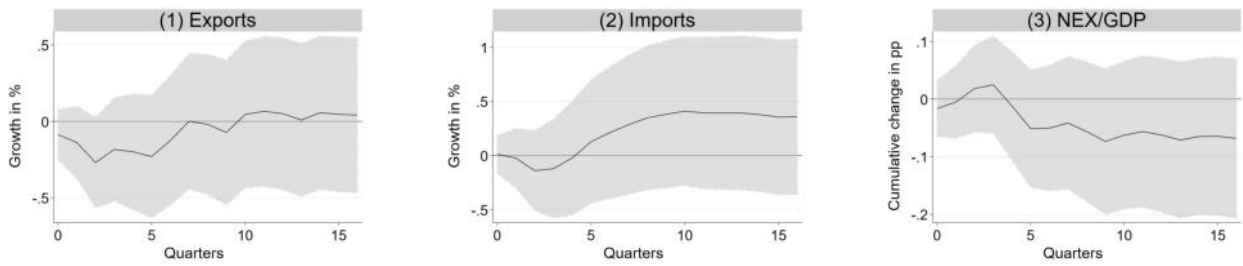


Figure A 102: Spill-over Effects, US Personal Income Tax Shock, UK Trade Variables, estimated as VAR

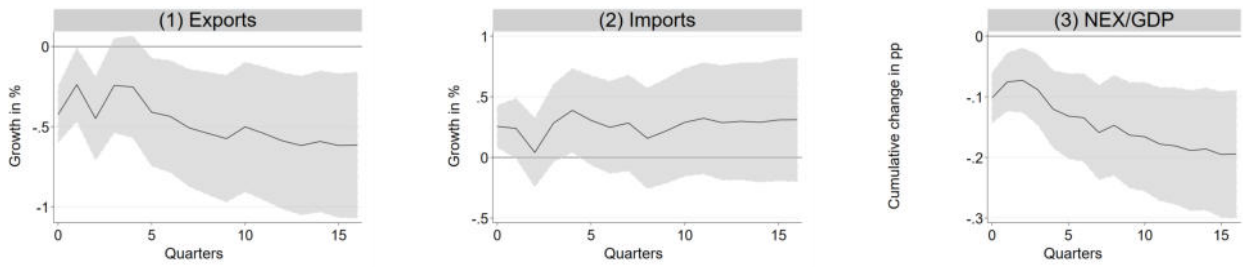


Figure A 103: Spill-over Effects, US Business Income Tax Shock, German Trade Variables, estimated as VAR

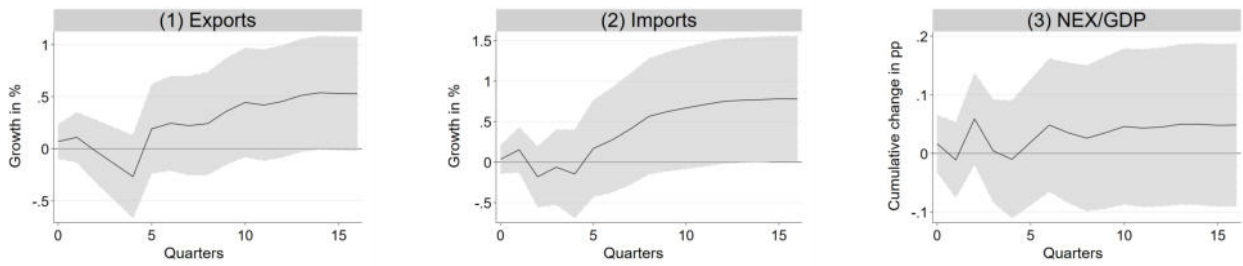


Figure A 104: Spill-over Effects, US Business Income Tax Shock, UK Trade Variables, estimated as VAR

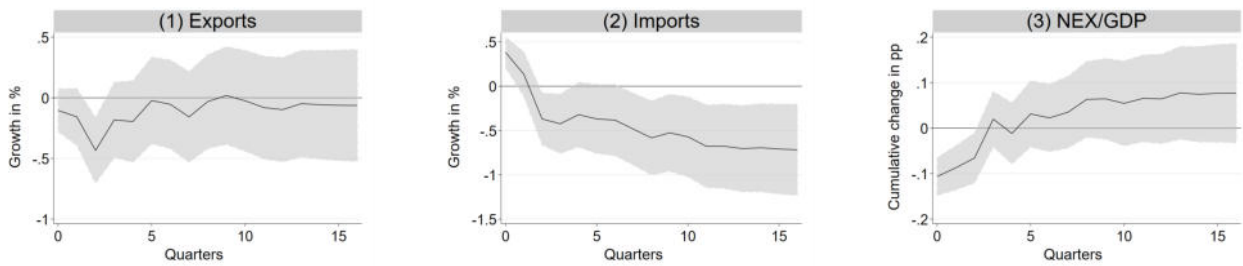


Figure A 105: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, German Trade Variables, estimated as VAR

