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# **Spillovers from Tax Shocks to the Euro Area**

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# Spillovers from Tax Shocks to the Euro Area

## Abstract

I study the spill-over effects of legislated discretionary tax changes in the United States, Germany, and the United Kingdom to 11 Eurozone countries for the period 1980Q1–2018Q4 employing Local Projections (Jordà, 2005). In general, I find spillovers from US tax legislation to have the smallest effects on Eurozone countries' real GDP and UK tax changes to exert the largest effect. There is substantial heterogeneity in both the sign and size of spillovers after US and German aggregated tax cuts, whereas UK tax cuts generally have beneficial effects. When I focus the analysis on the state-dependent case, I do not find clear evidence of larger spillovers when the recipient country is in a recession. The sign and size of the spillovers instead depend on the origin and sign of the tax change, as well as the recipient country, rather than on the overall state of the business cycle. Moreover, German tax cuts can be contractionary when recipient countries are in a recession, as the short-term interest rate rises. US tax cuts, on the other hand, stimulate the exports of most countries regardless of the state of the business cycle.

Keywords: Fiscal policy, tax policy, legislated tax changes, state dependence, Eurozone, fiscal spillovers, asymmetric effects, United States, Germany, United Kingdom, local projections, narrative approach

JEL code: E62, E63, F45, H20, H30, K34

# 1 Introduction

Due to a lack of common fiscal policy in the Economic and Monetary Union (EMU), member states need to coordinate their fiscal actions to achieve a union-wide collective response to economic challenges. In light of the current pandemic and the European Union's attempts to set up a common and coordinated fiscal programme, it is worth studying the spill-over effects of national fiscal policy. This paper provides new empirical evidence on how foreign fiscal shocks affect Eurozone economies. Although there is a growing body of work on domestic fiscal multipliers, evidence about spill-over effects is scarce and inconclusive regarding sign and size. I am the first to provide a comparison of country-specific spill-over effects from exogenous tax shocks originating in the United States, Germany, and the United Kingdom and to consider asymmetric tax shocks as well as state-dependent reactions.

Using deviations from professional forecasts and Local Projections (LPs) (Jordà, 2005), Auerbach and Gorodnichenko (2013) find significant positive spill-over effects from government spending in a panel of eight countries (the G7 plus Australia) for the period 1984–2007. Moreover, the magnitude of the effects depends on the state of the economy, with effects being larger when the recipient or the source country, or both, are in a recession. In this setup, government spending shocks mainly manifest through stimulated exports in the recipient country, as demand increases after a government spending hike in a foreign country.

However, this is not likely the only transmission channel. Nica (2015) estimates the spill-over effects of US spending and revenue shocks identified via sign restrictions (Mountford & Uhlig, 2009) in Canada, the United Kingdom, and Japan in a VAR setup. He finds negative effects of US tax hikes on foreign GDP, which in absolute terms are smaller than spillovers from government spending shocks and mostly insignificant. Moreover, he identifies goods and factor prices, asset pricing, and capital flows as other transmission channels in addition to demand for exports. Hebous and Zimmermann (2013) identify the exchange rate and short-term interest rates as other influential mechanisms. They study the spill-over effects of a 1% shock to the cyclically adjusted budget balance across the Euro 12 countries in a global VAR (GVAR) using quarterly data from 1979–2009. The impact of an area-wide fiscal shock on a member country's output tends to be positive and larger than that of a domestic shock. Moreover, the results indicate heterogeneity across Euro area members. Dabla-Norris et al. (2017) estimate a quarterly panel VAR for 10 Euro area countries over the period 1999–2016. They find that spillovers from government spending shocks are larger for countries with closer trade and financial links. In this setup, the current account appears to be the main channel of transmission.

Empirical evidence on the spill-over effects of tax changes is even rarer. Eller et al. (2017) estimate the effect of expansionary fiscal policy in Germany on 11 Eurozone countries and 18 extra-Euro countries in a Bayesian GVAR with sign restrictions and find positive spillovers from both government spending and net taxes. The effects are similar in size—less than 0.1%—but short-lived in the latter case. Moreover, the authors argue that there is considerable heterogeneity across recipient countries.

Some work has considered narratively identified tax shocks. Feyrer and Shambaugh (2012) use the exogenous tax changes identified by Romer and Romer (2009) and find that the changes spill over to investment in other countries over the period 1973–2005. An increase in US savings due to a tax hike is transmitted to the rest of the world via higher world savings and, as a result, lower interest rates, which then trigger higher investment. Goujard (2017) employs the narratively identified fiscal consolidation attempts constructed by Devries et al. (2011) to study the spill-over effects in OECD countries from 1978–2011 via LPs. He finds large spill-over effects on output, effects that are even larger between countries belonging to currency unions. Over the medium term, spillovers from spending cuts and tax hikes are similar in size. Employing LPs, Blagrove et al. (2017) study spill-over effects to a panel of 55 OECD countries from government spending and taxes originating in France, Germany, Japan, the United Kingdom, and the USA, taking asymmetric effects across the business cycle into account. Fiscal shocks are identified as in Blanchard and Perotti (2002) but the authors use Romer and Romer's (2010) tax shocks as a robustness check. Spillovers are computed by estimating the average of the fiscal shocks, weighted by trade exposure of the recipient country. The authors find larger spillovers from government spending, whereas tax shocks are significant only during the first year, reducing GDP on average by about 0.05%. Moreover, spillovers are larger when either the recipient or source countries are in a recession. Focusing on the effects on the Irish economy only, in an LP framework, Clancy (2019) employs shocks to US corporation taxes as identified by Mertens and Ravn (2013). He finds a cut in US corporation taxes to increase Irish GDP and investment. Metelli and Natoli (2019), using both corporate and personal income taxes as identified by Mertens and Ravn (2013), estimate a GVAR for 25 economies for the period 1979Q2–2006Q4. In most cases, spillovers are positive and significant, albeit small.

The authors explain that transmission occurs via a boost of exports in recipient economies stimulated by stronger US demand and real exchange rate depreciation vis-à-vis the US dollar. Long-term interest rates also play a role in the transmission of the spillovers.

Employing Local Projections, I study the spill-over effects to 11 Eurozone countries of legislated discretionary tax changes in the United States, Germany, and the United Kingdom for the period 1980Q1–2018Q4. I find (i) rather small (large) spill-over effects from US and German (UK) tax legislation to Eurozone countries. When not allowing for state-dependent effects, (ii) UK aggregated tax cuts exert only positive spillovers, whereas the effects of US and German aggregated tax cuts depend on the recipient country. Allowing for state-dependent effects, spillovers from (iii) UK aggregated tax cuts are generally expansionary regardless of the state of the business cycle, whereas (iv) US (German) tax cuts cause positive spillovers mainly during recessionary (non-recessionary) times. When allowing for asymmetric reactions to tax hikes and cuts across the business cycle, I find that (v) German tax *cuts* can be contractionary during recessions, whereas *hikes* can be expansionary, depending on the effect on the short-term interest rate and real exchange rate. In contrast, (vi) UK tax hikes (cuts) are mostly contractionary (expansionary), regardless of the state of the business cycle and (vii) the effects of US tax cuts are more often expansionary during recessions.

The rest of this paper is structured as follows. Section 2 lays out the data and method used. Section 3 presents the results. Possible transmission mechanisms are studied in Section 4. Section 5 contains robustness checks. Section 6 concludes.

## 2 Data and Method

I collected quarterly data on macroeconomic and financial variables for 11 EMU countries—Austria, Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain—from 1980Q1 to 2018Q4.<sup>1</sup> The data were retrieved from OECD Economic Outlook No. 106 and are expressed in nominal local currency and are seasonally adjusted. If necessary, data were deflated using the GDP deflator with base year 2010. Hence, all macro variables are expressed in seasonally adjusted real 2010 local currency. The narratively identified tax shocks come from Hayo and Mierzwa (2021a), who extend the series of Romer and Romer (2009), Cloyne (2012), and Uhl (2013) to the end of 2017. The last exogenous tax shocks in our narrative account were implemented in 2018Q2. In contrast to Hayo and Mierzwa (2021a), I consider only tax shocks exogenous to the current state of the business cycle and also consider temporary measures. As is standard in the literature, tax shocks are shifted to the next quarter when they are implemented in the second half of a quarter.

### Baseline Estimation

I employ country-specific Local Projections (Jordà, 2005) for 12 steps ahead. In the unconditional case, the model takes the form:

$$z_{i,t+h} = \alpha_i + \beta_i(L)\Delta\tau_i + \psi_i(L)X_i + \phi D + \varepsilon_t \quad (1)$$

The dependent variable,  $z_{t+h}$ , is defined as the cumulated h-step-ahead growth rate of the recipient country's real GDP, i.e.,  $z_{t+h} = \frac{Y_{t+h} - Y_{t-1}}{Y_{t-1}}$ , which is approximately equal to  $\ln(Y_{t+h}) - \ln(Y_{t-1})$ . In the context of domestic fiscal multipliers, the series used by Romer and Romer, (2010) Cloyne (2013), and Hayo and Uhl (2014) are expressed in per cent of nominal GDP. However, to account for differences in the size of the economies and make our results comparable to the literature on domestic fiscal multipliers, I convert the shocks into per cent of the *recipient country's* GDP. Hence, in the baseline estimation,  $\Delta\tau_i$  is defined as an implemented cut in overall tax liabilities<sup>2</sup> equal to 1% of the recipient country's GDP.  $B(L)$  is a lag polynomial containing contemporaneous values of tax shocks and up to four lags. The IRF are a sequence of estimated parameters  $\beta_{i,h=0}^{12}$  and their standard errors.  $X$  is a vector of controls, containing lagged real GDP and government spending, and—motivated by Hebous and Zimmermann (2013)—the real effective exchange rate and short-term interest rate. The latter enters in levels whereas the other three controls enter as logs. To preserve degrees of freedom,  $\psi(L)$  is of order one.<sup>3</sup>  $D$  contains a linear time trend.

<sup>1</sup> The GDP series for Ireland and Greece start in 1990Q1 and 1995Q1, respectively.

<sup>2</sup> Comprising all direct and indirect tax changes.

<sup>3</sup> The results are insensitive to the choice of lags and I therefore choose a parsimonious specification. However, in robustness checks, I experiment with different lag lengths of both controls and tax shocks.

By construction,  $\varepsilon_t$  is serially correlated and potentially correlated with  $X_i$  and, hence, I estimate Equation (1) and all following models with heteroscedasticity and autocorrelation robust standard errors (Newey & West, 1987) and allow the number of lags to be selected automatically (Newey & West, 1994).

In the next steps, I translate Equation (1) into the state-dependent case, allowing the effects to vary across the business cycle and, next, augment the estimation by tax hikes and cuts to check for asymmetries induced by the sign of the tax shock. Finally, I investigate possible transmission channels by replacing the dependent variable with the short- or long-term interest rate, investment, the real effective exchange rate, and exports.

## 3 Results

### 3.1 Aggregated Tax Shocks: Unconditional Case

A priori, determining the net effect of spillovers from foreign tax legislation is not a straightforward task, as there are many possible mechanisms at play, for example, through trade, interest rates, or the real exchange rate (see Hebous & Zimmermann, 2013, p. 111). A cut in US tax revenues, for example, can raise world interest rates via lower savings and, hence, crowd out investment in the rest of the world (Feyrer & Shambaugh, 2012). A German tax cut could cause the common exchange rate to appreciate and, hence, crowd out Eurozone countries' exports. On the other hand, tax cuts raise import demand in the United States and Germany (Hayo & Mierzwa, 2021a), which should raise exports and, hence, GDP in the Eurozone.

To economise on space, I present the results of the Local Projections as the peak minima and maxima, as well as the three-year-average effect.<sup>4</sup> The full dynamics of the impulse response functions (IRFs) can be found in the Appendix, Figures A1–A3. The results of Equation (1) for spill-over effects of a reduction in aggregated tax liabilities equal to 1% of the recipient country's GDP are presented in Table 1. Overall, the magnitude of the coefficients is similar to that of other studies. Starting with the spill-over effects of US aggregated tax cuts on European countries' real GDP, I discover that the effect can be either positive or negative. According to Table 1, a US tax cut equal to 1% of Belgian GDP causes a maximum increase in real GDP of 0.03%. US tax cuts seem to have a relatively long-lasting effect, as, on average, Belgian GDP grows significantly by 0.02% per quarter over the full 12-quarter forecast horizon (see the 'Avg' column in Table 1). Hence, adding up the average effect per quarter over the full horizon yields an increase of almost 0.3% after three years. I find positive spill-over effects for Ireland, as well, with a peak effect of about 0.14%. The peak effect is about the size Clancy (2019) finds for Irish GDP after a cut in US business taxes. French GDP is positively affected, too, and by around the same magnitude as was the case for Ireland. US tax cuts are not necessarily beneficial for the Eurozone countries, though, as Table 1 reveals some adverse effects as well. The harshest drop occurs in Spain, reaching a minimum of more than  $-0.1\%$  and significantly lowering real GDP by on average by  $-0.07\%$  per quarter. The real GDP in Portugal and the Netherlands drops by around 0.05%, with a significant average drop in all quarters of about that size only for Portugal. Hence, looking at a panel of countries may not be an appropriate way of studying the spill-over effects of US or other foreign tax shocks, as there is evidence for country-specific responses.

Table 1 shows that German tax cuts also have both positive and negative spill-over effects. On the one hand, this country's close neighbours—Austria, Belgium, France, and Luxembourg—benefit from German tax cuts, with peak effects from 0.02 (Luxembourg) to 0.8% (France). On the other hand, German tax cuts are contractionary for the periphery countries—Ireland, Portugal, and Spain—with GDP dropping between 0.2% (Ireland and Portugal) and 0.8% (Spain). Moreover, there are negative effects on the GDP of Finland and the Netherlands; for the latter, the effect is significant over the full horizon. Since the periphery countries are known to have problems with rising interest rates and the Dutch economy to be export oriented, these results could indicate a crowding-out effect via higher interest rates and exchange rates, as described above. Section 4 of this paper covers possible transmission mechanisms and reveals that, indeed, there is an increase in the short-term interest rate in almost all countries as well as a drop in exports in the case of the Netherlands. The adverse effects have important implications for coordinated fiscal action in the Eurozone, as German tax cuts could jeopardise the growth of not only the periphery countries, but also that of the Netherlands. Although this result seems counterintuitive, I am not the first to discover negative spill-over effects from German fiscal policy. Alloza et al. (2019) estimate spillovers of government spending across the four largest European economies via Local Projections, relying on Blanchard and Perotti's (2002) identification, and find negative effects on Italian real GDP after a positive German government spending shock.

<sup>4</sup> The three-year average is computed as  $\frac{1}{13} \sum_0^{12} \beta_i$ , following Auerbach and Gorodnichenko (2013) and Goujard (2017).

The authors argue that expansionary fiscal policy in larger member countries could raise the union interest rate, which, in turn, dampens positive spillovers.

Tax cuts originating in the United Kingdom are set out in the last three columns of Table 1 and it is evident that UK tax cuts cause only positive spillovers and that the effects are also the largest in magnitude. A cut equal to 1% of Italian GDP boosts real GDP by about 2%. The IRF, however, becomes statistically significant only toward the end of the three-year horizon and, hence, the average effect is not statistically different from zero. I find evidence of positive peak effects for France (+1.5%), Spain (0.9%), Belgium (0.2%), and Ireland (0.6%) and in the case of Ireland, I estimate a significant average increase over the full three years of about 0.3%, which sums up to more than 3% over three years. This result is not surprising, considering the strong links between the two economies.

In summary, I find mixed evidence for tax cuts originating in the United States and Germany, with periphery countries being negatively affected, and positive and large spillovers from UK tax cuts. In general, spillovers are not necessarily small and can have a substantial economic impact on European countries.

**Table 1: Aggregated Tax Shocks, Unconditional Case**

Country	USA			Germany			UK		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Austria	0.00	0.01	0.01	-0.01	0.18*	0.07	-0.09	0.20	0.02
Belgium	-0.00	0.03**	0.02**	-0.04	0.15**	0.03	-0.04	0.16*	0.06
Finland	-0.01	0.01	-0.00	-0.10**	0.06	-0.02	-0.05	0.11	0.04
France	0.02	0.10**	0.07**	-0.21	0.78*	0.15	-0.27	1.49**	0.58
Greece	-0.06	-0.00	-0.03	-0.24	-0.07	-0.19	-0.30	0.38	0.12
Ireland	0.01	0.14***	0.07***	-0.19**	-0.02	-0.10	0.01	0.58**	0.28*
Italy	-0.11	0.02	-0.03	-0.99	-0.12	-0.47	-0.10	2.04**	0.82
Luxembourg	-0.00*	0.00	0.00	-0.00	0.02**	0.01*	-0.01	0.02	0.01
Netherlands	-0.03**	0.05	0.02	-0.35**	-0.11**	-0.20**	-0.24	0.02	-0.10
Portugal	-0.06**	-0.00	-0.03**	-0.19**	-0.01**	-0.08*	-0.00	0.16	0.05
Spain	-0.13***	0.01	-0.07**	-0.79**	-0.16***	-0.40*	-0.09	0.90*	0.34

Notes: Table yields the IRFs' minima and maxima after a cut in aggregated taxes equal to 1% of the recipient country's GDP, as well as the average effect over three years following the shock. \*, \*\*, and \*\*\* indicate significance at the 10%, 5%, and 1% significance level, respectively.

### 3.2 Aggregated Tax Shocks: State-Dependent Effects

I now expand my model to the nonlinear case and allow for asymmetries depending on the phase of the business cycle. The evidence on state-dependent domestic responses to fiscal policy shocks is mixed. For example, Eskandri (2015) and Demirel (2020) find US tax cuts to have larger domestic effects when unemployment is low. For the United Kingdom, Colombo (2020) finds larger effects of exogenous tax cuts during recessions, whereas Hayo and Mierzwa (2021b) find no conclusive evidence for state-dependent effects of tax cuts in Germany and the United Kingdom. Auerbach and Gorodnichenko (2013) argue that the transmission of government spending shocks is amplified when the recipient countries are in a recession. Blagrove et al. (2017) also estimate larger effects for tax shocks when the recipient country is in a recession, but fail to find a statistically different reaction across the business cycle. These two studies rely on a two-year moving average to determine the state of the business cycle. However, interpreting this indicator is not straightforward. When studying state-dependent multipliers in the United States, Owyang et al. (2013) and Ramey and Zubairy (2018) rely on an unemployment threshold above 6.5% to determine economic slack. Here, however, due to our heterogeneous sample and lack of data, setting a threshold is not feasible. Instead, I propose a classification provided by the OECD to ensure comparability across the countries in our sample: the composite leading indicator (CLI).<sup>5</sup> The CLI identifies turning points in business cycles and has the advantage, first, of providing a comparable benchmark across countries and, second, avoiding the use of ex-post information as it is constructed to predict turning points six to nine months before they occur. Data on recession periods based on the CLI were retrieved from St. Louis FRED.<sup>6</sup> The data are available at a

<sup>5</sup><http://www.oecd.org/sdd/leading-indicators/oecdcompositeleadingindicatorsreferenceturningpointsandcomponentseries.htm>

<sup>6</sup> For example, Federal Reserve Bank of St. Louis, OECD Based Recession Indicators for Germany from the Period Following the Peak Through the Trough [DEUREC], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/DEUREC>, April 09, 2021

monthly frequency and I classify a quarter as a recession when at least two months of it are classified as such, as is also done in Hayo and Mierzwa (2021b).

