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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 US, Germany, and the UK. 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) asymmetric reactions after tax hikes and cuts, and (vi) spillovers of US tax changes into Germany and the UK. Generally, we find that after a reduction in aggregated tax liabilities, exports in the US and the UK react quite similarly and tend to fall, whereas imports tend to rise across all three countries. Consequently—and fostered by growing output—the net-exports-to-GDP ratio decreases, significantly so in the US and UK. When disaggregating the tax shocks, we find similar reactions in the US and UK, whereas for Germany, we often find a symmetric reaction of exports and imports, leaving the NEX-to-GDP ratio unchanged. 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.

JEL code: E62, F41, H30, K34

Keywords: Fiscal policy, tax policy, legislated tax changes, trade balance, exports, imports, Germany, United States, United Kingdom, 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. (2010) find that not only budget deficits, but also country-specific productivity shocks have a significant effect on the current account. Moreover, in the case of the US, 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.

Using Romer and Romer's (2010) narrative approach to identifying exogenous tax shocks, Feyrer & Shambaugh (2012) find foreign countries current account to decrease after a US tax hike. In a panel of OECD countries, Guajardo et al. (2014) employ narratively identified fiscal consolidations and find that consolidations typically increase net exports and reduce private investment. However, their dataset does not differentiate between revenue and spending measures. Klein and Linnemann (2019) use the (symmetric) fiscal shocks identified by Mertens and Ravn (2013) to analyse the twin-deficit hypothesis. They find that shocks that reduce the budget deficit cause a deterioration of the current account, mainly driven through higher import demand. Moreover, when differentiating between personal and corporate income taxes, the former causes a larger decline in the current account, which they interpret as evidence of the twin-deficit hypotheses. Focussing on the UK, Nguyen et al. (2021) employ narratively identified shocks to direct and indirect taxes as proxies in a SVAR. However, they find no significant effects on exports, imports, or the terms of trade.

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 comparative 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. Moreover, we disaggregate the tax shocks and consider tax cuts and hikes to further analyse the transmission of tax shocks and identify differences between the three economies. Finally, we estimate spillover effects from US tax legislation to Germany and the UK.

The theoretical literature provides contradictory predictions about the relationship between tax policy and the trade balance. Taking two extremes, the traditional Mundell-Fleming model of a small open economy with flexible exchange rates predicts an appreciation after loose fiscal policy, which brings about a large deterioration of the trade balance. Quite the reverse is found when considering the intertemporal model of the balance of payments, where, due to Ricardian equivalence, changes in taxes have no impact at all on the trade balance. From the empirical literature, we can derive the following hypotheses: a cut in aggregated taxes leads to a hike in imports , causing a deterioration of the trade balance (Klein & Linnemann, 2019). When disaggregating tax shocks, we should find heterogeneity in the effects across tax types and countries. Following a reduction in personal income taxes, Klein & Linnemann (2019) report higher imports in the US, whereas Felbermayr et al. (2017) predict no effect on the trade balance in Germany. Corporate income taxes should lead to a deterioration of the trade balance in the US (Klein & Linnemann, 2019) as well, but the magnitude should be lower than for personal income tax. In Germany, we would expect a deterioration, too, at least if the corporate income tax cut increases long-term growth and, hence, domestic investment (Felbermayr et al., 2017; Fratzscher, 2017). For the UK, Nguyen et al. (2021) report no effect of either of the two direct taxes (Nguyen et al., 2021). Cuts to indirect taxes are predicted to have no effect in either Germany or UK (Felbermayr et al., 2017; Nguyen et al., 2021). When allowing for asymmetric effects of tax increases and decreases, we would expect tax hikes (cuts) to increase (decrease) the trade balance through lower (higher) import demand, but also expect cross-country heterogeneity (Jones et al., 2015; Hussain & Malik, 2016).

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 UK, (v) asymmetric reactions after tax hikes and cuts, and (vi) spillovers of US tax changes into Germany and the UK.

Generally, we find that after a reduction in aggregated tax liabilities, exports fall in the US and the UK, whereas imports tend to rise across all three countries. Consequently—and fostered by growing output—the net-exports-to-GDP ratio decreases, significantly so in the US and UK. When disaggregating the tax shocks, we find similar reactions in the US and UK, whereas for Germany, we often find a symmetric reaction of exports and imports, rendering the net effect on the NEX-to-GDP ratio insignificant. 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 UK 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. 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 US, Germany, and the UK 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 (US rather closed, UK quite open, Germany very open), and opposite trade balances (persistent deficits in the US, persistent surpluses in Germany, the UK 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 tax 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.[1] 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 the robustness section, we check this assumption by only including tax changes identified as exogenous to the business cycle. 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.

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

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

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,

[1] 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 study a more parsimonious specification that only includes the real exchange rate and the net-exports-to-GDP ratio. 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).[2] $A(L)$ 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.[3] 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 US and the UK, 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 US 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 UK, however, we observe asymmetric behaviour in the GDP response, as tax increases affect GDP negatively, whereas tax decreases have no significant effect, as reported by Jones et al. (2015).

Starting with the US, the upper panel of Figure 1 shows that exports decrease by up to 4% within the first six quarters after the shock. Column (2) demonstrates that imports react quickly after the tax cut and then converge towards an increase of about 7% roughly two and a half years after the event. The effects on imports and exports are similar in size and duration to those reported by Romer and Romer (2010).

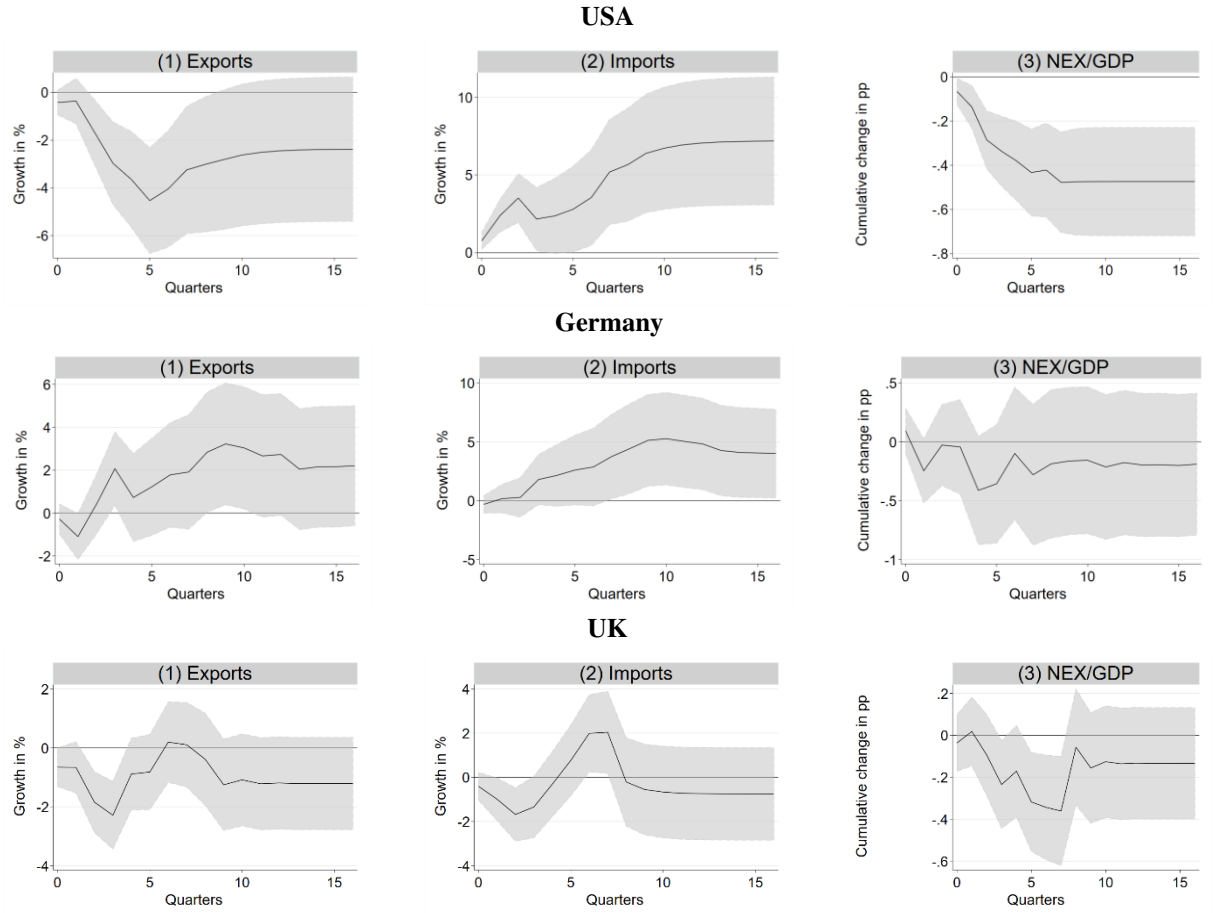
Our estimate of the effect of a tax cut on GDP is similar to the one reported by Romer and Romer (2010) when all legislated tax shocks and no controls were included (1.6 and 2, respectively). The net-exports-to-GDP ratio in column (3) depicts a straightforward deterioration of the US trade balance after a tax cut, which converges to roughly 0.5 percentage points (pp). To assess whether a movement of that

[2] 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.

[3] A step-dummy controlling for the European debt crisis was not significant and we do not include it in the presented model.

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 0.3 standard 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 1: 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).

Switching our focus to Germany, the middle panel of Figure 1 shows that over a time horizon of 16 quarters, German imports increase by about 5%. The peak effect occurs after 10 quarters. The effect of the tax reduction on GDP is positive, with an increase of about 2.9%, which is slightly higher than the 2.4% reported in Hayo and Uhl (2014). Column (1) shows that exports are barely affected. While there is an initial decrease of about 1% after one quarter, the effect becomes positive thereafter and reaches 3.2% after about 2.5 years. This increase is likely driven by the roughly 1% depreciation of the real exchange rate within the first five quarters after the shock.[4] The net-exports-to-GDP ratio drops by about 0.5 pp, but the effect is not significant over the observation window.

[4] All omitted results are available on request.

Turning now to the UK (see lower panel), we observe a drop in exports, a response similar to that found for the US. The peak effect two quarters after the tax cut is a bit smaller than that in the US, 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 4% over the forecast horizon, the same reaction Cloyne (2013) reports. The hump-shaped response of imports resembles the results in Cloyne (2013) but is of lower magnitude. The positive peak effect coincides with the one in GDP, which increases by 1.2% 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 US, the net-export-to-GDP ratio drops by about 0.4 after seven quarters (about 0.2 standard deviations). Thus, the movement of the net-exports-to-GDP ratio after a tax cut is remarkably similar across the three countries but the dynamics of the underlying components are quite different.

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 2% and 0.2%, respectively. The effect on the net-export-to-GDP ratio becomes roughly –0.1 pp in all three economies, which is one-quarter 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.[5] In the US, 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 UK; 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:

[5] 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.

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

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, $\Delta\tau^{PI}$, corporate income tax liabilities, $\Delta\tau^{CI}$, and, in the case of Germany and the UK, indirect taxes, $\Delta\tau^{ID}$.

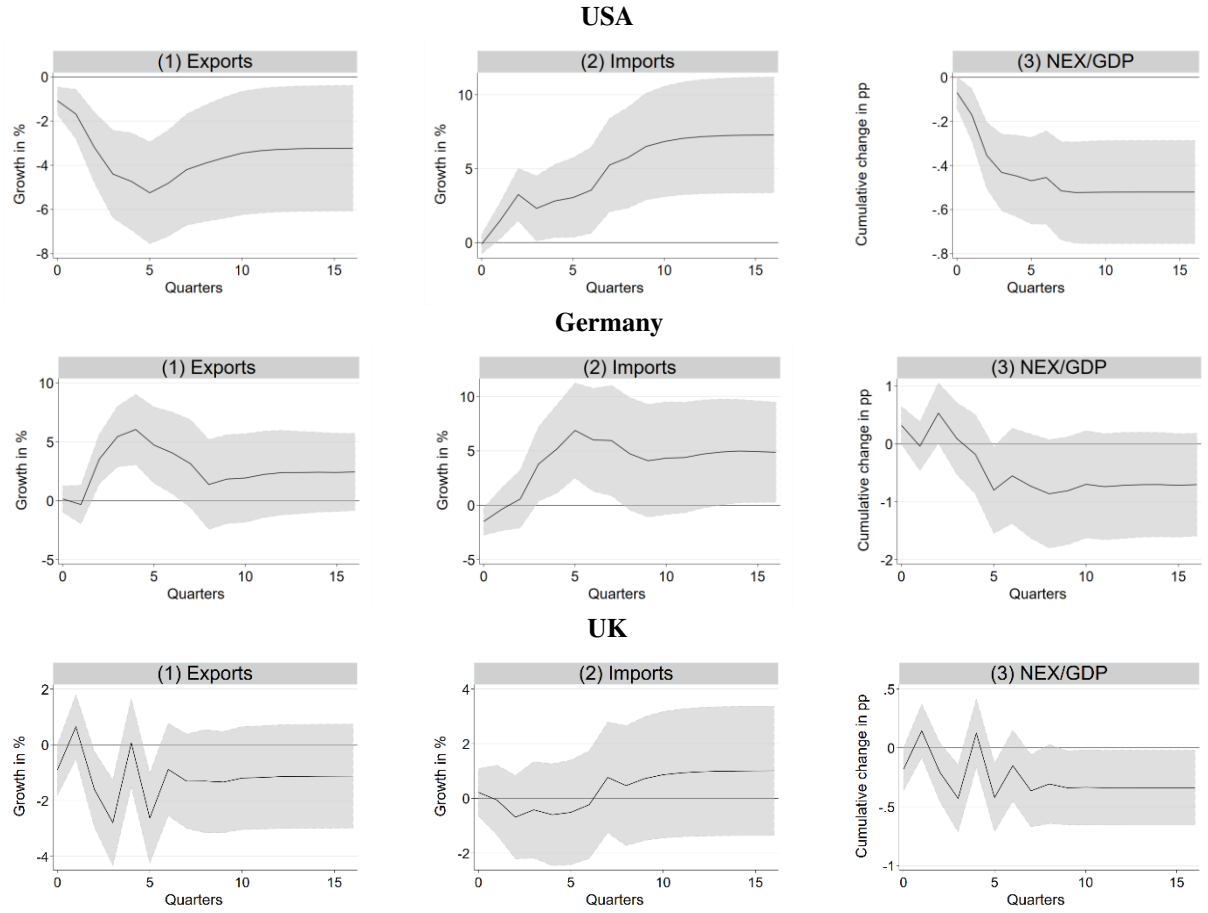
Personal Income Tax Shocks

Starting with a personal income tax cut, the IRFs for the US trade variables in Figure 2 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 5%, which is likely due to the accompanying real exchange rate appreciation. Column (3) in the upper panel of Figure 2 illustrates that a personal income tax reduction causes a permanent decrease in the net-exports-to-GDP ratio of approximately 0.5 pp after about one year, which translates into 0.3 standard deviations of this ratio.

Felbermayr et al. (2017) argue that German households increase their savings after a personal income tax cut, which would leave the trade balance unaffected. Column (1) in the middle panel of Figure 2 shows a significant increase in German exports, with a maximum hike of about 6%. As can be seen in column (2), imports drop on impact and then increase by roughly 6% after about one year. We would interpret this dynamic adjustment as rejecting Felbermayr et al.' s (2017) argument. Column (3) considers the net-exports-to-GDP ratio and generally reflects the movements of its components: first the ratio rises by about 0.5 pp, driven by lower imports, before it starts falling after about one year. The negative effect, however, does only become significant for one quarter.

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 column (1) in in the lower panel). 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 US 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 0.4 pp (or 0.2 standard deviations). Contrary to Lane and Perotti (1998), we find significant reactions of trade variables to personal income taxes in all three economies.

Figure 2: Personal Income Tax Shocks



Notes: See Figure 1.

Corporate Income Tax Shocks

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. Flipping their argument around, we would expect to see an initially higher NEX-to-GDP ratio after a business tax cut.

Figure 3 shows how US trade variables react to business tax shocks. Column (1) illustrates that exports increase significantly on impact, by roughly 5%. They then begin to fall, undershooting the baseline by roughly 7%. However, this effect is not significant. Column (2) of Figure 3 shows that imports jump upward on impact, but then the effect becomes insignificant. Column (3) shows that the net effect on the trade balance is zero. Klein and Linnemann (2019) also find a stronger reaction of the NEX-to-GDP ratio after a cut to personal income taxes.

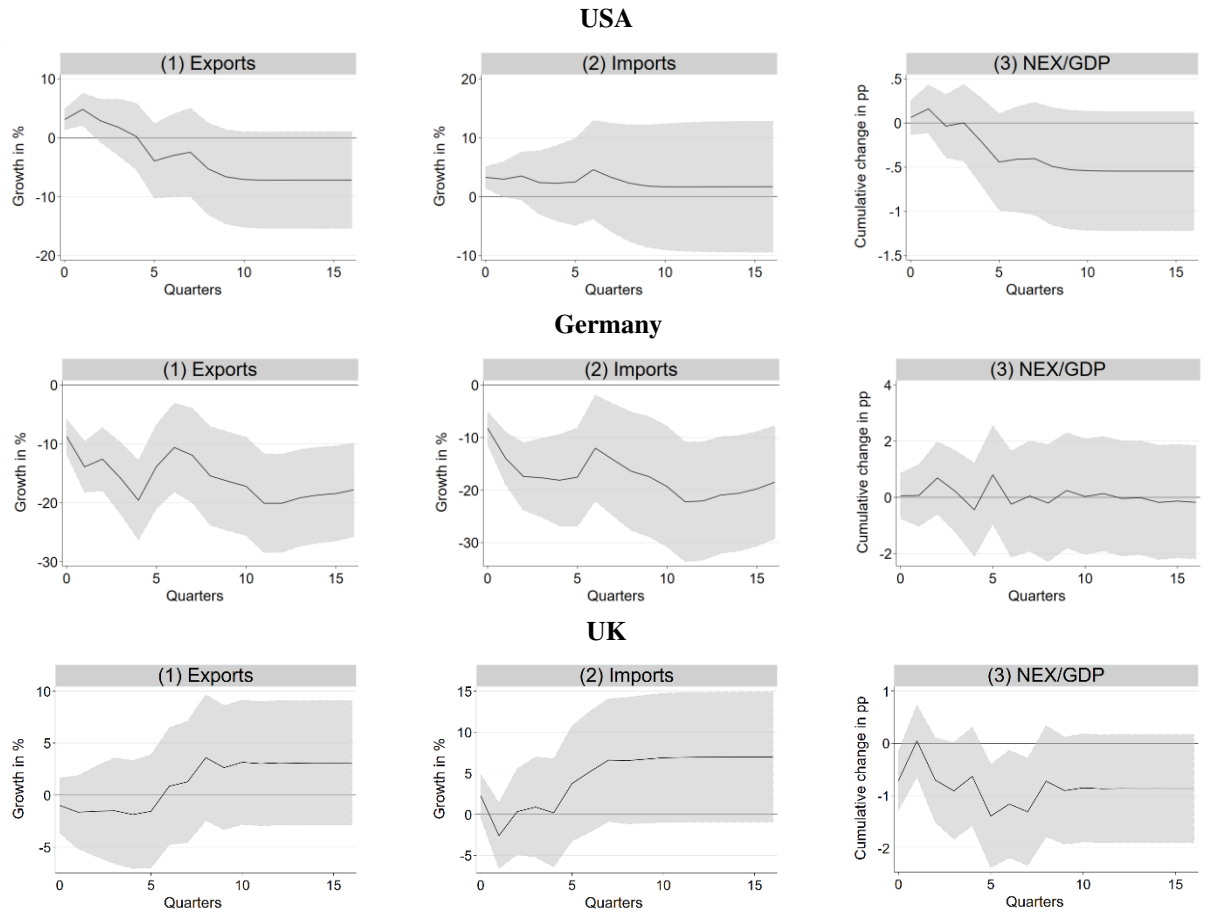
In the case of Germany, trade reacts differently to a reduction in business taxes. Column (2) in the centre panel of Figure 3 shows that imports drop immediately upon impact and that the peak effect is a massive reduction of more than 20%. Column (1) shows that exports decrease similarly to imports. 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 Column (3) demonstrates, after a cut in corporate income taxes, we find no significant change.

Turning now to the UK (see lower panels), the error bands of the responses after a cut in corporation taxes are quite large. As a result, neither imports nor exports have a significant reaction. We do, however, measure an increase in real GDP of almost 3% after two years, which is slightly higher than that reported by Hussain and Liu (2018). As a result, the net-export-to-GDP ratio drops by more than 1 pp (about 0.7 standard deviations). Overall, we find a zero net effect on the trade balance for the US and Germany, and only a short-lived drop in the UK. In the latter case, the temporary movement is not driven by changes in the trade variables but by an increase in real GDP.

Thus, we discover no evidence supporting Keen and Syed's (2006) prediction.

Figure 3: Corporate Income Tax Shocks



Notes: See Figure 1.

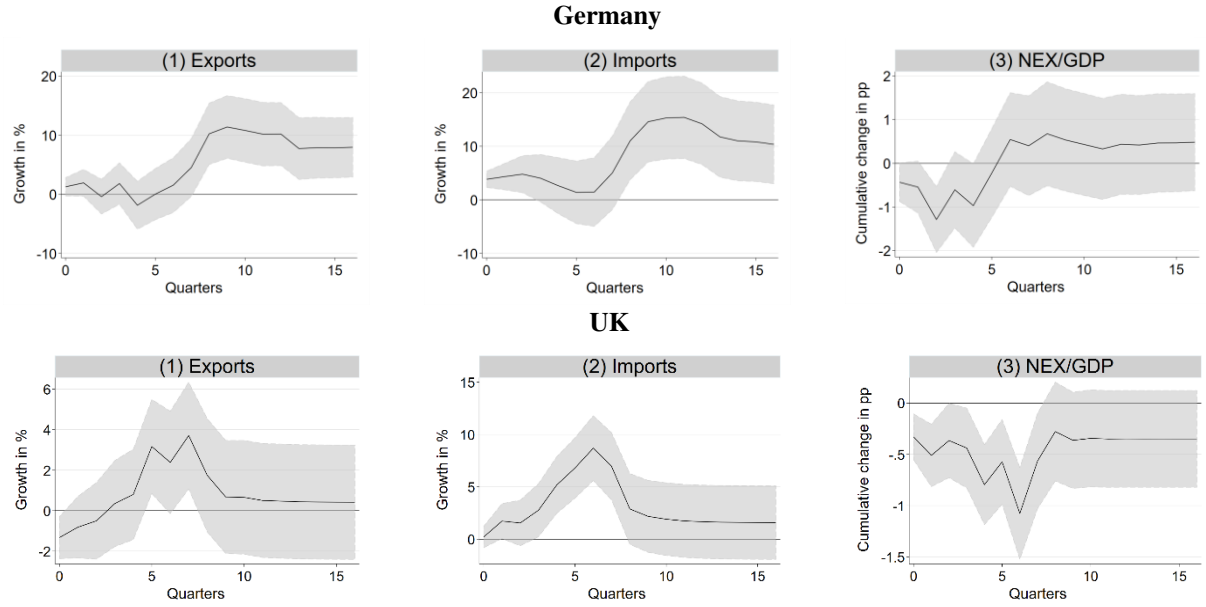
Indirect Tax Shocks

As mentioned earlier, we are only able to construct a series for indirect tax shocks for Germany and the UK. To study the reaction of trade to an indirect tax shock, we also include direct tax liabilities (the sum of personal and corporate income tax liability changes) as controls.

Using a model based on intertemporal optimisation, Felbermayr et al. (2017) predict that cutting indirect taxes has no effect on the trade balance, as they expect consumers to increase their savings accordingly. In contrast, the German BMWi (2017) estimates a drop in exports and a simultaneous hike in imports, affecting the trade balance negatively.

Column (2) of Figure 4 shows an increase in German imports on impact, which really jump upward after about two years, with a peak effect of 15%. In Column (1), we see that the reaction of exports is similar to the one of imports, with a slightly lower peak effect of around 11%. Studying the reaction of the net-exports-to-GDP ratio in column (3), we find that the overall trade effect is negative, with the ratio decreasing by about 1.3 pp, which corresponds to a decline equal to 0.2 standard deviations.

Figure 4: Indirect Tax Shocks



Notes: See Figure 1.

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 in contrast to Nguyen et al. (2021), we also find significant effects of indirect taxes on trade variables. As can be seen in the lower panel of Figure 4, exports increase in this country too. Overall, UK exports increase by almost 4% after one and a half years. The positive effect on imports kicks in after three quarters 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.

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 a decrease of US (UK) exports of more than 4% (1%). Quite the reverse is found for German exports, which increase by about 1.7%. The scaled effect on the UK trade balance translates to less than 0.1 pp, whereas the increase (decrease) is around 0.1 pp in Germany (USA). 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, as the drop in the net-export ratio equals 0.25 pp. In the UK, personal income taxes are the least influential type of tax for the trade balance; whereas a normal sized corporate income tax (indirect tax) cut lowers the NEX-to-GDP ratio by about 0.1 (0.2) pp. While the effects are small, they are roughly three times and five times as large as that of income tax shocks in the case of corporate income taxes and indirect taxes, respectively.

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 US and the UK, 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:[6]

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

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 US and the UK. The tax shock series is now separated into increases, $\Delta\tau^{+}$, and decreases, $\Delta\tau^{-}$.