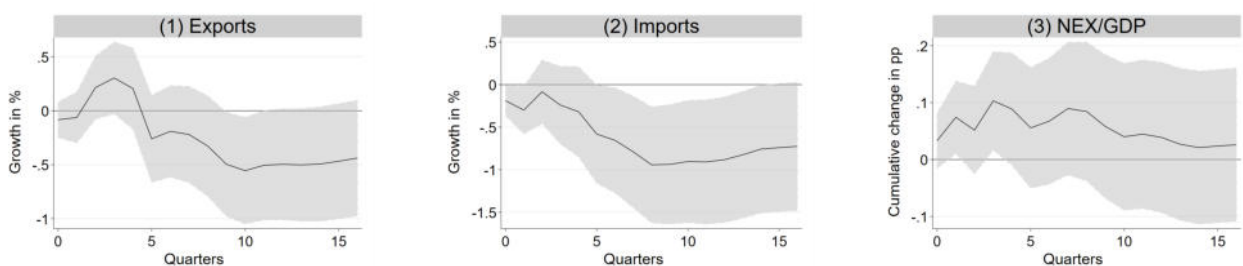


Figure A 106: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, UK Trade Variables, estimated as VAR

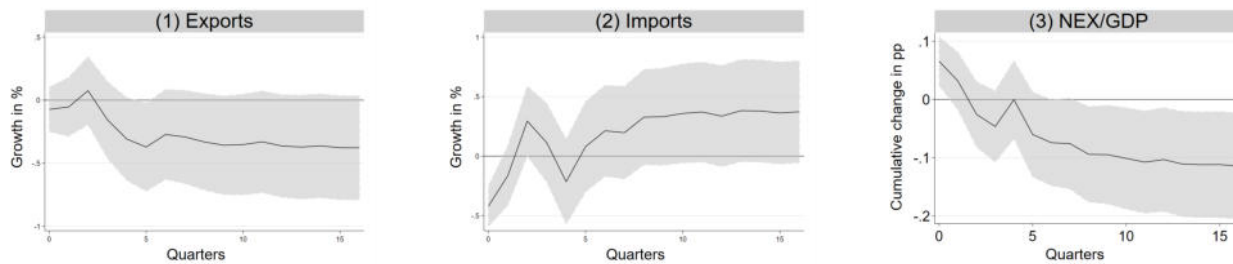


Figure A 107: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, German Trade Variables, estimated as VAR

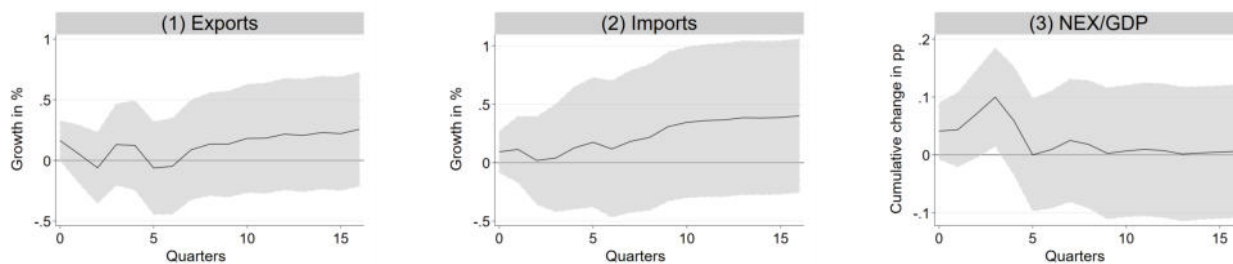
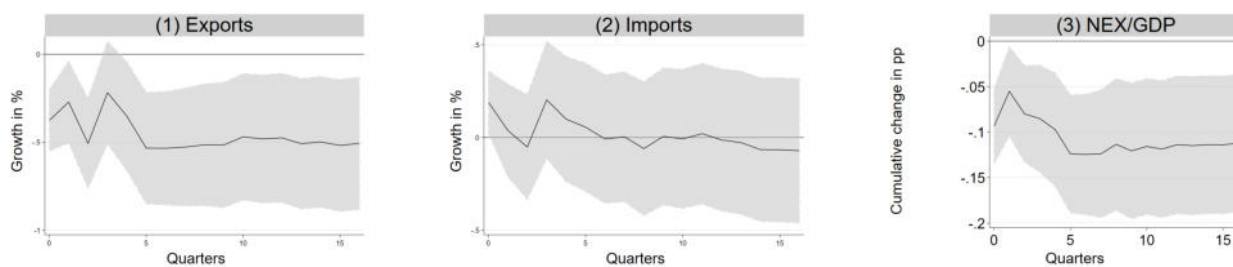


Figure A 108: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, UK Trade Variables, estimated as VAR





# With External Demand

Figure A 109: Aggregated tax shocks, US Trade Variables, with external demand

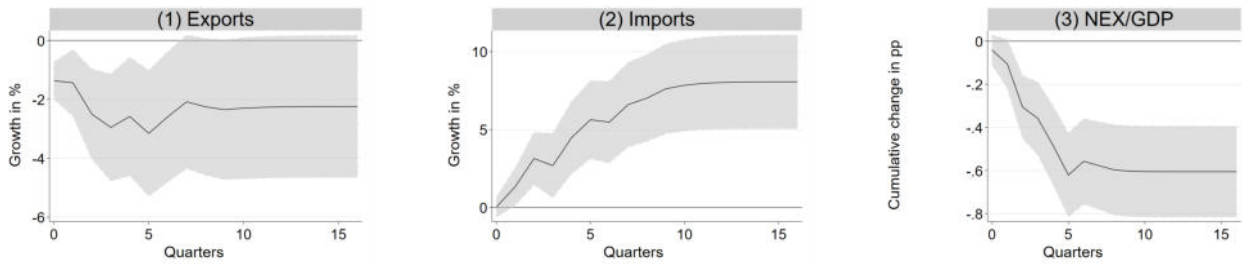


Figure A 110: Aggregated tax shocks, German Trade Variables, with external demand