I estimate:

$$z_{i,t+h} = \alpha_i + (1 - I_{i,t-1})[\beta_{i,NR}(L)\Delta\tau_{i,NR} + \psi_{i,NR}(L)X_{i,NR}] + I_{i,t-1}[\beta_{i,R}(L)\Delta\tau_{i,R} + \psi_{i,R}(L)X_{i,R}] + \phi D + \epsilon_{i,t} \quad (2)$$

Subscripts NR and R indicate non-recessionary and recessionary periods, respectively. The state indicator enters as a dummy and is defined as  $I_t = \begin{cases} 1, & \text{in recession} \\ 0, & \text{in non-recessions} \end{cases}$

Following the literature (Auerbach & Gorodnichenko, 2013; Owyang et al., 2013; Demirel, 2020), the state indicator is lagged by one quarter to account for delayed adjustment of employment and government revenues and to rule out contemporaneous correlations between the state of the business cycle and legislated tax changes. Variables are defined as in Equation (1) but I now allow coefficients to differ across the business cycle.

The results for the United States are given in Table 2. When US aggregated tax cuts hit European economies at different states of the business cycle, the effects are considerably different. For example, the positive spill over of a cut in US aggregated taxes to Belgian GDP that is shown in Table 1 turns out to be state dependent and driven by the reaction during recessions. For Finland, in Table 1, I failed to find a significant effect when looking at the average reaction across both states of the business cycle. However, when considering different phases of the business cycle, I find mixed spillovers when the Finish economy is not in a recession, with the net effect being insignificant, and negative spillovers of below 0.1% during recessions. Austria, France, Greece, and Ireland benefit from US cuts regardless of where they are in the business cycle. The peak effect is largest during recessions in Greece (+1%) and during other times in the case of Ireland (+0.6%). I also find negative spillovers, mainly during non-recessionary times. I find US aggregated tax cuts to be contractionary outside of recessions for Italy, Luxembourg, Portugal, and Spain, with the largest adverse effect for Italy, where GDP drops by almost -1%. Spanish and Finish GDP drop, on average, over the full sample when a US tax cut hits during a recession. The last column of Table 2 shows the difference in the average effects over the three-year horizon. Positive spillovers are larger during recessions only in the case of Belgium, Greece, and Luxembourg. However, I find more cases of significantly positive average effects during recessions, which is supportive of larger positive spillovers during recessionary times.

**Table 2: USA—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.02*	0.01	0.01**	0.04***	0.03***	0.18
Belgium	-0.05	0.01	-0.02	0.01***	0.04***	0.03***	0.09
Finland	-0.01**	0.05*	0.01	-0.06*	-0.00	-0.04**	0.03
France	-0.02	0.11*	0.07	0.04	0.18***	0.10***	0.56
Greece	0.00	0.05**	0.02*	-0.16*	0.95***	0.49***	0.00
Ireland	-0.46	0.64***	0.20	0.01**	0.10**	0.05***	0.45
Italy	-0.89***	0.01	-0.33**	-0.12	0.05	-0.01	0.14
Luxembourg	-0.01**	0.00	-0.00*	-0.00	0.00*	0.00	0.02
Netherlands	-0.05	0.10	0.02	-0.04	0.05	0.01	0.89
Portugal	-0.13***	-0.01***	-0.07***	-0.04	0.01	-0.02	0.10
Spain	-0.22*	0.03	-0.08	-0.16***	0.01	-0.08*	0.98

Notes: See Table 1. The last column refers to the difference across states of the average effects.

Looking at German aggregated tax cuts across the recipient countries' business cycles (Table 3), I again find negative spill-over effects, but now the effect mainly occurs during recessions, which is in contrast to the pattern for the United States. When the economies of Finland, Ireland, Netherlands, Portugal, and Spain are in a recessionary phase and a tax cut is implemented in Germany, these countries' GDP decreases. In the case of Ireland, the effect is negative regardless of the state of the economy, but the average effect is significant only during non-recessions. The largest drop, one of more than 2%, during recessions is reported for Spain, followed by one of more than 0.5% in Ireland and the Netherlands. I find evidence of German tax cuts bolstering GDP during a downturn only in the cases of France (+0.5%) and Luxembourg (+0.02%). In times other than recessions, I find evidence for more positive spillovers. The beneficial effect on Austrian GDP discovered in Table 1 is driven by



dynamics during non-recessionary times, with a peak effect of +0.3% and an average effect of more than +0.1% per quarter. I find the highest peak and average effect in the case of France, raising GDP by a maximum of +1.2% and 0.4% per quarter. Luxembourg's real GDP rises following a German tax cut regardless of the state of the economy and by about the same amount, leading me to conclude that, in this case, spillovers are positive and symmetric across the cycle. I find positive spillovers to the Italian and Greek economies outside of recessions, too. Ireland, on the other hand, experiences contractionary effects in either state of the business cycle. The expansionary effect on Greek and Italian GDP is significantly larger during non-recessions, whereas the negative effect on Dutch and Spanish GDP is larger during recessionary periods. This suggests that positive spillovers to the Eurozone countries in my sample are more common in non-recessionary times, which is opposite of what I observed in the case of the United States.

**Table 3: Germany—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.31**	0.15**	-0.14	0.02	-0.06	0.11
Belgium	-0.06	0.21	0.07	-0.13	0.03	-0.05	0.17
Finland	-0.09*	0.16*	0.02	-0.14**	0.02	-0.08	0.19
France	-0.21	1.20***	0.36**	-0.95	0.55**	-0.04	0.28
Greece	-0.07	0.50***	0.19**	-0.32	-0.11	-0.23	0.04
Ireland	-0.23**	-0.04	-0.15*	-0.53**	0.04	-0.17	0.92
Italy	-0.49	0.89**	0.15	-1.49	-0.25	-1.05	0.08
Luxembourg	-0.01	0.05***	0.02**	-0.01	0.02***	0.01**	0.39
Netherlands	-0.17	0.11	-0.06	-0.69**	-0.25	-0.46**	0.08
Portugal	-0.10	0.00	-0.03	-0.16**	0.00	-0.05	0.71
Spain	-0.13	0.39	0.09	-2.30***	-0.27***	-1.28***	0.00

Notes: See Table 1. The last column refers to the difference across states of the average effects.

I now analyse the spill-over effects of exogenous discretionary tax changes originating in the United Kingdom, coded as aggregated tax cuts equal to 1% of local GDP. Results are given in Table 4. Recall from Table 1 that I found evidence for only positive effects on Belgian, French, Irish, Italian, and Spanish GDP. When allowing for state-dependent effects, I again find almost exclusively positive spillovers from UK tax cuts, regardless of the state of the business cycle in the recipient country. The only exception is Spain, for which I find a drop in GDP during non-recessionary times, but a much larger increase during recessions. I find evidence of asymmetric effects in the case of Belgian, Finnish, and Portuguese (Dutch) GDP, which is boosted only during non-recessionary (recessionary) phases. Real GDP in France, Greece, Ireland, and Italy is bolstered by UK tax cuts during either state of the business cycle and I find no statistically different average effects. During non-recessions (recessions), the peak effect is largest for Italy (Spain), raising domestic GDP by about +2.7% (3.7%), and lowest in the case of Portugal (Austria), with GDP rising by around +0.02% (+0.4%). Unlike the case for the United States and Germany, I find no pattern of state-dependent tax spillovers, as the effects are positive and comparable in size across the business cycle.

**Table 4: UK—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference
	Min	Max	Avg	Min	Max	Avg	<i>p-val</i>
Austria	-0.00	0.12	0.07	0.07	0.41**	0.25*	0.19
Belgium	-0.09	0.13**	0.01	-0.03	0.11	0.04	0.85
Finland	0.08	0.37***	0.23**	0.04	0.29	0.16	0.58
France	-0.30	1.82***	0.92**	-0.47	2.28**	0.58	0.60
Greece	-0.38	0.61***	0.01	0.14	0.57**	0.38	0.34
Ireland	0.33	1.25***	0.78**	0.06	0.78	0.40**	0.26
Italy	-0.02	2.72***	1.04*	0.36	2.50*	1.53	0.65
Luxembourg	-0.01	0.03	0.01	-0.01	0.01	0.00	0.92
Netherlands	-0.37	0.21	-0.06	0.07	0.90***	0.41*	0.07
Portugal	0.02***	0.26	0.11	-0.19	0.02	-0.09	0.53
Spain	-1.32*	-0.20*	-0.72*	0.05	3.73**	1.92	0.02

Notes: See Table 1. The last column refers to the difference across states of the average effects.

In summary, (i) the spill-over effects of US and German tax cuts depend on the country hit by the shock, (ii) US (German) tax cuts cause positive spillovers mainly during recessionary (non-recessionary) times, but the effect for periphery countries is contractionary during non-recessions (recessions), (iii) Eurozone countries almost exclusively benefit from UK tax cuts, regardless of the position of their business cycle.

### 3.3 Asymmetric Tax Shocks: State-Dependent Effects

To this point, I have viewed tax hikes as negative tax cuts. However, according to Eskandri (2015), Jones et al. (2015), Hussain and Malik (2016), and Hayo and Mierzwa (2021b), tax hikes and tax cuts have different effects on domestic GDP in the United States, Germany, and the United Kingdom. This leads me to suspect that spill-over effects might be dependent on the sign of the shock. Hence, I now consider the spill-over effects of tax increases and decreases separately across the business cycle in the recipient countries. I translate Equation (2) into the asymmetric case and estimate:

$$z_{i,t+h} = \alpha_i + (1 - I_{i,t-1})[\beta_{i,NR}^+(L)\Delta\tau_{i,NR}^+ + \beta_{i,NR}^-(L)\Delta\tau_{i,NR}^- + \beta_{i,NR}^{other}(L)\Delta\tau_{i,NR}^{other} + \psi(L)X_{i,NR}] + I_{i,t-1}[\beta_{i,R}^+(L)\Delta\tau_{i,R}^+ + \beta_{i,R}^-(L)\Delta\tau_{i,R}^- + \beta_{i,R}^{other}(L)\Delta\tau_{i,R}^{other} + \psi(L)X_{i,R}] + \varepsilon_{it} \quad (3)$$

The variables in Equation (3) are defined as before.  $\Delta\tau_i^+(\Delta\tau_i^-)$  describes tax hikes (cuts) originating in either the United States, Germany, or the United Kingdom, expressed in recipient country  $i$ 's nominal GDP. To conserve degrees of freedom, I consider tax hikes and cuts of only one country of origin at a time while controlling for the two aggregated shocks. Hence,  $\Delta\tau_i^{other}$  contains the remaining two aggregated tax shock series not under consideration, expressed as a cut equal to 1% of local GDP, as was the case in Equation (1).

Starting with US tax hikes in Table 5, I find mostly harmful effects for Eurozone economies. Only for France, the Netherlands, and Portugal do I find positive effects during non-recessionary periods. In Portugal, the effect holds, and is statistically larger, during recessions, too. In Greece, Ireland, and Luxembourg, GDP shrinks in both states of the business cycle. In Spain, on the other hand, I find a clearly asymmetric pattern, with GDP shrinking (growing) by, on average, -0.4% (+0.3%) during non-recessions (recessions).

**Table 5: USA—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.07	0.03	-0.02	-0.01	0.10	0.04	0.29
Belgium	-0.04*	0.08**	0.01	-0.10***	-0.01	-0.05*	0.18
Finland	-0.33***	0.05	-0.08	-0.13	0.05	-0.02	0.52
France	0.10*	1.19***	0.81***	-0.39	0.20	-0.10	0.00
Greece	-0.24**	-0.00	-0.12*	-5.17***	-0.11	-3.45***	0.00
Ireland	-0.94***	0.34	-0.47**	-0.17**	0.09	-0.04	0.04
Italy	-0.24	1.03	0.16	-0.30	0.28	-0.05	0.61
Luxembourg	-0.02*	-0.00	-0.01*	-0.02***	0.00	-0.01***	0.36
Netherlands	-0.03	0.36***	0.17**	-0.14	0.06	-0.05	0.03
Portugal	-0.04	0.02***	-0.01	0.01	0.26***	0.15***	0.00
Spain	-0.66**	-0.12**	-0.38**	0.11*	0.42***	0.33***	0.00

Notes: See Table 1. The last column refers to the difference across states of the average effects.

Recall from Table 1 that US tax aggregate cuts caused periphery countries' GDP to drop. However, when I now differentiate between hikes and cuts, I find these effects to be state dependent. Generally, US tax cuts have expansionary spill-over effects, but when a US tax cut hits outside of recessions, the GDP of Finland, Italy, Luxembourg, Portugal, and Spain drops. The adverse effect is smallest for Luxembourg (-0.01%) and largest for Italy (-0.9%). The drop is significant, on average, over the full horizon and statistically different from the effects during recessions in the case of Luxembourg, Portugal, and Spain. In the case of Ireland, I also find a drop in GDP; however, this is dominated by an increase, rendering the net average effect positive during non-recessions. When hit by a US tax cut outside of recessions, the real GDP of France, Greece, and the Netherlands increases. During recessions, I find mostly positive spillovers of US tax cuts: the largest point estimate is found for Greece (+0.5%) and the smallest for Luxembourg (<0.01%). Hence, I cannot unambiguously translate the finding of Auerbach and Gorodnichenko (2013) to tax cuts, as the positive effect is not necessarily larger when the recipient country is in a recession. This is only the case for Austria, Luxembourg, Portugal, and Spain. Thus, US tax cuts appear to follow a general pattern of creating expansionary effects, whereas there is no clear pattern for tax hikes.

**Table 6: USA—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.01	-0.00	0.01**	0.05***	0.04***	0.07
Belgium	-0.06	-0.00	-0.03	0.00	0.04***	0.03***	0.13
Finland	-0.01**	0.04	0.01	-0.11**	-0.02	-0.06*	0.10
France	0.06***	0.51***	0.32***	0.07	0.22***	0.15***	0.02
Greece	-0.00	0.04**	0.02	-0.67***	0.45*	-0.04	0.75
Ireland	-0.81**	1.31***	0.41*	0.00	0.10	0.05	0.13
Italy	-0.90**	0.26	-0.29	-0.06	0.14	0.06	0.25
Luxembourg	-0.01***	0.00	-0.00***	0.00	0.00**	0.00	0.00
Netherlands	0.03	0.58***	0.33***	-0.05	0.02	-0.00	0.00
Portugal	-0.14***	-0.01***	-0.07***	-0.00	0.03***	0.01***	0.00
Spain	-0.51***	-0.02	-0.27***	0.03	0.16*	0.12	0.00

Notes: See Table 1. The last column refers to the difference across states of the average effects.

As previously mentioned, German tax hikes may cause a beneficial interest rate response in struggling neighbouring countries. Indeed, I find beneficial effects in the case of Ireland and the Netherlands regardless of the business cycle phase; both countries could benefit from lower interest and exchange rates after a German tax increase. Greek GDP, on the other hand, is adversely affected in either state of the business cycle. I find asymmetric effects

in the case of Austria and France (Belgium and Portugal), as their GDP grows only during non-recessionary (recessionary) phases, as well as for Italy (Spain), where GDP increases only in recessionary (non-recessionary) times but not (a negative effect) in the opposite state.

**Table 7: Germany—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.30**	0.10	-0.07	0.01	0.53	0.41	0.14
Belgium	-0.19	0.06	-0.05	-0.34***	0.03	-0.09	0.82
Finland	-0.20	0.09	-0.04	-0.42	-0.03	-0.19	0.26
France	-1.33**	0.30	-0.31	-2.02	-0.16	-0.87	0.72
Greece	-0.98***	0.00	-0.37***	-0.45***	-0.05	-0.23**	0.29
Ireland	0.01	0.18**	0.09	0.15	2.69***	1.46***	0.00
Italy	-0.80	0.85	0.11	0.04	1.41***	1.05	0.35
Luxembourg	-0.05***	0.06***	0.00	-0.05***	0.03***	-0.02*	0.03
Netherlands	-0.17	0.29*	0.08	-0.14	0.97	0.36*	0.20
Portugal	-0.06	0.03	-0.02	-0.88***	-0.06	-0.45**	0.05
Spain	-0.06	0.34**	0.17	-0.46***	1.30	0.70	0.58

Notes: See Table 1. The last column refers to the difference across states of the average effects.

By taking into account the sign of the tax change, we now see that the positive spillovers of tax *cuts* are almost exclusively driven by effects that occur outside of recessions, whereas I observe almost exclusively negative effects during recessions. The only exception is Ireland, for which I find positive spillovers during recessionary periods. This is an important finding, as German tax cuts worsen economic downturns in Belgium, Finland, France, the Netherlands, Portugal, and Spain. The adverse effects are largest for France, with a negative peak effect of around -3.2%. However, German tax cuts have a pro-cyclical effect during non-recessions in Austria, Belgium, France, Greece, Italy, Luxembourg, and Spain. The peak effect is largest for Italy (+1.4%) and smallest for Belgium (+0.3%). The average effect is statistically larger only in non-recessionary times in Belgium and Luxembourg.

Hence, I argue that the effect of German tax hikes is comparable to that of the United States, that is, there is no clear pattern across countries or the business cycle. The effect of tax cuts, on the other hand, is the opposite of what occurs after tax cuts in the United States, as we observe more positive spillovers during non-recessions, and even contractionary effects during recessions.

**Table 8: Germany—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.02	0.40**	0.23**	-0.12	0.14	0.01	0.24
Belgium	-0.22**	0.34***	0.14**	-0.21**	-0.01	-0.09	0.04
Finland	-0.14*	0.14	0.01	-0.59***	-0.03	-0.39***	0.02
France	-0.26***	1.05***	0.42*	-3.24**	0.66	-1.08	0.01
Greece	-0.15***	0.59***	0.24***	-0.87	-0.07	-0.52	0.21
Ireland	-0.77	-0.00	-0.47	-0.05	0.49**	0.21	0.16
Italy	-0.73	1.36*	0.31	-1.16	-0.31	-0.74	0.31
Luxembourg	0.02***	0.06	0.04*	-0.00	0.03	0.01	0.15
Netherlands	-0.33	0.39	0.01	-1.20*	-0.32	-0.77*	0.12
Portugal	-0.13*	0.01	-0.04	-0.43***	-0.01	-0.20***	0.04
Spain	-0.13	0.82*	0.42	-2.70***	-0.33	-1.43***	0.00

Notes: See Table 1. The last column refers to the difference across states of the average effects.

In contrast to German tax hikes, UK tax hikes have exclusively contractionary effects on European countries when considering the average effects in non-recessionary periods. In such periods, both Eurozone core countries and periphery countries experience a drop in GDP after a tax hike in the United Kingdom. During recessions, there is mostly evidence for negative average effects, with Austrian GDP being the exception, which grows by around

1.6% per quarter. In general, point estimates and average effects are larger for UK tax hikes than they are for either German or US tax hikes.

**Table 9: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.36***	0.11*	-0.13*	-0.11	2.94***	1.59***	0.00
Belgium	-0.78***	0.16***	-0.26*	-1.17***	1.17**	-0.10	0.51
Finland	-1.01***	-0.06	-0.59***	-3.99***	-0.60***	-2.77***	0.01
France	-3.80***	2.09***	-0.30	-3.68	3.15	0.12	0.73
Greece	-2.39	0.01	-0.93	-1.30***	-0.26***	-0.86***	0.95
Ireland	-1.15	0.43	-0.45	-2.33***	0.07	-1.21***	0.33
Italy	-6.21***	-0.39	-3.29***	-13.57***	2.72	-5.39	0.55
Luxembourg	-0.08	0.03	-0.04	-0.10	0.19*	0.05	0.25
Netherlands	-0.10	0.84	0.47	-2.94***	1.31**	-0.42	0.21
Portugal	-1.99***	0.01	-0.88***	-0.80***	0.04	-0.46***	0.12
Spain	-3.92**	-0.02	-2.24***	-0.33	4.07	2.65	0.18

Notes: See Table 1. The last column refers to the difference across states of the average effects.