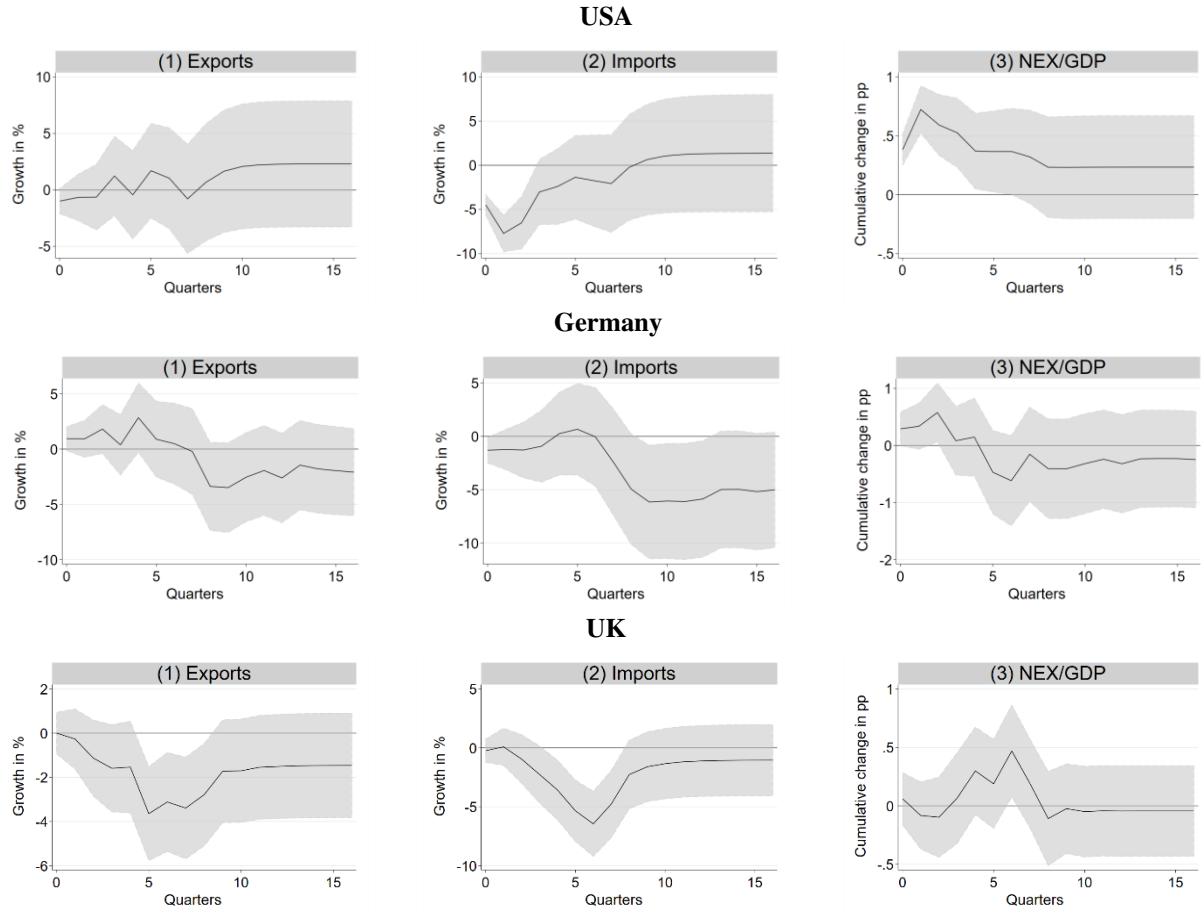
Tax Hikes

Commencing our asymmetric analysis with tax increases in the US, Panel (1) in the top row of Figure 5 shows that a tax hike does not affect US exports. We also observe a reduction in US imports, as can be seen from column (2). The reaction is instantaneous, lasts for almost two years, and reaches a maximum decline of about 8%. 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.

[6] See Kilian and Vigfusson (2011) and Hussain and Malik (2016) for a discussion of linear and nonlinear IRFs.

(2015), we obtain the standard result of falling GDP after a tax hike, whereas they do not observe significant output effects. Adjustment of the US net-exports-to-GDP ratio is demonstrated in column (3) of Figure 5. The graph shows a significantly positive development, which lasts about one and a half years. The positive total effect on the US net-exports-to-GDP ratio amounts to about 0.6 pp (0.4 standard deviations), which is mainly due to drops in GDP and imports.

Figure 5: Only Increase in Aggregated Tax Shocks



Notes: See Figure 1.

The centre row of Figure 5 demonstrates that the reaction is similar in Germany. Column (2) shows a barely significant downward tendency in German imports, which reaches -6% after nine quarters. German exports remain unaffected. Column (3) in the centre of Figure 5 shows that the German net-exports-to-GDP ratio is dominated by the export reaction, as the ratio becomes positive after two quarters. Thus, the reaction of the trade balance to a tax increase is similar in the US and Germany, but imports are the driving force in the US.

In the lower row of Figure 5, we study an increase in aggregated taxes in the UK. 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 appears to be driven by the decrease in UK GDP of about 2.4% after six quarters. Comparing this reaction with the extant literature on exogenous tax increases in the UK, Jones et al. (2015) and

Hussain and Liu (2018) report even steeper drops of about –6%.[7] 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 (0.2 standard deviations) after six quarters. Statistically, the effect is barely significant.

Tax Cuts

Next, we investigate the reaction to tax decreases, starting with the US (see Figure 6). Jones et al. (2015) and Hussain and Malik (2016) estimate a significant increase of GDP after a cut in aggregated tax liabilities. Hence, we would expect an increase in imports, as a share of the higher disposable income is used for import demand. If households do not adjust savings, overall savings decrease and the interest rate rises, causing net capital inflows, which in turn lead to an exchange rate appreciation and a crowding out of exports. Indeed, the IRF in column (1) shows that US exports react negatively and the effect is significant over the whole forecast horizon. Imports soar upward after two years, stay significantly positive throughout our observation window, and reach a peak increase of almost 6%. Column (3) of Figure 6 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 0.4 pp (about 0.3 standard deviations). It remains significant at that level for the remainder of the four-year observation period.

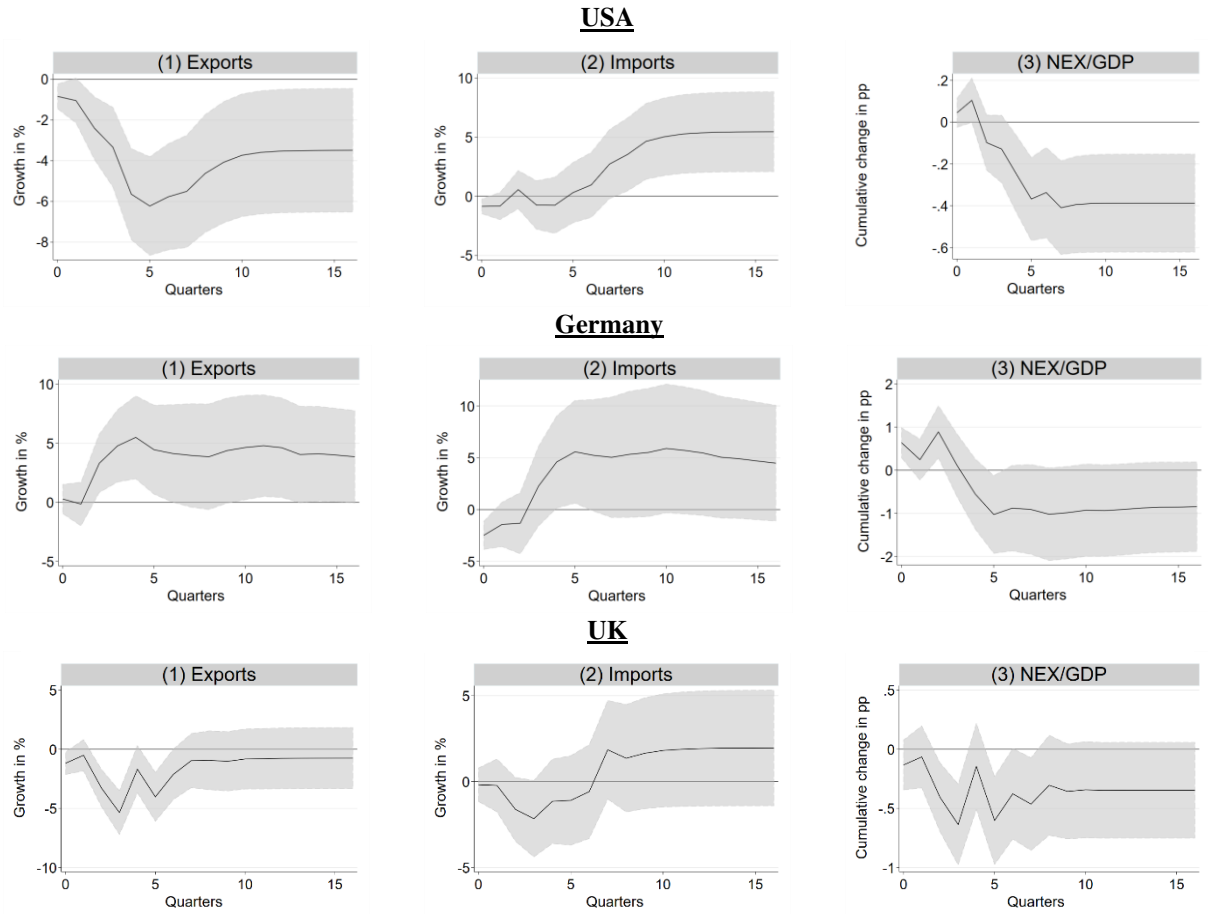
In the centre row of Figure 6, we study the reaction of German trade to a domestic tax decrease. The centre panel shows that German imports initially drop before the effects becomes positive, peaking at about 5% after one year. The left-hand side shows that exports also increase after a tax reduction, even with a similar time profile and magnitude. Column (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 after five quarters. Quantitatively, the positive part of the reaction reaches about 1 pp, whereas the negative one reaches a loss of roughly 1 pp, corresponding to 0.2 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. However, the underlying mechanisms are again quite different, as German (US) exports grow (shrink).

Finally, in the lower row, we look at how the UK trade variables respond to aggregated tax decreases only. In column (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.

[7] 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 UK. 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.

Imports drop too, but the effect is not significant. As a result, the net-export-to-GDP ratio decreases by about 0.6 pp (about 0.3 standard deviations), which is the same magnitude as the reaction of the US trade balance and about half the size of the one in Germany.[8]

Figure 6: Only Decrease in Aggregated Tax Shocks



Notes: See Figure 1.

Hence, we find a qualitatively similar reaction of the trade balance to a cut in aggregated tax liabilities. However, the underlying mechanisms are quite different across the countries, as a tax cut in the US raises imports and crowds out exports, whereas we find a negative effect on UK exports but no effect on imports. In Germany, exports and imports rise simultaneously, but the latter effect on the outweighs the former.

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 about 0.1 pp after a normal tax cut compared to an increase of 0.3 pp after a normal tax hike. For the US, we do not find such an asymmetry, as the results translate in an increase (decrease) of the ratio of

[8] When excluding the two aforementioned tax outliers, the effect on exports remains, whereas we observe increasing GDP and imports. Still, the negative effect on the trade balance remains at 0.6 pp.

about 0.2 after a tax hike (cut). We find a considerable asymmetry for the UK, with the NEX-to-GDP ratio increasing by less than 0.1 pp after a tax hike, but dropping by more than 0.25 pp after a tax cut.

Hence, cross-country heterogeneity is not only present when looking at GDP, consumption, and investment (Jones et al., 2015; Hussain & Malik, 2016) but also with respect to trade. Tax hikes reduce imports in all three countries, but only in the US and UK do we find a significant improvement in the net-export-to-GDP ratio. Tax cuts reduce US and UK exports, but increase German ones.

6. Spill-Over Effects from US Tax Legislation

With up to 10% and 14% of exports from Germany and the UK, respectively, over the period 1988 to 2018, the US is an important trading partner for the two European countries.[9] 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 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:

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

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 $\Delta\tau^{\mathrm{d}}$ describes eight lags of the aggregated domestic tax shocks series. $\Delta\tau^{\mathrm{f}}$ is the aggregated US tax shock series, which also enters with eight lags.

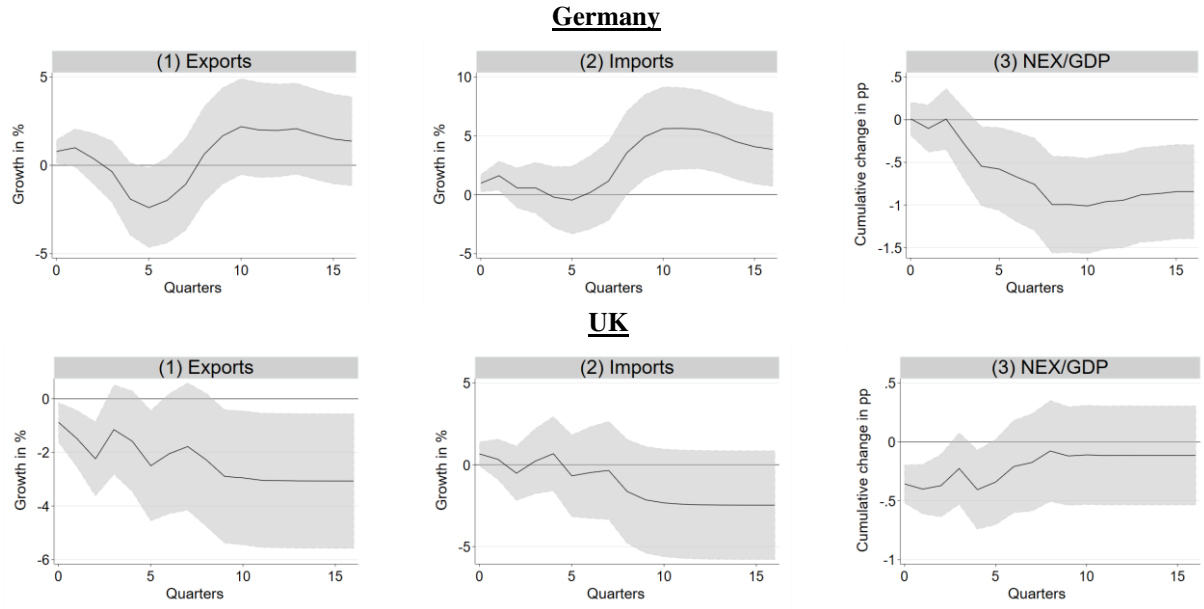
Panels (1) and (2) in the upper row of Figure 7 show that a decrease in US taxes has a similar influence on German exports and imports, even though the effect on exports is not significant. As demonstrated in Panel (3), the net effect on the net-export-to-GDP ratio is dominated by the effect on imports and the ratio falls by about 1 pp.

The effect of US tax legislation on UK trade variables is shown in the lower row. The effect occurs earlier in the UK than in the case of Germany, as UK exports drop on impact and by about 3% after ten quarters, whereas imports have an (insignificant) downward tendency. Unlike Clancy (2019) for the case of Ireland, we find no increase in GDP, which likely reflects the fact that the UK is relatively less dependent on US trade than is Ireland. Still, the net-export-to-GDP ratio drops by about 0.4 pp after two

[9] 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.

quarters, which is a notable spillover, as it is comparable to the reaction after a domestic personal income tax cut.

Figure 7: 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

When considering tax hikes and cuts, we discover a symmetric pattern: the German net-export-to-GDP ratio increases by more than 1.5 pp (decreases by almost 1 pp) after two and a half years after a tax hike (cut). In the UK, the effect is negative in both cases. After a tax hike, the NEX-to-GDP ratio initially jumps up but then drops by almost 1 pp after about six month. Hence, when considering US tax decreases, we find that both European trade balances deteriorate. The peak effect is below -1 pp in both cases, but the effect comes about a bit earlier in the UK. In either case, exports drop after a US tax cut.

US Personal Income Tax Change

Assumption of symmetric effects of US personal income tax shock

After an aggregated cut in US personal income taxes we discover a deterioration of the trade balance in both countries. The effect is about twice as large in Germany (-1pp) but comes about earlier for the UK. In either case, exports drop after about one year. Like Metelli and Natoli (2019), we find that UK GDP has a positive reaction to US personal income tax shocks. However, the effect is only significant on impact but not thereafter.

US Business Tax Change

Assumption of symmetric effects of US business tax shock

A cut in US business taxes causes the German trade balance to drop by about 2pp after seven quarters. Even though German exports rise by about 8% after twelve quarters, imports rise earlier and more strongly, resulting in the negative net effect on the trade balance. In the UK, the NEX-to-GDP ratio first declines by about 1 pp, as exports drop initially, but then it rises by almost 2 pp, as imports fall and exports return to their equilibrium path.

7. Robustness

When analysing the effects of discretionary tax policy on trade variables, we argued that the endogeneity of taxes with regard to income can be ignored. To check this assumption, we re-estimate the models using only tax changes classified as exogenous. Results can be found in the Online Appendix, Figures A1–A11. The confidence bands are now wider, as we have fewer observations. Overall, all results but one remain the same: German imports seem to react more strongly to countercyclical fiscal policy measures, as the effect of aggregated and personal tax cuts is now insignificant.

Next, we re-estimate the models as local projections (Jordà, 2005). Results are given in Figures A12–A22. Results remain qualitatively the same.

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 A23–A33, and for various exogenous lags in Figures A34–A44. In almost all cases, the IRFs lie within the confidence bounds of the above estimations.

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.[10] The IRFs in Figures A45–A55 of the Online Appendix demonstrate that our results do not change in a noteworthy way.

[10] 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.

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	−	0	−
Personal Income Tax Shocks	−	+	−
Corporate Income Tax Shocks	0	0	−
Indirect Tax Shocks	n.a.	−	−
Only *Increase* in Aggregated Tax Shocks	+	+	+/−
Only *Decrease* 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.

Second, German 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 case of corporate income tax shocks, there is no significant reaction in the US and Germany after a tax cut, whereas we observe a deteriorating net-exports-to-GDP ratio in the UK. In the case of only increasing aggregated tax shocks, a tax hike barely affects the German net-exports-to-GDP ratio, whereas it improves the US and UK ones. The negative effects on domestic GDP, however, suggest 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 UK, 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 (BMWi, 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 reduces the German and UK net-export-to-GDP ratio.

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 1 pp lower net-export-to-GDP ratio in the case of lower aggregated taxes in Germany. Estimated effects for the US and the UK 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 (BMWi, 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 indirect taxes, causing a deterioration of the German net-exports-to-GDP ratio of about 1.3 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 all three cases. 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 US 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 US and the UK 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. Moreover, considerable cross-country heterogeneity with respect to the dynamics of the underlying trade variables call for a cautious evaluation of the different policy options.

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Online Appendix

Table A1: Data Description

Variable	Description	Source
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

	USA			Germany				UK			
Date \ Type	All	PI	CI	All	PI	CI	Indirect	All	PI	CI	Indirect
1974q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975q1	0.0	0.0	0.0	13.0	8.3	4.6	0.0	0.0	0.0	0.0	0.0
1975q2	22.9	18.1	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975q3	-8.1	-8.1	0.0	-3.6	0.0	-3.6	0.0	0.0	0.0	0.0	0.0
1975q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976q1	-14.8	-10.0	-4.8	-0.9	-0.6	-0.3	-0.1	0.0	0.0	0.0	0.0
1976q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976q3	0.0	0.0	0.0	0.0	0.0	0.0	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	0.0	0.0	0.0	0.0
1977q1	0.9	0.8	0.0	0.2	1.1	0.0	-0.9	-0.3	0.0	0.0	-0.3
1977q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.3	0.0	-0.7
1977q3	10.5	8.3	2.2	0.4	0.4	0.0	0.0	-0.1	0.0	0.0	-0.1
1977q4	0.0	0.0	0.0	2.8	2.8	0.0	0.0	1.3	1.3	0.0	0.0
1978q1	1.0	-0.7	1.7	3.7	3.8	0.0	-0.1	0.0	0.0	0.0	0.0
1978q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.8	0.1	0.0
1978q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978q4	2.5	2.3	0.2	0.0	0.0	0.0	0.0	-0.2	0.0	-0.2	0.0
1979q1	-1.1	2.1	-3.2	5.7	5.8	0.0	-0.1	-0.1	0.0	-0.1	0.0
1979q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
1979q3	0.0	0.0	0.0	-3.3	0.0	0.0	-3.3	-3.8	1.0	-0.1	-4.7
1979q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	0.0	0.0
1980q1	-1.1	-0.3	-0.8	2.6	0.7	2.0	-0.1	0.0	0.0	0.0	0.0
1980q2	-7.9	0.0	0.2	0.0	0.0	0.0	0.0	-1.5	-0.3	-0.1	-1.2
1980q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.2	0.0
1980q4	0.0	0.0	0.0	1.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0
1981q1	-21.0	-8.6	-8.3	3.4	3.3	0.2	-0.1	0.0	0.0	0.0	0.0
1981q2	0.0	0.0	0.0	-1.8	0.0	0.0	-1.8	-5.2	-2.6	-0.1	-2.4
1981q3	28.7	25.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981q4	-17.8	-17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982q1	46.0	50.6	-0.5	1.6	1.7	0.2	-0.3	0.0	0.0	0.0	0.0
1982q2	0.0	0.0	0.0	-0.2	0.0	0.0	-0.2	0.1	0.6	0.4	-0.9
1982q3	0.5	0.0	0.5	0.8	1.0	1.0	-1.3	1.2	0.0	1.2	0.0
1982q4	-7.5	0.0	-6.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
1983q1	42.1	53.6	-8.6	-1.6	-1.7	0.1	0.0	0.6	0.0	0.6	0.0
1983q2	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	1.9	1.7	0.8	-0.6
1983q3	0.0	0.0	0.0	-4.1	0.0	0.0	-4.1	0.4	0.0	0.4	0.0
1983q4	-0.4	0.0	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984q1	24.0	30.0	-6.1	2.4	1.1	1.2	0.0	-0.1	0.0	-0.1	0.0
1984q2	0.0	0.0	0.0	-0.2	0.0	-0.2	0.0	0.2	1.2	0.1	-1.0
1984q3	-7.2	-4.3	-3.1	1.4	0.0	0.0	1.4	0.0	0.0	0.0	0.0
1984q4	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.9	0.0
1985q1	3.6	8.7	-5.1	0.6	0.9	0.0	-0.3	0.0	0.0	0.0	0.0
1985q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0.1	-0.9
1985q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-0.2
1985q4	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
1986q1	-4.3	-2.1	-2.2	7.2	6.3	0.9	0.0	0.0	0.0	0.0	0.0
1986q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.6	0.1	-0.9
1986q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986q4	-21.8	-0.7	-21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987q1	6.7	19.3	-12.7	-0.5	-0.3	-0.2	0.0	0.0	0.0	0.0	0.0
1987q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	-0.2	0.2
1987q3	6.7	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988q1	-24.7	-10.1	-14.3	4.2	4.2	0.0	0.0	0.0	0.0	0.0	0.0
1988q2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	5.9	5.5	0.3	0.2
1988q3	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
1988q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989q1	-1.5	-0.1	-1.4	-8.0	-3.0	-0.6	-4.5	0.0	0.0	0.0	0.0
1989q2	0.0	0.0	0.0	-0.3	0.0	0.0	-0.3	0.8	-0.2	0.0	1.0
1989q3	0.0	0.0	0.0	2.5	2.4	0.1	0.0	0.0	0.0	0.0	0.0
1989q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8	0.0	0.0
1990q1	-10.1	-5.0	-5.2	14.7	15.2	-0.4	-0.2	-0.2	0.0	-0.2	0.0
1990q2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	-0.7	-0.5	-0.2	0.0
1990q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1
1990q4	-4.7	0.0	-4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991q1	-23.2	-5.2	-6.6	-0.5	0.0	0.0	-0.5	0.2	0.2	0.0	0.0

1991q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.6	3.1	0.3	-5.9
1991q3	-1.9	-1.0	-1.0	-17.4	-3.8	-4.3	-9.3	0.0	0.0	0.0	0.0
1991q4	0.0	0.0	0.0	-0.4	-0.4	0.0	0.0	0.0	0.0	0.0	0.0
1992q1	-2.2	-0.2	-2.0	-2.5	-0.1	-0.4	-2.1	1.2	0.0	0.1	1.1
1992q2	0.0	0.0	0.0	1.3	3.4	-1.6	-0.5	1.7	1.8	0.4	-0.5
1992q3	0.0	0.0	0.0	10.1	5.0	5.1	0.0	0.1	0.0	0.0	0.1
1992q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.5	0.6
1993q1	0.0	0.0	0.0	-5.5	-4.8	5.3	-6.0	0.3	0.0	0.0	0.3
1993q2	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-3.5	-1.9	-1.0	-0.6
1993q3	-24.2	-22.5	-1.9	0.1	0.9	0.0	-0.8	0.0	0.0	0.0	0.0
1993q4	-4.4	0.0	0.0	-0.2	0.0	-0.2	0.0	-0.5	0.0	-0.5	0.0
1994q1	-8.2	-7.6	-0.6	-6.8	-2.8	0.7	-4.5	-2.2	-0.4	-0.2	-1.7
1994q2	0.0	0.0	0.0	0.8	0.4	0.4	0.1	-6.2	-4.7	0.7	-2.3
1994q3	0.2	0.0	0.2	-0.1	0.0	0.0	-0.1	0.1	0.0	0.1	0.0
1994q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	-1.2
1995q1	-0.6	-0.6	0.0	-16.8	-7.7	-7.8	-1.3	-1.8	0.0	-0.2	-1.6
1995q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-1.3	0.2	0.0
1995q3	-2.2	0.0	-2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995q4	-3.2	0.0	0.0	0.2	0.2	0.0	-0.1	0.0	0.0	0.0	0.0
1996q1	3.5	0.0	1.1	6.8	6.5	0.0	0.4	-0.9	0.1	0.0	-0.9
1996q2	0.0	0.0	0.0	-0.4	0.0	0.0	-0.4	4.4	4.1	0.2	0.0
1996q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
1996q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.9	0.0	-0.4	-0.5
1997q1	0.0	0.0	0.0	2.8	0.5	2.3	0.0	-2.6	-0.2	-0.8	-1.6
1997q2	0.0	0.0	0.0	-0.2	-0.2	0.0	0.0	3.1	3.4	0.6	-0.9
1997q3	-6.6	-3.9	-3.7	0.0	0.0	0.0	0.0	-3.6	-4.1	1.7	-1.2
1997q4	-5.9	-0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1
1998q1	23.1	21.8	1.4	4.6	2.8	1.9	0.0	-4.7	-1.7	-2.6	-0.4
1998q2	0.0	0.0	0.0	-5.8	0.0	0.0	-5.8	-0.7	-1.5	2.5	-1.7
1998q3	-0.7	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	0.0	0.0	-0.4
1999q1	0.7	0.0	0.7	7.4	6.0	1.3	0.0	-2.6	0.0	-2.6	0.0
1999q2	0.0	0.0	0.0	-19.3	-5.6	-5.7	-7.9	-1.4	0.3	1.4	-3.0
1999q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-0.1	-0.2	-0.3
1999q4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0
2000q1	-2.8	0.0	0.0	7.6	9.4	0.8	-2.7	0.0	0.0	0.0	0.0
2000q2	0.0	0.0	0.0	-0.7	-0.7	0.0	0.0	-1.6	-0.1	-0.4	-0.9
2000q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.2	0.0
2000q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001q1	0.0	0.0	0.0	11.9	14.3	0.2	-2.7	-0.1	0.0	-0.1	0.0
2001q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	2.0	2.1	1.0
2001q3	70.7	70.7	0.0	0.1	0.1	0.0	0.0	0.3	0.0	-0.2	0.4
2001q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1
2002q1	15.4	15.4	0.0	5.0	6.1	3.1	-4.2	0.5	0.0	0.0	0.4
2002q2	41.8	0.1	41.6	0.0	0.0	0.0	0.0	0.2	0.1	0.7	-0.5
2002q3	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	-0.6	0.0	0.0	-0.5
2002q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.4	0.1
2003q1	0.4	0.5	0.0	-4.9	1.0	-1.2	-4.7	-1.3	-0.4	-0.7	-0.1
2003q2	0.0	0.0	0.0	0.6	0.6	0.0	0.0	-9.4	-5.1	-4.0	-0.3
2003q3	140.3	104.3	36.0	-4.4	-0.1	-4.3	0.0	0.0	0.0	0.0	0.0
2003q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	-0.3
2004q1	-5.5	0.1	-5.5	5.8	7.0	-1.1	-0.1	0.1	0.0	0.1	0.0
2004q2	0.0	0.0	0.0	-0.8	0.0	0.0	-0.8	-0.5	0.0	-0.8	0.3
2004q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1
2004q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	0.0	-0.3
2005q1	4.6	4.7	-0.1	10.8	11.7	0.0	-0.8	-0.4	-0.7	-0.3	0.6
2005q2	0.0	0.0	0.0	0.0	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	0.0	0.0	0.1	0.0	0.0	0.1
2005q4	0.0	0.0	0.0	-0.8	0.0	0.0	-0.8	0.1	-0.1	0.0	0.2
2006q1	1.6	1.6	0.0	3.1	0.6	2.5	0.0	-2.8	-0.2	-3.0	0.4
2006q2	0.0	0.0	0.0	4.1	2.2	1.9	0.0	-0.8	-0.5	-0.1	-0.2
2006q3	-0.7	-0.3	-0.4	1.2	0.0	0.0	1.2	-0.8	0.0	-0.8	-0.1
2006q4	0.0	0.0	0.0	-1.2	0.0	0.0	-1.2	-0.5	0.0	0.0	-0.6
2007q1	6.1	-1.1	7.2	-28.3	-3.5	1.4	-26.2	-1.9	-0.1	-0.5	-1.3
2007q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-0.2	-0.3	-0.4
2007q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	0.0	-0.2	-0.4
2007q4	0.0	0.0	0.0	-1.6	0.0	-1.6	0.0	1.3	1.1	-0.1	0.3
2008q1	106.2	105.1	1.1	8.7	3.9	4.8	0.0	0.0	0.0	0.0	0.0
2008q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.6	-0.6	-1.2
2008q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008q4	6.6	4.8	1.8	0.0	0.0	0.0	0.0	-0.5	0.0	0.0	-0.5
2009q1	-108.7	-105.7	-3.0	9.4	6.9	2.4	0.0	7.1	0.2	0.0	6.9
2009q2	110.1	89.4	20.7	4.6	4.6	0.0	0.0	0.1	0.2	0.9	-1.0
2009q3	0.0	0.0	0.0	1.1	-1.5	0.9	1.7	0.4	0.0	0.3	0.0
2009q4	33.3	0.0	33.3	-1.7	0.0	0.0	-1.7	-0.6	0.0	0.0	-0.6
2010q1	-13.5	-15.2	1.7	19.8	17.7	1.1	1.0	-9.1	0.0	-1.2	-7.9
2010q2	-5.3	-9.4	4.1	0.0	0.0	0.0	0.0	-4.8	-3.6	-0.7	-0.5