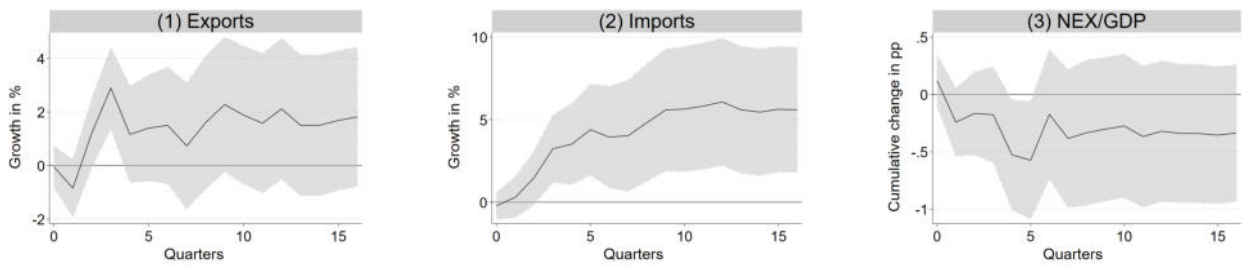


Figure A 111: Aggregated tax shocks, UK Trade Variables, with external demand

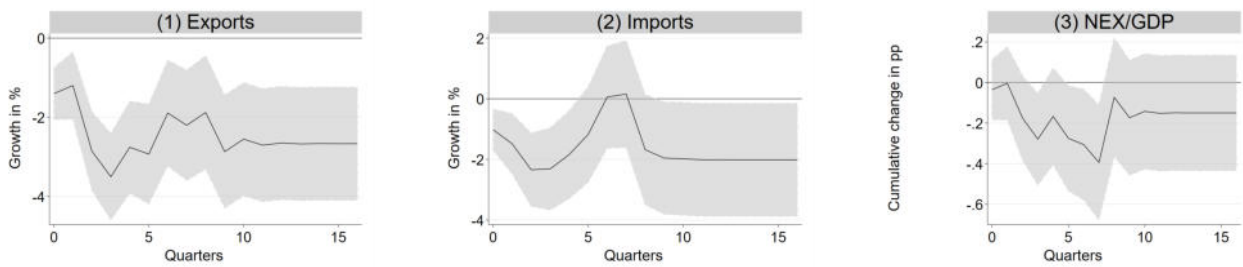


Figure A 112: Personal Income Tax Shock, US Trade Variables, with external demand

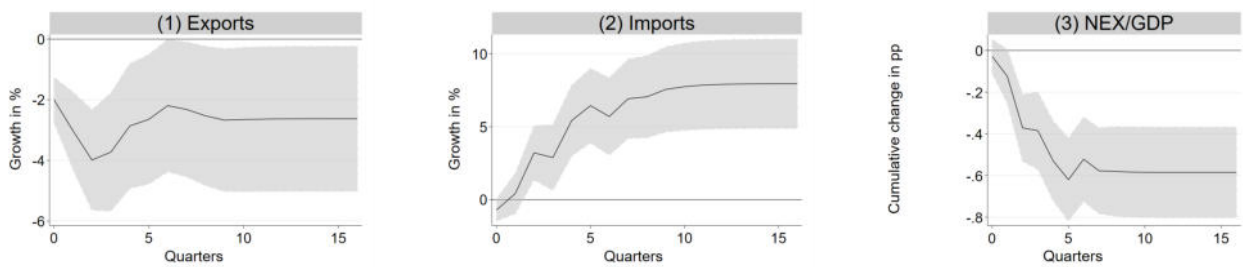


Figure A 113: Personal Income Tax Shocks, German Trade Variables, with external demand

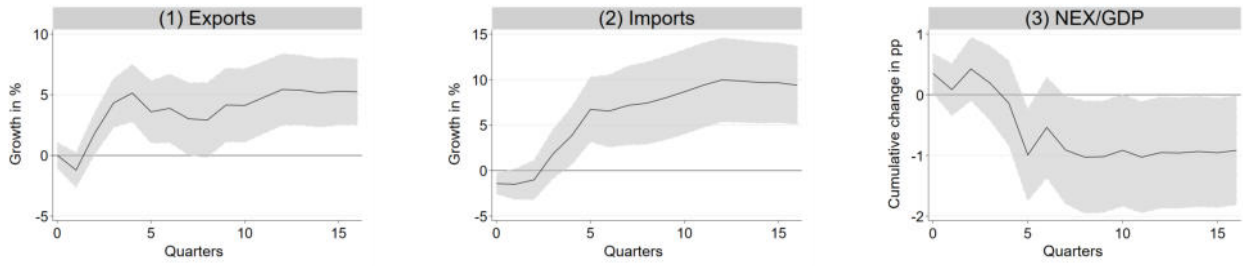


Figure A 114: Personal Income Tax Shocks, UK Trade Variables, with external demand