Recall that UK aggregated tax cuts have exclusively expansionary effects on European countries when not allowing for asymmetries in the sign of the tax shock. When allowing for asymmetries through the business cycle phase, as well as through tax shocks, this result holds, albeit with a few exceptions. There is some evidence for on average lower GDP in the case of Belgium and Spain during non-recessions, and for Portugal during recessions. In some instances, there are significant drops, which, however, are usually equalised by increases, making the average effect insignificant. I therefore argue that UK tax hikes (cuts) have, in general, adverse (expansionary) effects on Eurozone countries' GDP, regardless of the phase of the business cycle.

**Table 10: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.03*	0.15	0.10	0.09***	0.72***	0.52***	0.09
Belgium	-0.34*	0.03	-0.14*	-0.13	0.28	0.06	0.25
Finland	-0.06	0.21	0.10	-0.10	0.15	0.04	0.78
France	0.10	1.84**	1.24**	-0.08	3.30***	0.85	0.62
Greece	-0.51	0.76***	-0.06	-0.92*	-0.09	-0.50	0.44
Ireland	1.24	3.97***	2.32***	-0.25	0.39*	0.01	0.00
Italy	-1.08	1.79	-0.01	0.06	1.95**	0.97	0.48
Luxembourg	-0.04**	0.02	-0.01	-0.02**	0.05*	0.02	0.18
Netherlands	-0.18	0.51***	0.18	0.22	0.87**	0.53**	0.32
Portugal	-0.09	0.05**	-0.01	-1.47***	-0.03	-0.87***	0.00
Spain	-1.78**	-0.10	-0.83*	-0.00	4.69*	2.24	0.03

Notes: See Table 1. The last column refers to the difference across states of the average effects.

In summary, there is considerable heterogeneity in the effect of tax hikes and cuts across economies as well as across the business cycle. In general, the effect of US and German tax hikes appears to depend on the recipient country, as there are no clear patterns either regarding the sign of the tax shock or the state of the business cycle. UK tax hikes, on the other hand, are predominantly contractionary across countries and the business cycle. US tax cuts are beneficial more often during recessions. German tax cuts during recessions (non-recessions), on the other hand, can worsen (improve) the economic downturn (upswing) of affected countries and this adverse effect of German tax cuts is not only restricted to periphery countries. UK tax cuts, on the other hand, bolster European countries' GDP when those countries are in a recession, and cause mostly positive effects during non-recessions, as well.

## 4 Transmission Channels

In this section, I explore possible transmission mechanisms for the patterns discovered in Section 3. One would expect trade to be the main transmission channel of fiscal policy spillovers, as a tax cut boosts US and German import demand and lowers the trade balance in the United States, Germany, and the United Kingdom (Hayo & Mierzwa, 2021a). As a consequence, exports in the rest of the world should rise. However, as argued by Nicar (2015) and Hebous and Zimmermann (2013), there could be other transmission mechanisms, for example, through the real exchange rate and the trade balance, as well as a change in long- and short-term interest rates. To shed light on the transmission channels, I replace real GDP ( $z_{i,t+h}$ ) in Equations (1)–(3) with the short-term interest rate, private investment, the real effective exchange rate,<sup>7</sup> and exports. Macro variables are scaled by lagged real GDP such that shock and response are expressed in the same unit (i.e., % of GDP) (see Barro & Redlick, 2011; Owyang et al., 2013). The results for possible transmission channels can be found in the Appendix, in Figures A4–A15.

### 4.1 Aggregated Tax Shocks: Unconditional Case

When not allowing for state-dependent effects or asymmetries in the sign of the tax shocks, as in Equation (1), US tax cuts boost investment in Austria, Belgium, France, Ireland, and the Netherlands (Figure A7), likely driven by a drop in short-term interest rates (Figure A4), which contradicts the reasoning of Feyrer and Shambaugh (2012). German aggregated tax cuts drive up short-term interest rates in nine out of the 11 Eurozone countries (Figure A4), which crowds out investment in Belgium, Finland, Greece, and Portugal (Figure A7). Regarding the transmission channels for aggregated UK tax cuts, there is evidence of stimulated private investment in the countries positively affected (Figure A7), except in the case of Ireland, for which I instead find an increase in exports (Table A13).

### 4.2 Aggregated Tax Shocks: State-Dependent Effects

When augmenting Equation (2) with possible transmission mechanisms, I find that US tax cuts crowd out Italian and Portuguese investment over the full horizon during times other than recessions (Figure A8), as short-term interest rates rise (Figure A5), thus explaining the negative spillover. During recessions, the effect of US tax cuts on Eurozone investment is positive in general.

Turning to the main channels for German aggregated tax cuts, the net effect on interest rates during times other than recessions remains unclear as there is evidence of oscillating behaviour (Figure A5), crowding out investment in some member countries, but boosting investment in an almost equal number (Figure A8). In eight member countries, exports are crowded out during non-recessionary phases. During recessions, German aggregated tax cuts increase short-term interest rates of many Euro countries, crowding out investment. I also find real appreciation following the cut (Figure A11), which crowds out real exports (Figure A14). Hence, German tax cuts implemented during Eurozone countries' recessions worsen their economic situation, especially that of the periphery countries, through higher interest rates and reduced competitiveness, whereas there are fewer cases of a loss in competitiveness and rising interest rates during non-recessions.

In many cases, UK aggregated tax cuts during recessions cause short-term interest rates to drop and investment to grow, explaining the expansionary effects on economies discussed above. During non-recessions, European interest rates rise but the adverse effect seems to be relaxed through real depreciations and, as a consequence, rising exports.

### 4.3 Asymmetric Tax Shocks: State-Dependent Effects

I now replace the dependent variable in Equation (3) to identify the transmission of tax hikes and cuts across the business cycle. Again, when looking at the supply side of those countries negatively affected by US tax *hikes*, there is, in many cases, a drop in exports (Figure A15), which appears somewhat more pronounced during recessions. As argued by Feyrer and Shambaugh (2012), a US tax cut affects the rest of the world via the current account through lower world savings. On the other hand, US tax cuts could boost European exports via higher US demand (Hayo & Mierzwa, 2021a). Indeed, with few exceptions, I find higher exports after US tax cuts, regardless of the state of the business cycle (Figure A15). The exceptions are Belgium, Greece, Ireland, and Portugal, for which I observe a real appreciation (Figure A12), impeding higher exports. In line with Feyrer and Shambaugh (2012), I find short-term interest rates to increase in most cases, with the effect somewhat more pronounced during non-recessions (Figure A6).

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<sup>7</sup> Based on unit labour costs, an increase indicates a real appreciation and, hence, a loss in competitiveness.

German tax hikes, on average, cause real depreciations (Figure A12) regardless of where the recipient countries are in the business cycle. This boosts exports, with the effect lasting longer during recessions (Figure A15). After German tax *cuts*, on the other hand, exports often drop, especially during non-recessions (Figure A15). Short-term interest rates rise in almost all member countries during recessions (Figure A6), which may explain the adverse effects. Hence, I again argue that German tax cuts are not necessarily beneficial for European countries during a recession, as the negative effect of higher interest rates and a real appreciation outweigh the positive effect of increased German demand.

Finally, I turn to state-dependent and asymmetric reactions after UK tax shocks. In either state of the recipient countries' business cycle, UK tax hikes cause a drop in local investment in most European economies, as short-term interest rates increase (Figure A6). Recall from the previous section that UK tax cuts have mainly expansionary effects on European countries when not allowing for asymmetries across the business cycle or different signs of tax shocks. The effect of UK tax cuts on Eurozone countries' investment, on average, is symmetric to the effect of tax hikes, but without a clear pattern across the business cycle (Figure A9).

This section can be summarised as follows. US tax *hikes* might be contractionary via lower US demand, but, on the other hand, have beneficial effects on interest rates in many cases, making it difficult to see a clear pattern. US tax *cuts* create positive spillovers for European exports. German tax *hikes* can be expansionary in a few cases and in either state of the business cycle due to the positive effect on interest rates and the real exchange rate. German tax *cuts*, on the other hand, can worsen economic downturns in Eurozone countries, as interest rates rise and the real effective exchange rate appreciates. During non-recessionary periods, German tax cuts, on average, improve Euro countries' competitiveness, and are beneficial. UK tax hikes depress Eurozone countries' investment. UK tax *cuts*, on the other hand and on average, stimulate private investment, regardless of the state of the business cycle.

## 5 Robustness

Throughout the analysis, I used four lags of the exogenous tax shock series and one lag for the controls. To rule out that my results are driven by that choice, I re-estimate Equations (1)–(3) with varying lag lengths. Results when using four lags of the controls are given in Appendix Tables A1–A10 and for eight lags<sup>8</sup> of the tax shocks are given in Tables A11–A20.

Next, I exclude temporary measures and estimate the models using only permanent tax changes (see Cloyne, 2013). Results are given in Tables A21–A30.

To confirm that my state-dependent results are not driven by my particular choice of the business cycle indicator, I re-estimate Equations (1)–(3) using a smooth-transition parameter (Auerbach & Gorodnichenko, 2013) based on an eight-month moving average of (log-) real GDP and fixing the parameter of the logistic function  $\gamma$  to 1.5. Results are qualitatively and quantitatively similar, as can be seen in Tables A31–A39.

In my baseline estimations, the control variables in  $X_i$  are expressed in logarithms (with the exception of the short-term interest rate) and so, finally, I re-estimate the models employing first differences, thereby allowing the shocks to have permanent effects (Alloza et al., 2019). Again, the pattern of my results holds, as can be seen in Tables 40–A49.

Since signs and size of the responses remain stable throughout the variations just described, I conclude that my results are robust to various econometric specifications.

## 6 Conclusion

I study the spill-over effects of narratively identified exogenous tax changes on 11 Eurozone countries for the period 1980Q1–2018Q4. I employ Local Projections (Jordà, 2005) and consider asymmetric tax changes as well as state-dependent effects based on a classification provided by the OECD and St. Louis FRED.

When considering the effects of a cut in tax liabilities equal to 1% of local GDP, I find mixed evidence for tax cuts originating in the United States and Germany, with periphery countries often being negatively affected, and positive and large spillovers from UK tax cuts. The effects are in general lower than domestic multipliers but sometimes exceed them.

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<sup>8</sup> I cannot estimate the state-dependent model for Greece and Ireland with eight lags of exogenous tax shocks because the number of parameters exceeds the number of observations.

When allowing the effects of aggregated tax cuts to differ over the recipient countries' business cycles, I find US (German) tax cuts to cause positive spillovers mainly during recessionary (non-recessionary) times, but the effect for periphery countries is contractionary during non-recessions (recessions). Eurozone countries nearly always benefit from UK tax cuts, regardless of where they are in the business cycle. UK tax cuts also cause the largest spillovers.

Considering the sign of the tax changes and taking stage of the business cycle into account, I find the effects of US and German tax hikes to have country-specific rather than state-dependent effects. UK tax hikes, on the other hand, are predominantly contractionary across countries and the business cycle. US tax cuts are often more beneficial during recessions. German tax cuts, on the other hand, can worsen (improve) the affected countries' economic downturns (upswings) during recessions (non-recessions) and this effect is not restricted to periphery countries.

When investigating the transmission channels for these effects, I looked at the short-term interest rate, private investment, the real exchange rate, and exports as possible drivers. The effects of US tax hikes on European exports and short-term interest rates are heterogeneous. US tax cuts tend to spill over through trade, as exports are boosted, especially during non-recessionary times. German tax cuts are contractionary for many Eurozone countries during recessions due to rising short-term interest rates, which crowd out investment. German tax hikes, on the other hand, can be expansionary in both phases of the business cycle, as the Eurozone countries experience a real depreciation and, hence, an improvement in their external competitiveness, which in turn boosts exports. UK tax shocks seem to work through private investment, which is mostly depressed (boosted) after tax hikes (cuts). The adverse effect of tax hikes is larger during recessions and asymmetric, whereas there is no statistically significant difference across states when considering only tax cuts.

In light of these results, especially the effects of German fiscal policy, I argue that European countries need to monitor Germany's fiscal stance, especially since tax changes in that country can have considerable heterogeneous spill-over effects, which might even worsen the recession in some countries. European countries should also monitor UK tax policy, as these spillovers are the largest. Especially in light of the UK having left the EU, it will be an interesting exercise to trace the development of spill-over effects, as the size might decrease when trade links loosen, or might even increase through increased competition between the two economic entities.



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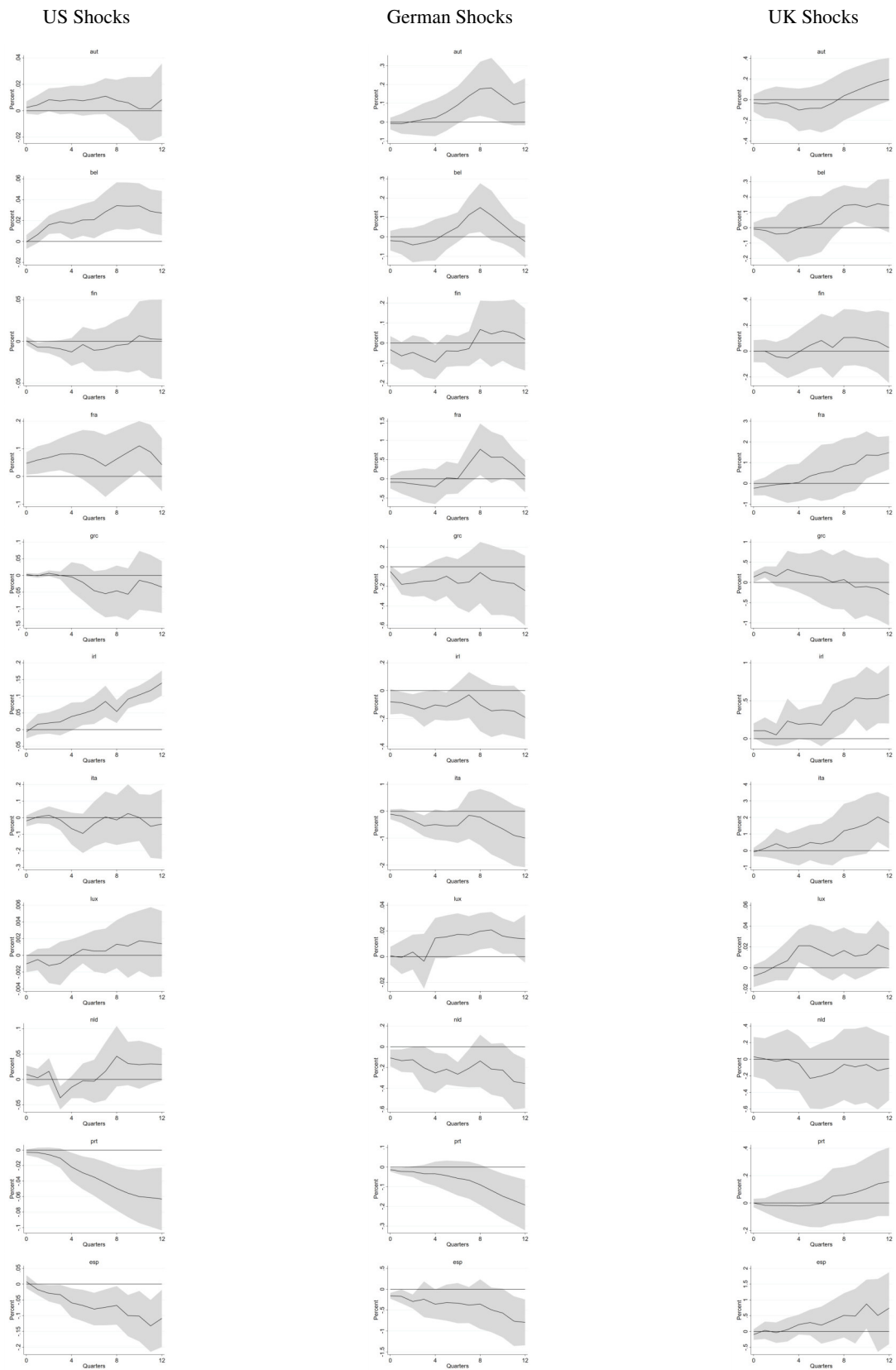
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# Appendix

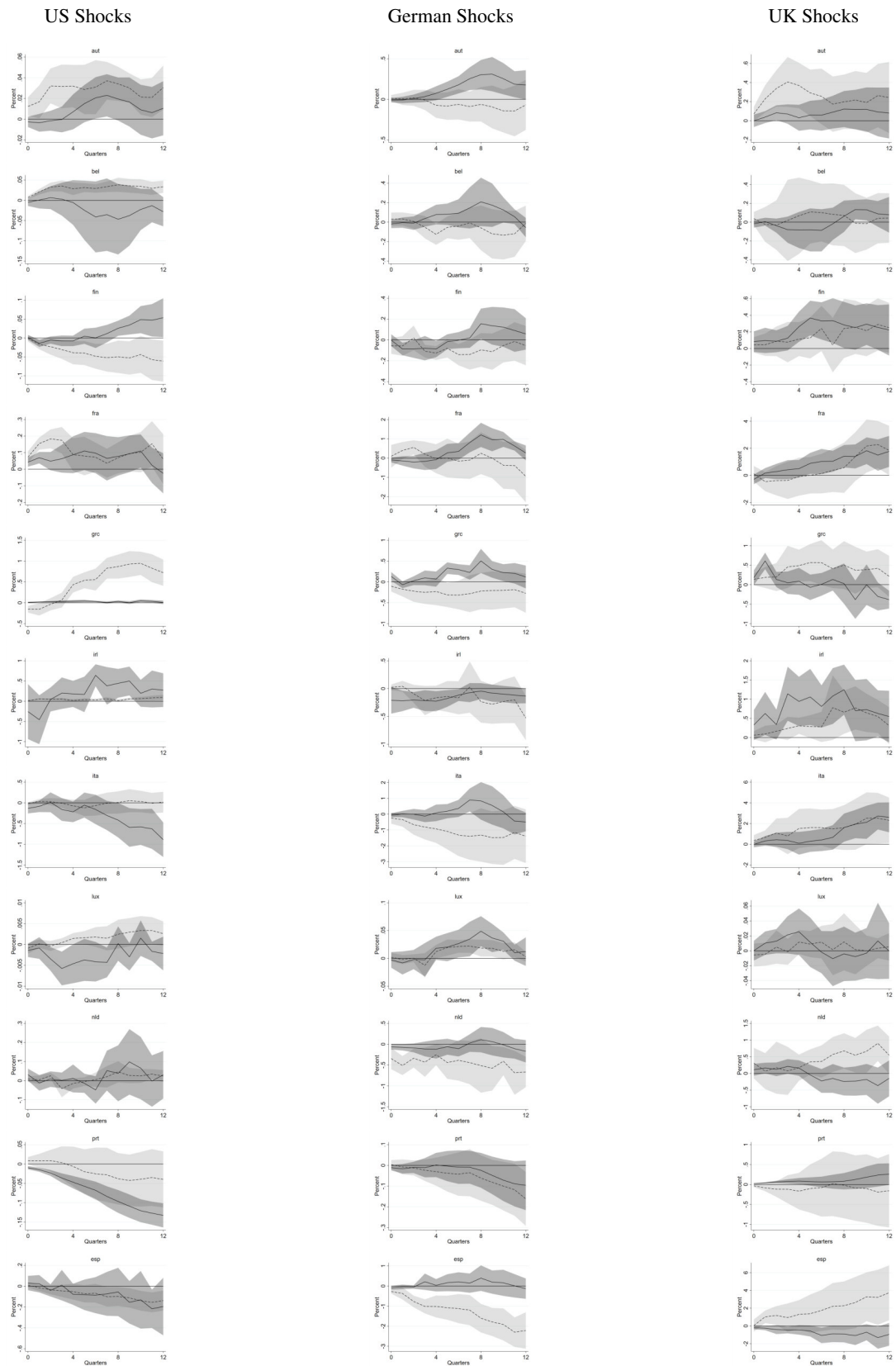
## IRFs of Models (1) - (3)