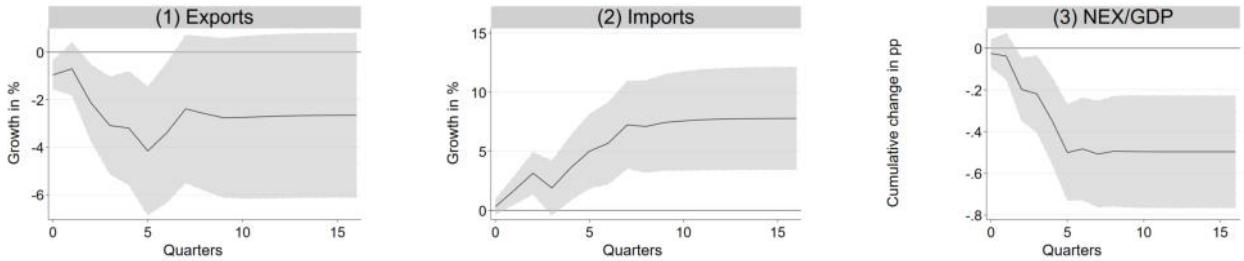
2010q3	-0.2	0.0	-0.2	0.0	0.0	0.0	0.0	0.8	0.3	0.3	0.2
2010q4	12.3	1.5	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-0.1
2011q1	-28.7	20.8	-49.7	-5.2	-1.8	-2.1	-1.3	-13.4	0.0	-0.8	-12.6
2011q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.0	-1.4	-1.6	2.1
2011q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011q4	-0.4	-0.4	0.0	0.0	0.0	0.0	0.0	-1.2	0.0	-1.2	0.0
2012q1	-22.4	-2.4	-21.8	-2.4	-0.7	0.0	-1.7	1.0	0.0	0.0	1.0
2012q2	0.0	0.0	0.0	1.7	0.0	0.0	1.7	-1.9	-0.6	-0.5	-0.8
2012q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012q4	-0.3	0.0	-0.3	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0
2013q1	-103.7	-95.6	-8.1	1.4	-0.7	0.0	2.2	-0.5	0.0	-0.5	0.0
2013q2	0.0	0.0	0.0	6.1	6.1	0.0	0.0	4.4	2.3	2.8	-0.7
2013q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	-0.1	0.8
2014q1	1.5	11.0	-9.4	0.0	0.0	0.0	0.0	-0.5	0.0	-0.5	0.0
2014q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	-0.5	5.9	0.6
2014q3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.1	-0.5	-0.6	0.0
2014q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.7
2015q1	-8.0	0.0	-8.0	0.0	0.0	0.0	0.0	-0.3	-0.4	-0.6	0.8
2015q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	-1.6	0.3
2015q3	0.0	0.0	0.0	2.0	2.0	0.0	0.0	-0.9	0.0	-0.3	-0.5
2015q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	-1.2
2016q1	3.0	0.2	0.5	3.3	3.3	0.0	0.0	-0.1	-0.1	0.1	-0.1
2016q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.1	-0.2	-5.9	-1.0
2016q3	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2016q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	-0.2
2017q1	-1.5	-6.1	7.9	3.6	2.6	-0.3	1.3	-0.5	-0.1	-0.4	0.0
2017q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.4	-1.3	0.5
2017q3	0.0	0.0	0.0	6.3	0.0	0.0	6.3	-0.8	0.0	0.0	-0.8
2017q4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2018q1	293.7	201.2	94.8	-2.7	3.6	0.0	-6.3	0.3	-0.2	-0.2	0.8
2018q2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-2.4	0.1	0.6

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

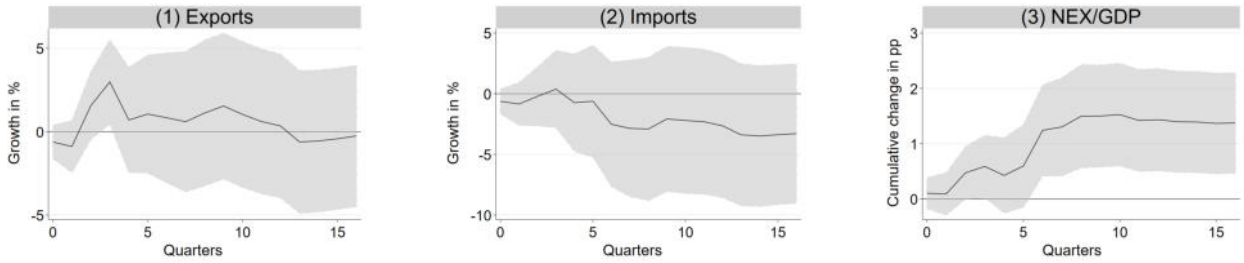
Only Exogenous Tax Shocks

Figure A 1: Aggregated Tax Shocks, Only Exogenous Shocks

USA



Germany



UK

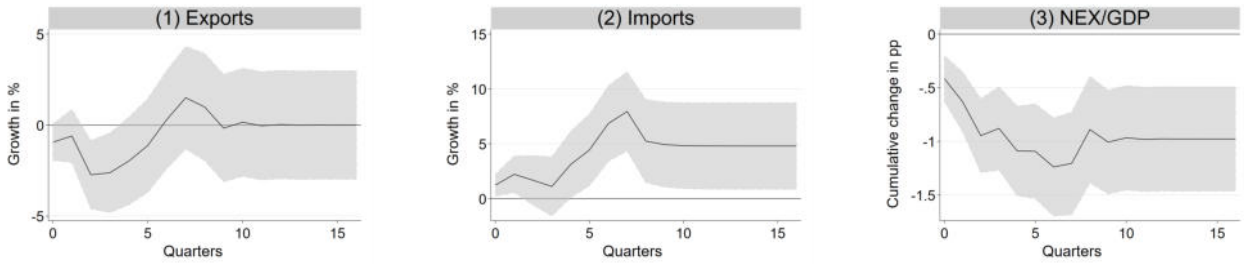
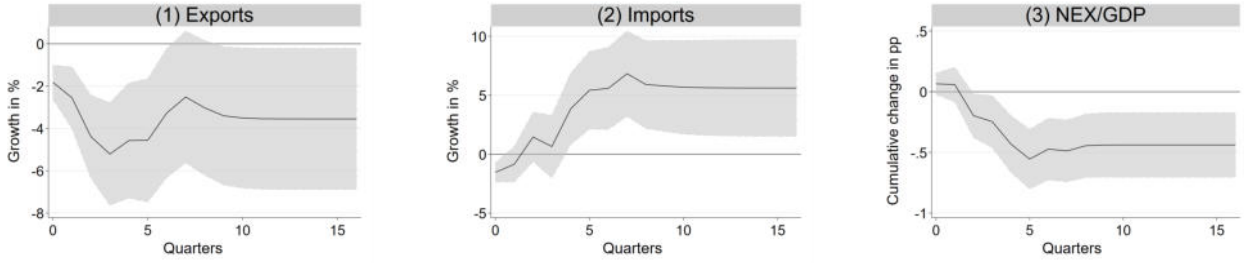


Figure A 2: Personal Income Tax Shocks, Only Exogenous Shocks

USA



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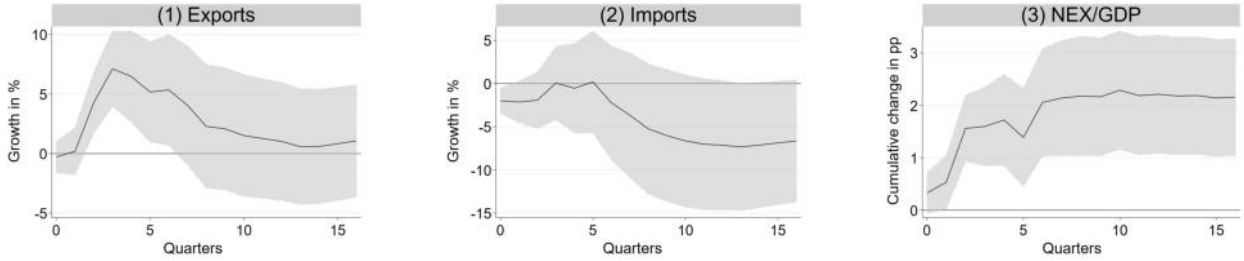

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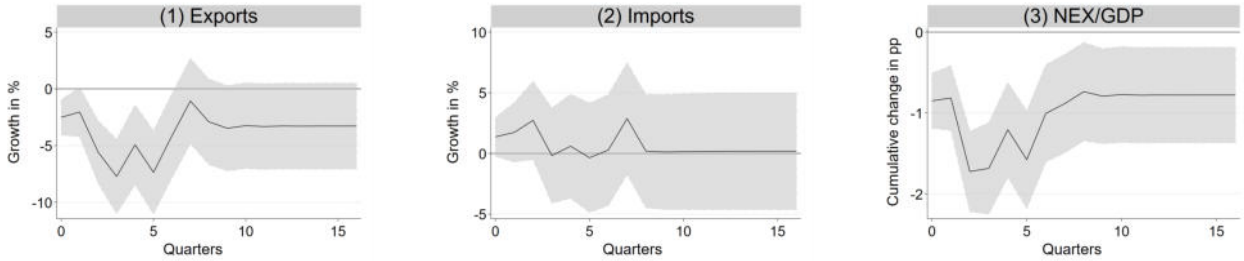
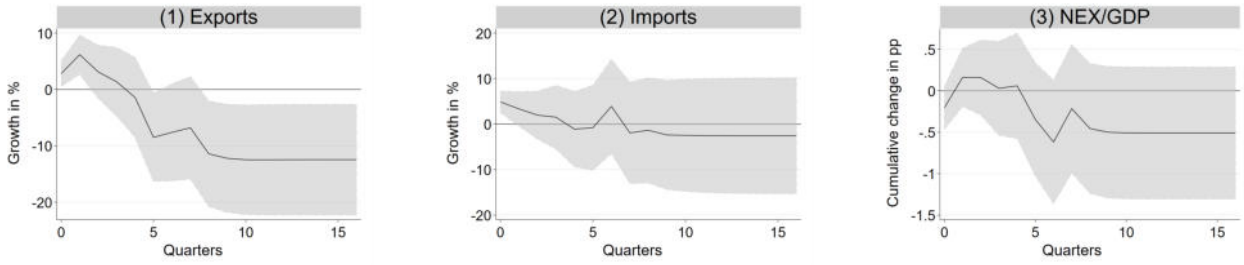


Figure A 3: Corporate Income Tax Shocks, Only Exogenous Shocks

USA



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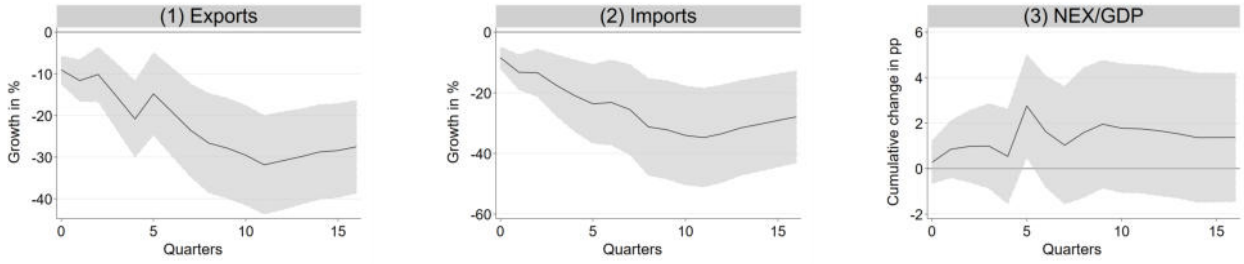

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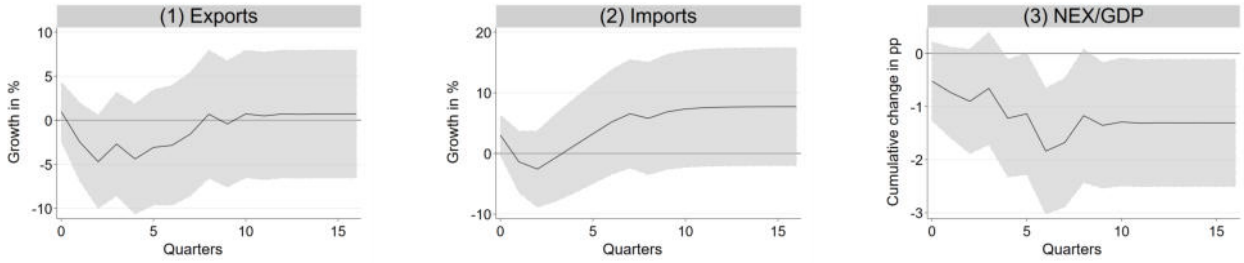
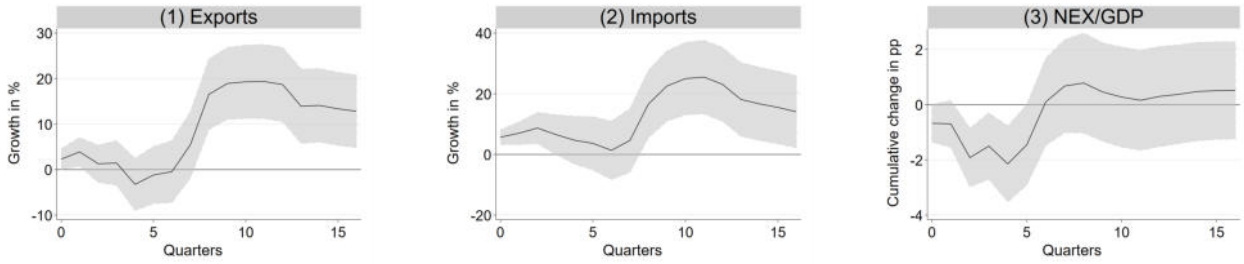


Figure A 4: Indirect Tax Shocks, Only Exogenous Shocks

Germany



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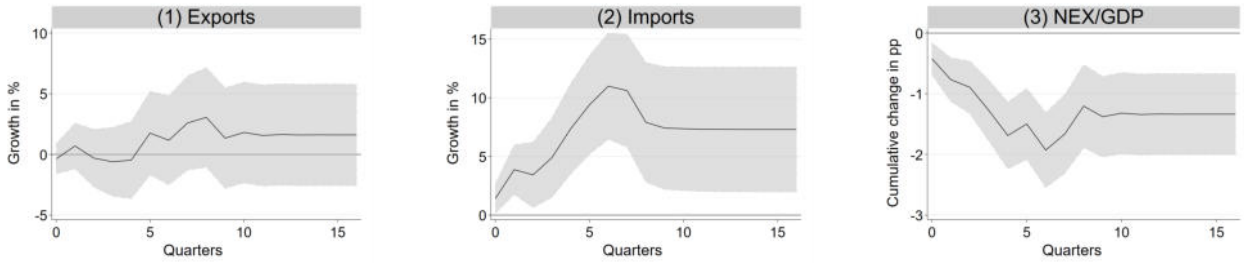
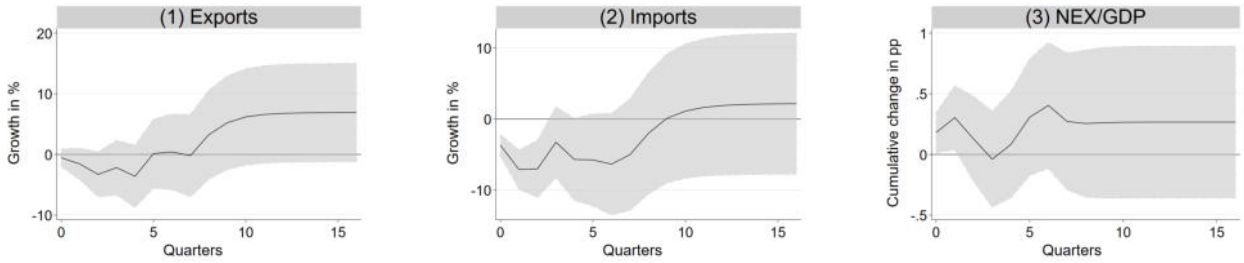


Figure A 5: Only Increase in Aggregated Tax Shocks, Only Exogenous Shocks

USA



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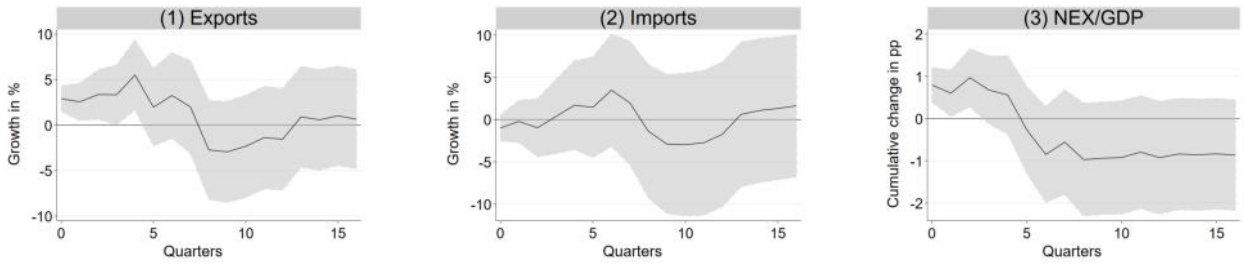


UK

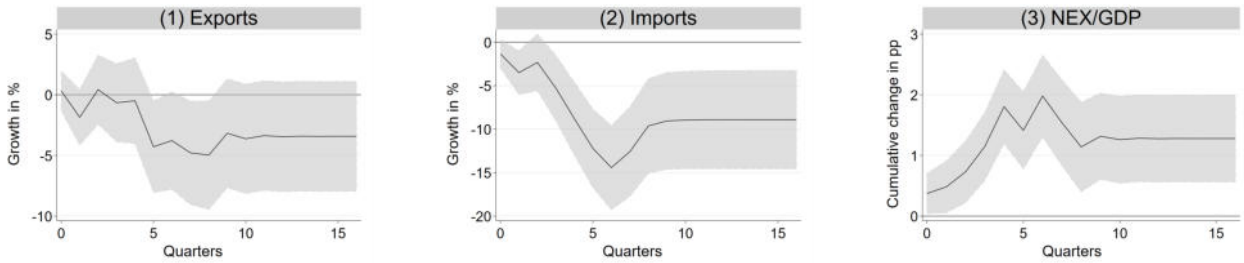
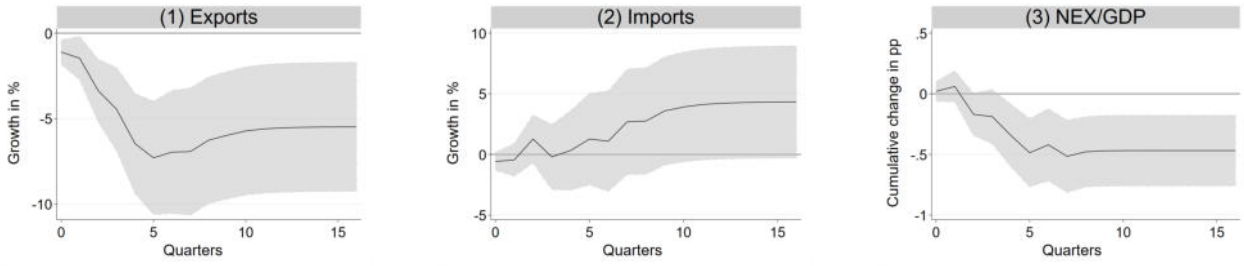


Figure A 6: Only Deccrease in Aggregated Tax Shocks, Only Exogenous Shocks

USA



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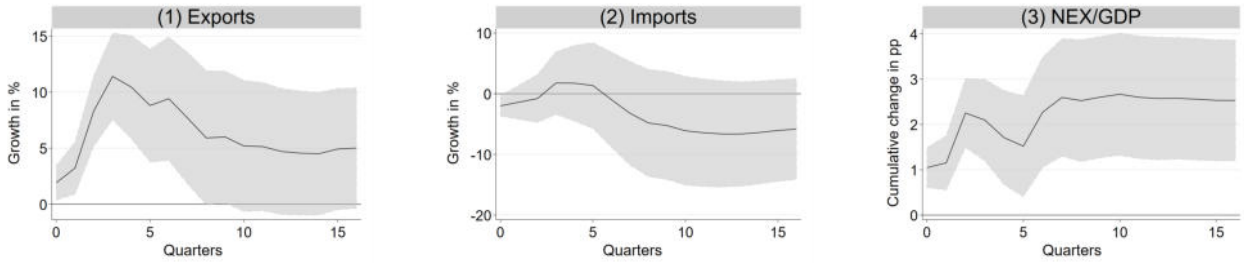

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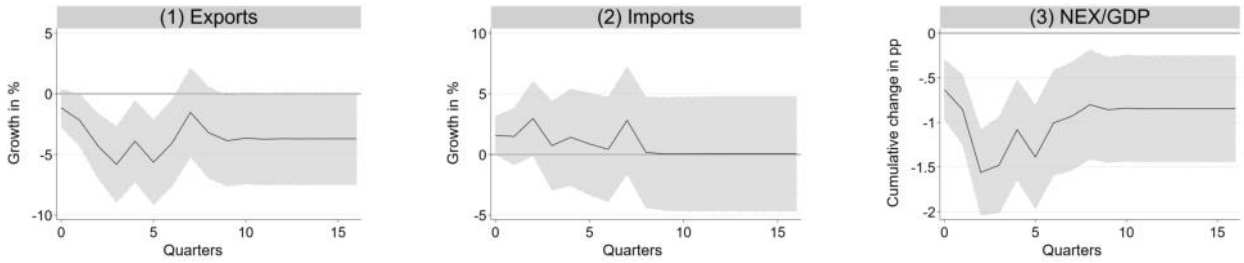
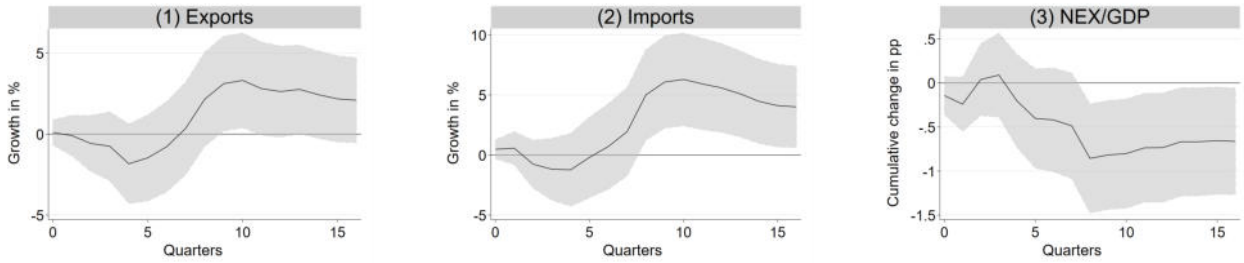


Figure A 7: Spill-Over Effects of Aggregated US Tax Liabilities, Only Exogenous Shocks