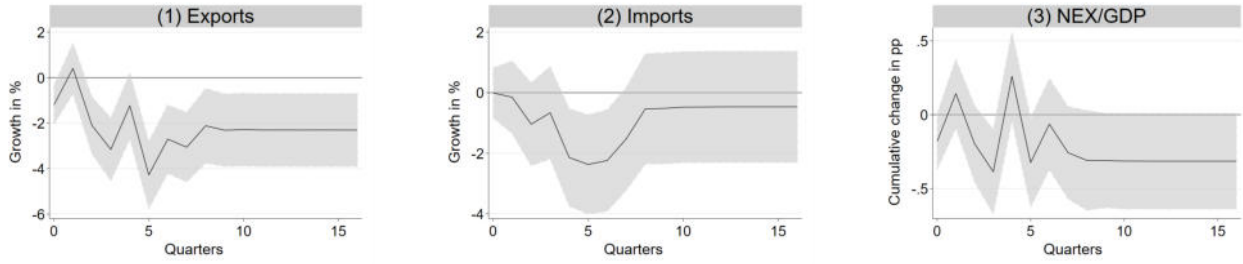


Figure A 115: Corporate Income Tax Shock, US Trade Variables, with external demand

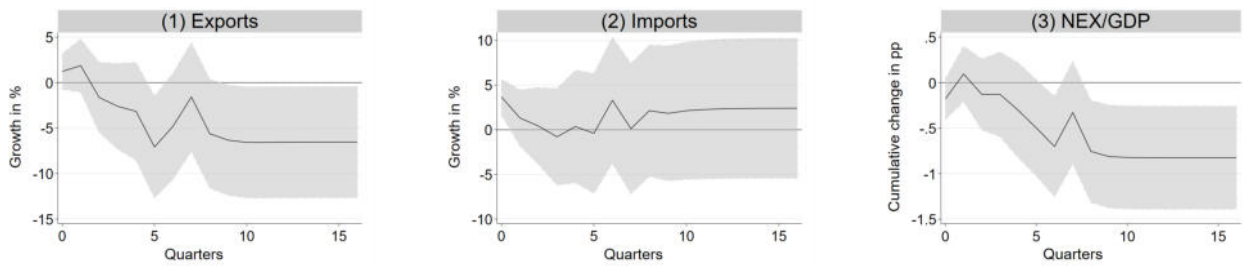


Figure A 116: Corporate Income Tax Shock, German Trade Variables, with external demand

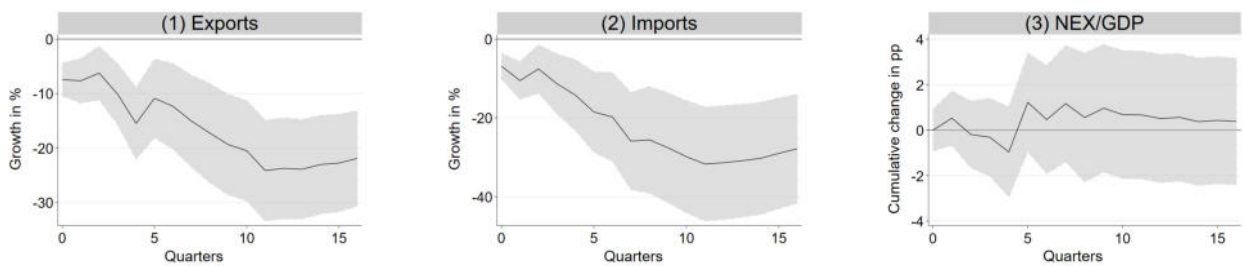


Figure A 117: Corporate Income Tax Shock, UK Trade Variables, with external demand