Figure A 1: Unconditional, Aggregated Tax Cuts



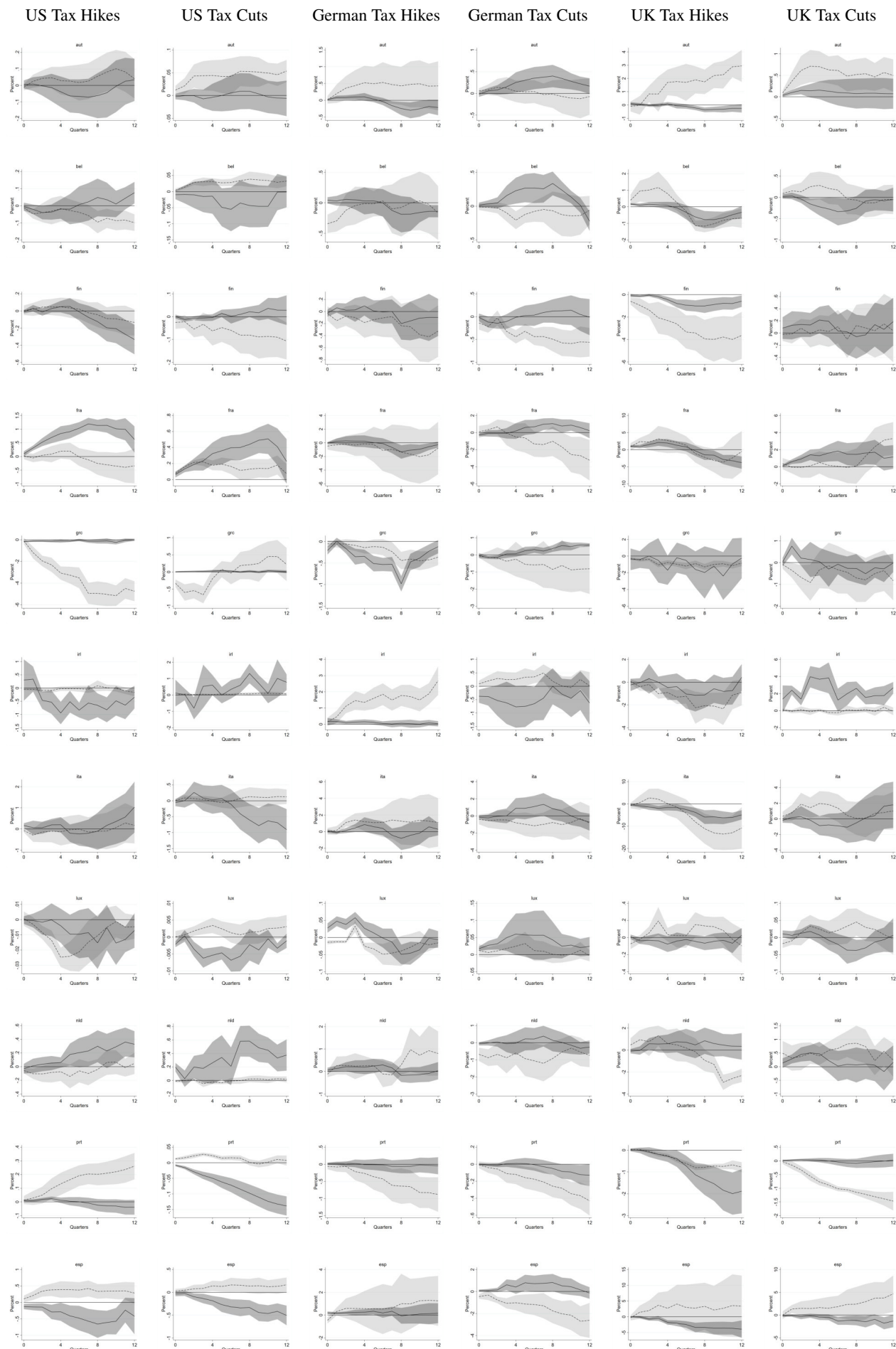
Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Shaded areas represent 90% confidence bands.

Figure A 2: State-dependency, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. The shaded area represents 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

Figure A 3: State-dependency, Asymmetric Tax Shocks



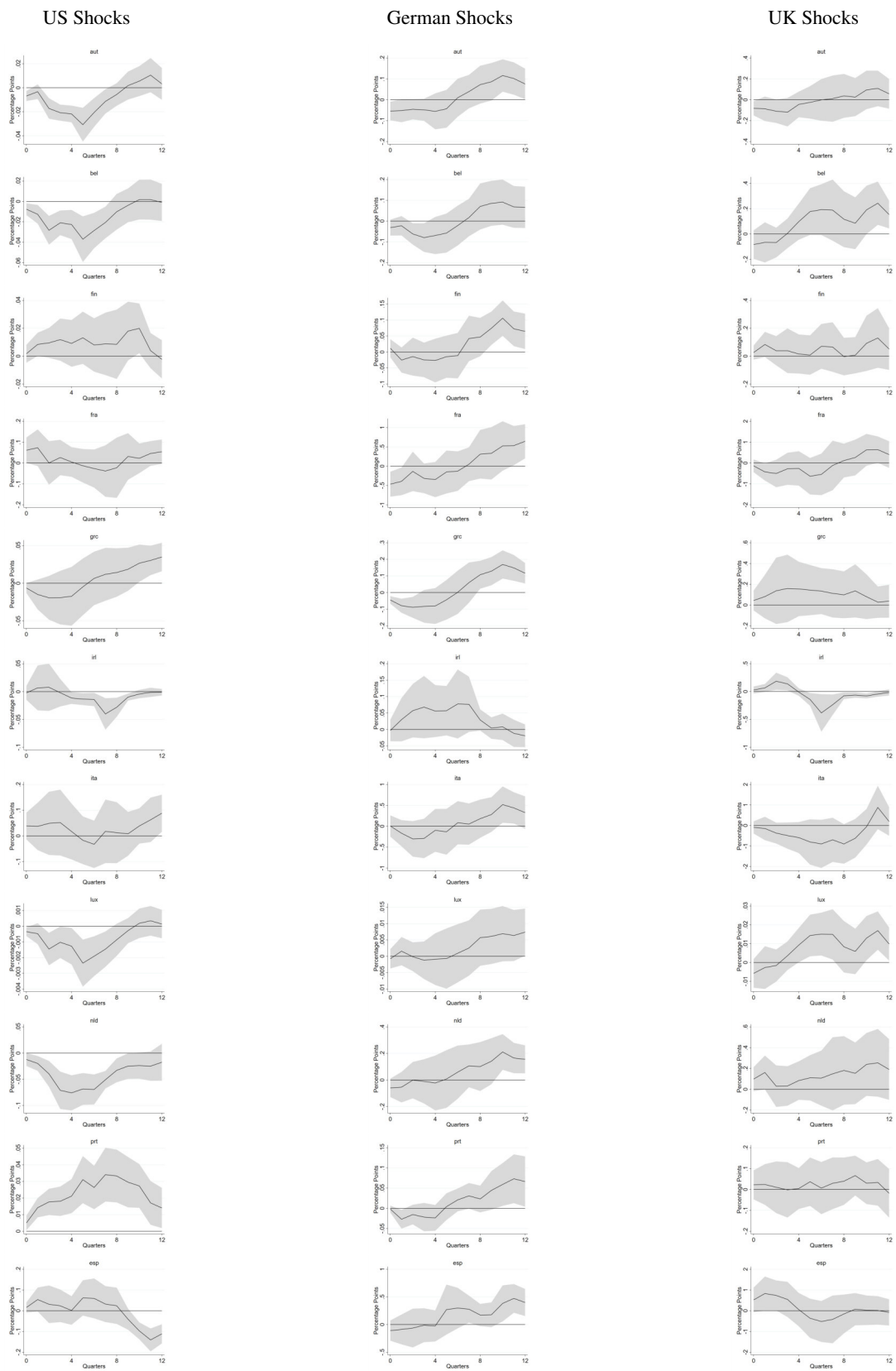
Notes: Figures present IRFs after a tax cut or hike equal to 1% of recipient country's GDP. Shaded areas represent 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

# Transmission Channels

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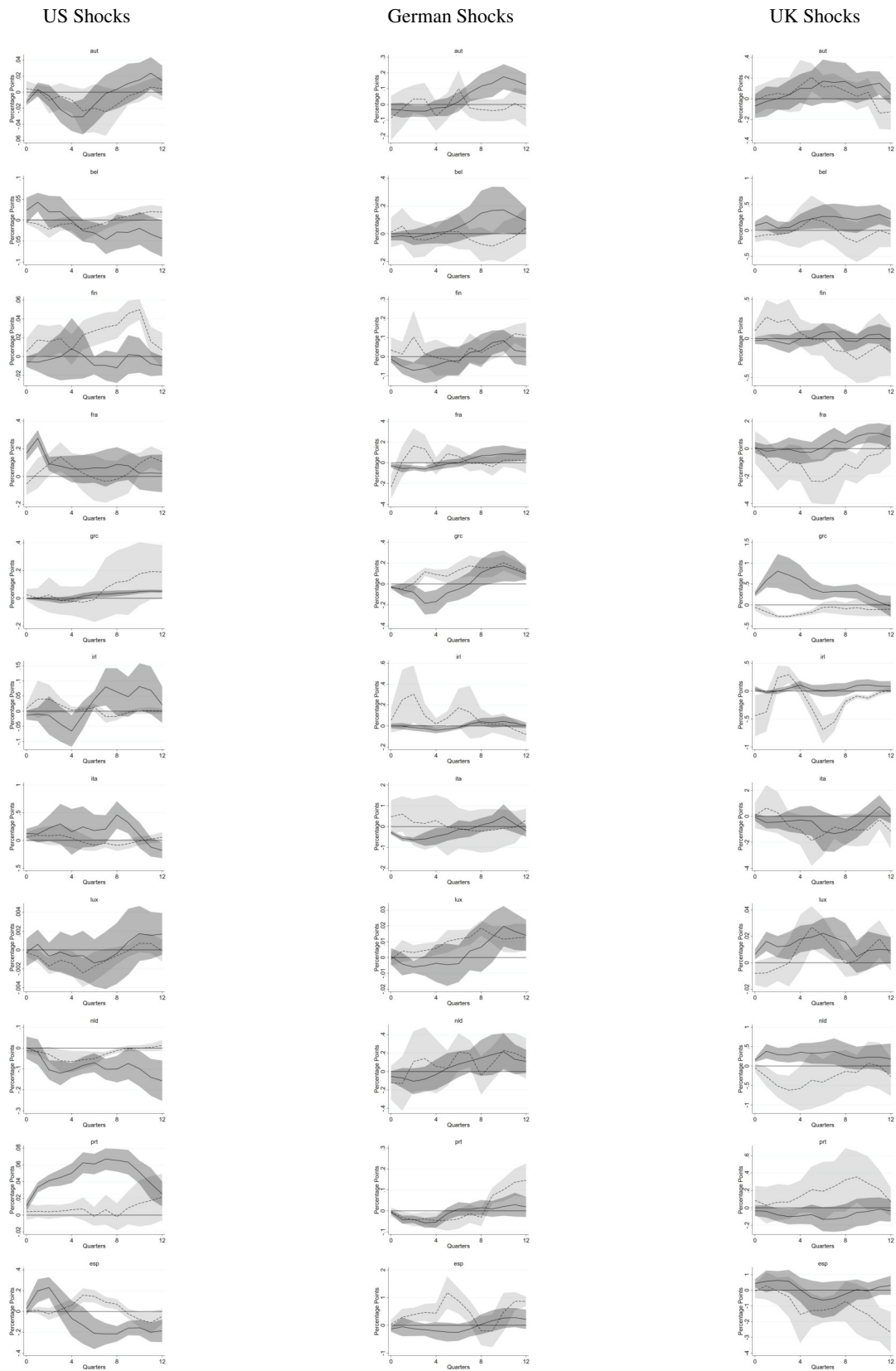
# Short-Term Interest Rates

Figure A 4: Short-Term Interest Rates, Unconditional, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Shaded areas represent 90% confidence bands.

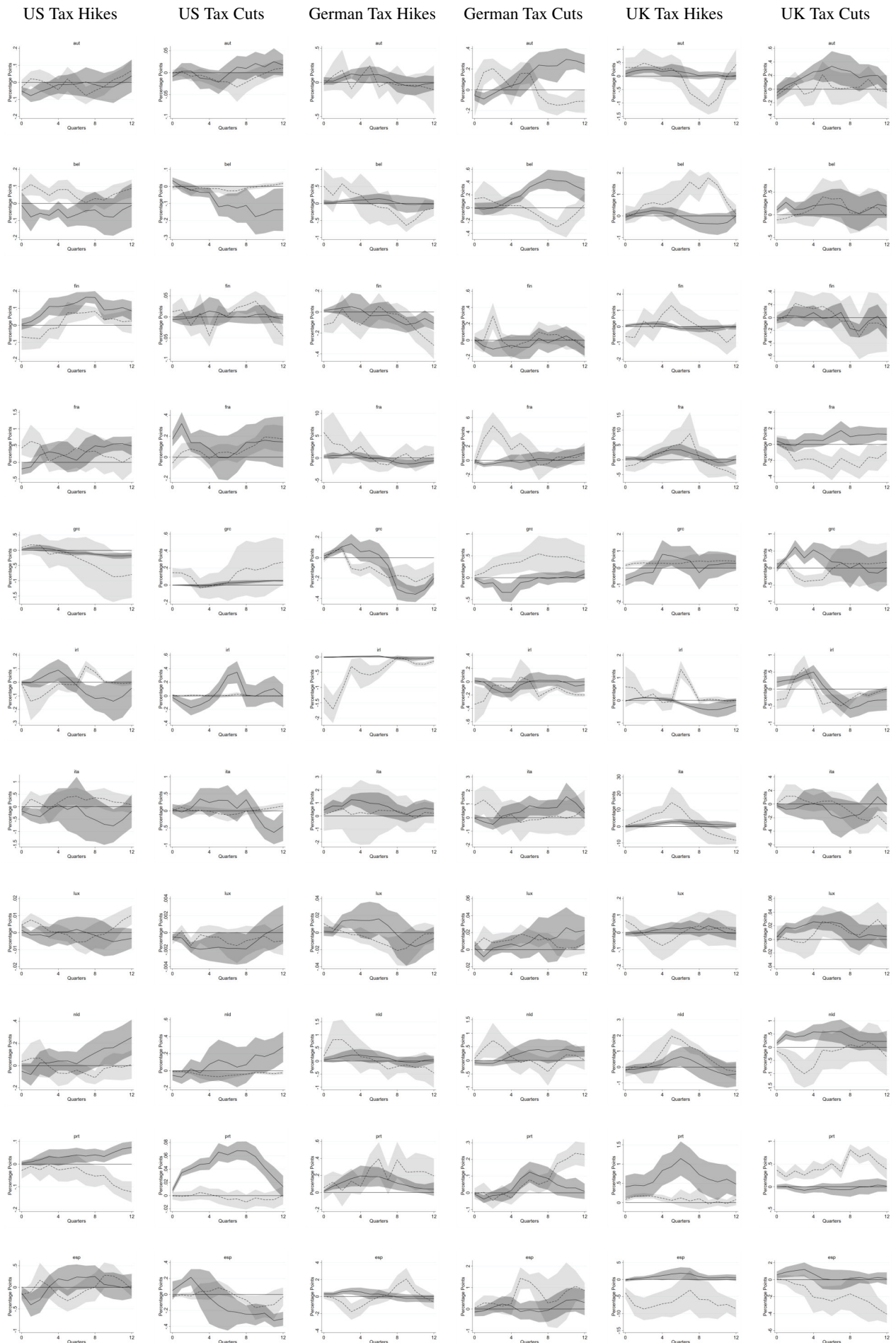
Figure A 5: Short-Term Interest Rates, State-dependency, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. The shaded area represents 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.



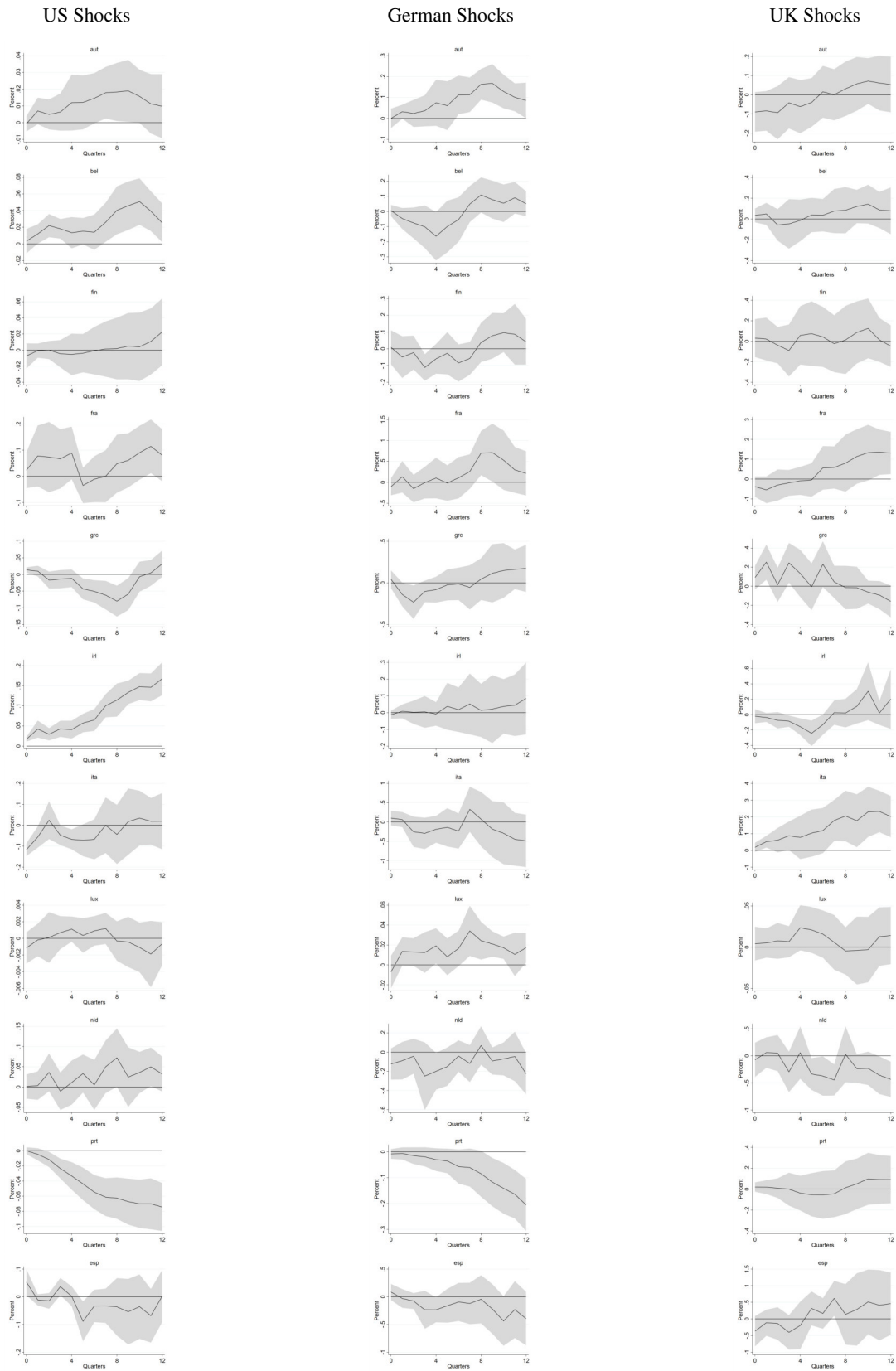
Figure A 6: Short-Term Interest Rates, State-dependency, Asymmetric Tax Shocks