Germany



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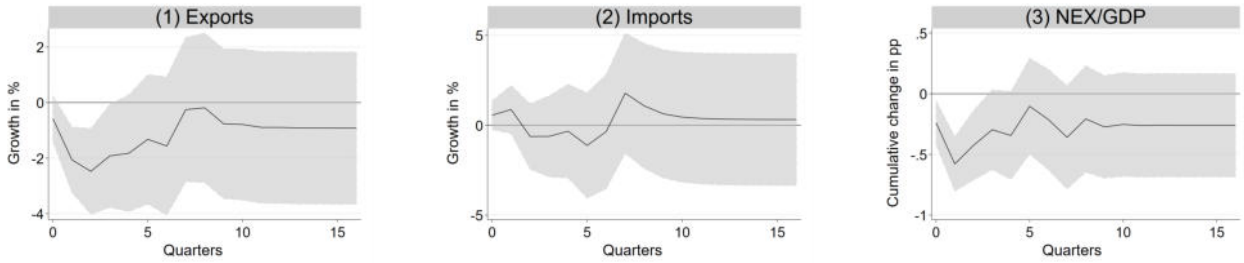
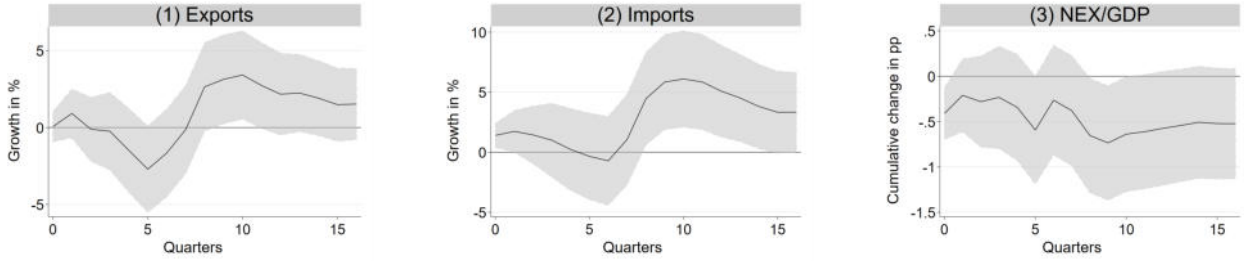


Figure A 8: Spill-Over Effects of Personal Income Tax, Only Exogenous Shocks

Germany



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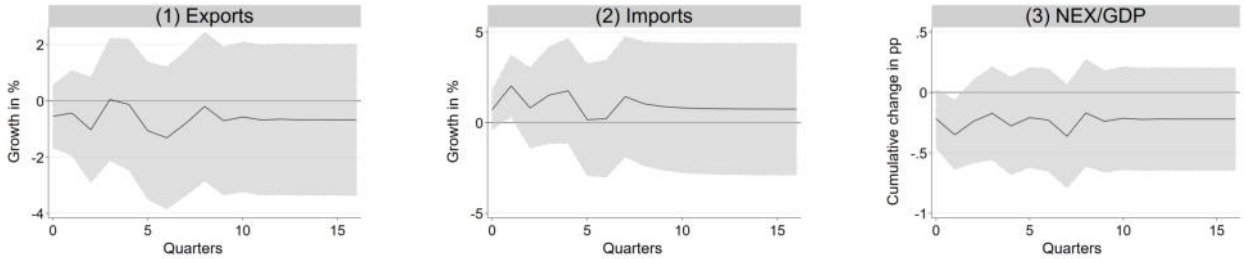
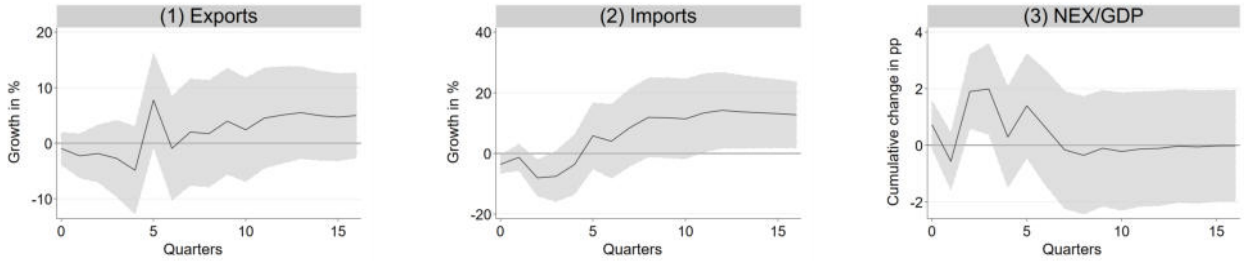


Figure A 9: Spill-Over Effects of Corporate Income Tax, Only Exogenous Shocks

Germany



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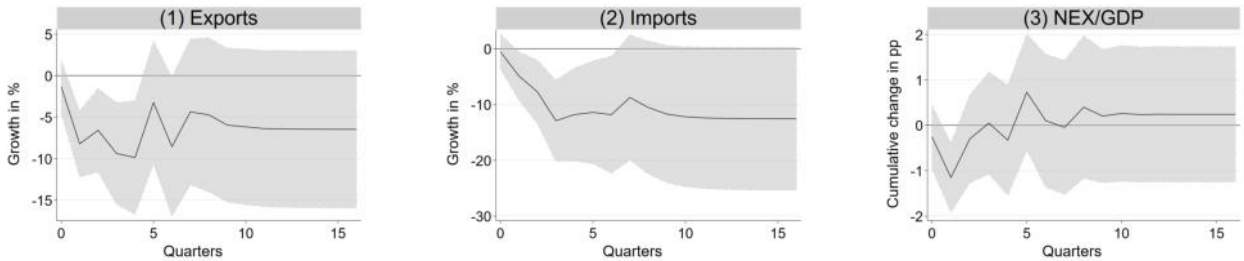
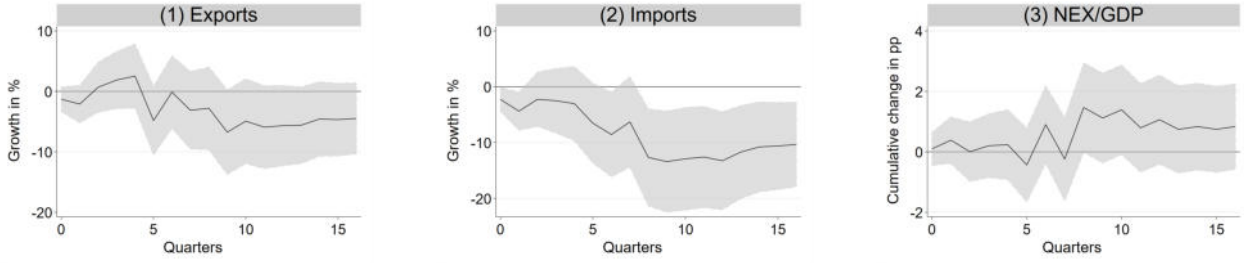


Figure A 10: Spill-Over Effects of US Tax Increases, Only Exogenous Shocks

Germany



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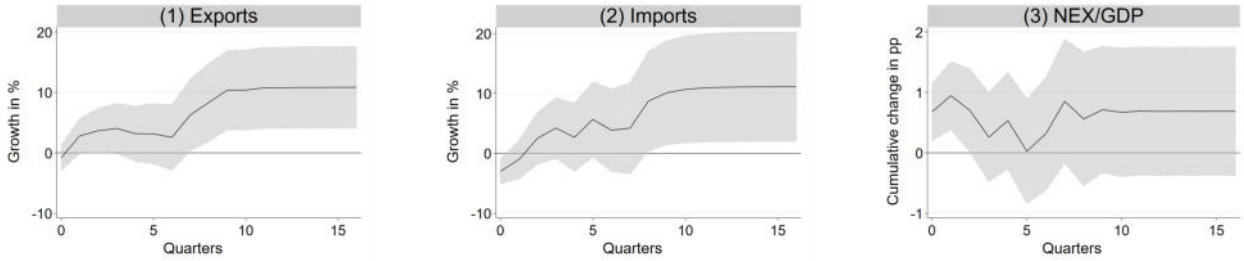
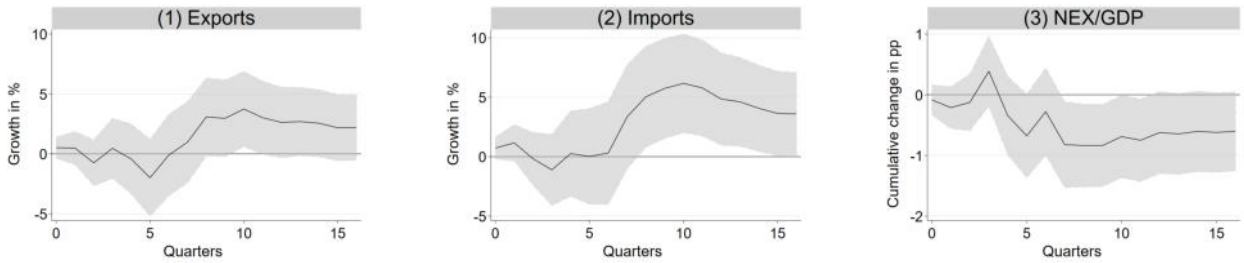


Figure A 11: Spill-Over Effects of US Tax Decreases, Only Exogenous Shocks

Germany



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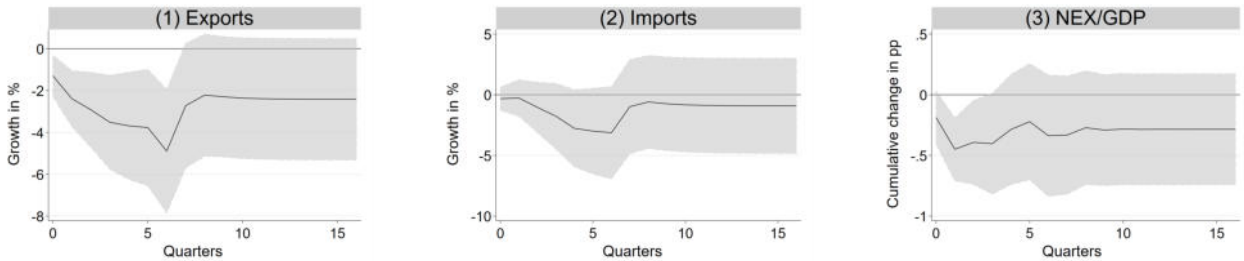
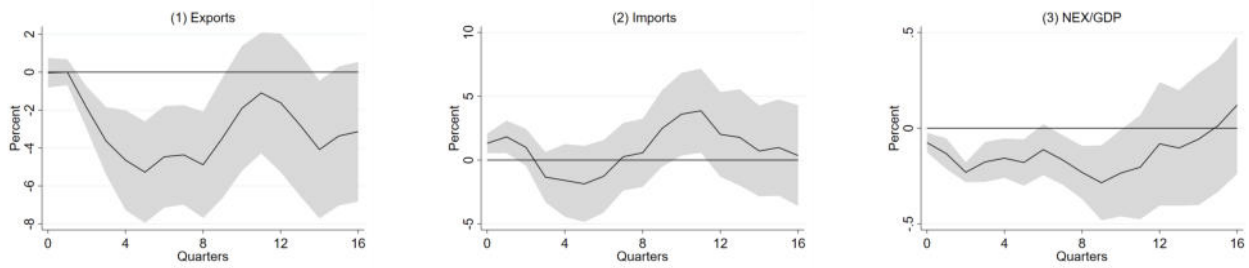


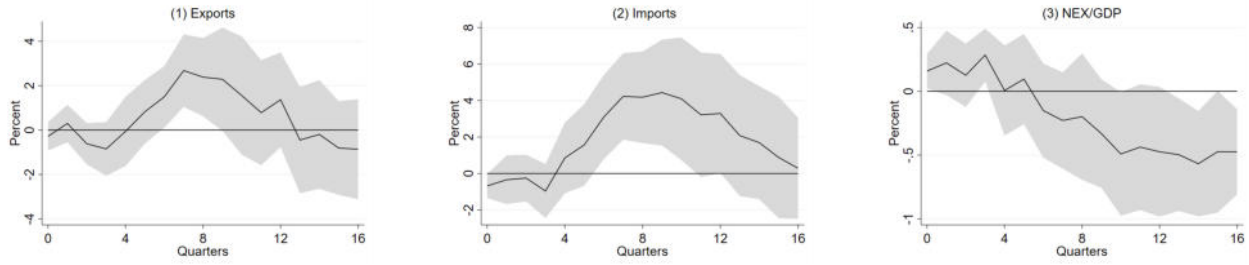
Local Projections

Figure A 12: Aggregated tax shock, estimated as LP

USA



Germany



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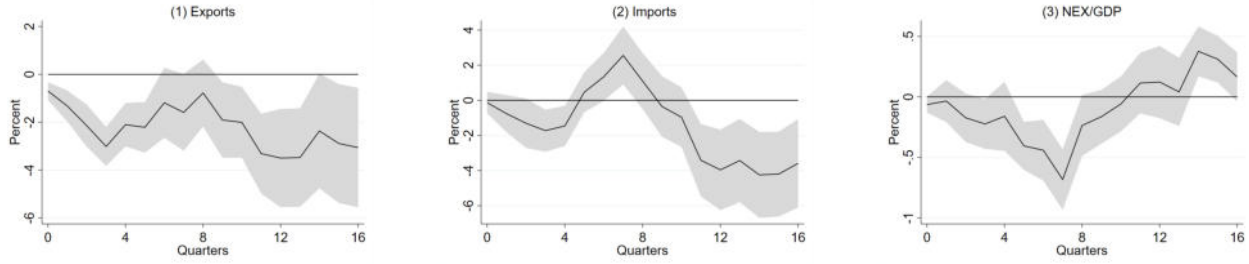
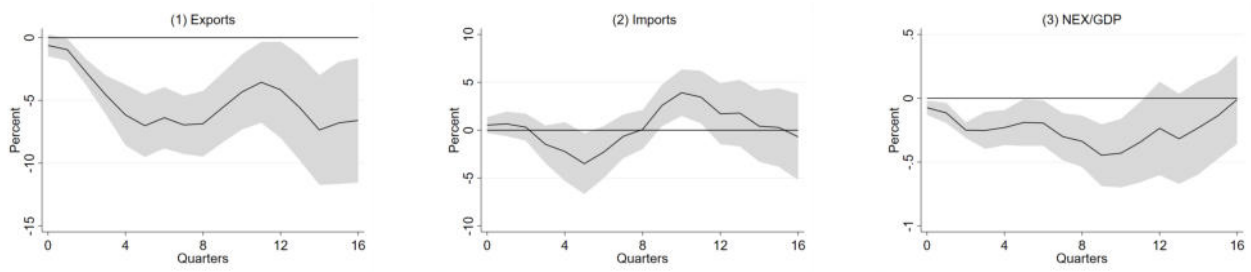
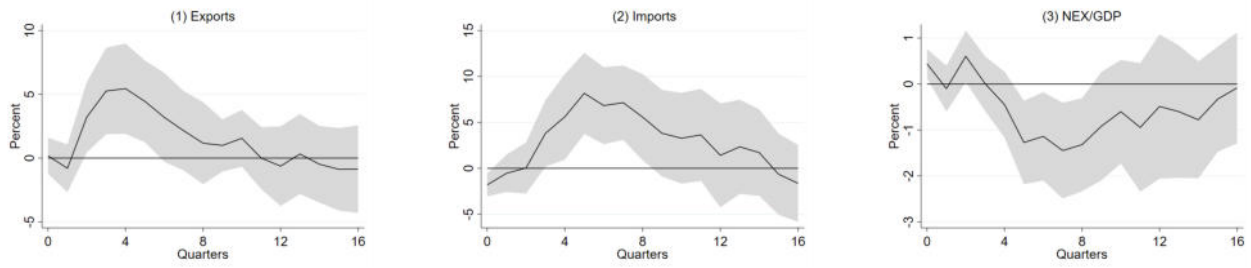


Figure A 13: Personal Income Tax Shock, estimated as LP

USA



Germany



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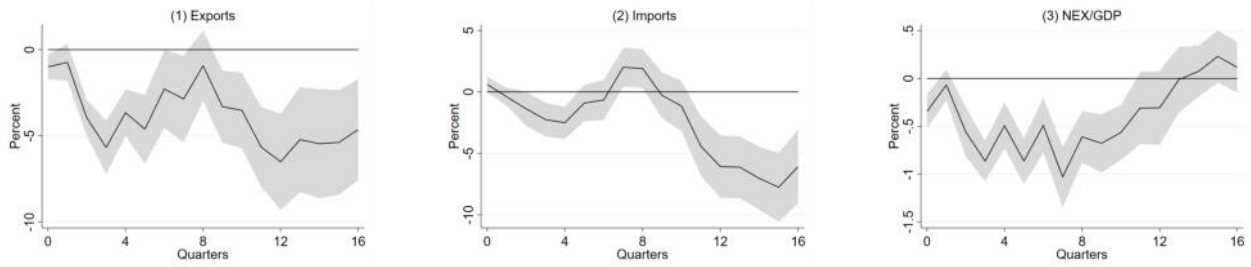
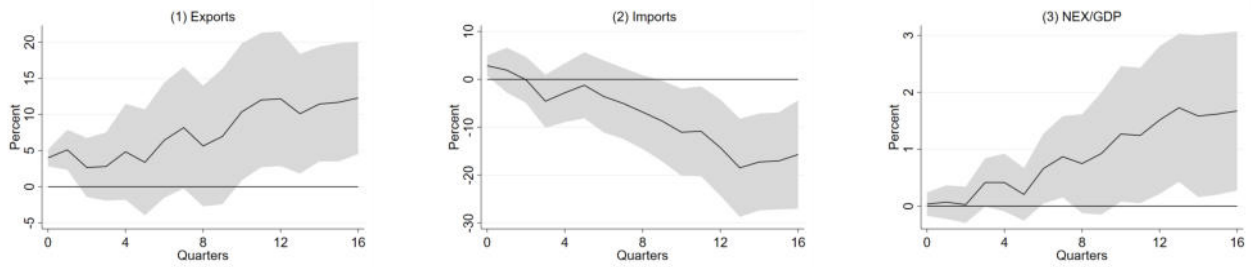
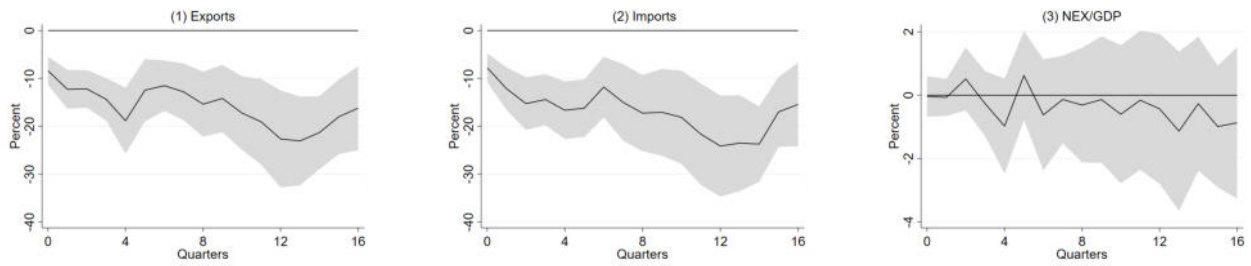


Figure A 14: Corporate Income Tax Shocks, estimated as LP

USA



Germany



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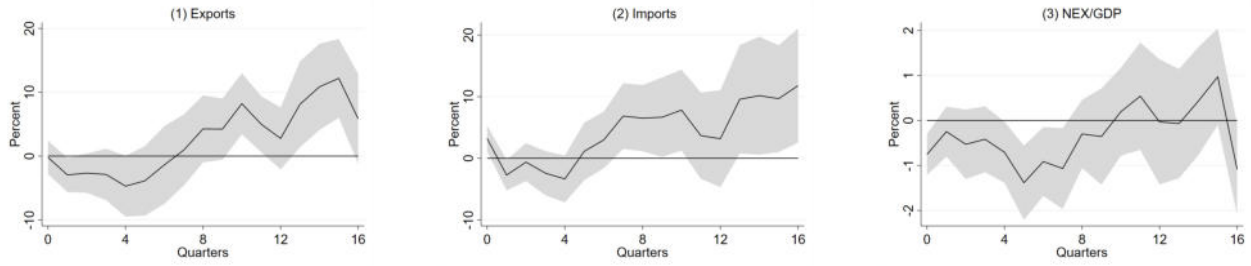
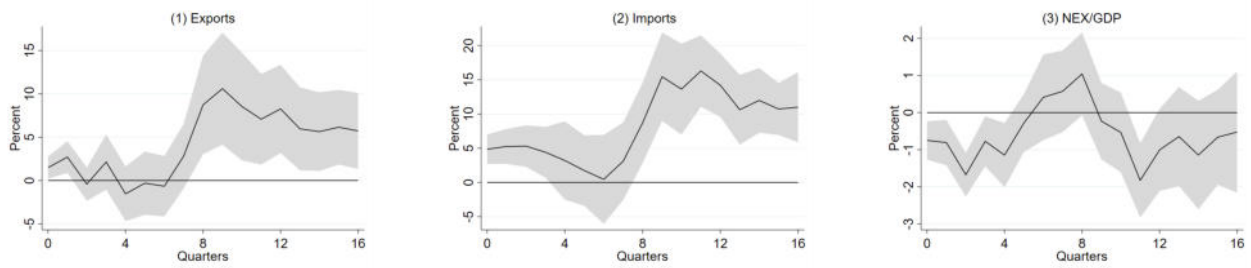


Figure A 15: Indirect Tax Shocks, estimated as LP

Germany



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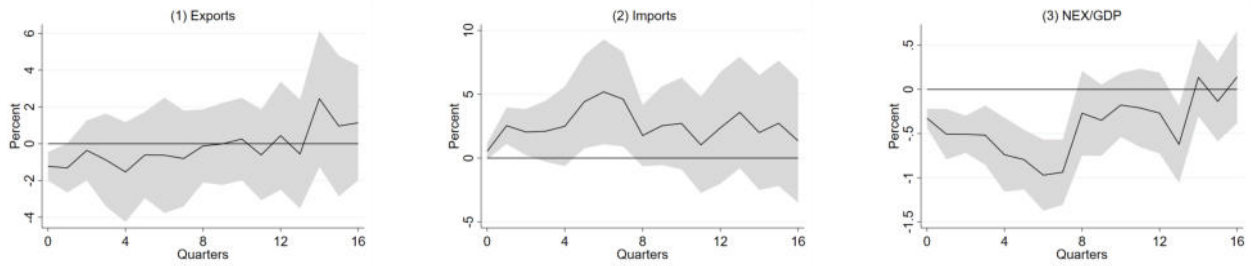
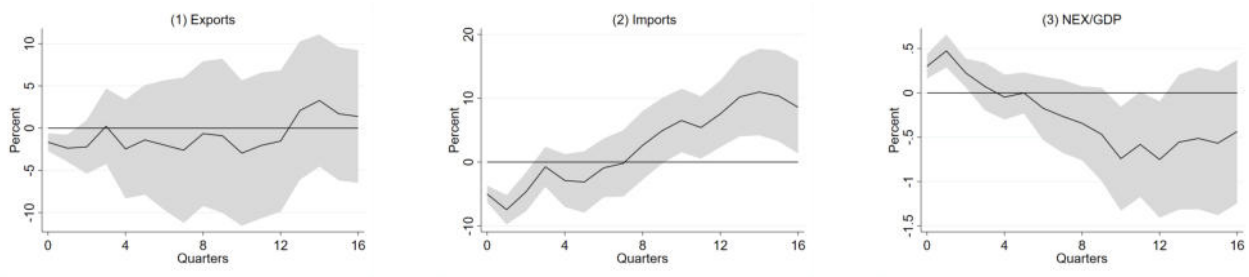


Figure A 16: Only Increase in Aggregated Tax Shocks, estimated as LP

USA



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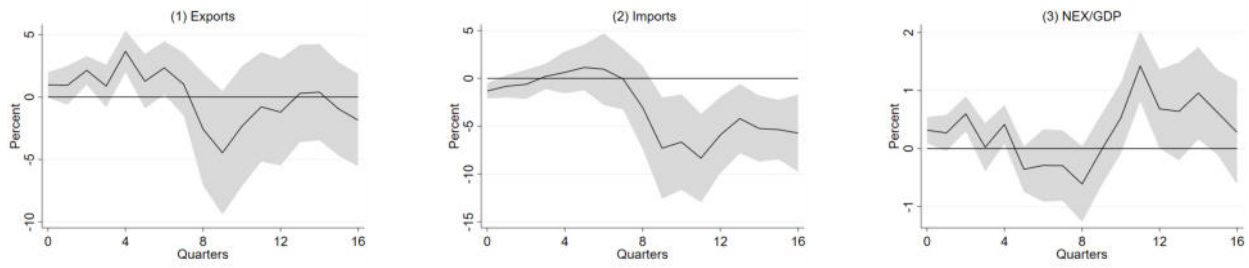

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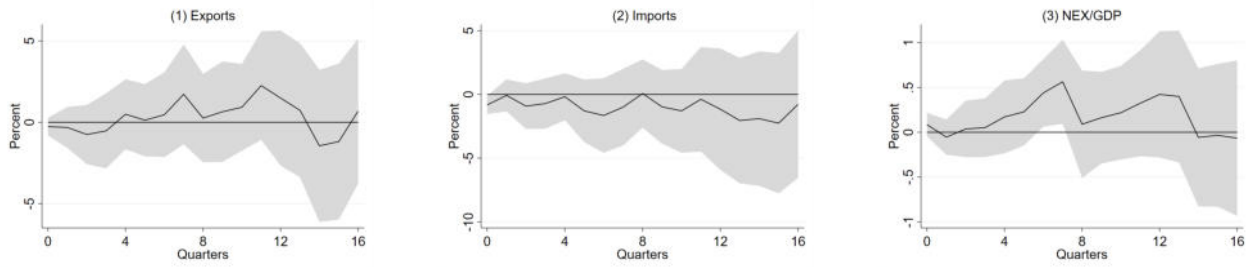
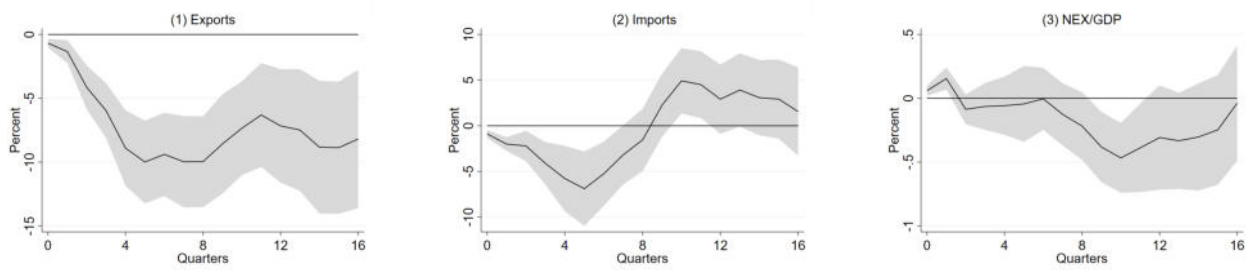