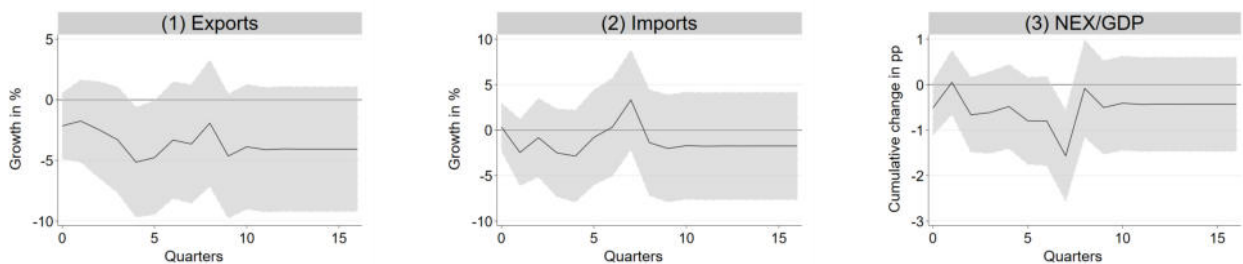


Figure A 118: Indirect Tax Shock, German Trade Variables, with external demand

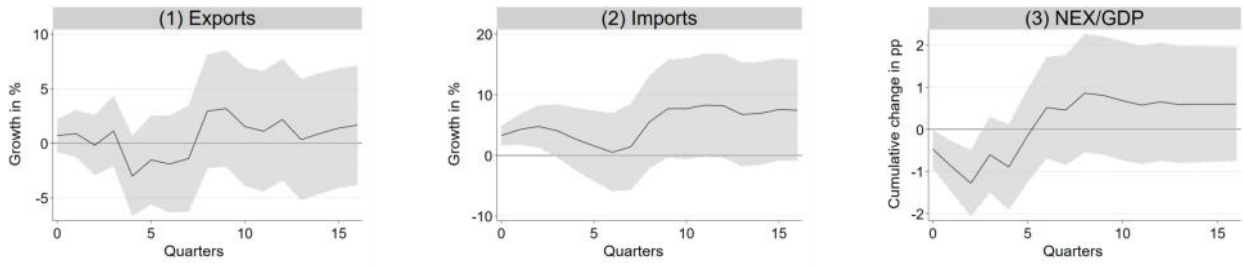


Figure A 119: Indirect Tax Shock, UK Trade Variables, with external demand

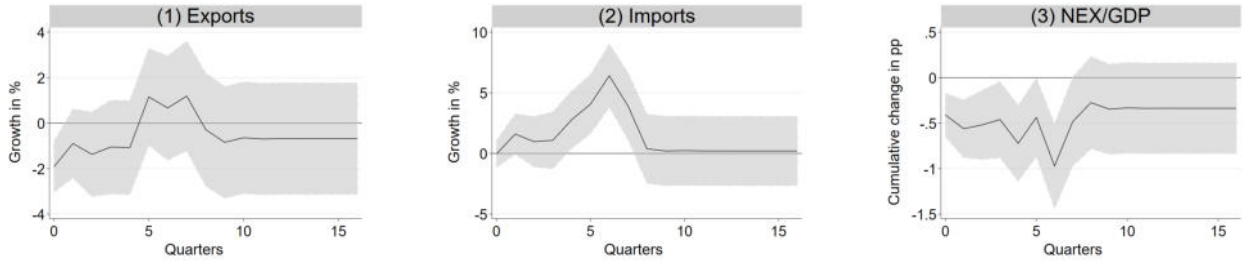


Figure A 120: Increase in Aggregated Tax Shocks, US Trade Variables, with external demand

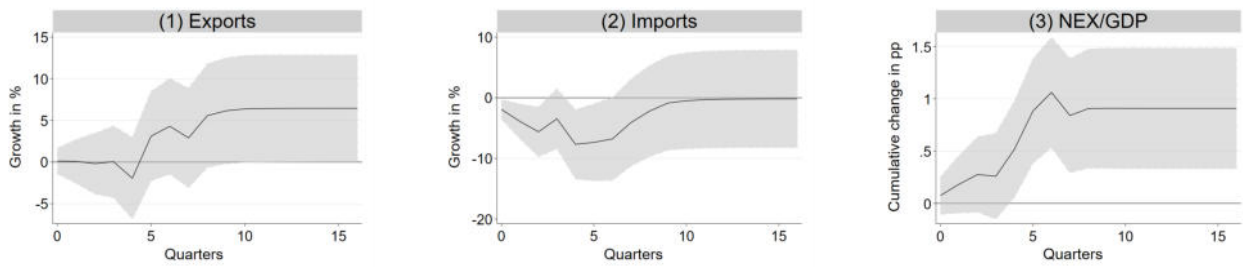


Figure A 121: Increase in Aggregated Tax Shocks, German Trade Variables, with external demand

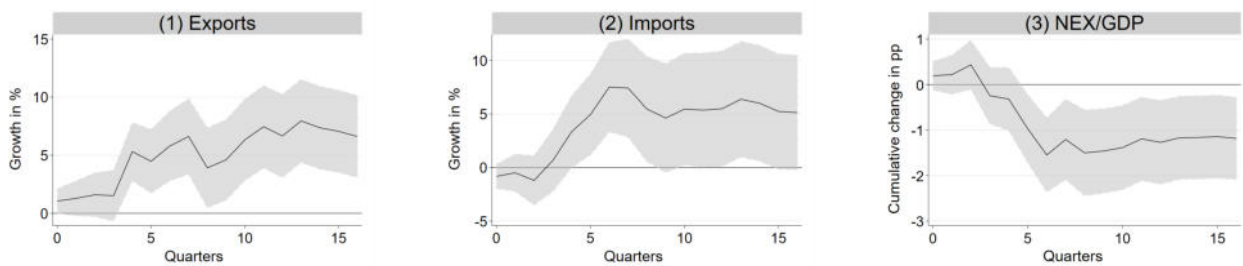


Figure A 122: Increase in Aggregated Tax Shocks, UK Trade Variables, with external demand