Notes: Figures present IRFs after a tax cut or hike equal to 1% of recipient country's GDP. Shaded areas represent 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

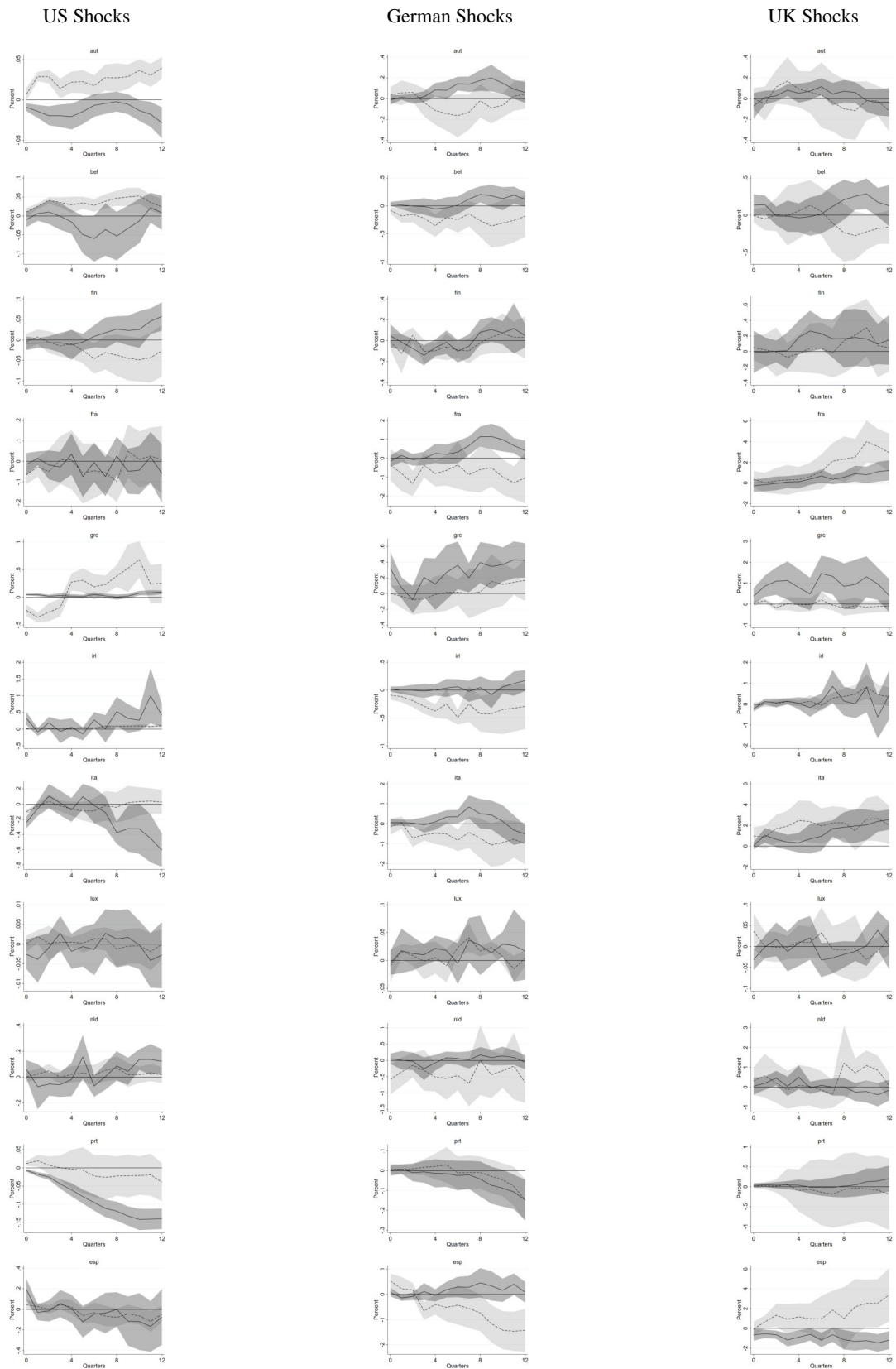
# Private Investment

Figure A 7: Investment, Unconditional, Aggregated Tax Cuts



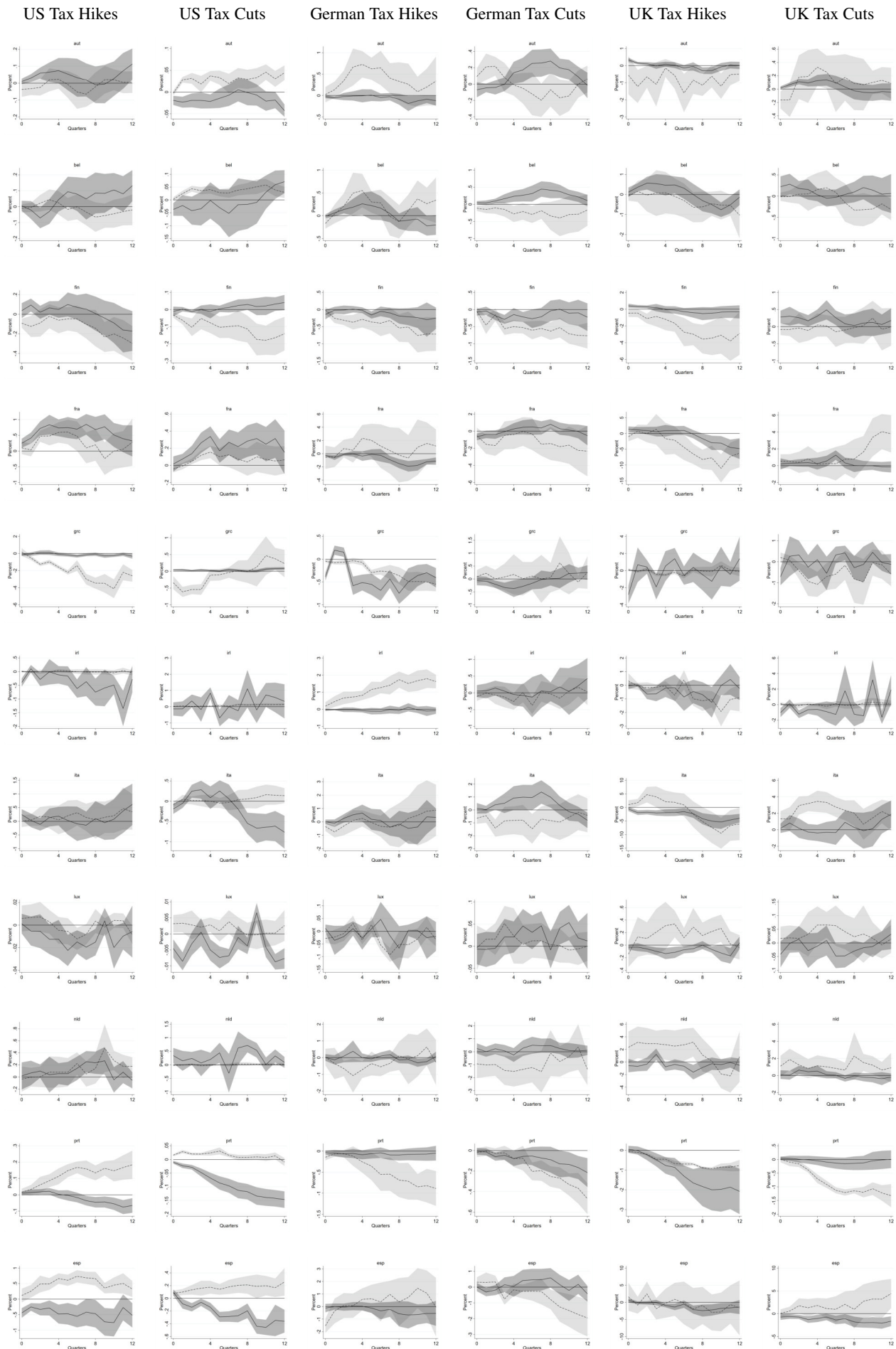
Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Dependent variable is expressed in percent of GDP. Shaded areas represent 90% confidence bands.

Figure A 8: Investment, State-dependency, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Dependent variable is expressed in percent of GDP. The shaded area represents 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

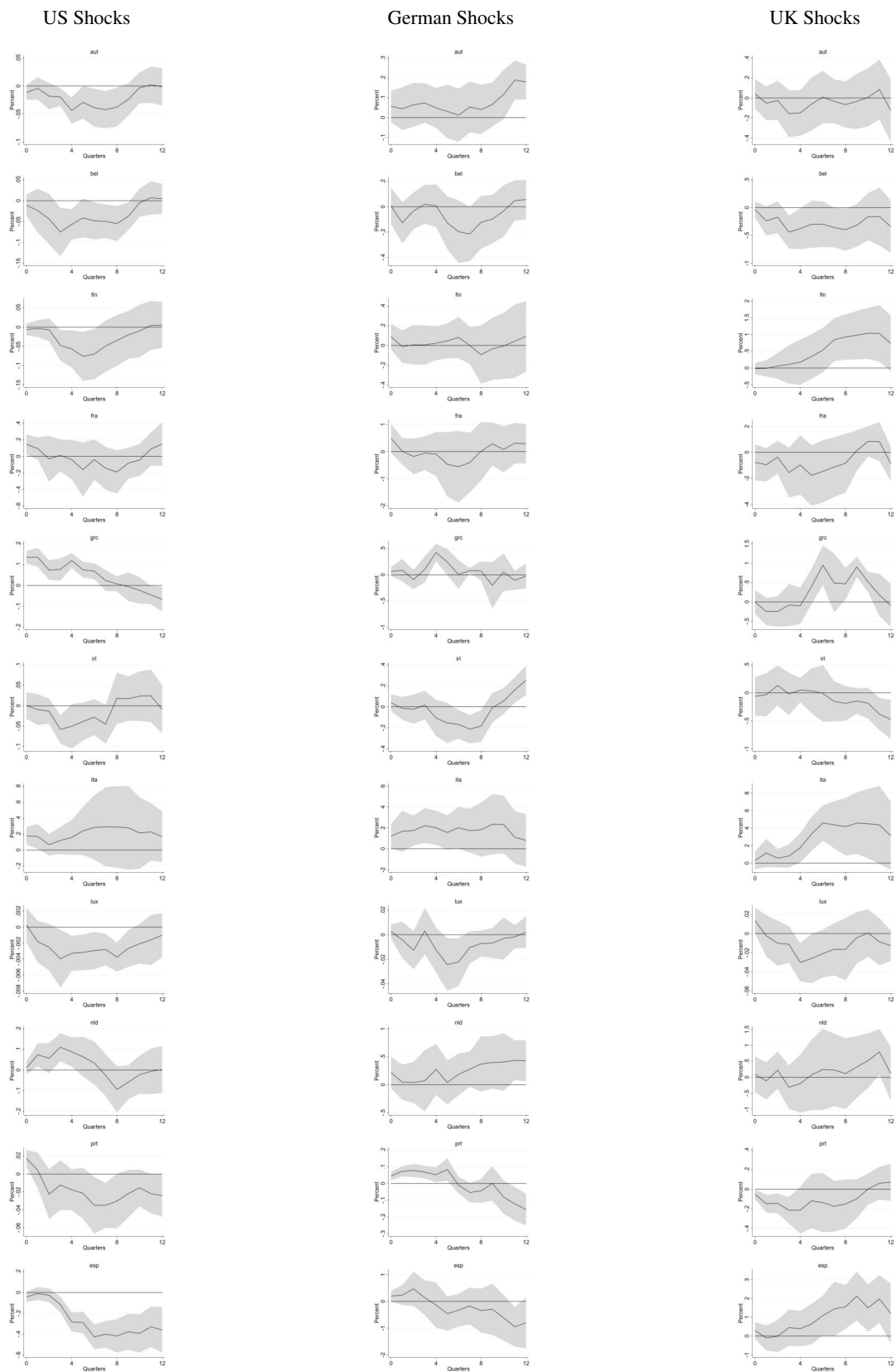
Figure A 9: Investment, State-dependency, Asymmetric Tax Shocks



Notes: Figures present IRFs after a tax cut or hike equal to 1% of recipient country's GDP. Dependent variable is expressed in percent of GDP. Shaded areas represent 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

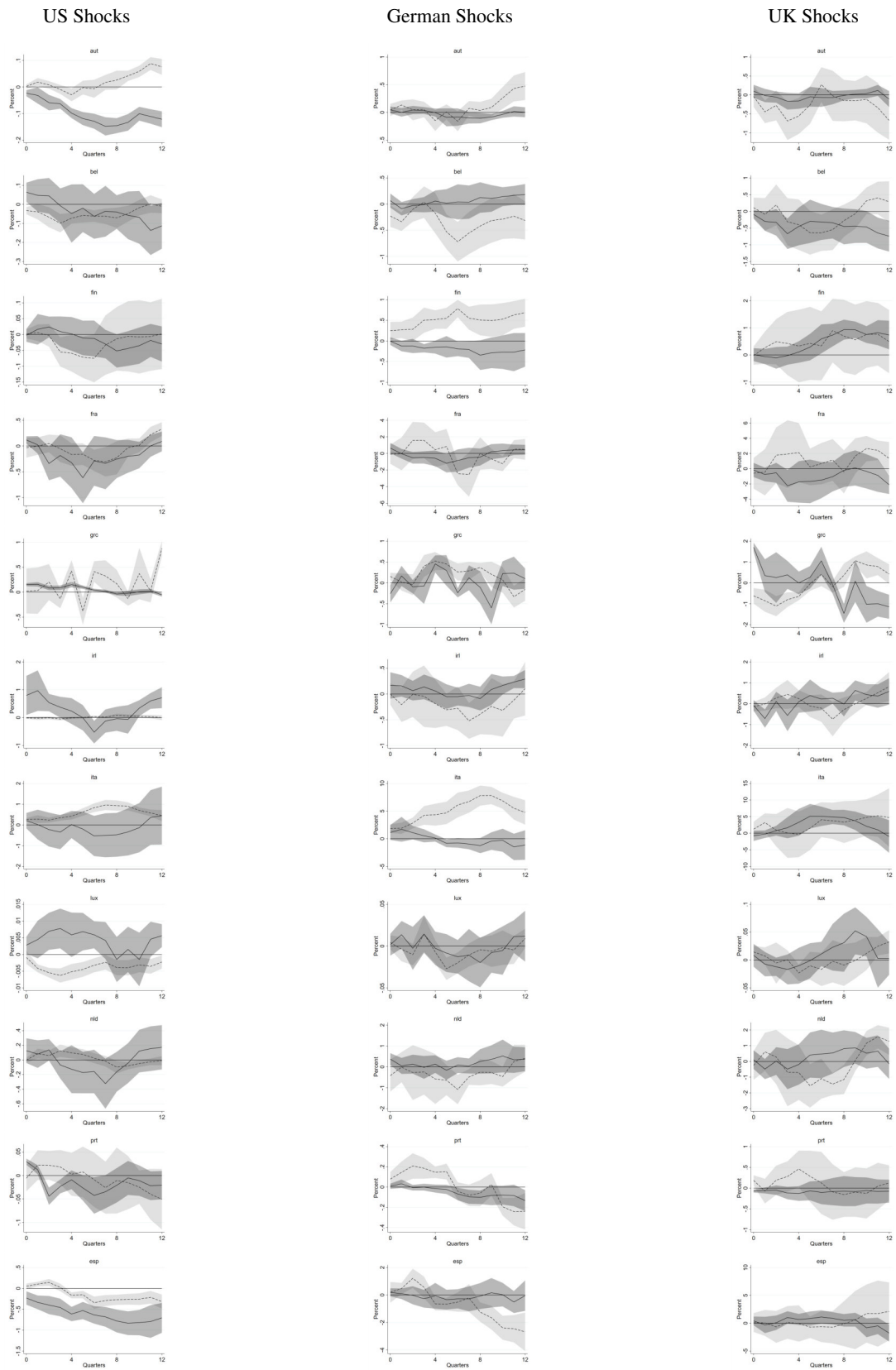
# Real Effective Exchange Rate

Figure A 10: REER, Unconditional, Aggregated Tax Cuts



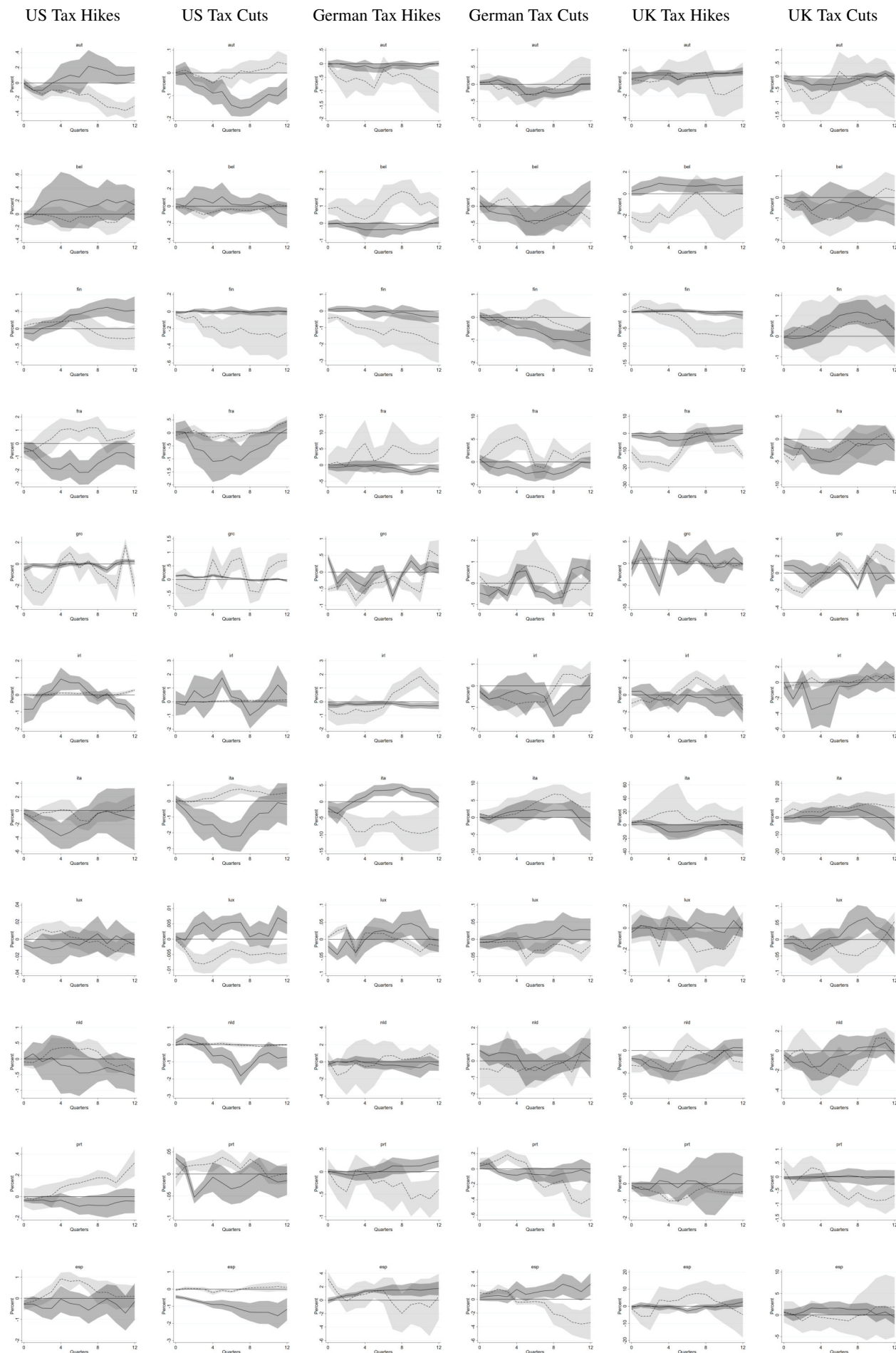
Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Shaded areas represent 90% confidence bands.