Figure A 17: Only Decrease in Aggregated Tax Shocks, estimated as LP

USA



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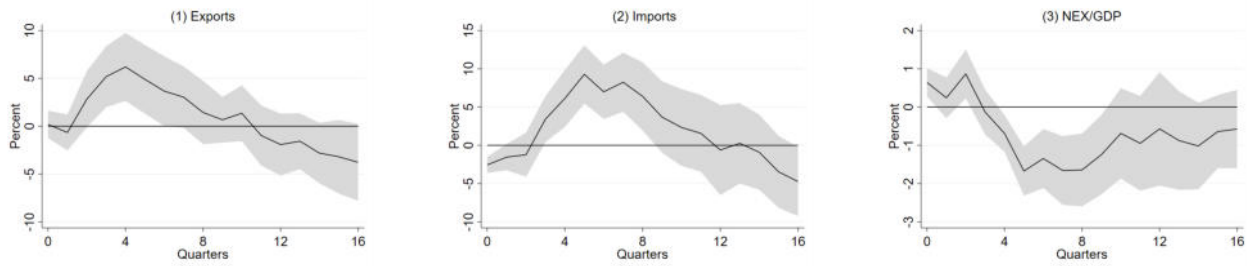

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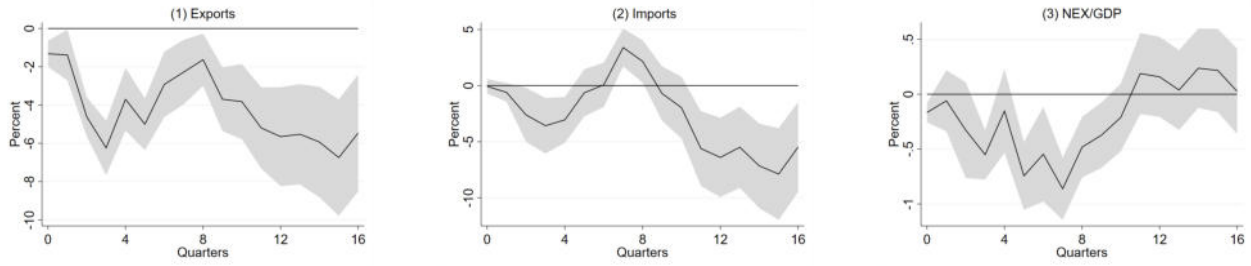
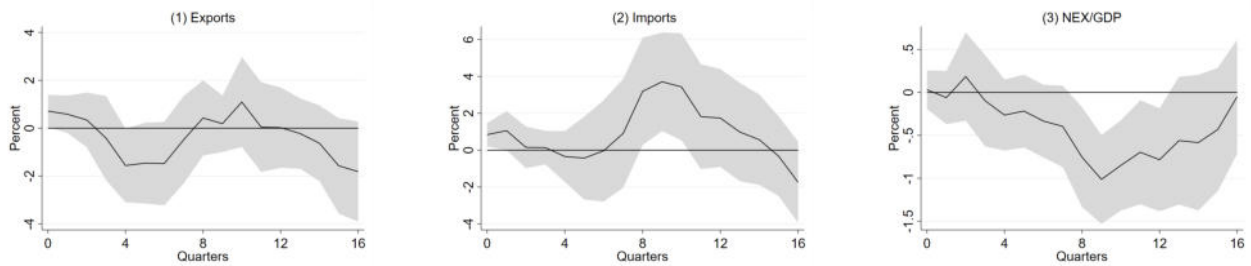


Figure A 18: Spill-Over Effects of Aggregated US Tax Liabilities, estimated as LP

Germany



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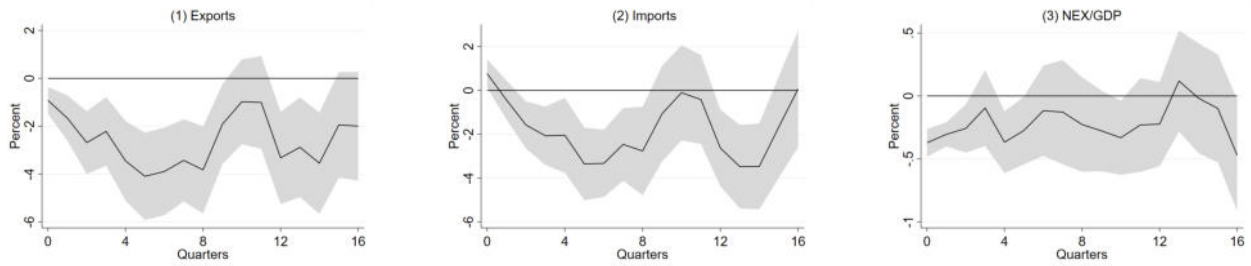
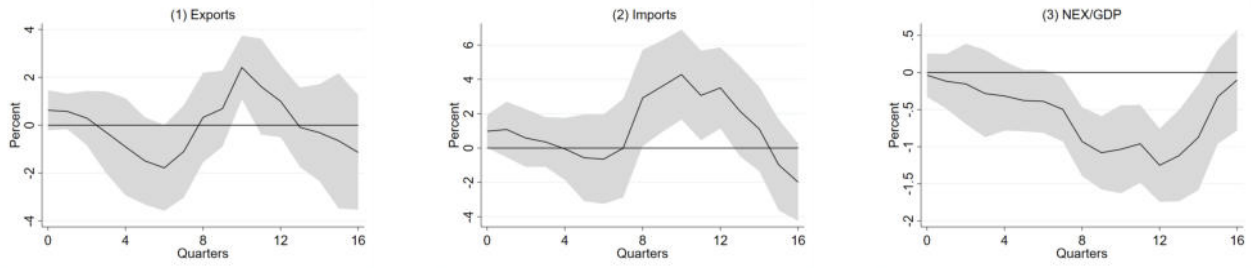


Figure A 19: Spill-Over Effects of US Personal Income Tax, estimated as LP

Germany



UK

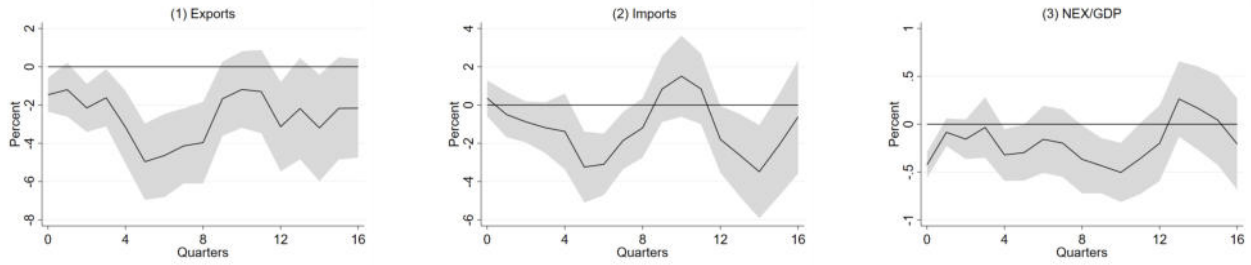
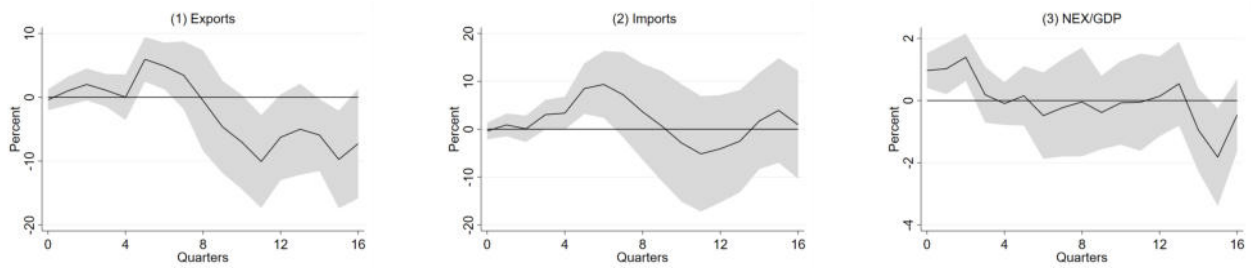


Figure A 20: Spill-Over Effects of US Corporate Income Tax, estimated as LP

Germany



UK

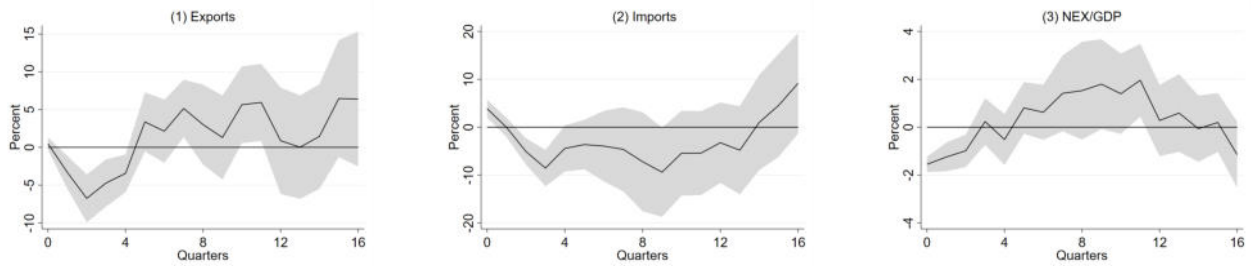
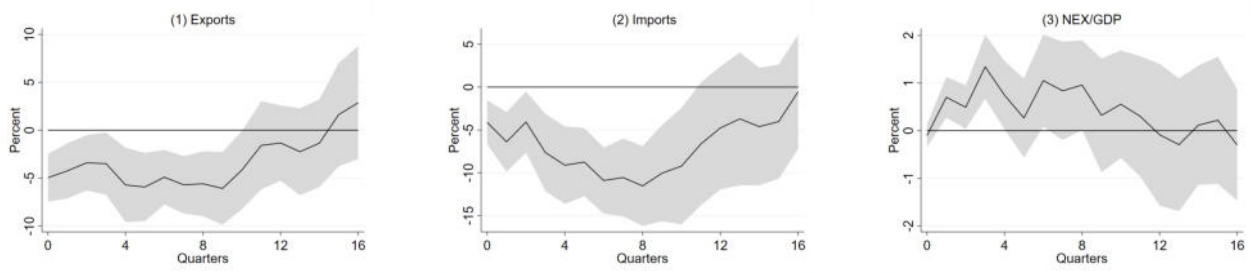


Figure A 21: Spill-Over Effects of US Tax Increases, estimated as LP

Germany



UK

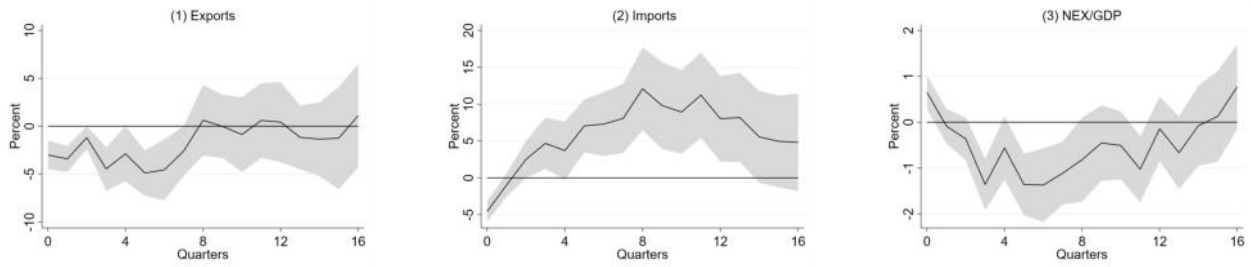
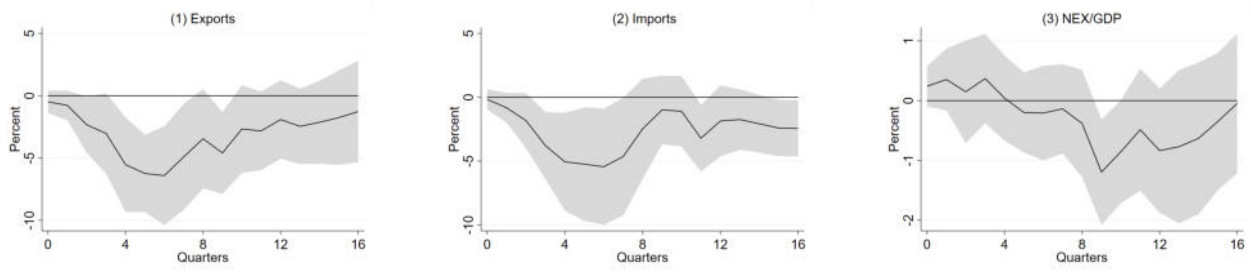


Figure A 22: Spill-Over Effects of US Tax Decreases, estimated as LP

Germany



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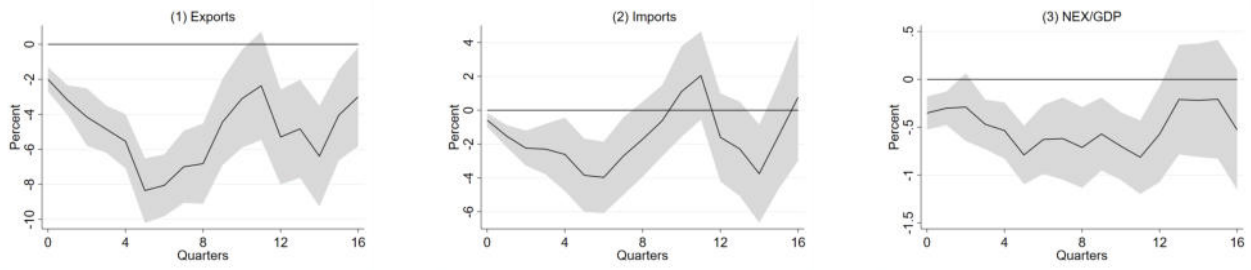
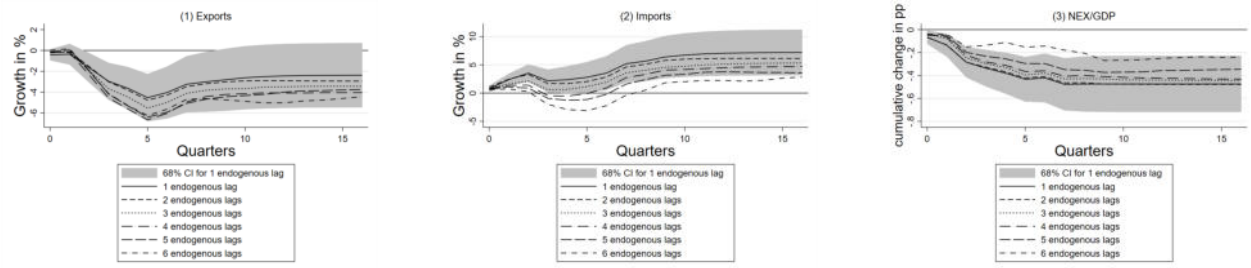


Varying Lag Lengths of Endogenous Tax Shocks

Figure A 23: Aggregated Tax Shocks, Varying Endogenous Lag Length

USA



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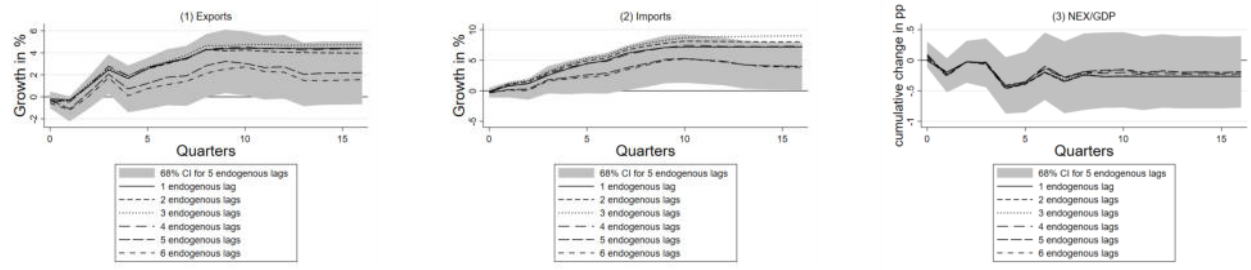

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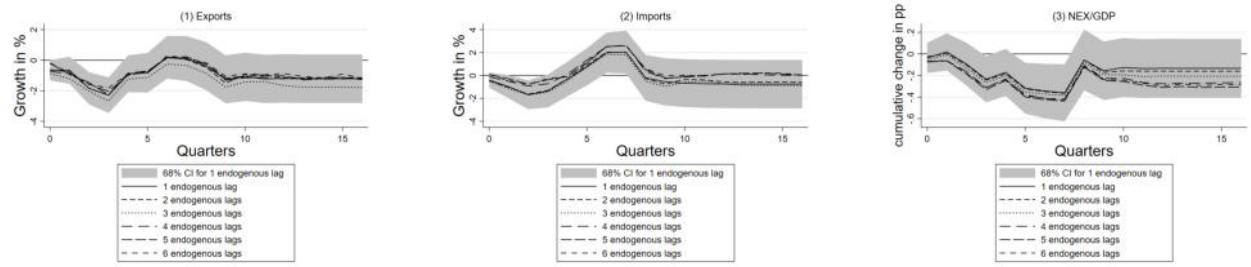
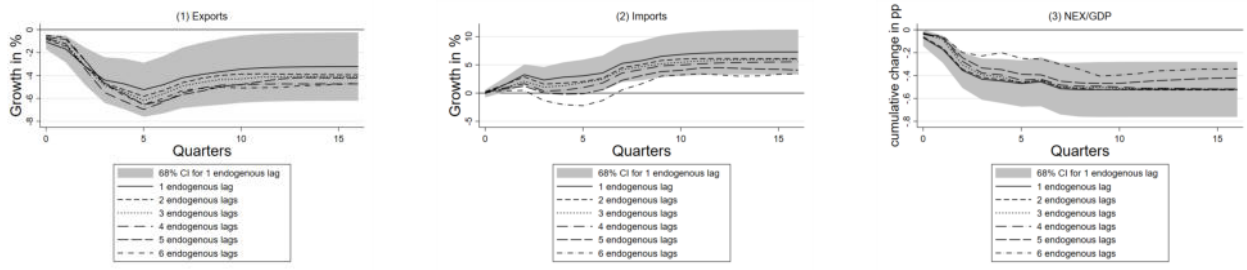
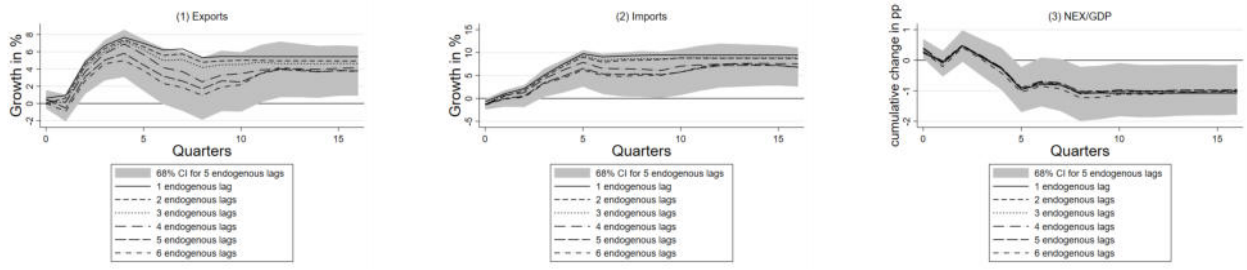


Figure A 24: Personal Income Tax Shocks, Varying Endogenous Lag Length

USA



Germany



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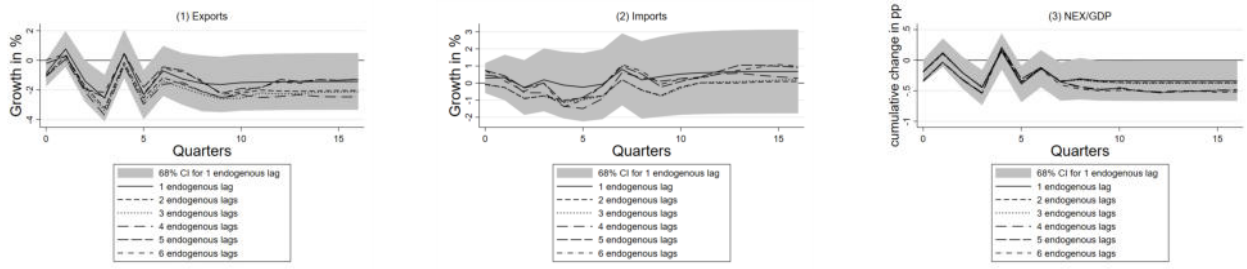
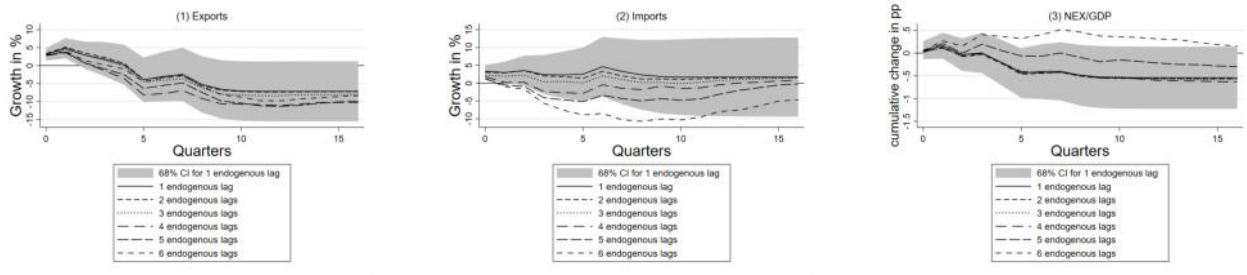
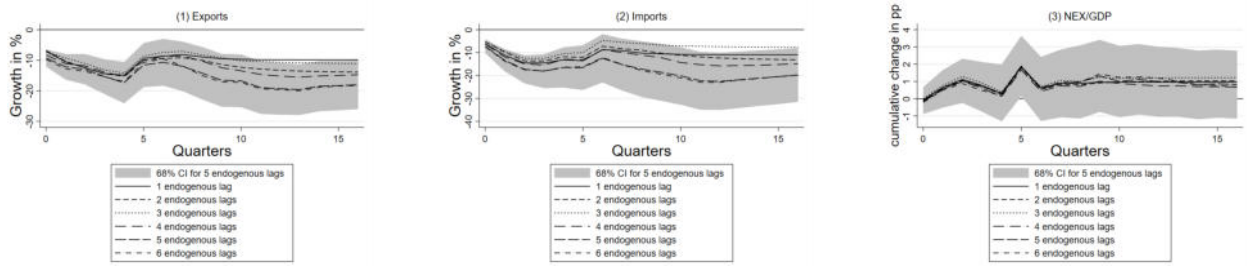


Figure A 25: Corporate Income Tax Shocks, Varying Endogenous Lag Length

USA



Germany



UK

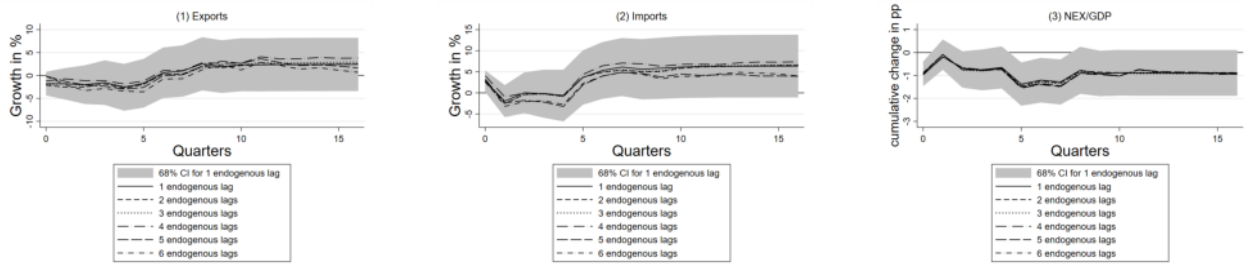
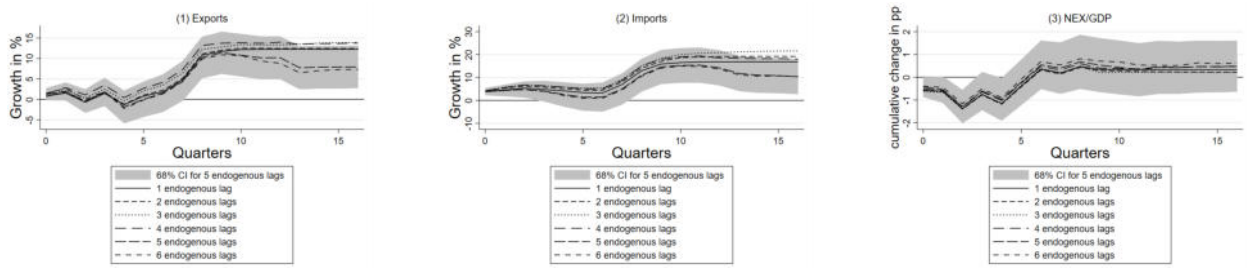