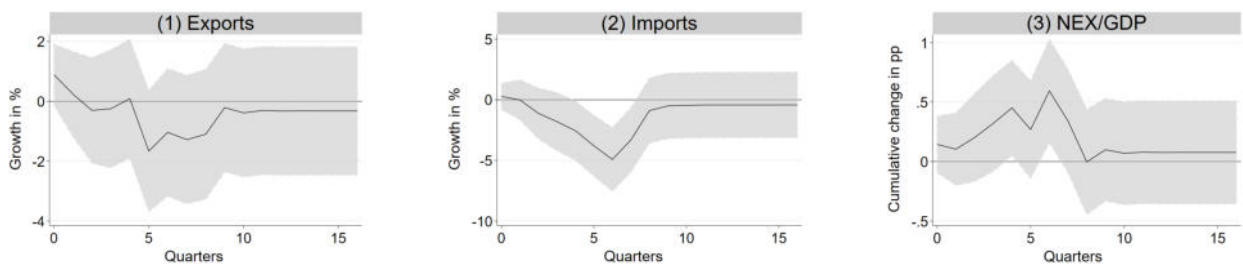


Figure A 123: Decrease in Aggregated Tax Shocks, US Trade Variables, with external demand

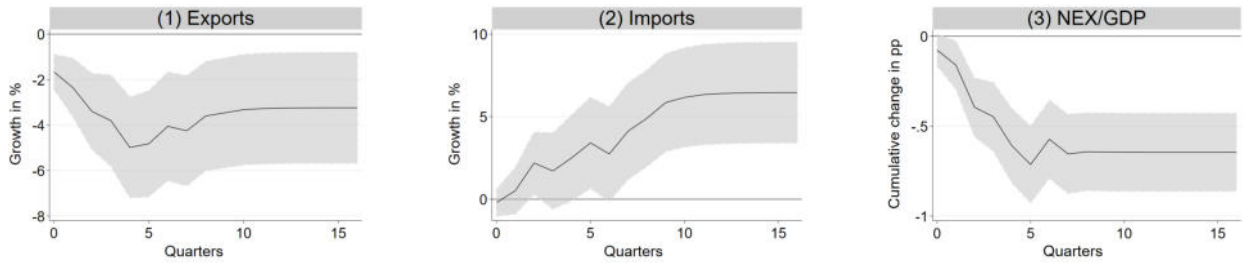


Figure A 124: Decrease in Aggregated Tax Shocks, German Trade Variables, with external demand

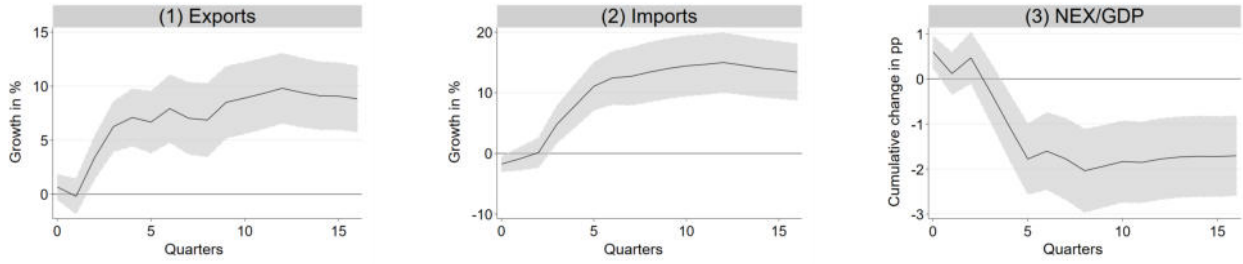


Figure A 125: Decrease in Aggregated Tax Shocks, UK Trade Variables, with external demand

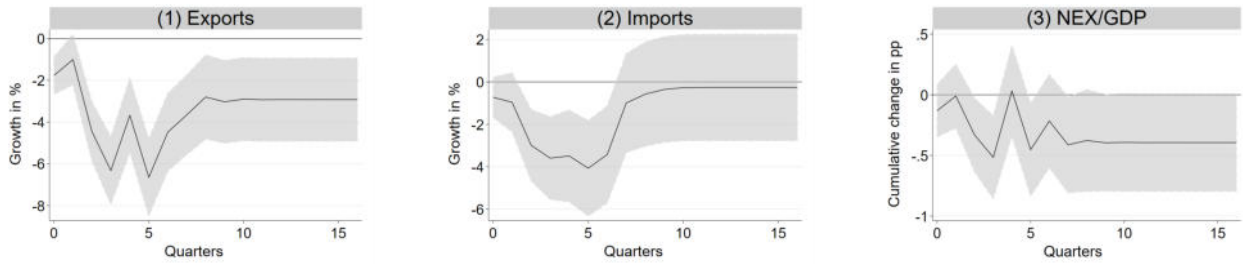


Figure A 126: Spill-over Effects, All US Tax Liabilities, German Trade Variables, with external demand

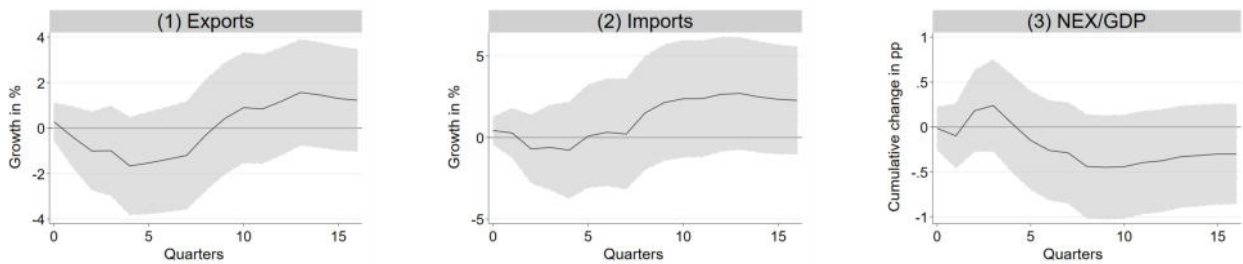


Figure A 127: Spill-over Effects, All US Tax Liabilities, UK Trade Variables, with external demand