Figure A 11: REER, State-dependency, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. The shaded area represents 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

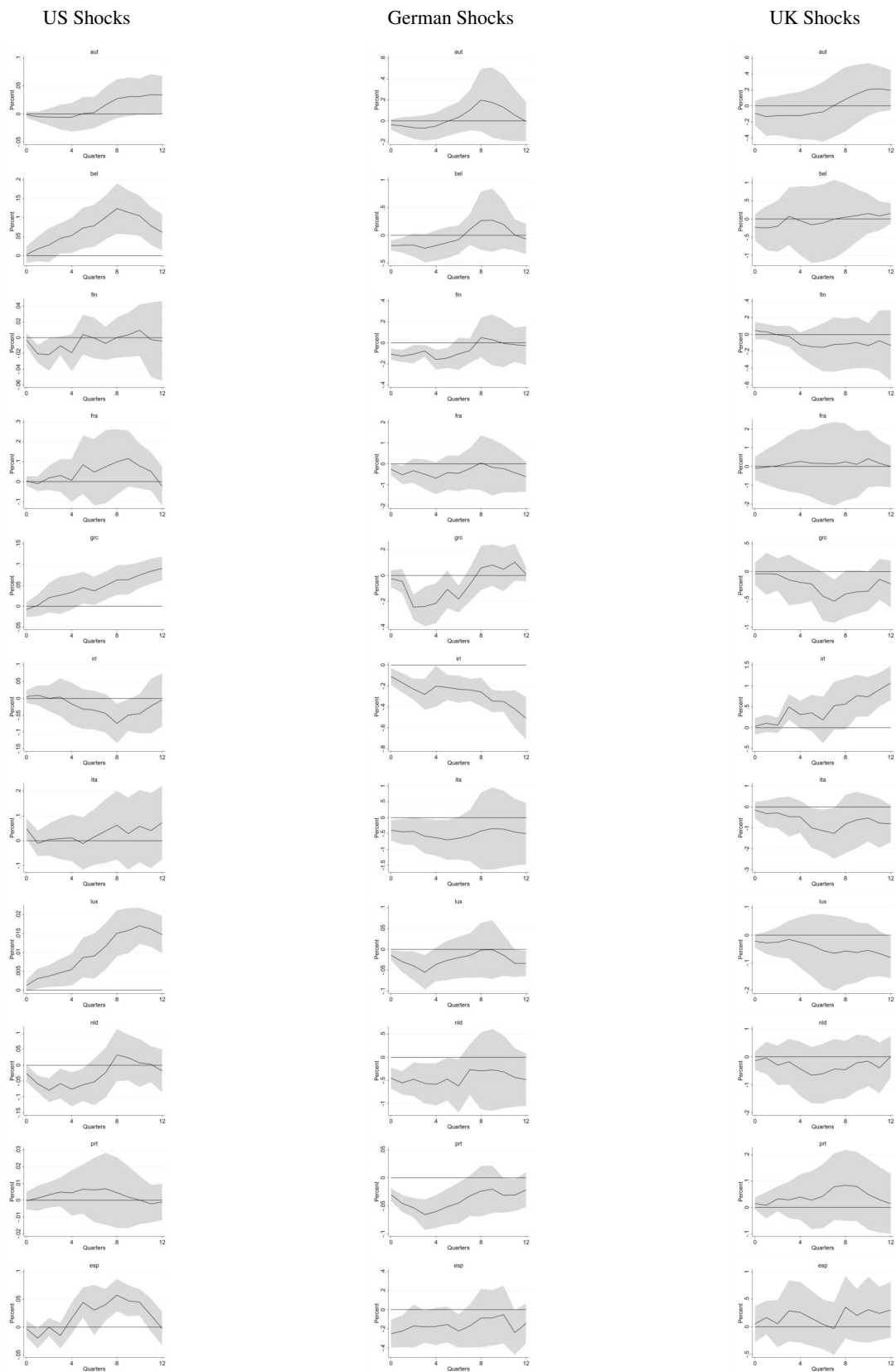
Figure A 12: REER, State-dependency, Asymmetric Tax Shocks



Notes: Figures present IRFs after a tax cut or hike equal to 1% of recipient country's GDP. Shaded areas represent 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

# Real Exports

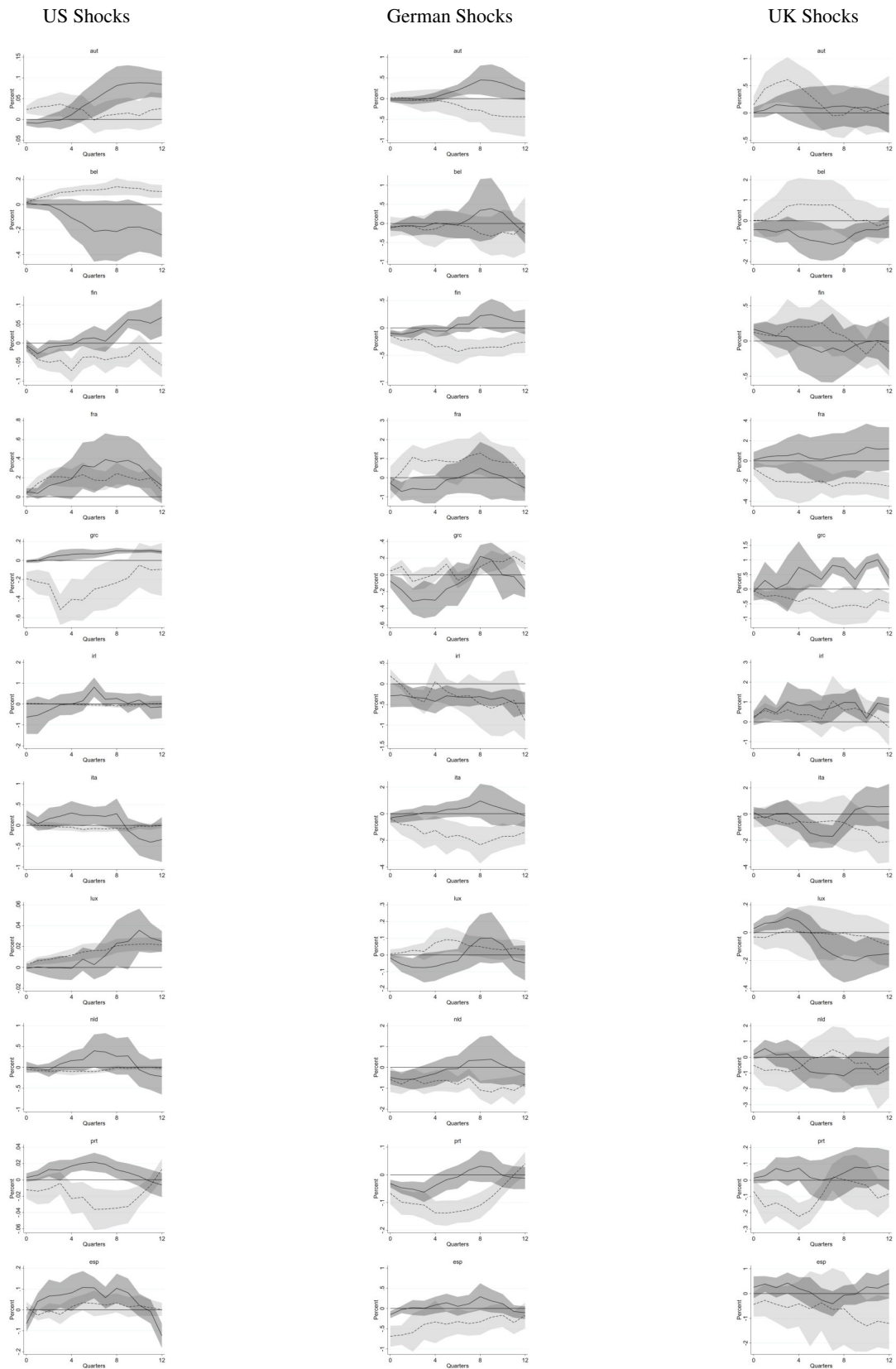
Figure A 13: Exports, Unconditional, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Dependent variable is expressed in percent of GDP. Shaded areas represent 90% confidence bands.

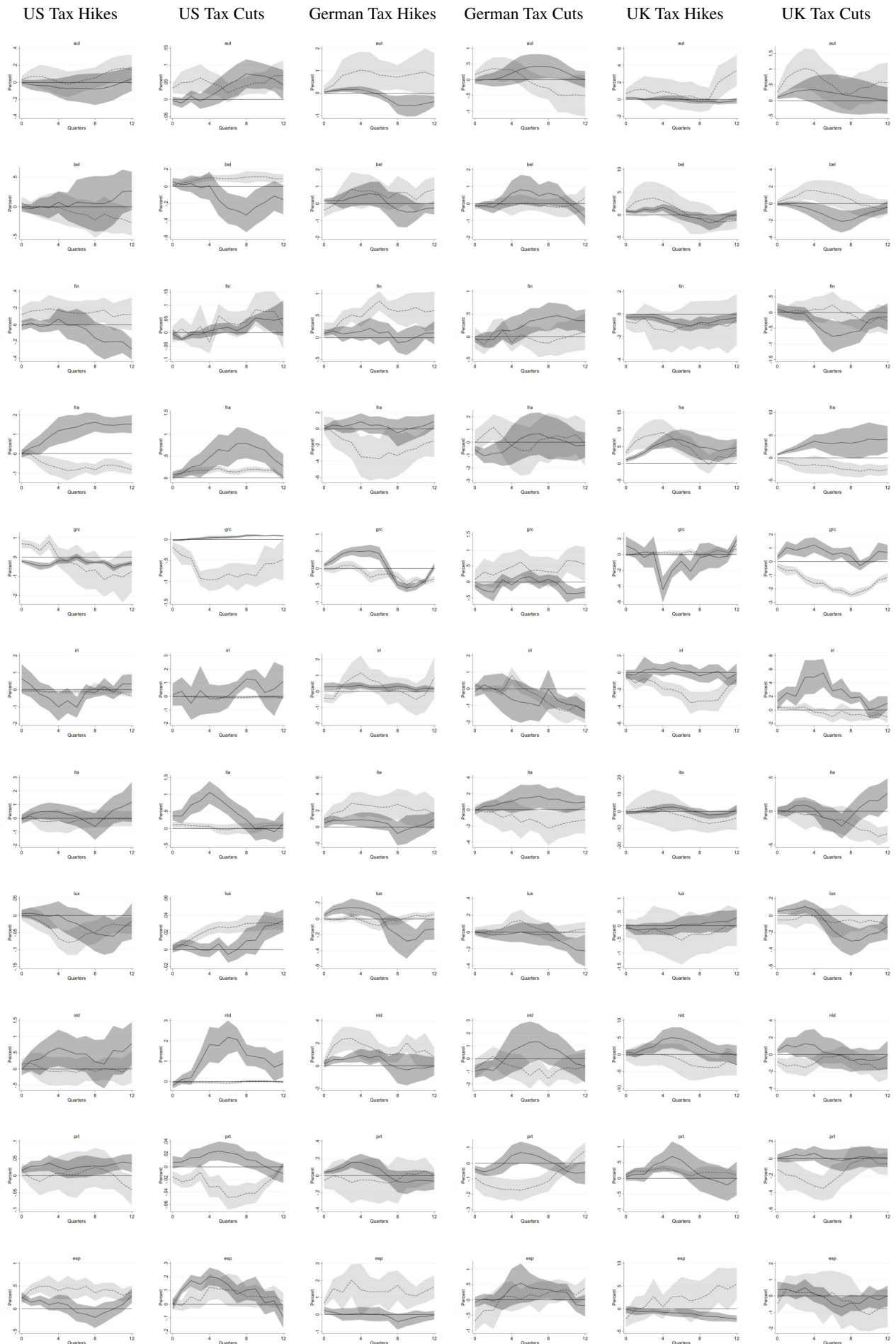


Figure A 14: Exports, State-dependency, Aggregated Tax Cuts



Notes: Figures present IRFs after a cut to aggregated taxes equal to 1% of recipient country's GDP. Dependent variable is expressed in percent of GDP. The shaded area represents 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

Figure A 15: Exports, State-dependency, Asymmetric Tax Shocks



Notes: Figures present IRFs after a tax cut or hike equal to 1% of recipient country's GDP. Dependent variable is expressed in percent of GDP. Shaded areas represent 90% confidence bands. The lighter (darker) shaded area represents recession (non-recession) periods.

## Robustness

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## 4 Lags of Control Variables

**Table A 1: Aggregated Tax Shocks, Unconditional Case**

Country	USA			Germany			UK		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Austria	0.00	0.03***	0.02**	-0.02	0.18**	0.07	-0.11	0.04	-0.04
Belgium	0.00	0.02*	0.01**	-0.03	0.18**	0.05*	-0.10	0.11	-0.02
Finland	-0.01	0.01	0.00	-0.05	0.11	0.01	-0.12	0.12	0.01
France	-0.01	0.10**	0.05	-0.25	0.67*	0.10	-0.57***	1.41***	0.28
Greece	-0.03	0.03***	0.01	-0.14***	0.10	-0.03	-0.13	0.37	0.20
Ireland	-0.04	0.04	0.01	-0.25***	-0.05	-0.13**	-0.03	0.51***	0.24*
Italy	-0.05**	0.21	0.07	-0.66	0.05	-0.33	-0.21*	2.45***	1.07**
Luxembourg	-0.00*	0.00	-0.00	-0.01	0.02*	0.01	-0.01	0.02**	0.01
Netherlands	-0.02	0.07	0.03	-0.38***	-0.13	-0.23***	-0.24	0.05	-0.09
Portugal	-0.04*	-0.00	-0.02*	-0.12**	-0.01	-0.04	0.00	0.24*	0.09
Spain	-0.10	0.02	-0.04	-0.77**	-0.08	-0.33	0.01	1.07**	0.48

Notes: Table yields the IRFs' minima and maxima after a cut in aggregated taxes equal to 1% of the recipient country's GDP, as well as the average effect over three years following the shock. \*, \*\*, and \*\*\* indicate significance at the 10%, 5%, and 1% significance level, respectively.

**Table A 2: USA—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.08**	0.05**	0.00	0.02**	0.01**	0.10
Belgium	-0.03	0.02	-0.00	0.00	0.03***	0.02***	0.04
Finland	-0.04***	0.03**	-0.01	-0.05**	0.00	-0.03*	0.15
France	-0.25***	0.13*	0.00	-0.01	0.22***	0.09**	0.15
Greece	-0.09***	0.00	-0.04***	-0.44***	0.13	-0.16	0.55
Ireland	-0.80*	0.60***	-0.07	-0.14**	0.05***	-0.04*	0.73
Italy	-0.44	0.20	-0.12	-0.02	0.47***	0.20**	0.04
Luxembourg	-0.01**	0.00	-0.00**	-0.00***	0.00***	0.00*	0.01
Netherlands	-0.15***	0.02	-0.04	-0.04**	0.07	0.02	0.06
Portugal	-0.10***	-0.01**	-0.06***	-0.03***	0.01***	-0.01	0.00
Spain	-0.05	0.08	0.01	-0.22***	0.00	-0.13**	0.19

Notes: See Table A1. The last column refers to the difference across states of the average effects.

**Table A 3: Germany—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.38***	0.19***	-0.23**	-0.04**	-0.11	0.01
Belgium	-0.04	0.24	0.10**	-0.15***	0.06	-0.04	0.03
Finland	-0.14**	0.14	-0.01	-0.07	0.11	-0.00	0.93
France	-0.30	1.09***	0.32**	-1.36	0.88***	-0.27	0.18
Greece	-0.09***	0.66***	0.22***	-0.12	0.86***	0.50***	0.02
Ireland	-0.31**	0.07*	-0.04*	-0.89	0.03	-0.41	0.15
Italy	-0.50*	0.89*	0.16	-1.21**	-0.28*	-0.79*	0.07
Luxembourg	-0.02	0.02*	0.00	-0.01	0.03***	0.02***	0.12
Netherlands	-0.31	-0.11	-0.20**	-0.58***	-0.17	-0.34**	0.40
Portugal	-0.13**	-0.01	-0.05	-0.07***	-0.01	-0.04	0.86
Spain	-0.12**	0.53	0.14	-2.31***	-0.39***	-1.51***	0.00

Notes: See Table A2.

**Table A 4: UK—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.19	0.02	-0.05	0.15**	0.56***	0.33**	0.01
Belgium	-0.23	0.01	-0.10	-0.21	0.09	-0.10	0.95
Finland	-0.03	0.26	0.12	0.02	0.30	0.14	0.89
France	-0.25	1.16*	0.34	-1.74**	-0.11	-1.07***	0.00
Greece	-2.19***	0.11	-1.55***	-0.34***	0.17***	0.01	0.00
Ireland	0.06	1.79***	0.94***	-0.03	0.91***	0.50	0.23
Italy	-1.03	0.83	-0.11	0.39	5.04***	3.17***	0.01
Luxembourg	-0.02	0.06***	0.01	-0.03**	0.00	-0.01**	0.01
Netherlands	-0.38	0.22	-0.10	0.00	0.85***	0.37***	0.00
Portugal	0.03***	0.41***	0.16**	-0.26	-0.05	-0.15	0.15
Spain	-1.13	-0.20	-0.76	-0.74	1.03	0.04	0.32

Notes: See Table A2..

**Table A 5: USA—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.13	0.01	-0.06	-0.04***	0.11**	0.02	0.21
Belgium	-0.00	0.11	0.05	-0.10***	-0.00	-0.05***	0.00
Finland	-0.47***	0.01	-0.14***	-0.27**	0.04	-0.11	0.68
France	0.13	0.75**	0.30	-0.37***	0.01	-0.20**	0.01
Greece	-1.64***	3.26***	1.22**	-2.84***	2.73***	-1.11	0.00
Ireland	-0.87***	1.19***	-0.05	-0.06	0.19*	0.04	0.38
Italy	-0.80**	0.16*	-0.32	-0.57***	-0.13	-0.29	0.95
Luxembourg	-0.02***	0.00	-0.01***	-0.01***	0.00	-0.00	0.14
Netherlands	-0.08*	0.40***	0.21***	-0.05	0.14*	0.02	0.06
Portugal	-0.10*	0.02**	-0.04*	0.05***	0.30***	0.18***	0.00
Spain	-0.93***	0.04	-0.45*	0.19**	0.67***	0.52***	0.00

Notes: See Table A2.

**Table A 6: USA—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.00	0.07	0.03	-0.00	0.04***	0.02***	0.77
Belgium	-0.02	0.07*	0.03	-0.00	0.03***	0.02**	0.47
Finland	-0.04***	0.02	-0.01	-0.11**	-0.02	-0.04	0.43
France	-0.58***	0.14***	-0.12**	-0.05	0.18***	0.08**	0.00
Greece	-0.34***	0.07	-0.16***	-1.43***	0.44	-0.41	0.45
Ireland	-1.08**	2.95***	0.45	-0.11***	0.05***	-0.04*	0.20
Italy	-0.97**	0.42**	-0.19	0.02	0.53***	0.25**	0.11
Luxembourg	-0.01***	0.00***	-0.00***	-0.00**	0.01***	0.00**	0.00
Netherlands	-0.07	0.68***	0.34***	-0.03***	0.06	0.01	0.00
Portugal	-0.12***	-0.01***	-0.07***	-0.03***	0.01***	-0.01	0.00
Spain	-0.23	0.06	-0.08	0.00	0.10	0.05	0.13

Notes: See Table A2.