Figure A 26: Indirect Tax Shocks, Varying Endogenous Lag Length

Germany



UK

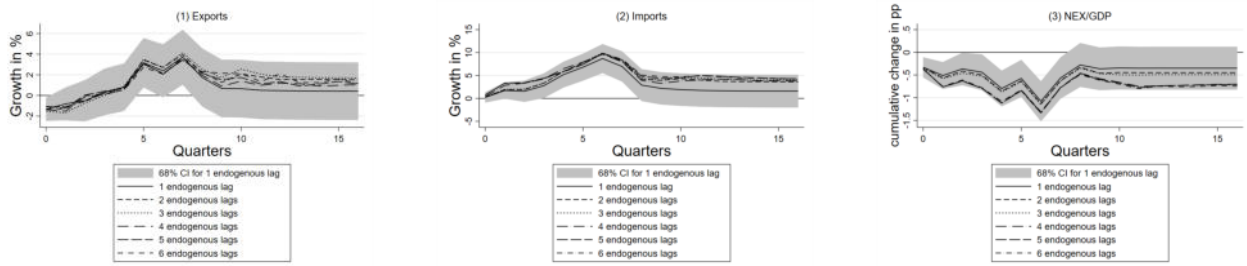
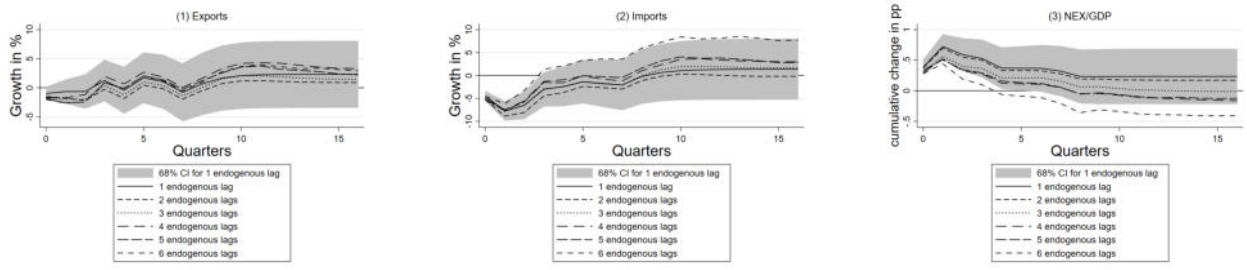
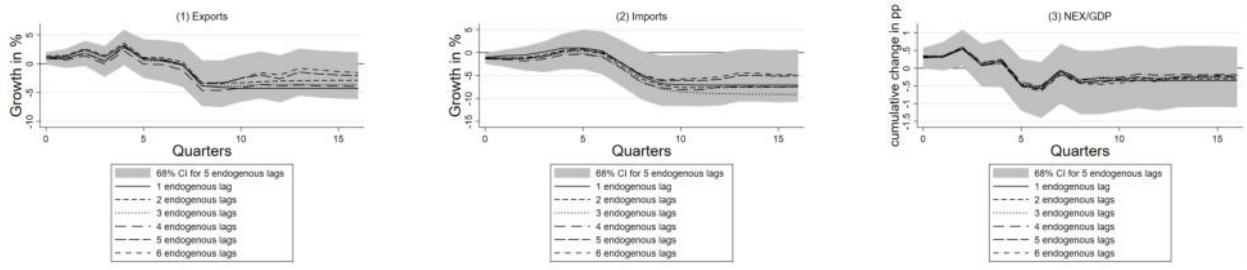


Figure A 27: Only Increase in Aggregated Tax Shocks, Varying Endogenous Lag Length

USA



Germany



UK

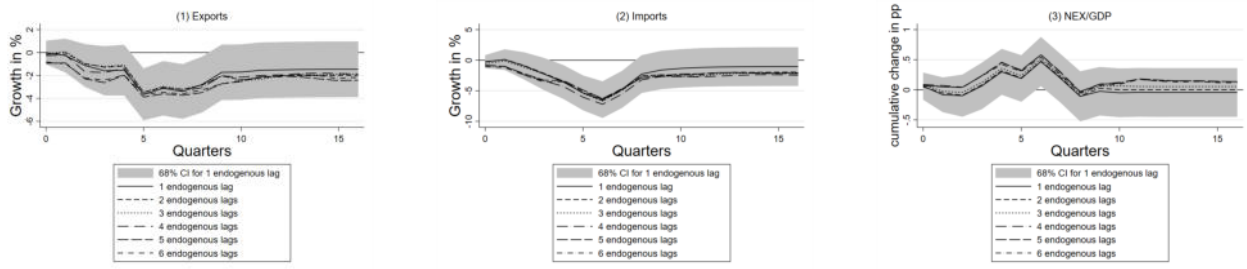
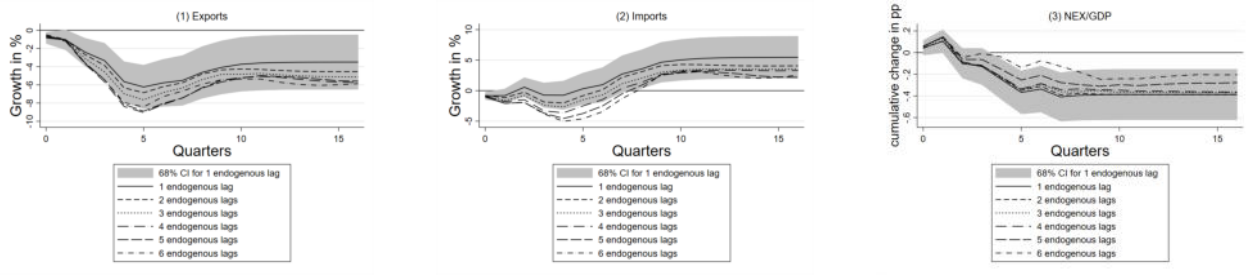
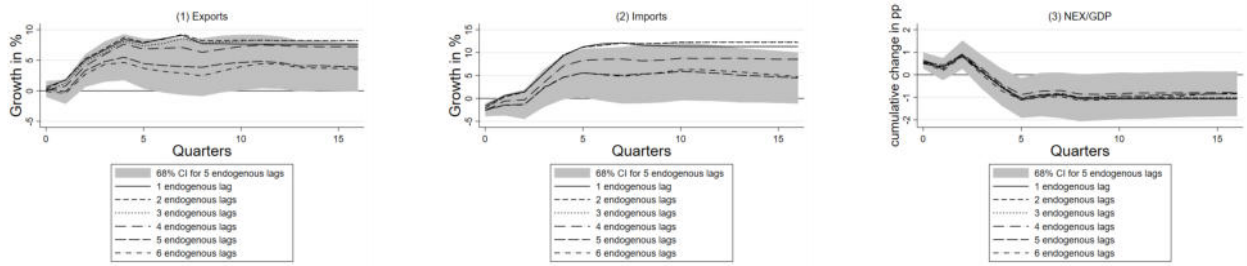


Figure A 28: Only Decrease in Aggregated Tax Shocks, Varying Endogenous Lag Length

USA



Germany



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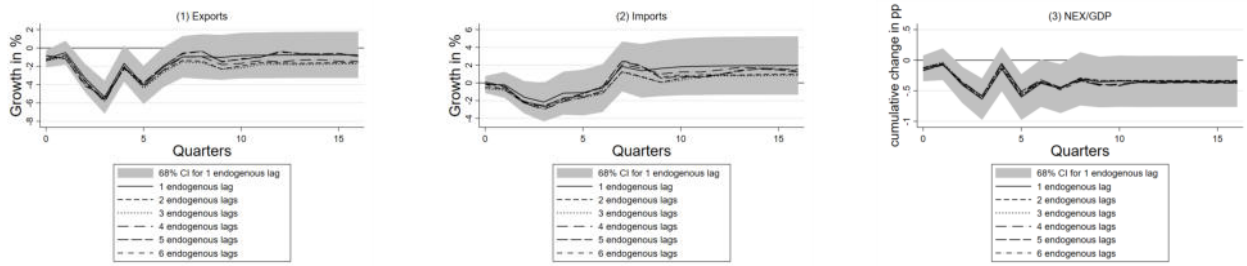
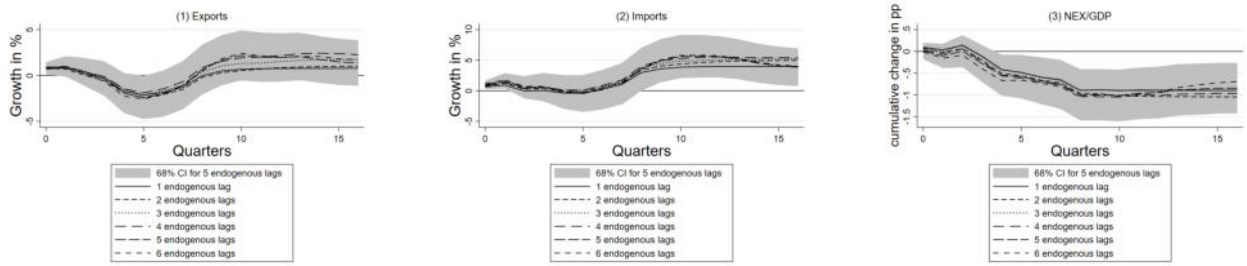


Figure A 29: Spill-Over Effects of Aggregated US Tax Liabilities, Varying Endogenous Lag Length

Germany



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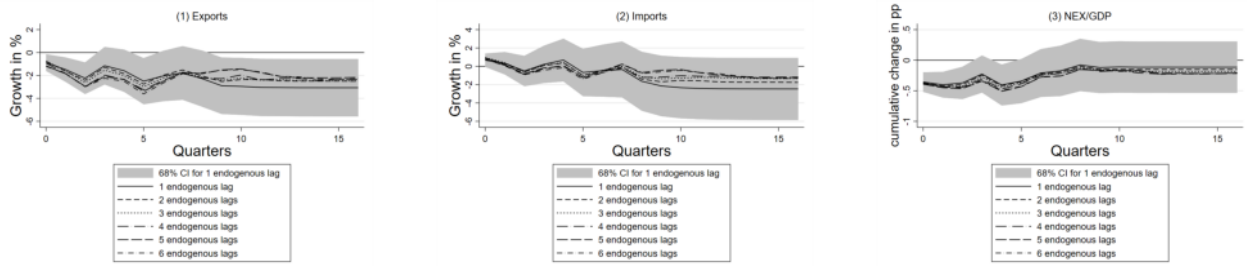
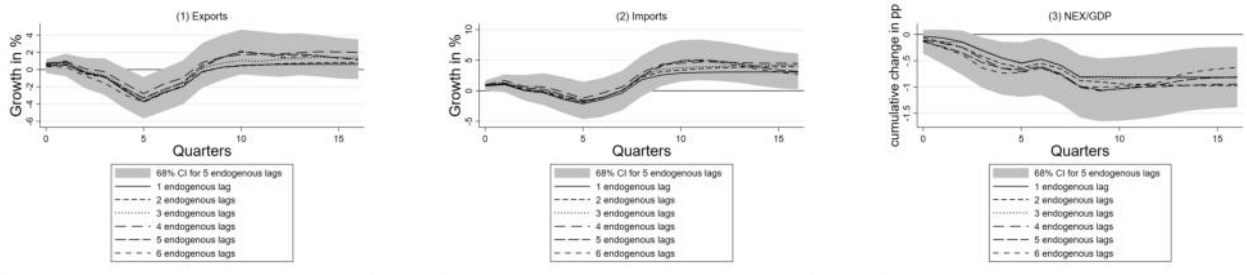


Figure A 30: Spill-Over Effects of Personal Income Tax Shocks, Varying Endogenous Lag Length

Germany



UK

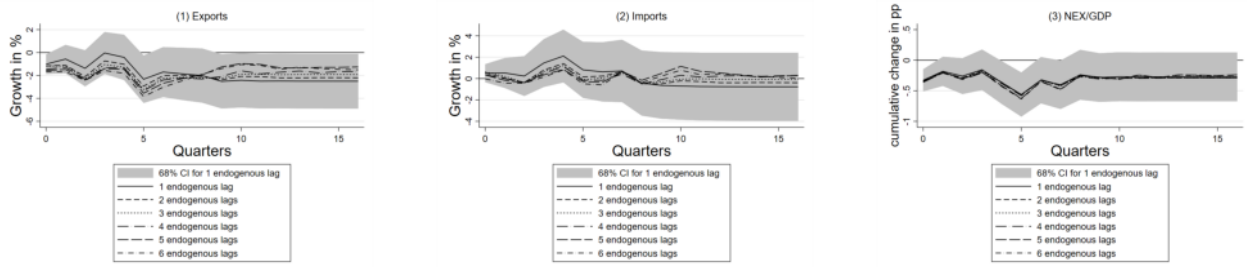
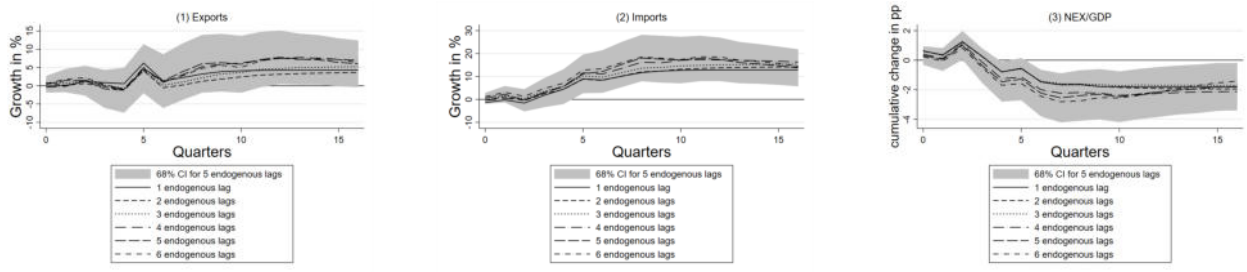


Figure A 31: Spill-Over Effects of Corporate Income Tax Shocks, Varying Endogenous Lag Length

Germany



UK

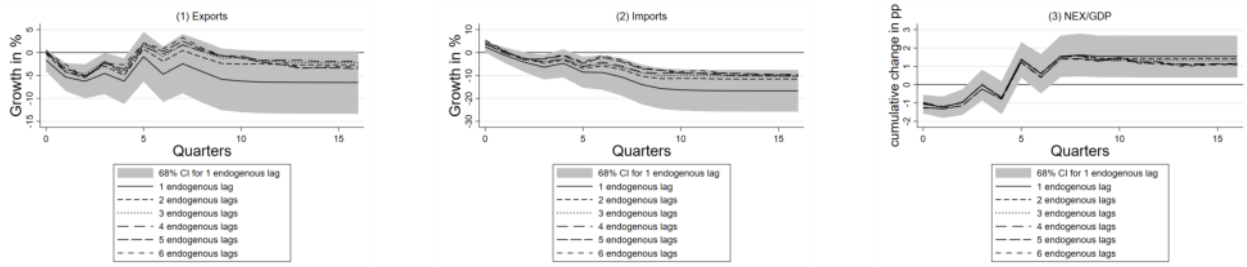
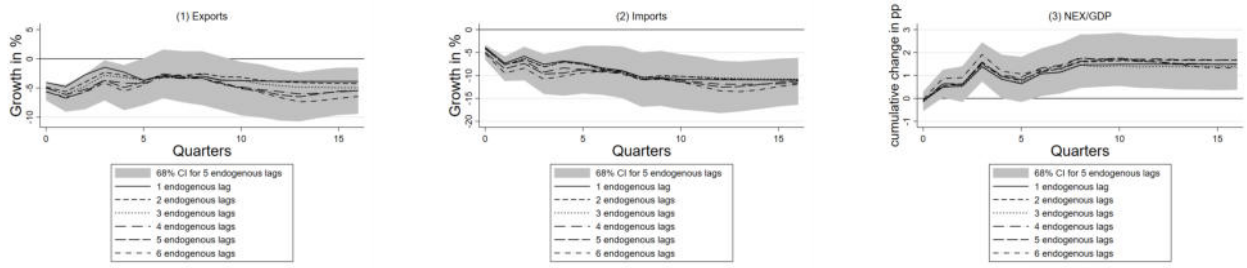


Figure A 32: Spill-Over Effects of US Tax Increases, Varying Endogenous Lag Length

Germany



UK

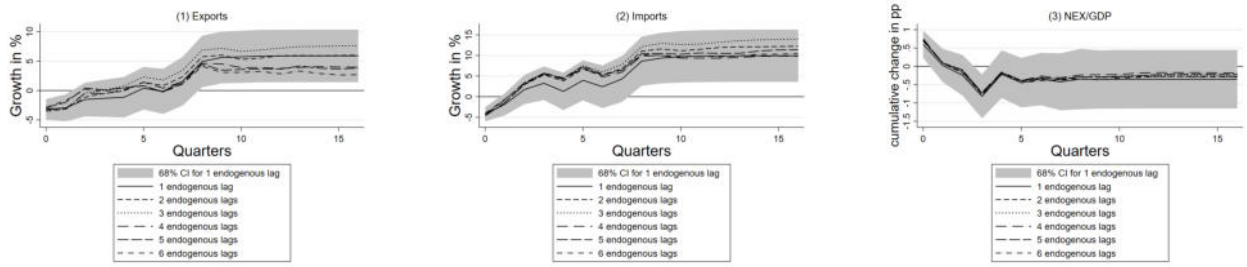
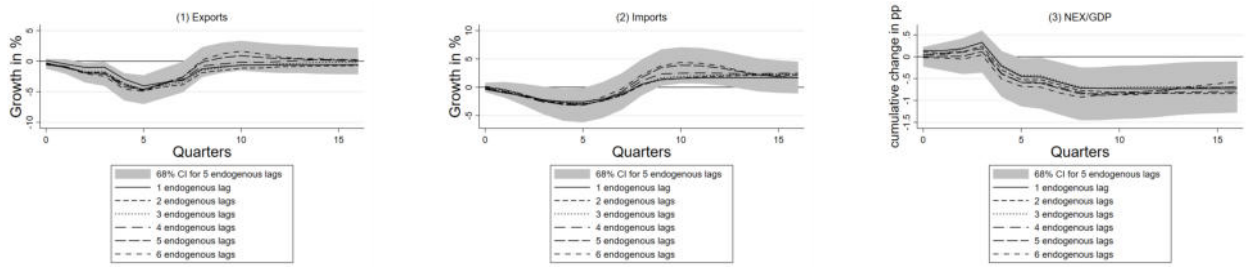
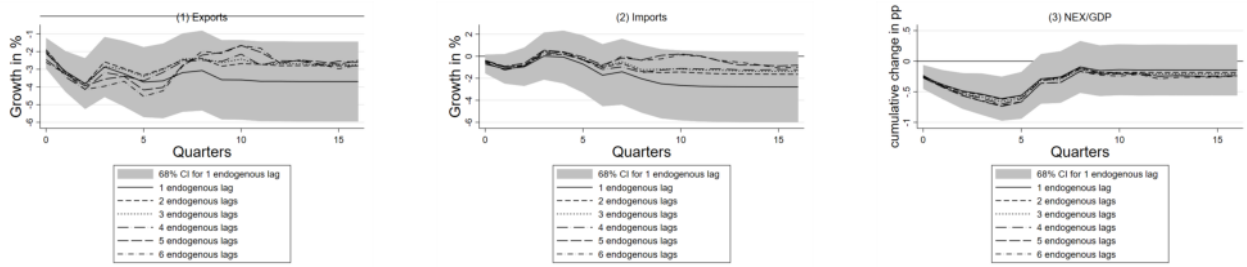


Figure A 33: Spill-Over Effects of US Tax Decreases, Varying Endogenous Lag Length

Germany



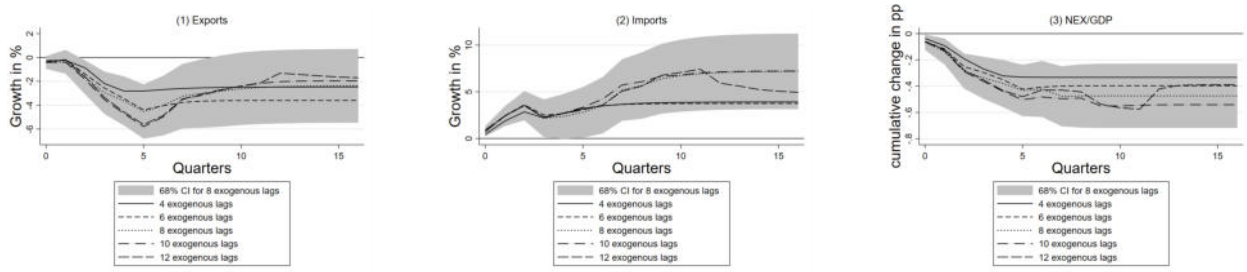
UK



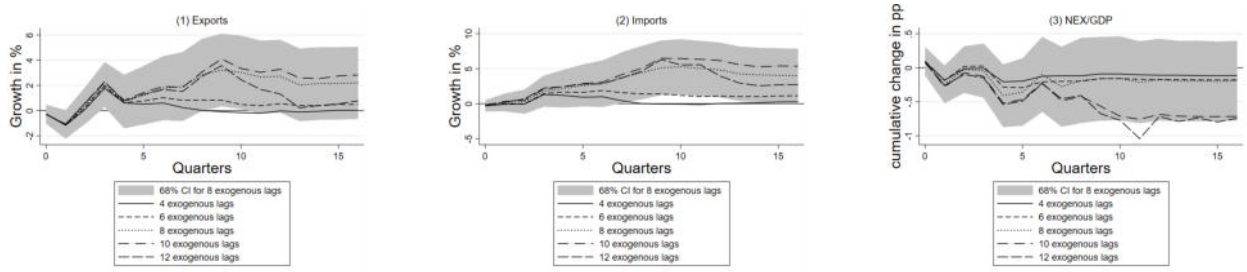
Varying Lag Lengths of Exogenous Tax Shocks

Figure A 34: Aggregated tax shock, Varying Exogenous Lag Length

USA



Germany



UK

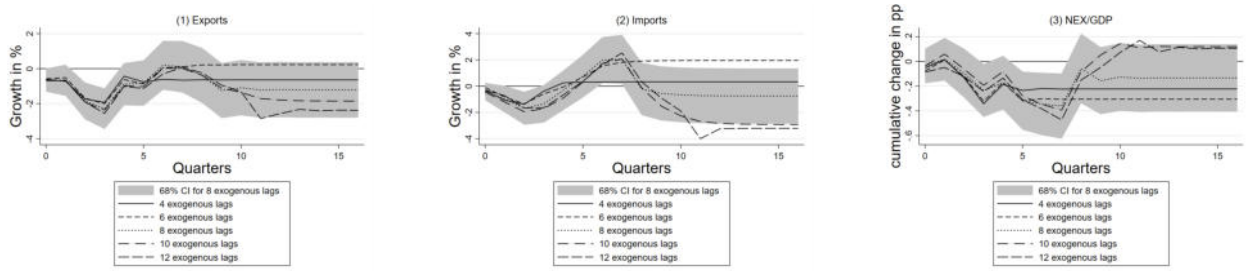
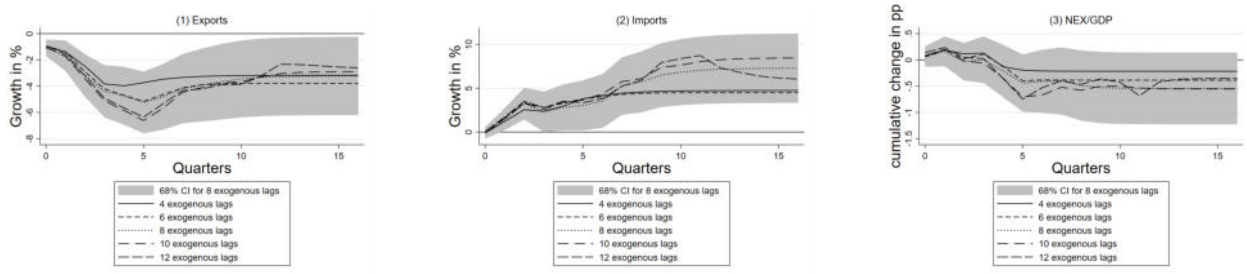
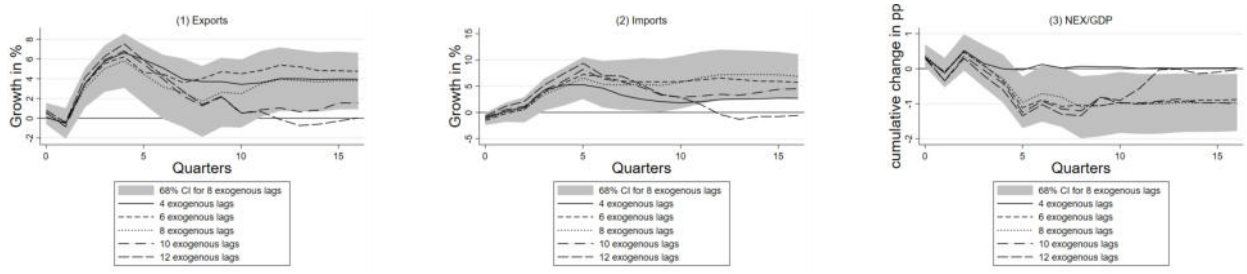


Figure A 35: Personal Income Tax Shock, Varying Exogenous Lag Length

USA



Germany



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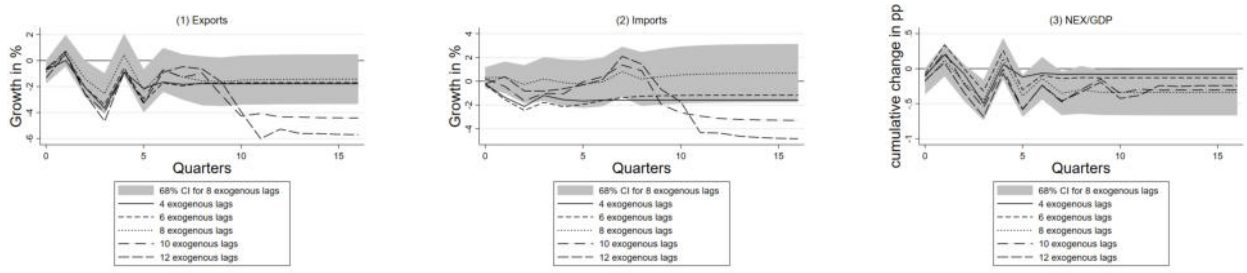
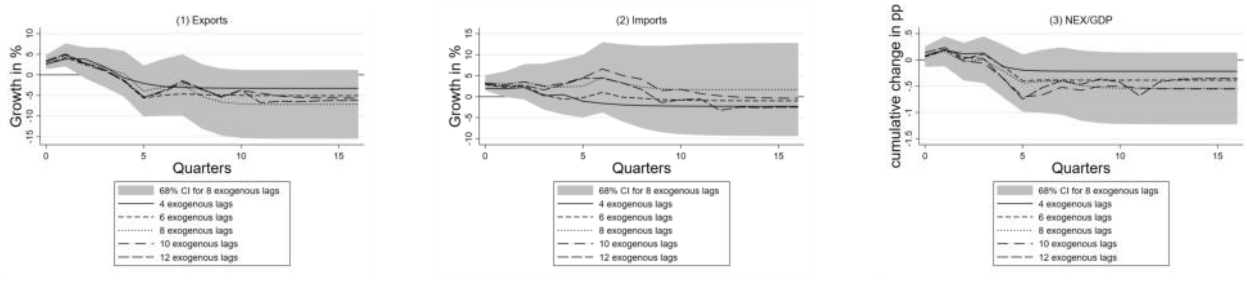
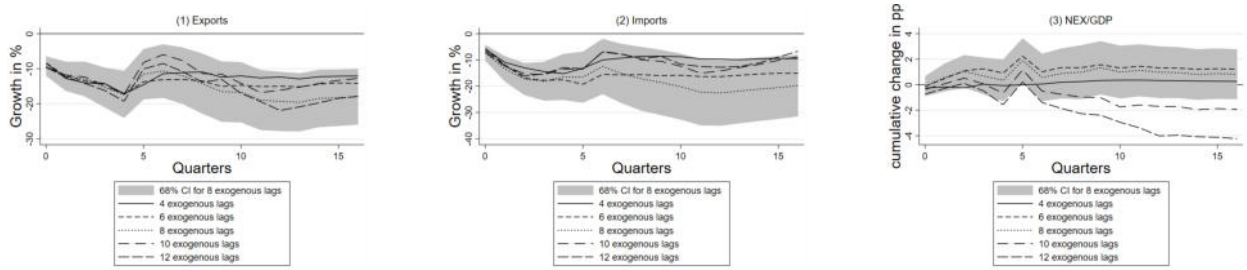