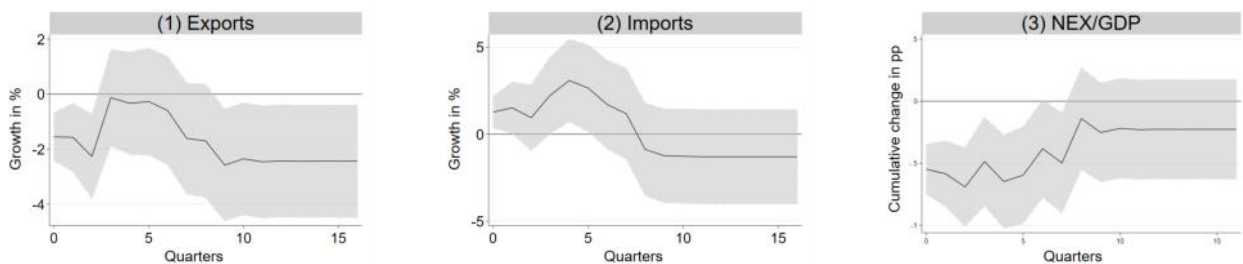


Figure A 128: Spill-over Effects, US Personal Income Tax Shock, German Trade Variables, with external demand

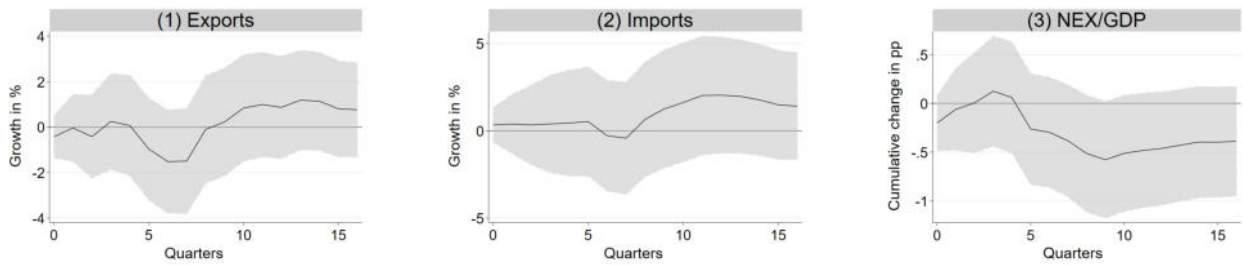


Figure A 129: Spill-over Effects, US Personal Income Tax Shock, UK Trade Variables, with external demand

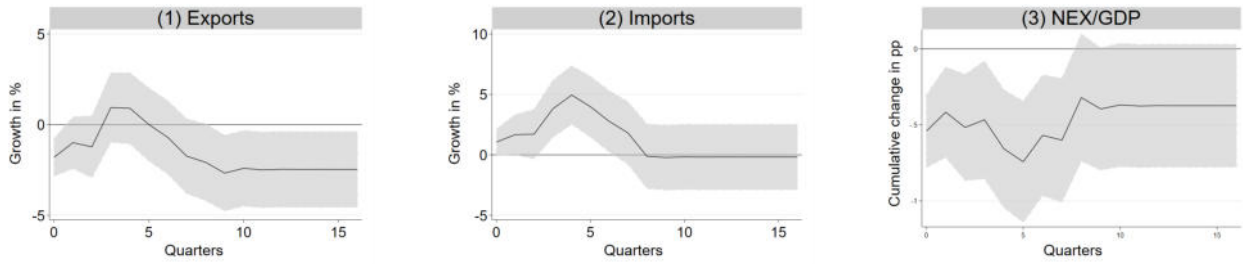


Figure A 130: Spill-over Effects, US Business Income Tax Shock, German Trade Variables, with external demand

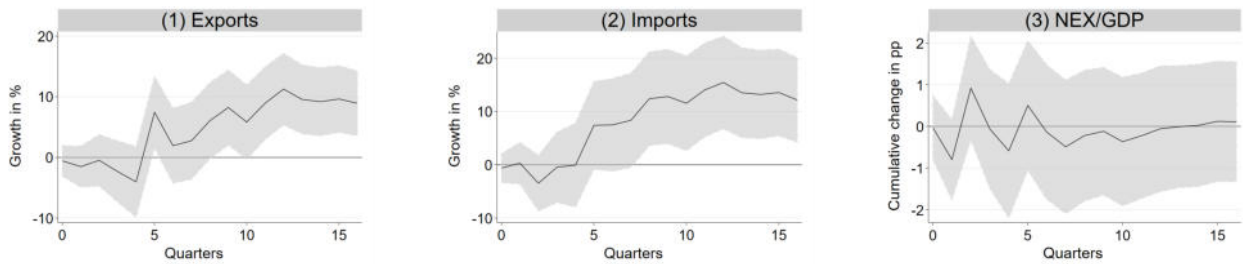


Figure A 131: Spill-over Effects, US Business Income Tax Shock, UK Trade Variables, with external demand