**Table A 7: Germany—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.35***	0.08	-0.12***	0.01	0.49**	0.27	0.04
Belgium	-0.25*	0.05**	-0.11**	-0.41	-0.16	-0.29**	0.19
Finland	-0.00	0.30***	0.14**	-0.61***	-0.16**	-0.35**	0.01
France	-1.80***	0.35	-0.57***	-2.92***	2.13	-1.13	0.43
Greece	-0.49***	0.37***	-0.03	-2.12***	-0.37***	-1.32***	0.00
Ireland	-0.09**	0.28**	0.04	0.39***	3.25***	1.79***	0.00
Italy	-0.32	1.14*	0.37	0.25	1.59**	0.73*	0.55
Luxembourg	-0.07***	0.05***	-0.01	-0.04***	0.04***	-0.02**	0.09
Netherlands	0.01	0.69**	0.30**	-0.19	1.04***	0.45	0.66
Portugal	-0.16	0.02	-0.08	-0.55**	0.01	-0.29	0.28
Spain	-0.21	0.25	0.06	0.09	3.68***	2.37***	0.01

Notes: See Table A2.

**Table A 8: Germany—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.49***	0.30***	-0.40***	-0.06***	-0.23*	0.01
Belgium	-0.18*	0.46***	0.21***	-0.25***	-0.02	-0.12***	0.00
Finland	-0.11*	0.50***	0.19***	-0.40***	0.11	-0.24***	0.00
France	-0.24	0.32	0.05	-3.99***	0.51	-1.88***	0.00
Greece	-0.64***	1.97***	0.54***	-0.12***	0.51***	0.19***	0.00
Ireland	-0.71**	1.10***	0.37**	-0.16	0.80*	0.37**	0.99
Italy	-0.56	1.70**	0.57	-1.33*	-0.51	-0.85	0.06
Luxembourg	-0.05***	0.03	-0.00	-0.01	0.05***	0.01	0.57
Netherlands	-0.41	0.41**	0.01	-0.91	-0.14	-0.48	0.29
Portugal	-0.34***	-0.01	-0.15***	-0.18	-0.00	-0.09	0.60
Spain	-0.05	1.04**	0.44	-1.25**	-0.37	-0.80	0.04

Notes: See Table A2.

**Table A 9: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.12	0.33	0.07	0.09	2.75***	1.57***	0.00
Belgium	-0.39	0.44***	0.06	-0.65	1.57***	0.29**	0.23
Finland	-0.91**	0.11	-0.44*	-5.18***	-0.33	-3.39***	0.00
France	-0.25	1.55	0.82**	-2.79*	4.50***	1.42*	0.47
Greece	-2.14	3.51***	0.79	-0.20	1.24***	0.48***	0.68
Ireland	-2.86***	0.10	-1.03***	-5.12***	0.09	-2.13***	0.12
Italy	-5.06***	0.09	-2.70***	-3.03	3.05	-0.22	0.36
Luxembourg	-0.08*	0.08	-0.01	-0.17*	0.11	-0.03	0.72
Netherlands	0.23**	1.34*	0.92**	-3.68***	1.28***	-0.95***	0.00
Portugal	-2.97***	0.00	-1.41***	-0.92***	-0.02	-0.45***	0.00
Spain	-4.47***	0.10	-2.95***	-0.92	4.48*	2.47	0.00

Notes: See Table A2.

**Table A 10: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			<i>Difference</i> <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.09	0.17***	0.06	0.19***	1.47***	0.95***	0.00
Belgium	-0.43***	0.08***	-0.20***	-0.29	0.21**	-0.07	0.38
Finland	-0.07	0.20	0.07	-0.14	0.14	0.04	0.87
France	-0.09	2.21***	0.70**	-2.12**	0.24	-0.78*	0.00
Greece	-4.84***	1.46***	-1.19***	-0.76***	1.54***	0.40**	0.00
Ireland	-3.34**	1.89***	-0.43	-0.27***	1.60***	0.28	0.37
Italy	-1.96	1.15*	-0.35	-0.02	6.17***	4.26***	0.00
Luxembourg	-0.07***	0.05***	0.00	-0.05**	0.02*	-0.01**	0.08
Netherlands	-0.54**	0.49	-0.02	0.25	0.74***	0.58***	0.02
Portugal	-0.09	0.07	-0.00	-2.12***	-0.26**	-1.43***	0.00
Spain	-0.29	0.57	0.17	-2.46*	0.47	-1.27	0.10

Notes: See Table A2.

## 8 Lags of Exogenous Tax Shocks

Table A 11: Aggregated Tax Shocks, Unconditional Case

Country	USA			Germany			UK		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Austria	0.00	0.01	0.01	-0.01	0.16	0.06	-0.10	0.17	0.01
Belgium	-0.00	0.03***	0.02***	-0.04	0.15*	0.03	-0.01	0.17*	0.07*
Finland	-0.02	0.01	-0.00	-0.12***	0.05	-0.03	-0.05	0.11	0.04
France	0.02	0.13***	0.07***	-0.10	0.91**	0.24*	-0.13	1.65**	0.75
Italy	-0.10**	0.03	-0.03	-1.07	-0.11	-0.49	-0.00	1.83**	0.66
Luxembourg	-0.00	0.00	0.00	-0.01	0.02**	0.01*	-0.01	0.02**	0.01
Netherlands	-0.03**	0.05	0.02	-0.32***	-0.07	-0.18**	-0.23	0.05	-0.11
Portugal	-0.06***	-0.00	-0.03***	-0.21***	-0.02**	-0.08**	0.02	0.16	0.07
Spain	-0.10*	0.01	-0.04	-0.88**	-0.17**	-0.42**	-0.00	1.01**	0.45

Notes: See Table A1.

Table A 12: USA—Aggregated Tax Shocks, State Dependency

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.05**	0.03***	0.01**	0.05***	0.03***	0.87
Belgium	-0.10***	0.04	-0.03	0.00	0.03***	0.02***	0.07
Finland	-0.01	0.07***	0.02**	-0.12***	0.01	-0.06***	0.00
France	0.04	0.23***	0.15**	-0.02	0.22	0.08	0.51
Italy	-1.30***	-0.07	-0.56***	-0.14	0.02	-0.04	0.00
Luxembourg	-0.01***	0.00	-0.00	-0.00	0.00***	0.00*	0.07
Netherlands	-0.05	0.18*	0.06	-0.08**	0.01	-0.02	0.34
Portugal	-0.11***	-0.01***	-0.06***	-0.02	0.02	0.00	0.00
Spain	-0.27**	0.07	-0.06	-0.16*	-0.00	-0.09	0.77

Notes: See Table A2.

Table A 13: Germany—Aggregated Tax Shocks, State Dependency

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.02	0.35***	0.15***	-0.15	0.13**	-0.02	0.10
Belgium	-0.09	0.23**	0.08**	-0.26***	0.14*	-0.07	0.03
Finland	-0.09*	0.18**	0.04	-0.01	0.24	0.08	0.73
France	-0.18	1.45***	0.41**	-1.73**	0.81*	-0.18	0.10
Italy	-0.88**	1.43***	0.22	-1.64*	-0.39	-1.05	0.07
Luxembourg	-0.01	0.05***	0.01	-0.03***	0.02*	0.00	0.23
Netherlands	-0.21	0.22	-0.01	-0.91***	-0.29**	-0.53***	0.01
Portugal	-0.07	0.01	-0.02	-0.14**	0.07**	-0.00	0.81
Spain	-0.06	0.55**	0.17	-3.07***	-0.43***	-1.76***	0.00

Notes: See Table A2.



**Table A 14: UK—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.21	0.09**	-0.06	-0.03	0.22**	0.07	0.25
Belgium	-0.25	0.05	-0.08	0.11	0.35***	0.19**	0.04
Finland	0.04	0.31**	0.21**	-0.12	0.22	0.04	0.36
France	-0.36**	2.03***	0.97**	-0.42	3.21***	1.02	0.94
Italy	-0.06	3.79***	1.29***	0.10	3.50***	1.87***	0.43
Luxembourg	-0.00	0.04*	0.01	-0.01	0.04***	0.02**	0.48
Netherlands	-0.29	0.35	0.01	0.34	0.78***	0.53***	0.02
Portugal	0.03***	0.32*	0.17*	-0.04	0.29	0.13	0.78
Spain	-1.82*	-0.24*	-1.02*	0.05	3.23***	1.59**	0.00

Notes: See Table A2.

**Table A 15: USA—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.02*	0.13*	0.06*	-0.05	0.04	-0.00	0.05
Belgium	-0.18***	0.09*	-0.05	-0.09***	-0.01	-0.06***	0.66
Finland	-0.20***	0.04	-0.04	-0.10	0.09**	-0.01	0.59
France	0.03	1.63***	0.96***	-0.51***	-0.21***	-0.34	0.00
Italy	-0.19	1.35**	0.56*	-0.54	0.09	-0.24	0.06
Luxembourg	-0.02*	0.02***	-0.00	-0.03***	0.01	-0.01***	0.14
Netherlands	-0.01	0.56***	0.19*	-0.21*	0.10	-0.04	0.09
Portugal	-0.03	0.02	-0.01	-0.07***	0.10	-0.01	0.92
Spain	-0.34**	0.07	-0.19*	-0.20	0.19	0.08	0.13

Notes: See Table A2.

**Table A 16: USA—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.00	0.07***	0.04***	0.01	0.04	0.02	0.29
Belgium	-0.20***	-0.01	-0.11***	0.01***	0.04***	0.03***	0.00
Finland	-0.01	0.07***	0.02	-0.15***	0.05*	-0.03	0.26
France	0.04*	0.60***	0.38***	-0.10*	0.41**	0.15**	0.05
Italy	-1.42***	0.05	-0.56*	-0.15	0.30*	0.03	0.03
Luxembourg	-0.01**	0.00	-0.00**	-0.01**	0.00	-0.00	0.58
Netherlands	0.12	0.67***	0.46***	-0.10***	0.03	-0.04	0.00
Portugal	-0.12***	-0.00	-0.06***	-0.02*	0.02*	0.00	0.00
Spain	-0.28	0.05	-0.11	-0.01	0.14***	0.06**	0.33

Notes: See Table A2.

**Table A 17: Germany—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.38***	0.07***	-0.13***	-0.15***	0.83	0.40	0.04
Belgium	-0.16	0.04	-0.05	-0.45***	0.43***	0.03	0.42
Finland	-0.12	0.17**	0.04	-1.07***	-0.07	-0.60***	0.00
France	-2.06***	0.36	-0.61*	-2.48	2.58	-1.08	0.73
Italy	-1.94***	0.62	-0.41	-1.35	1.20***	-0.09	0.67
Luxembourg	-0.05***	0.07***	0.01	-0.05*	0.04**	-0.01	0.36
Netherlands	-0.39	0.24*	-0.03	-0.63	1.11**	0.37	0.18
Portugal	-0.09	0.01	-0.04	-0.14	0.21	0.02	0.83
Spain	-0.02	0.55	0.30	0.00	1.69***	1.29**	0.04

Notes: See Table A2.

**Table A 18: Germany—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.06	0.39*	0.20	-0.11	0.30***	0.09	0.42
Belgium	-0.44***	0.56***	0.09	-0.37***	0.21	-0.13*	0.06
Finland	-0.12	0.41***	0.18***	-0.93***	-0.09	-0.57**	0.00
France	-0.58	0.63	-0.17	-4.27***	0.59	-1.83***	0.00
Italy	-1.86	1.89	0.30	-3.57***	-0.27	-2.11**	0.03
Luxembourg	-0.05	0.09	0.03	-0.06***	0.02**	-0.02**	0.28
Netherlands	-0.69***	0.39	-0.04	-1.83***	-0.86***	-1.19***	0.00
Portugal	-0.10	-0.01	-0.04	-0.39***	0.00	-0.22**	0.18
Spain	-0.06	1.47**	0.69*	-4.07***	-0.18	-1.93***	0.00

Notes: See Table A2.

**Table A 19: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.36**	0.10	-0.17**	-0.07	2.54***	1.00	0.09
Belgium	-0.94***	0.13***	-0.32***	-1.50***	0.48	-0.63**	0.23
Finland	-0.91***	-0.09	-0.49***	-2.01***	-0.51	-1.27***	0.10
France	-1.63	1.76***	0.29	-4.88*	3.13**	-1.17	0.30
Italy	-5.37***	0.25	-2.48***	-0.15	14.81***	6.99*	0.01
Luxembourg	-0.18***	-0.02	-0.10***	-0.10	0.31***	0.11	0.02
Netherlands	-0.08	1.03	0.53	-1.05**	2.31***	0.94	0.67
Portugal	-2.47***	-0.05	-1.26***	-0.79***	-0.04**	-0.51***	0.00
Spain	-3.46***	-0.14	-2.29***	0.52	6.33	3.29*	0.00

Notes: See Table A2.

**Table A 20: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.22	0.14**	-0.06	-0.05	0.38**	0.13	0.37
Belgium	-0.68***	0.01	-0.33***	0.01	0.21*	0.11	0.00
Finland	-0.08	0.47***	0.10	-0.45*	0.02	-0.25*	0.00
France	-0.21***	1.72**	0.99***	-0.93	3.26**	0.52	0.57
Italy	-1.70	3.37*	-0.13	-2.65***	2.20**	-0.22	0.95
Luxembourg	-0.03	0.03	0.00	-0.02**	0.10***	0.05***	0.01
Netherlands	0.18	1.09***	0.62***	0.43	1.10***	0.86***	0.32
Portugal	-0.01	0.07	0.04	-1.22***	-0.00	-0.91***	0.00
Spain	-1.52	-0.20	-0.89	0.31	5.08***	2.08***	0.00

Notes: See Table A2.



## Only Permanent Tax Changes

**Table A 21: Aggregated Tax Shocks, Unconditional Case**

Country	USA			Germany			UK		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Austria	-0.00	0.00	0.00	-0.03	0.15*	0.04	-0.09	0.18	0.01
Belgium	-0.00	0.02	0.01	-0.06	0.10	-0.00	-0.04	0.15	0.05
Finland	-0.01	-0.00	-0.01	-0.13**	0.04	-0.04	-0.03	0.15	0.06
France	-0.01	0.05	0.02	-0.43	0.64*	0.06	-0.30	1.59***	0.67
Greece	-0.01***	0.02	0.01	-0.30	-0.09**	-0.23	-0.28	0.33	0.10
Ireland	-0.02	0.10***	0.04**	-0.23*	-0.05	-0.13*	0.09	0.64***	0.31*
Italy	-0.08*	0.00	-0.04	-0.89	-0.10	-0.49	-0.15	1.92**	0.78
Luxembourg	-0.00*	0.00	0.00	-0.01	0.02*	0.01	-0.01	0.02	0.01
Netherlands	-0.02	0.04	0.01	-0.29**	-0.10*	-0.20**	-0.19	0.04	-0.08
Portugal	-0.04**	-0.00	-0.02**	-0.16**	-0.01**	-0.07	-0.01	0.17	0.06
Spain	-0.10**	0.00	-0.07**	-0.58*	-0.15	-0.31	-0.06	1.02**	0.43

Notes: See Table A1.

**Table A 22: USA—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.02	0.01	-0.01	0.01	-0.00	0.50
Belgium	-0.03	0.02	-0.01	0.00	0.02**	0.01	0.24
Finland	-0.01**	0.06**	0.02**	-0.05***	0.00	-0.03***	0.00
France	-0.01	0.07	0.02	-0.08	0.09**	-0.00	0.75
Greece	-0.01**	0.01**	0.00	-0.04	0.69***	0.40***	0.00
Ireland	-0.16	0.37***	0.12*	-0.01	0.10***	0.04***	0.25
Italy	-0.29	0.01	-0.14	-0.05	0.07	0.02	0.30
Luxembourg	-0.00**	0.00	-0.00	-0.00	0.00**	0.00	0.06
Netherlands	-0.02	0.10	0.03	-0.01	0.04	0.02	0.75
Portugal	-0.12***	-0.01***	-0.06***	0.00	0.02***	0.01	0.00
Spain	-0.18**	0.03	-0.09	-0.09*	0.01	-0.05	0.61

Notes: See Table A2.

**Table A 23: Germany—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.27***	0.12**	-0.14	0.00	-0.09	0.09
Belgium	-0.03	0.18	0.05	-0.16	0.02	-0.08	0.14
Finland	-0.14**	0.11	-0.02	-0.14***	0.01	-0.07	0.47
France	-0.26	1.08***	0.30*	-0.25	0.51	0.10	0.52
Greece	-0.13*	0.38**	0.05	-0.46**	-0.13*	-0.37*	0.07
Ireland	-0.36**	-0.13**	-0.22**	-0.37**	0.05*	-0.14	0.57
Italy	-0.28	0.77**	0.10	-1.51*	-0.25	-1.05*	0.06
Luxembourg	-0.01	0.04**	0.01*	-0.01	0.02**	0.01	0.36
Netherlands	-0.17	0.05	-0.06	-0.71***	-0.23	-0.47***	0.04
Portugal	-0.02	0.03	0.00	-0.15*	0.01	-0.05	0.27
Spain	-0.10**	0.35	0.08	-2.00***	-0.26***	-1.11***	0.01

Notes: See Table A2.

**Table A 24: UK—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.14	0.08	-0.06	0.21	0.05	0.85
Belgium	-0.08	0.13**	0.01	-0.04	0.13	0.06	0.71
Finland	0.07	0.36***	0.24**	0.00	0.28	0.15	0.50
France	-0.29	1.88***	0.98***	-0.83	3.09***	0.81	0.78
Greece	-0.47	0.29*	-0.01	0.14*	0.69***	0.47***	0.13
Ireland	0.19	1.42***	0.79**	0.05	0.78***	0.42***	0.37
Italy	-0.01	2.61***	1.05*	0.14	2.12	1.22	0.88
Luxembourg	-0.01	0.03	0.01	-0.01	0.01	0.01	0.82
Netherlands	-0.33	0.22	-0.02	0.02	0.84**	0.41**	0.07
Portugal	0.02***	0.31*	0.13	-0.19	0.03	-0.09	0.42
Spain	-1.27*	-0.16	-0.69	-0.08	2.56	1.17	0.16

Notes: See Table A2.

**Table A 25: USA—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.14	0.08	-0.06	0.21	0.05	0.85
Belgium	-0.08	0.13**	0.01	-0.04	0.13	0.06	0.71
Finland	0.07	0.36***	0.24**	0.00	0.28	0.15	0.50
France	-0.29	1.88***	0.98***	-0.83	3.09***	0.81	0.78
Greece	-0.47	0.29*	-0.01	0.14*	0.69***	0.47***	0.13
Ireland	0.19	1.42***	0.79**	0.05	0.78***	0.42***	0.37
Italy	-0.01	2.61***	1.05*	0.14	2.12	1.22	0.88
Luxembourg	-0.01	0.03	0.01	-0.01	0.01	0.01	0.82
Netherlands	-0.33	0.22	-0.02	0.02	0.84**	0.41**	0.07
Portugal	0.02***	0.31*	0.13	-0.19	0.03	-0.09	0.42
Spain	-1.27*	-0.16	-0.69	-0.08	2.56	1.17	0.16

Notes: See Table A2.