Figure A 36: Corporate Income Tax Shocks, Varying Exogenous Lag Length

USA



Germany



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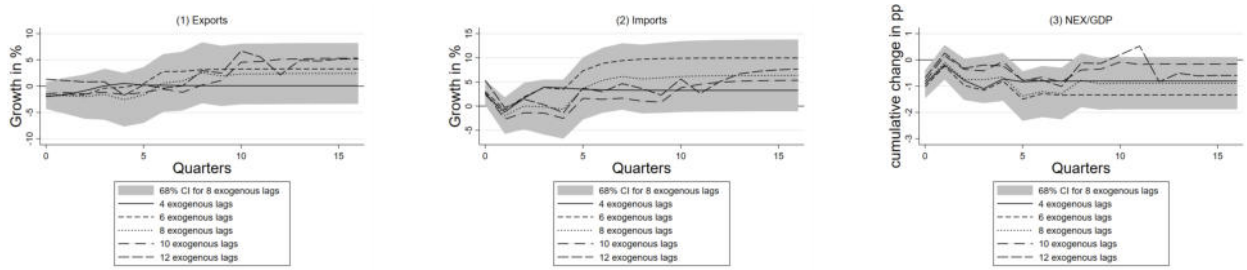
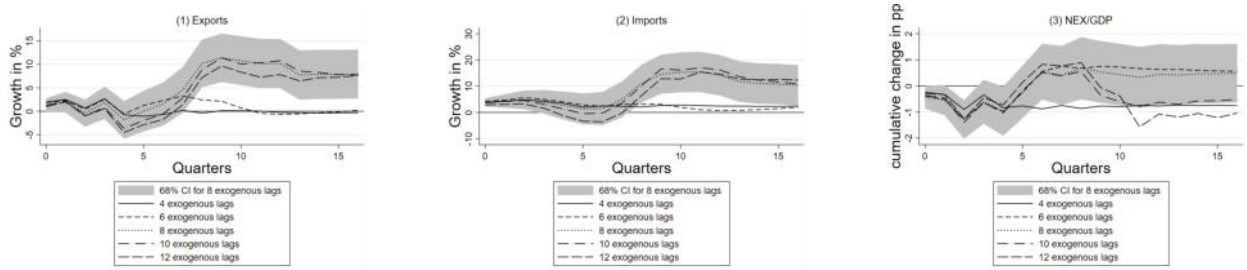


Figure A 37: Indirect Tax Shocks, Varying Exogenous Lag Length

Germany



UK

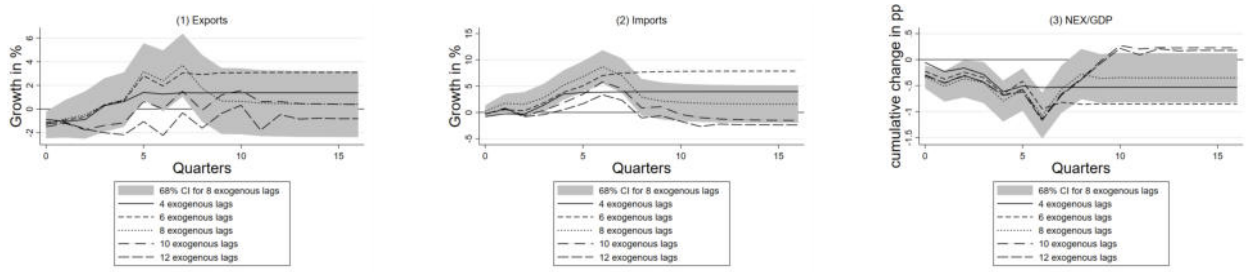
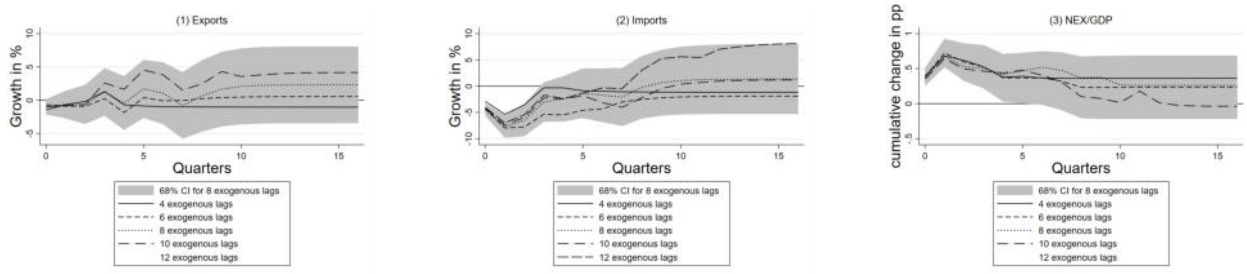
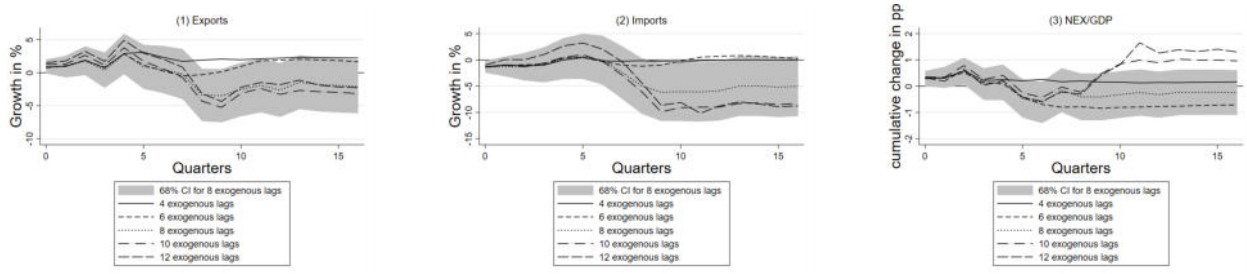


Figure A 38: Only Increase in Aggregated Tax Shocks, Varying Exogenous Lag Length

USA



Germany



UK

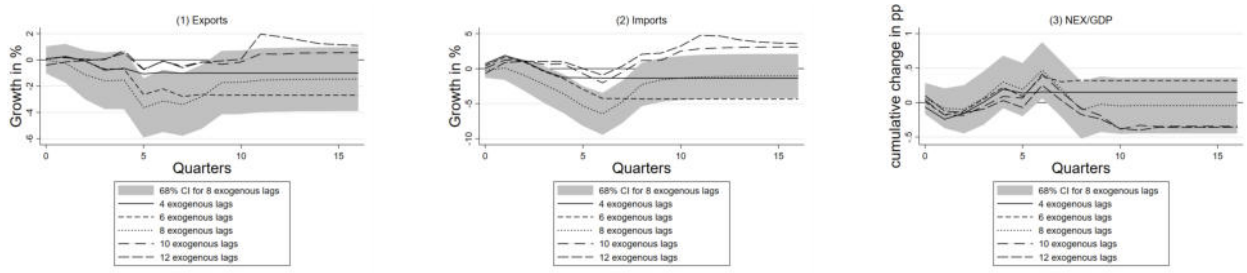
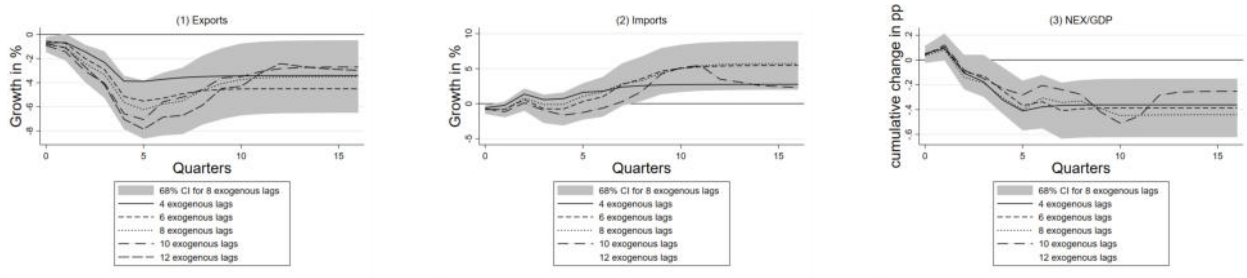
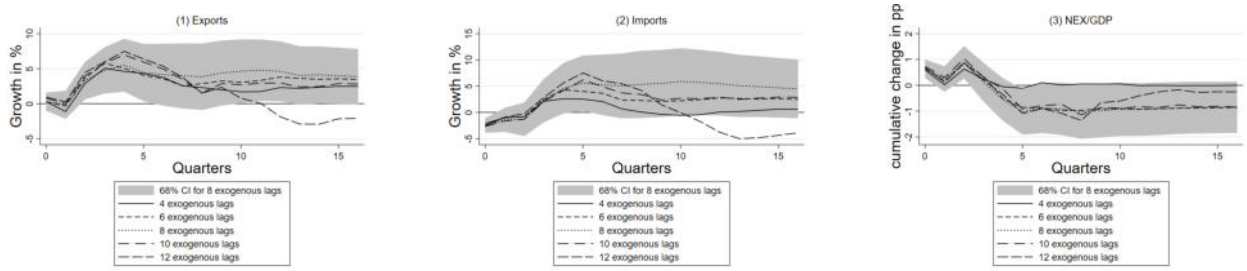


Figure A 39: Only Decrease in Aggregated Tax Shocks, Varying Exogenous Lag Length

USA



Germany



UK

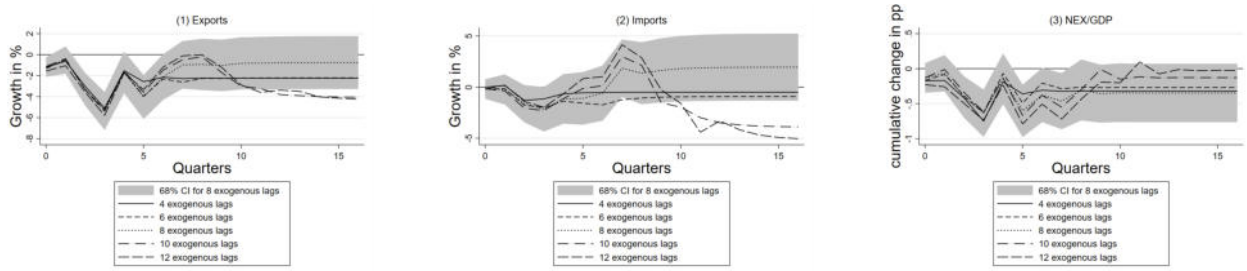
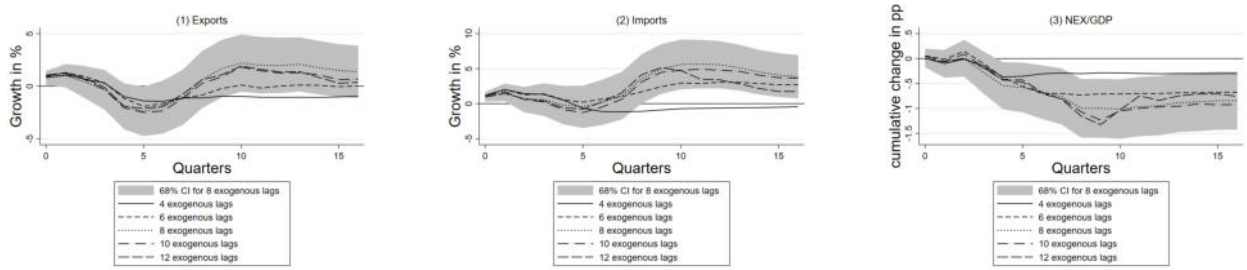


Figure A 40: Spill-Over Effects of Aggregated US Tax Liabilities, Varying Exogenous Lag Length

Germany



UK

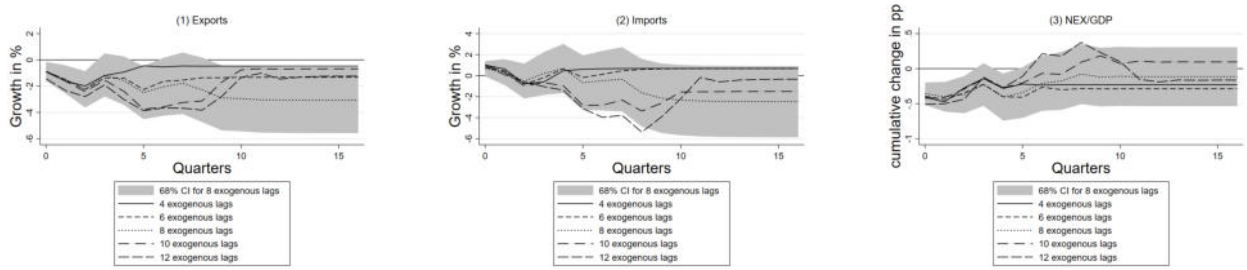
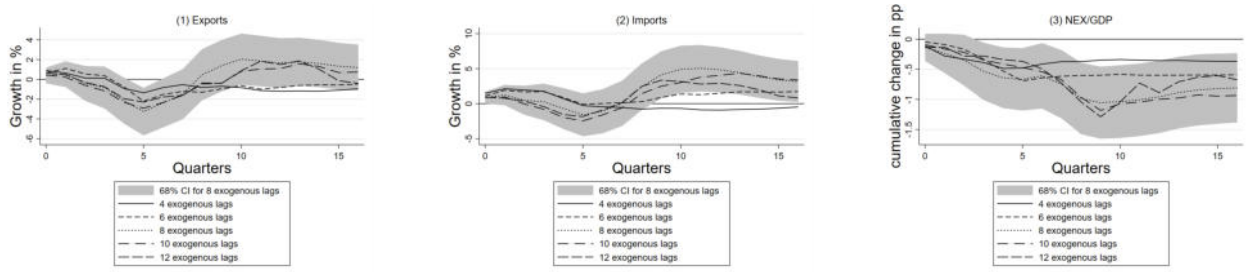


Figure A 41: Spill-Over Effects of Personal Income Tax Shock, Varying Exogenous Lag Length

Germany



UK

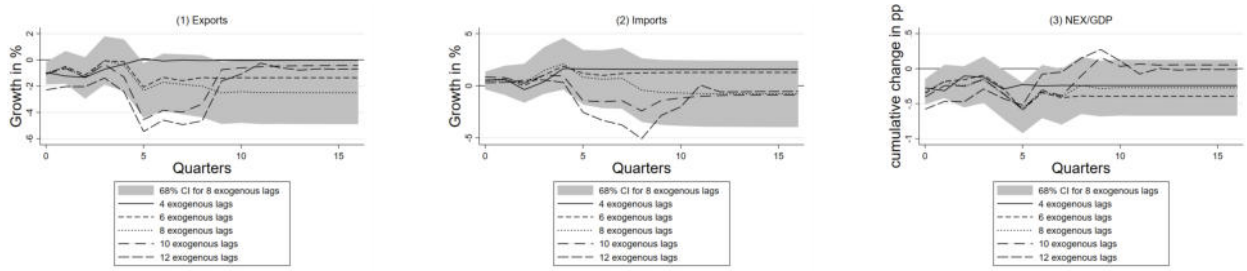
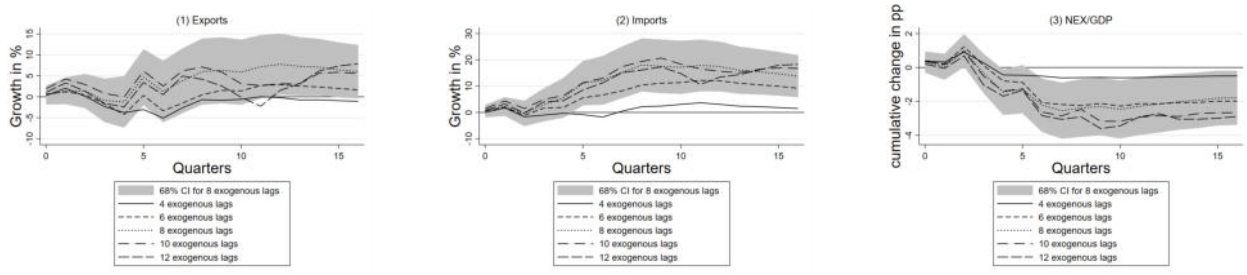


Figure A 42: Spill-Over Effects of Corporate Income Tax Shock, Varying Exogenous Lag Length

Germany



UK

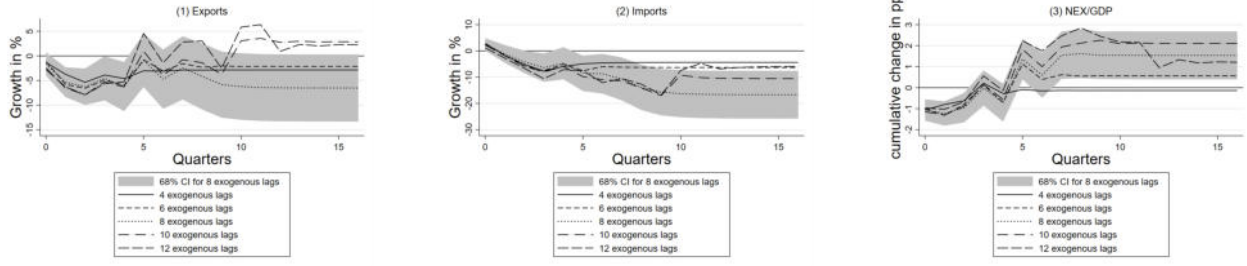
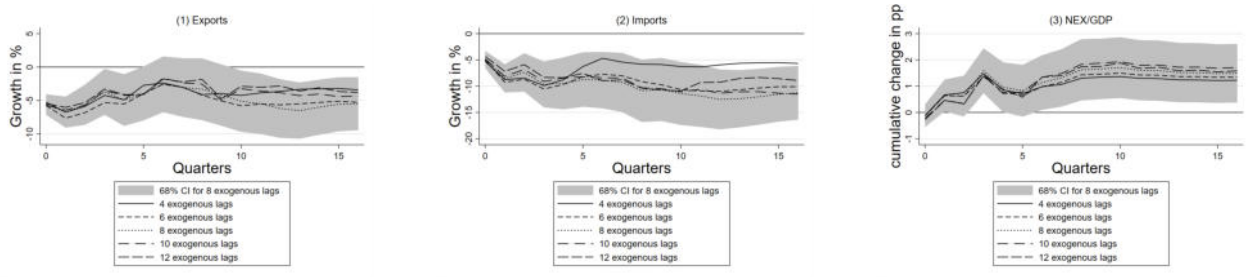


Figure A 43: Spill-over Effects of Increase in US Tax Liabilities, Varying Exogenous Lag Length

Germany



UK

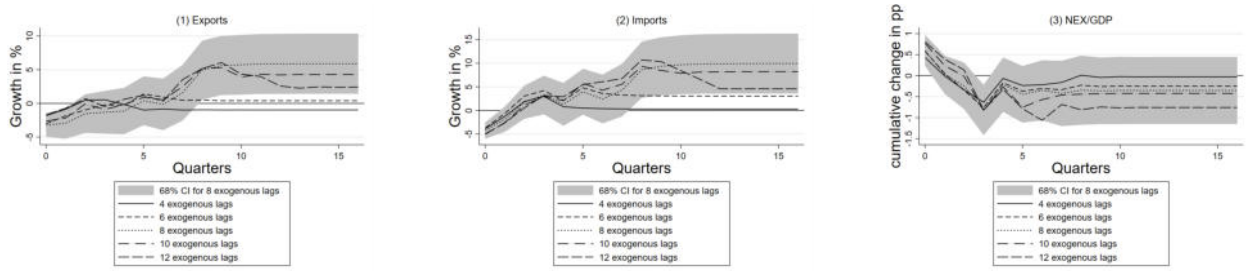
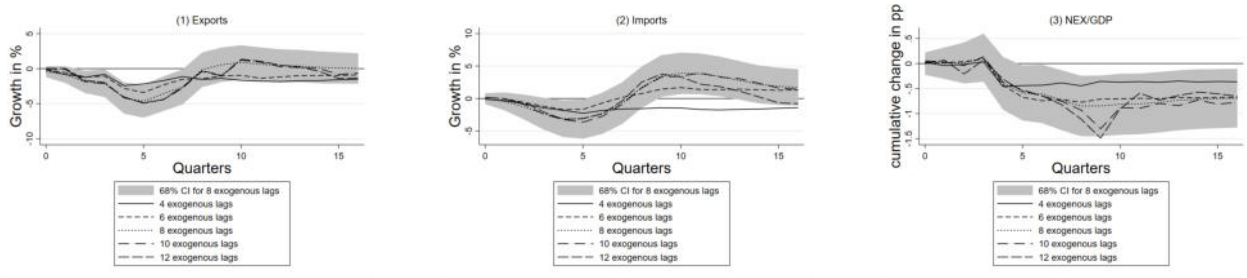
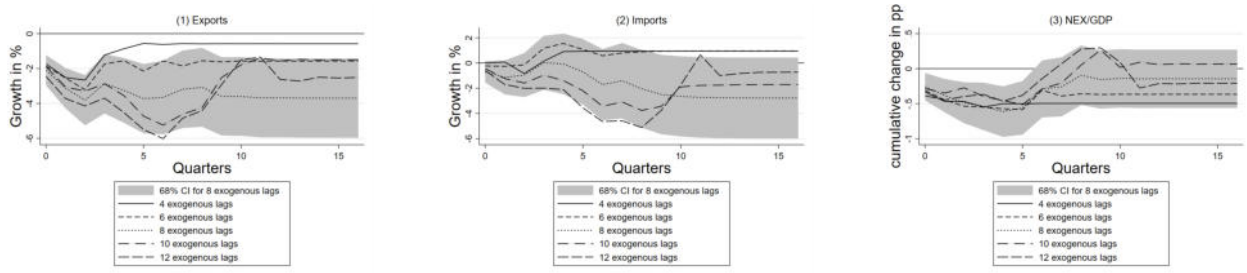


Figure A 44: Spill-over Effects of Decrease in US Tax Liabilities, Varying Exogenous Lag Length

Germany



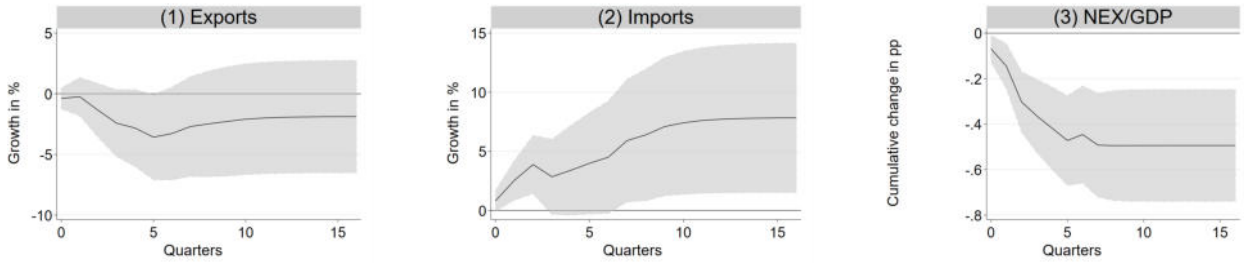
UK



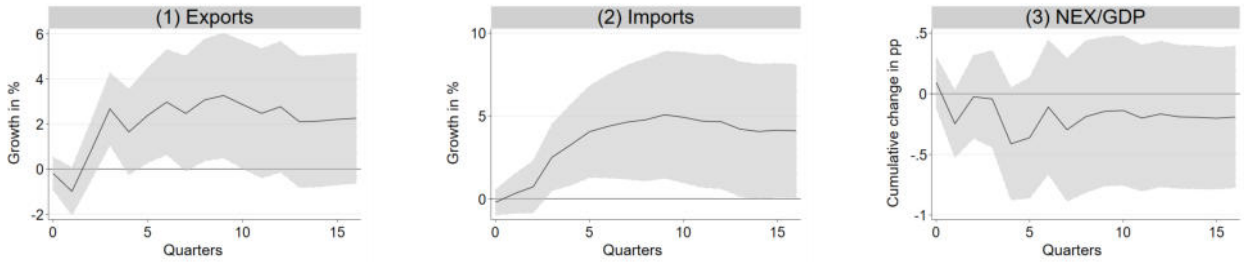
With External Demand

Figure A 45: Aggregated Tax Shock, With External Demand

USA



Germany



UK

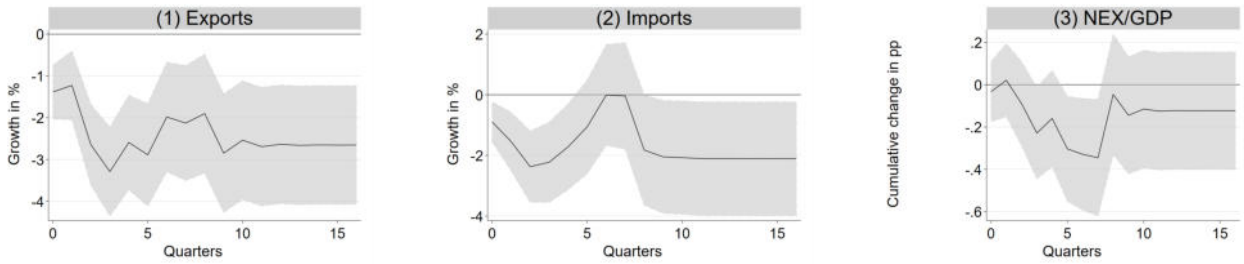
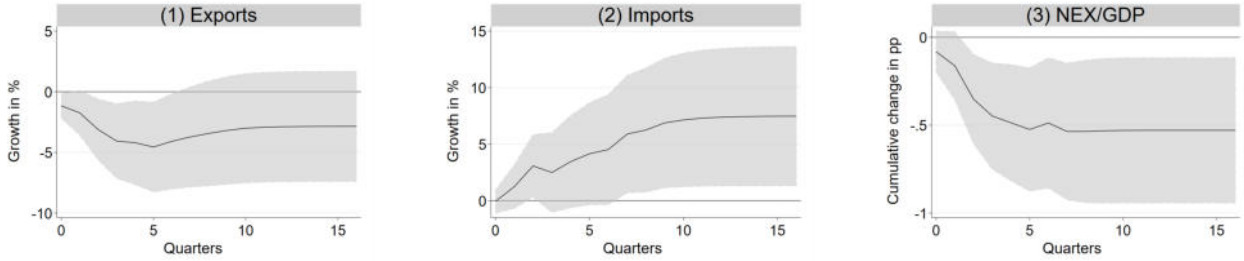
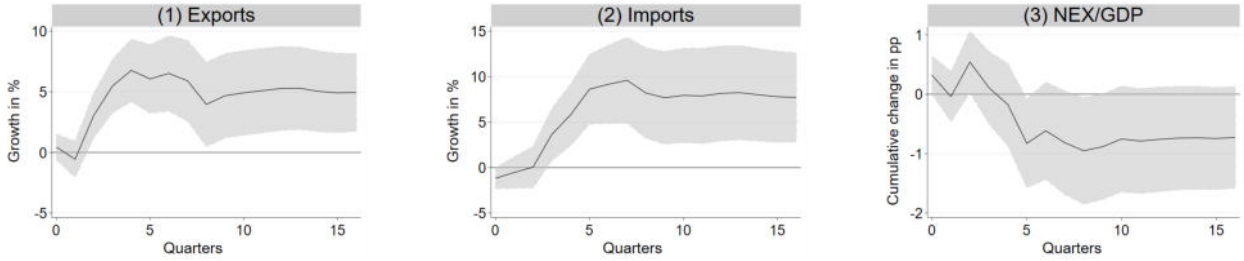