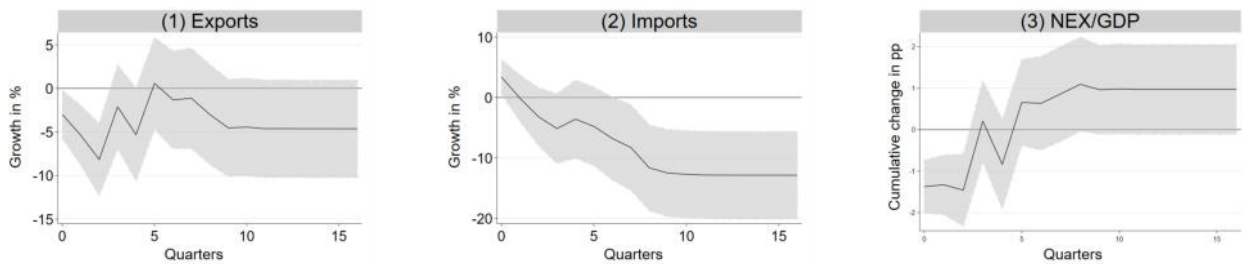


Figure A 132: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, German Trade Variables, with external demand

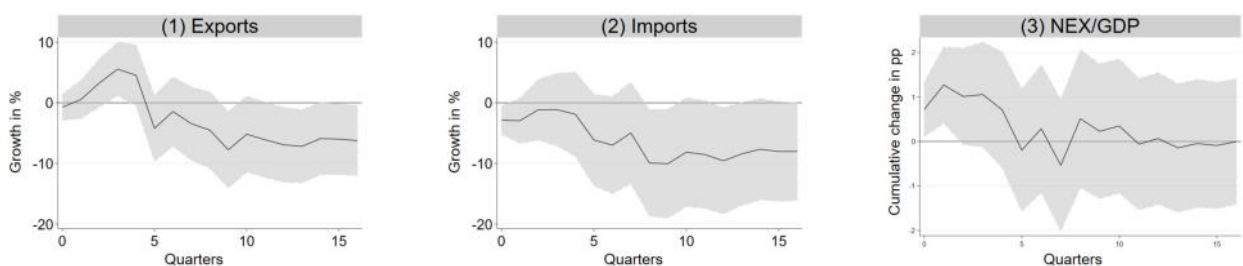


Figure A 133: Asymmetric Spill-over Effects, Increase in US Tax Liabilities, UK Trade Variables, with external demand

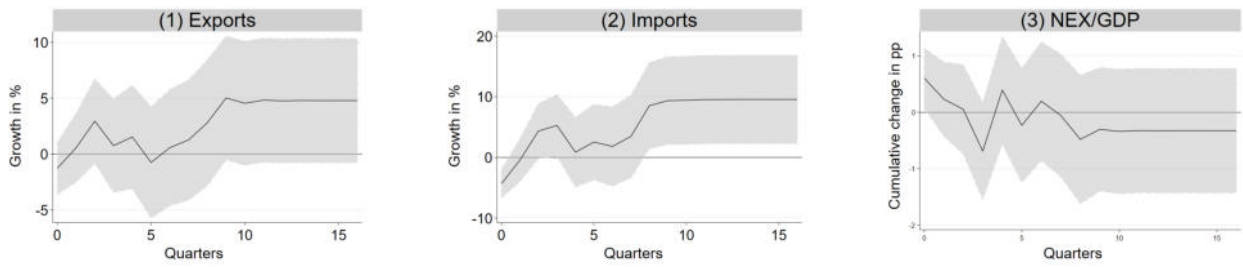


Figure A 134: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, German Trade Variables, with external demand

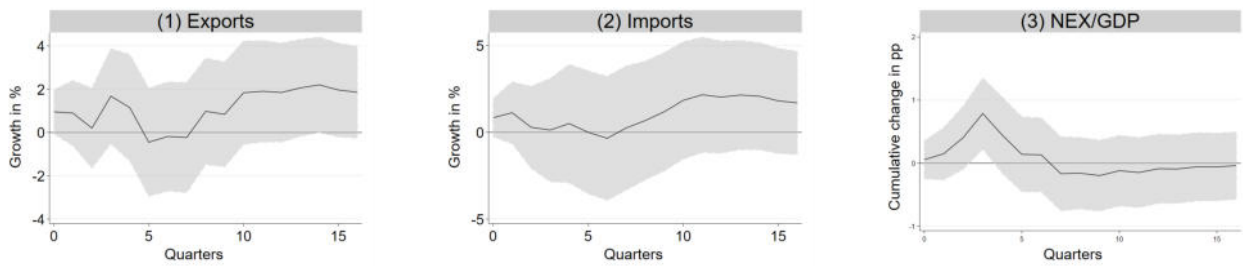


Figure A 135: Asymmetric Spill-over Effects, Decrease in US Tax Liabilities, UK Trade Variables, with external demand