Figure A 46: Personal Income Tax Shock, With External Demand

USA



Germany



UK

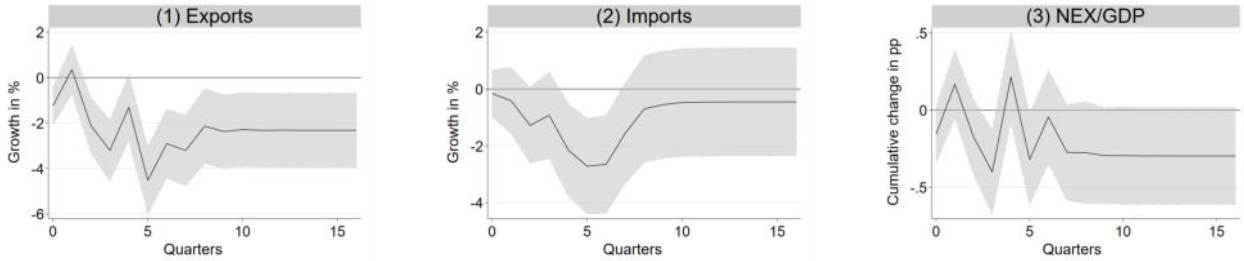
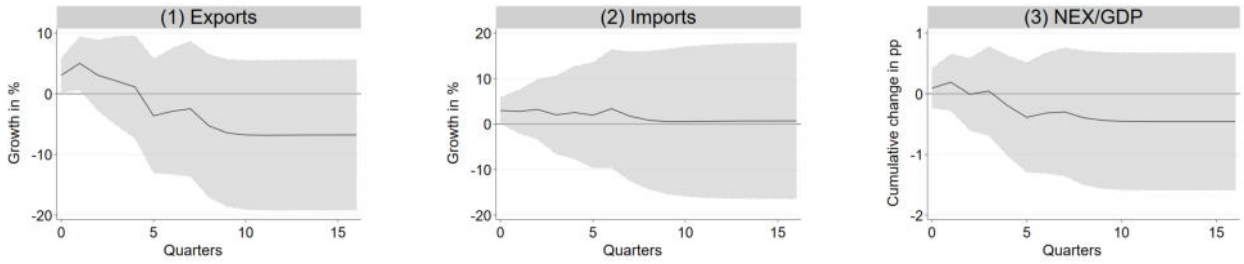
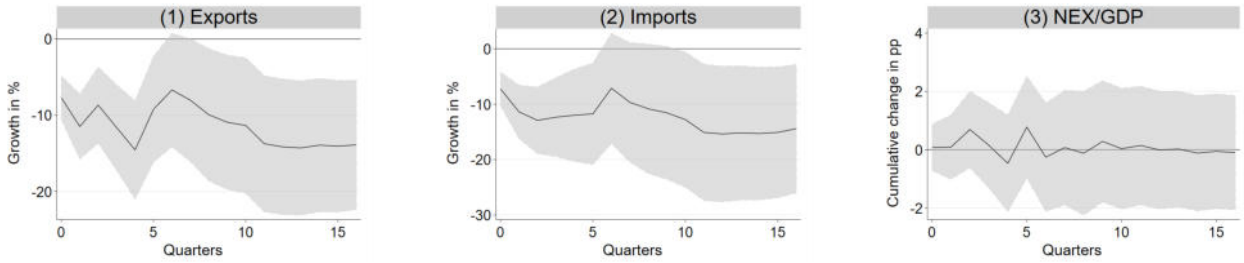


Figure A 47: Corporate Income Tax Shocks, With External Demand

USA



Germany



UK

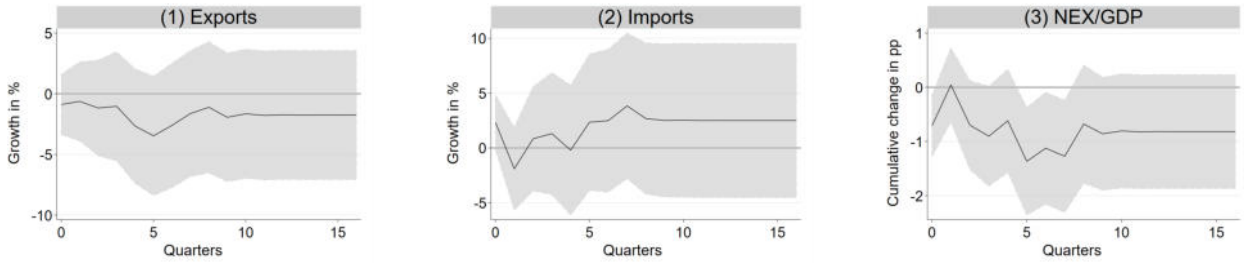
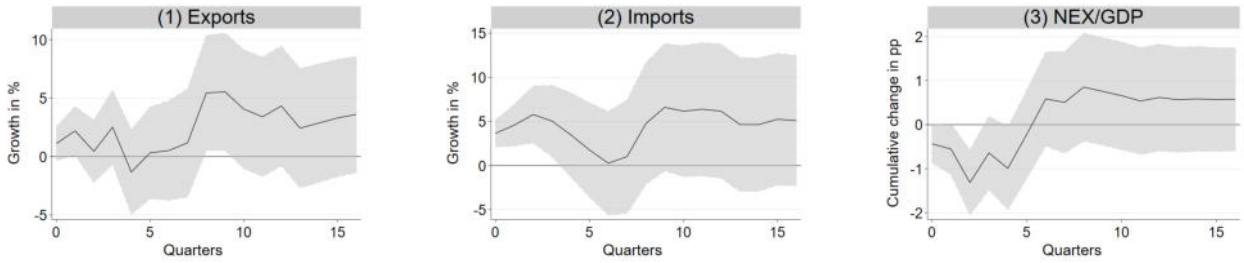


Figure A 48: Indirect Tax Shocks, With External Demand

Germany



UK

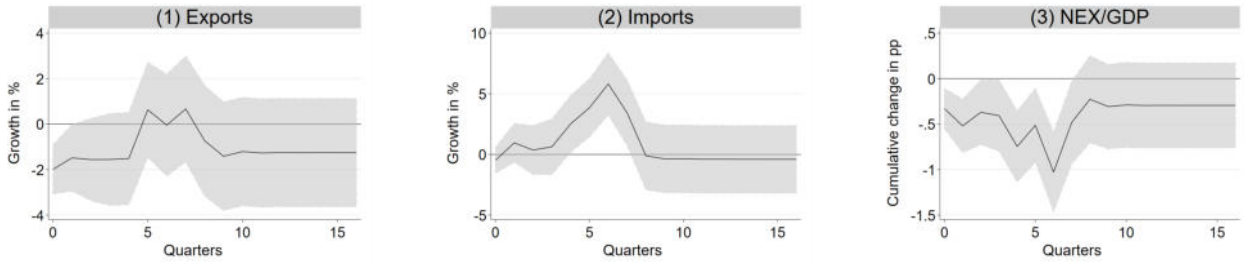
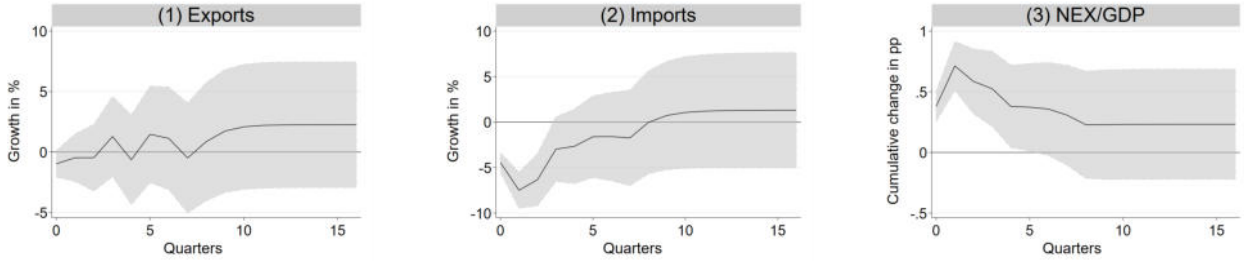
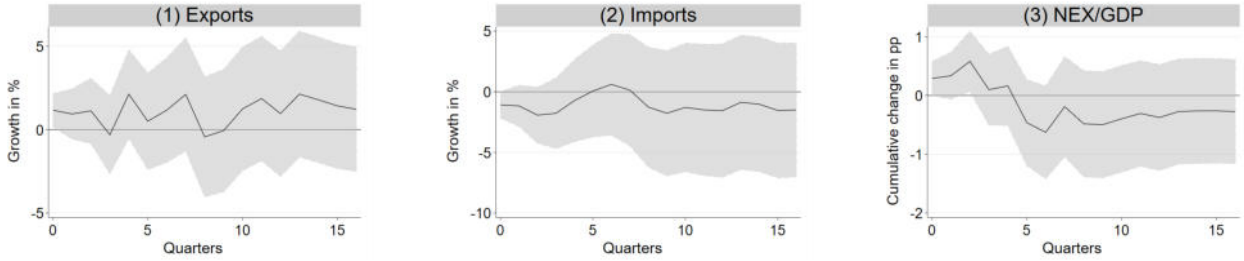


Figure A 49: Only Increase in Aggregated Tax Shocks, With External Demand

USA



Germany



UK

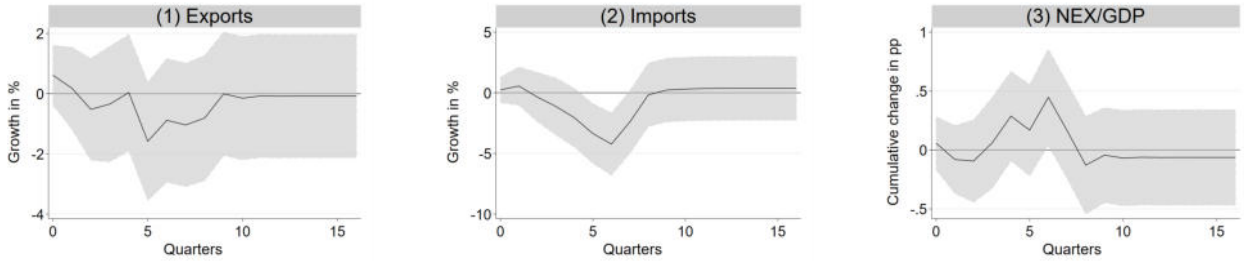
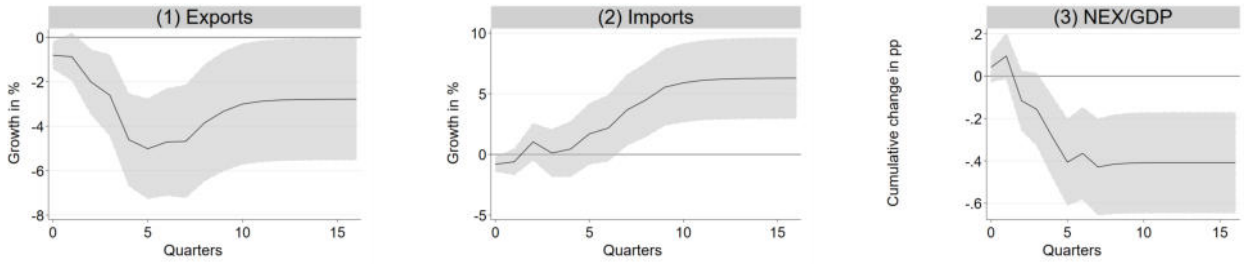
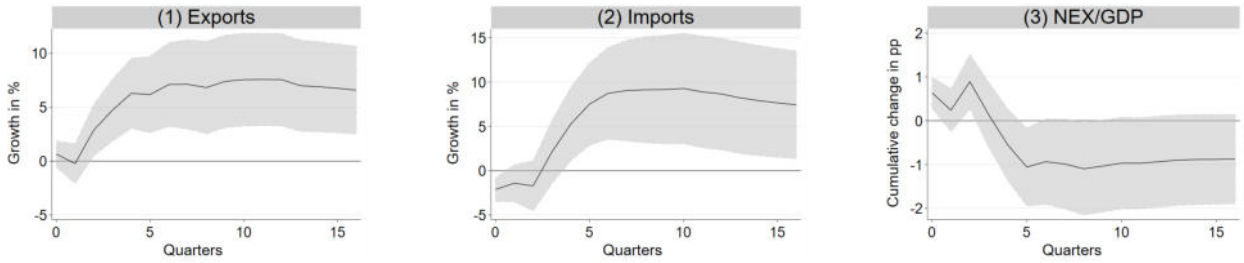


Figure A 50: Only Deccrease in Aggregated Tax Shocks, With External Demand

USA



Germany



UK

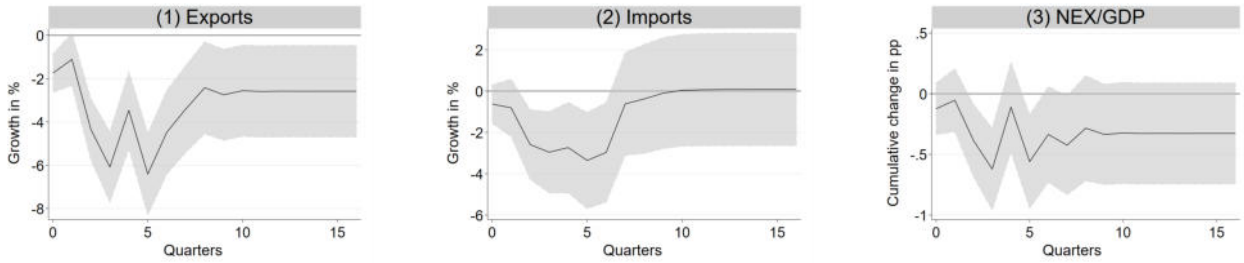
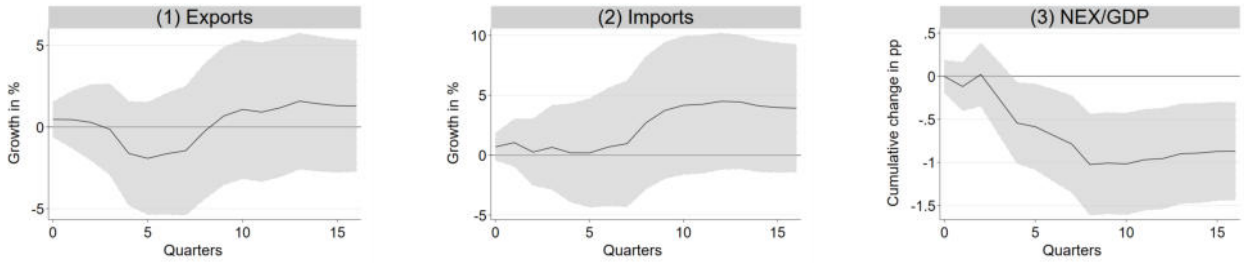


Figure A 51: Spill-Over Effects of Aggregated US Tax Liabilities, With External Demand

Germany



UK

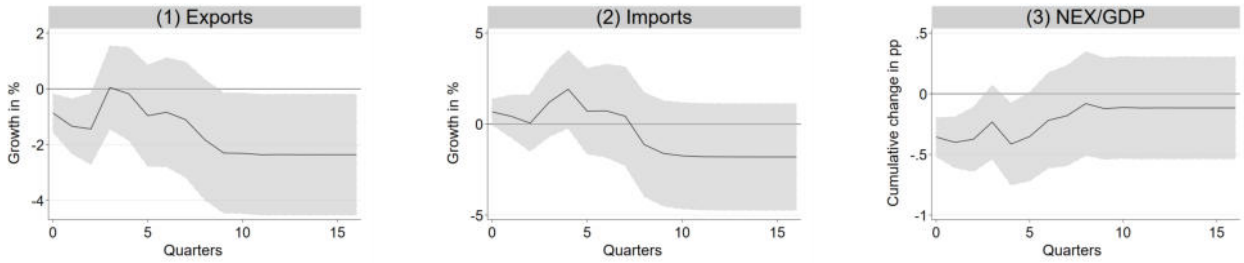
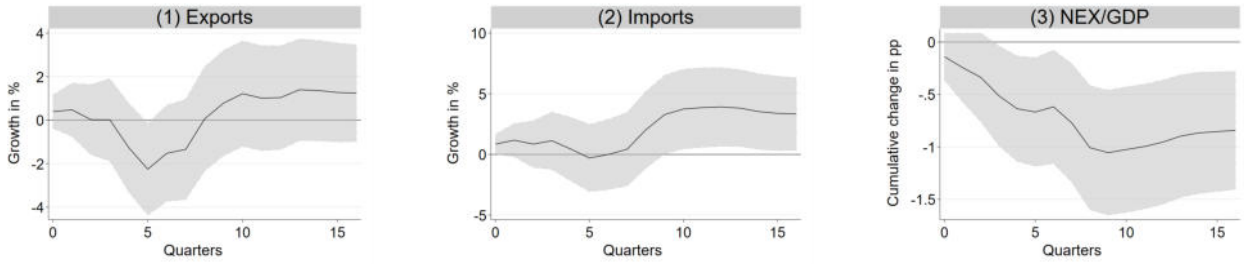


Figure A 52: Spill-Over Effects of US Personal Income Tax Shocks, With External Demand

Germany



UK

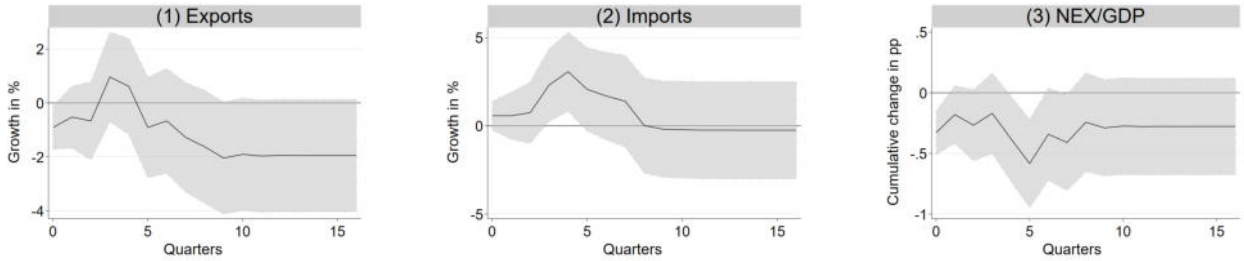
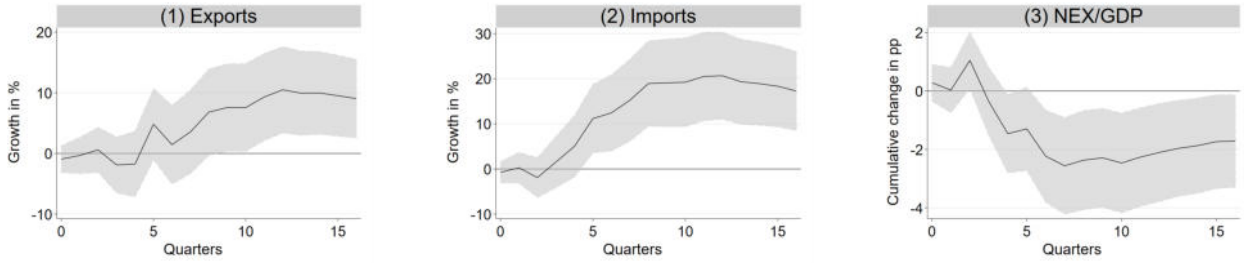


Figure A 53: Spill-Over Effects of US Corporate Income Tax Shocks, With External Demand

Germany



UK

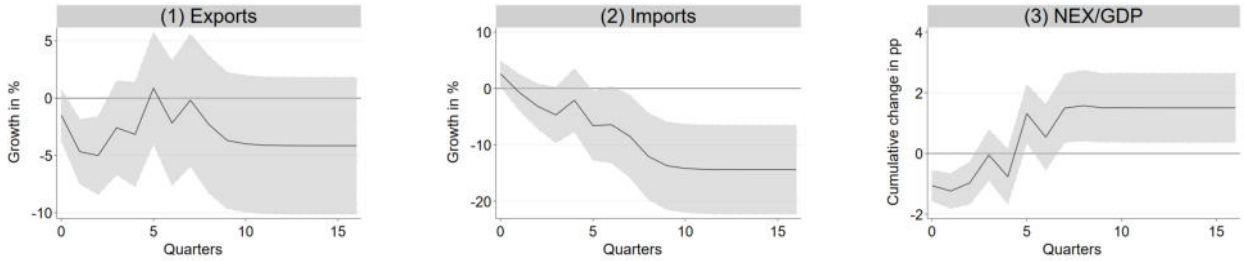
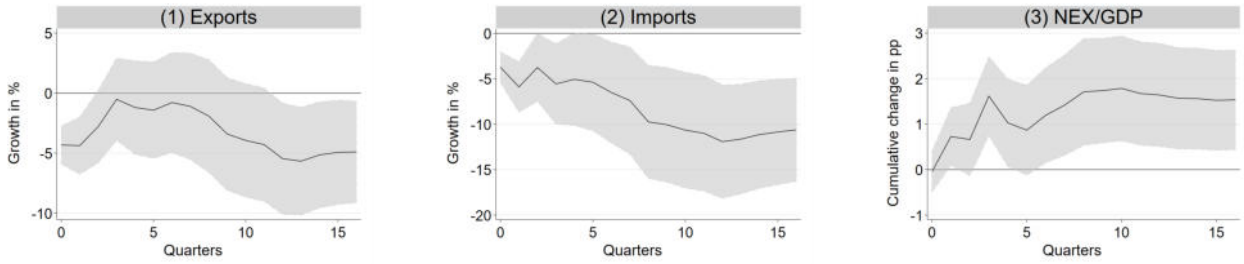


Figure A 54: Spill-Over Effects of US Aggregated Tax Increases, With External Demand

Germany



UK

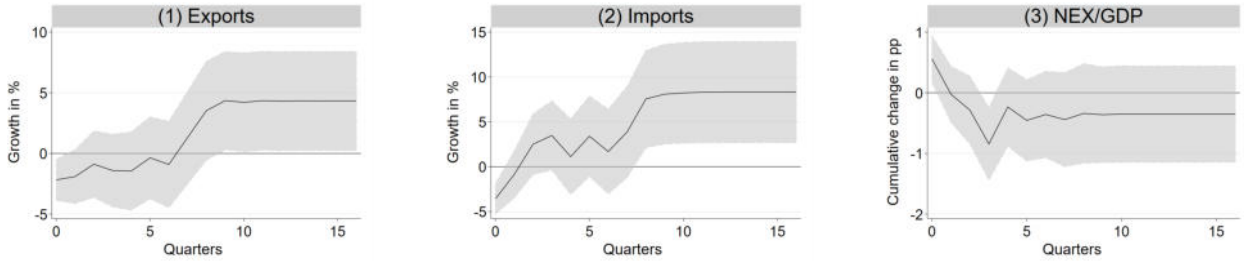
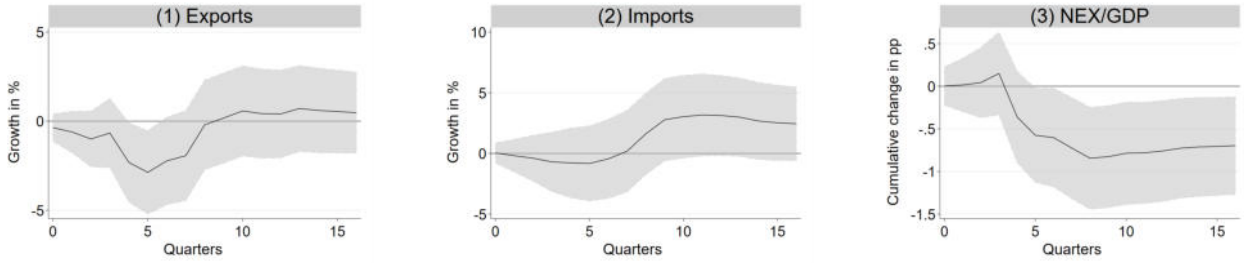


Figure A 55: Spill-Over Effects of US Aggregated Tax Decreases, With External Demand

Germany



UK