**Table A 26: USA—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.01	0.00	-0.01	0.01	0.00	0.87
Belgium	-0.04	0.06***	0.00	-0.00	0.02**	0.01	0.75
Finland	-0.01**	0.05	0.02	-0.05***	0.00	-0.02**	0.02
France	0.04	0.43***	0.24***	-0.10	0.08	-0.00	0.00
Greece	-0.02**	0.01	-0.00	-0.01	0.63***	0.37***	0.00
Ireland	-0.32***	0.33***	0.01	-0.01	0.11***	0.03***	0.77
Italy	-0.07	0.20	0.04	-0.01	0.09	0.03	0.98
Luxembourg	-0.01***	0.00	-0.00*	-0.00	0.00**	0.00	0.02
Netherlands	-0.02	0.25***	0.11*	-0.01	0.03	0.01	0.08
Portugal	-0.14***	-0.00*	-0.07***	0.01	0.03***	0.02***	0.00
Spain	-0.28***	-0.01	-0.16**	0.01	0.10*	0.07	0.00

Notes: See Table A2.

**Table A 27: Germany—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.30**	0.12	-0.07	0.02	0.44	0.30	0.18
Belgium	-0.23	0.05	-0.08	-0.34***	0.39**	0.10	0.10
Finland	-0.24	0.07	-0.05	-0.27	0.04	-0.08	0.80
France	-1.14*	0.31	-0.20	-0.25	1.58	0.50	0.54
Greece	-0.96***	0.01	-0.41***	-0.00	0.28***	0.14***	0.00
Ireland	0.01	0.26***	0.12*	0.30***	3.06***	1.67***	0.00
Italy	-1.05	0.71	-0.04	-0.08	1.52	1.07	0.29
Luxembourg	-0.04**	0.06***	0.01	-0.04***	0.03***	-0.02**	0.03
Netherlands	-0.23	0.22*	0.04	-0.37	0.92*	0.31**	0.11
Portugal	-0.14	0.02	-0.06	-0.66*	-0.03	-0.29	0.33
Spain	-0.04	0.34**	0.18	-0.46***	1.32	0.68	0.65

Notes: See Table A2.

**Table A 28: Germany—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.02	0.31**	0.18*	-0.16	0.06	-0.06	0.11
Belgium	-0.12	0.27***	0.10*	-0.25***	-0.02	-0.10	0.03
Finland	-0.22**	0.05	-0.09	-0.32	0.01	-0.22	0.44
France	-0.37	1.04**	0.28	-1.85*	0.03	-0.89*	0.04
Greece	-0.59***	0.25	-0.18*	-1.86***	0.08	-1.14***	0.00
Ireland	-1.61***	-0.27	-0.86***	0.03	0.35***	0.22**	0.00
Italy	-0.44	0.93*	0.12	-1.36*	-0.45	-0.91	0.29
Luxembourg	0.01	0.07*	0.04*	-0.00	0.02	0.01	0.08
Netherlands	-0.20	0.26	0.01	-1.35**	-0.53	-0.87***	0.03
Portugal	-0.03	0.02	0.00	-0.37**	0.00	-0.14**	0.04
Spain	0.09	0.84*	0.46	-2.26***	-0.27	-1.19**	0.01

Notes: See Table A2.

**Table A 29: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.39***	0.14*	-0.13	-0.02	2.67***	1.52***	0.01
Belgium	-0.86***	0.11***	-0.35***	-1.06***	1.24***	-0.01	0.14
Finland	-1.05***	-0.02	-0.59***	-3.71***	-0.63***	-2.60***	0.00
France	-3.15***	1.21**	-0.77*	-3.67	3.27*	0.17	0.38
Greece	-3.95**	-0.50	-2.31*	-1.06***	-0.15***	-0.68***	0.18
Ireland	-0.94	0.36	-0.41	-1.31***	0.01	-0.71***	0.55
Italy	-7.09***	-0.51	-3.85***	-13.43***	2.88	-5.14	0.74
Luxembourg	-0.11**	0.05	-0.05	-0.14	0.18*	0.04	0.21
Netherlands	-0.07	0.77	0.36	-3.03***	0.99	-0.60	0.19
Portugal	-2.22***	-0.02	-1.07***	-0.78***	0.07	-0.43***	0.08
Spain	-3.89**	-0.13	-2.32***	-0.17	6.77	4.73	0.11

Notes: See Table A2.

**Table A 30: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			<i>Difference</i> <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.04**	0.17	0.12	0.03	0.40*	0.23	0.52
Belgium	-0.29	0.01	-0.13	-0.09	0.34*	0.11	0.14
Finland	-0.05	0.27	0.11	-0.17	0.07	-0.03	0.45
France	0.08	1.77**	1.18**	-0.34	5.13***	1.39*	0.80
Greece	-1.69***	-0.03	-0.91**	-0.49**	0.27	-0.07	0.25
Ireland	0.90	3.89***	2.83***	-0.08	0.47**	0.13*	0.00
Italy	-1.11	2.02	0.03	-0.44	1.91	0.62	0.66
Luxembourg	-0.04**	0.03**	-0.00	-0.02***	0.04*	0.02	0.28
Netherlands	-0.16	0.50***	0.18	0.09	0.81**	0.49**	0.27
Portugal	-0.11	0.04*	-0.03	-1.60***	-0.03	-0.87***	0.00
Spain	-1.89**	-0.09	-0.90**	-0.11	3.51	1.54	0.07

Notes: See Table A2.

## Smooth–Transition Parameter (Auerbach & Gorodnichenko, 2013)

**Table A 31: USA—Aggregated Tax Shocks, State Dependency**

Country	Non–Recession			Recession			Difference <i>p</i> –val
	Min	Max	Avg	Min	Max	Avg	
Austria	–0.04	0.01	–0.01	0.00	0.04	0.02	0.60
Belgium	0.00	0.10**	0.07***	–0.02	0.03	0.01	0.04
Finland	–0.31***	0.01	–0.15***	–0.01	0.33***	0.16***	0.00
France	–0.22	0.64	0.12	–0.21	0.32***	0.13	0.97
Greece	–0.07***	0.08***	0.01	–0.21***	0.34**	0.01	0.96
Ireland	–0.37	0.20	–0.06	–0.13	0.33	0.11	0.61
Italy	–0.37	0.18	–0.09	–0.34*	0.08*	–0.06	0.94
Luxembourg	–0.01*	0.00	–0.00	–0.00	0.01***	0.00	0.14
Netherlands	0.06	0.19	0.10	–0.09***	0.01	–0.03	0.13
Portugal	0.00	0.11*	0.06*	–0.08	0.00	–0.04	0.11
Spain	0.11	0.83***	0.42***	–0.46***	–0.04	–0.25***	0.00

Notes: See Table A2.

**Table A 32: Germany—Aggregated Tax Shocks, State Dependency**

Country	Non–Recession			Recession			Difference <i>p</i> –val
	Min	Max	Avg	Min	Max	Avg	
Austria	–0.06*	0.51**	0.20*	–0.29	0.04	–0.12	0.19
Belgium	–0.22*	0.27	0.07	–0.14	0.26	–0.01	0.66
Finland	–0.10	0.45*	0.17	–0.97**	0.24*	–0.28	0.12
France	–1.06***	2.11***	0.53	–1.16	1.51***	0.53	1.00
Greece	0.15*	0.86***	0.44***	–0.87	–0.01	–0.46*	0.01
Ireland	–0.08	0.24***	0.05	–0.49***	0.31	–0.02	0.83
Italy	–0.18	2.19*	0.88	–5.09***	–0.22	–2.15*	0.09
Luxembourg	0.00	0.04**	0.03***	–0.05***	0.00	–0.01*	0.01
Netherlands	–0.03	0.43*	0.15	–1.22***	–0.40	–0.82***	0.00
Portugal	–0.02	0.20*	0.09	–0.51***	0.04	–0.18**	0.09
Spain	–0.11	1.20*	0.58**	–2.42***	–0.13	–1.15***	0.01

Notes: See Table A2.

**Table A 33: UK—Aggregated Tax Shocks, State Dependency**

Country	Non–Recession			Recession			Difference <i>p</i> –val
	Min	Max	Avg	Min	Max	Avg	
Austria	–0.01	0.16	0.08	–0.17	0.11	–0.07	0.77
Belgium	–0.17	0.37	0.06	–0.27	0.32	0.04	0.92
Finland	–0.48	0.49***	0.11	–0.83***	1.12***	–0.08	0.60
France	–0.98	4.64***	2.29**	–3.74***	2.69*	–1.40	0.04
Greece	–1.14***	–0.01	–0.61***	–0.08	0.84***	0.27	0.00
Ireland	–1.03***	0.18	–0.36	0.05	1.50***	0.80***	0.00
Italy	–4.05**	1.01	–1.07	0.16	9.03***	3.39**	0.05
Luxembourg	–0.07***	0.01	–0.03	–0.00	0.14***	0.06**	0.06
Netherlands	–0.52	0.29	–0.14	–0.27	0.65	0.19	0.60
Portugal	0.02*	0.43**	0.16*	–0.08	0.25	0.08	0.73
Spain	–1.86***	0.19	–0.92**	0.03	2.98*	1.73*	0.01

Notes: See Table A2.



**Table A 34: USA—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.22	0.01	-0.13*	-0.01	0.12***	0.08**	0.03
Belgium	-0.20*	-0.02	-0.11*	0.03	0.13	0.08	0.14
Finland	-0.08***	0.29***	0.13***	-0.49***	0.04	-0.23***	0.00
France	-0.62	0.60***	0.16	-0.25	0.33	-0.03	0.71
Greece	-0.03	0.74***	0.44***	-0.49***	0.01	-0.25**	0.01
Ireland	-0.37	0.82**	0.33*	-0.34*	0.38	-0.02	0.27
Italy	-0.35*	1.35	0.65	-2.12**	0.11	-1.13*	0.07
Luxembourg	-0.02***	0.00	-0.01	-0.04***	0.00	-0.01	0.59
Netherlands	-0.22	-0.03	-0.14	-0.14	0.31*	0.08	0.25
Portugal	-0.11***	0.00	-0.05**	0.01	0.08*	0.06	0.05
Spain	-1.08***	-0.19	-0.58***	0.24**	1.07***	0.74***	0.00

Notes: See Table A2.

**Table A 35: USA—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.23***	-0.03	-0.16**	0.01	0.14**	0.10**	0.02
Belgium	0.02	0.13***	0.08**	-0.02	0.04	-0.00	0.18
Finland	-0.25*	-0.01	-0.09	-0.01	0.27*	0.10	0.20
France	-0.79**	1.19	0.25	-0.25	0.67***	0.13	0.92
Greece	-0.20	0.67**	0.26	-3.87**	1.21	-1.45	0.19
Ireland	-2.12***	0.98	-0.76	-0.63	2.00***	0.84	0.50
Italy	-3.35***	-0.11	-1.79**	0.04	1.56**	0.85*	0.03
Luxembourg	-0.05***	-0.01	-0.02***	0.00	0.02***	0.01***	0.00
Netherlands	-0.07	0.58**	0.27*	-0.15**	0.03	-0.07	0.08
Portugal	-0.02	0.19	0.10	-0.08	0.02	-0.03	0.37
Spain	-0.02	0.41	0.12	-0.01	0.15	0.06	0.85

Notes: See Table A2.

**Table A 36: Germany—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.87***	-0.04	-0.40**	0.09	0.69	0.36	0.08
Belgium	-0.07	0.31**	0.15	-0.71**	-0.08	-0.42*	0.09
Finland	-0.37	0.11	-0.12	-0.41	0.61	0.12	0.69
France	-1.94**	1.04*	-0.44	-3.04***	2.17	-1.28	0.55
Greece	-2.41***	0.43	-0.83*	-1.33	4.60***	1.47	0.15
Ireland	-0.45**	0.15	-0.19	-0.37	0.99***	0.19	0.45
Italy	-1.31**	1.60	0.13	-4.55	2.04**	-0.84	0.72
Luxembourg	-0.05**	0.03***	-0.00	-0.05**	0.04***	-0.00	0.96
Netherlands	-0.97***	0.09	-0.39***	-0.13	2.22***	1.15***	0.00
Portugal	-0.11	0.03	-0.03	-0.11	-0.02	-0.07	0.88
Spain	-2.25***	0.23**	-0.83*	-0.28	2.65*	1.17	0.13

Notes: See Table A2.

**Table A 37: Germany—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.16**	0.33*	0.08	-0.16	0.18	-0.00	0.72
Belgium	-0.13	0.82***	0.42***	-0.81***	-0.09	-0.43**	0.00
Finland	-0.37***	0.52**	0.09	-0.82**	0.33***	-0.14	0.39
France	-1.64***	2.22**	0.38	-0.59	1.28*	0.30	0.95
Greece	-0.32	0.60***	0.08	-0.57	1.00	0.08	0.99
Ireland	-0.51*	0.17	-0.20	-1.03*	0.87***	0.01	0.68
Italy	-0.88	3.75**	1.55	-8.81***	-0.10	-4.30**	0.06
Luxembourg	0.03***	0.10***	0.06***	-0.10***	-0.03	-0.06**	0.01
Netherlands	-0.38	0.41	0.05	-0.89***	-0.03	-0.45	0.25
Portugal	-0.05	0.43***	0.20***	-0.95***	0.06	-0.39***	0.00
Spain	-0.23	1.17***	0.59**	-2.41***	-0.18	-1.23***	0.00

Notes: See Table A2.

**Table A 38: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.80	0.26	-0.48	-0.07	0.96	0.30	0.47
Belgium	-1.77***	0.39	-0.46	-0.89	0.45	-0.15	0.62
Finland	-2.26***	-0.40**	-1.41***	-2.08*	0.54	-0.29	0.11
France	-14.56***	-2.56	-9.71***	0.79	11.18***	5.49**	0.01
Greece	-1.49**	2.00*	-0.16	-0.70***	0.44	0.02	0.78
Ireland	-2.23***	-0.21	-1.23***	-1.44***	0.59*	-0.63***	0.37
Italy	-8.20***	8.85	0.71	-10.94**	6.04**	-3.31	0.54
Luxembourg	-0.05	0.21***	0.05	-0.34***	0.07	-0.11**	0.14
Netherlands	-0.28	4.26**	1.21	-2.37**	0.58**	-0.87	0.22
Portugal	-1.40	0.37	-0.28	-1.31***	-0.07*	-0.78***	0.47
Spain	-4.89	1.04	-2.30	-4.66***	0.46**	-2.37***	0.97

Notes: See Table A2.

**Table A 39: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.08*	0.36	0.18	-0.37	0.23*	-0.07	0.59
Belgium	-0.28	0.21	-0.01	-0.54*	0.43*	-0.04	0.93
Finland	-0.95***	0.35***	-0.21	-1.21***	0.53	-0.32	0.82
France	-1.46	4.03***	1.90**	-3.68***	3.22	-1.38	0.10
Greece	-1.80***	-0.22	-1.11***	-1.27	2.14***	0.25	0.13
Ireland	-0.69	1.16	0.20	-2.14*	0.75	-0.39	0.63
Italy	-3.97**	0.44	-0.91	1.08	12.48***	4.10	0.16
Luxembourg	-0.08***	0.01	-0.03	0.01	0.13***	0.06**	0.07
Netherlands	-0.60	0.35	-0.15	-0.53	0.76	0.21	0.57
Portugal	0.04***	0.43**	0.16	-0.57**	0.02	-0.36***	0.01
Spain	-1.41**	0.67	-0.30	-0.39	1.68	0.43	0.67

Notes: See Table A2.

## Control Variables in First Differences

**Table A 40: Aggregated Tax Shocks, Unconditional Case**

Country	USA			Germany			UK		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Austria	-0.04**	-0.00	-0.02	-0.06	0.04	-0.02	-0.06	0.35***	0.08
Belgium	-0.02	0.01	-0.01	-0.16	0.01	-0.07	0.01	0.40***	0.20**
Finland	0.00	0.02	0.01	-0.09	0.02	-0.04	0.05	0.21	0.12
France	-0.13	0.06	-0.04	-0.54	0.18	-0.25	-0.25	1.83**	0.76
Greece	0.03**	0.08**	0.05**	-0.15	0.04	-0.07	0.23***	1.44**	0.99**
Ireland	-0.07	0.03*	-0.02	-0.52**	-0.11**	-0.29*	0.13	1.07**	0.55*
Italy	-0.15**	0.01	-0.05	-0.59*	0.02	-0.33	-0.19	2.79***	1.21*
Luxembourg	-0.00	-0.00**	-0.00	-0.00	0.02	0.01	-0.00	0.07***	0.04***
Netherlands	-0.08	0.01	-0.04	-0.71**	-0.15***	-0.44**	0.16	0.95**	0.64**
Portugal	-0.06***	-0.00	-0.03**	-0.12**	-0.00	-0.04	0.02	0.29*	0.14
Spain	-0.01	0.03	0.01	-0.86*	-0.14***	-0.39	0.07	2.06**	1.07**

Notes: See Table A1.

**Table A 41: USA—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.08***	0.00	-0.03**	-0.01	0.03***	0.02	0.02
Belgium	-0.09**	-0.00	-0.05*	-0.01	0.02	0.00	0.15
Finland	-0.01	0.07**	0.03**	-0.03	0.01*	-0.01	0.03
France	-0.45***	0.00	-0.25***	-0.04	0.19***	0.08	0.01
Greece	-0.00	0.11	0.04	-0.17	1.11	0.41	0.27
Ireland	-0.79	0.43	-0.14	-0.09**	0.04***	-0.04	0.81
Italy	-0.34	0.01	-0.14	-0.19**	0.02	-0.06	0.59
Luxembourg	-0.01	0.00	-0.00	-0.00*	0.00	-0.00	0.74
Netherlands	-0.17*	0.02	-0.08	-0.08**	-0.01	-0.04	0.54
Portugal	-0.09***	-0.01***	-0.05***	-0.03	0.02	0.00	0.07
Spain	0.03	0.24	0.14	-0.17*	0.00	-0.09	0.24

Notes: See Table A2.

**Table A 42: Germany—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.02	0.12	0.02	-0.26	0.06	-0.08	0.53
Belgium	-0.16	0.15	0.02	-0.11	0.08	-0.01	0.80
Finland	-0.10**	0.16	0.01	-0.09	0.11	-0.01	0.86
France	-0.79	0.02	-0.40	-0.07	0.63**	0.28	0.34
Greece	-0.09*	0.53***	0.24*	-1.56**	-0.10	-0.73**	0.00
Ireland	-0.74***	-0.18*	-0.38**	-0.10	0.46**	0.16	0.01
Italy	-0.61	0.69	0.05	-1.32	-0.26	-0.90	0.31
Luxembourg	-0.00	0.08*	0.04	-0.04**	-0.00	-0.01	0.05
Netherlands	-0.37	-0.09**	-0.25	-0.77	-0.22	-0.46	0.61
Portugal	-0.09*	0.01	-0.02	-0.16***	0.00	-0.05	0.59
Spain	-1.02	0.01	-0.35	-1.05**	-0.22	-0.64*	0.38

Notes: See Table A2.

**Table A 43: UK—Aggregated Tax Shocks, State Dependency**

Country	Non-Recession			Recession			Difference
	Min	Max	Avg	Min	Max	Avg	<i>p-val</i>
Austria	-0.06	0.29*	0.08	0.07	0.30	0.18	0.61
Belgium	-0.07	0.27**	0.07	0.14***	0.49	0.29	0.38
Finland	-0.03	0.23	0.11	0.03	0.35	0.19	0.82
France	-0.34	1.64	0.49	0.42	4.95*	3.30**	0.11
Greece	-0.37	0.82	0.11	0.28***	2.18***	1.40***	0.02
Ireland	0.02	2.27**	1.34*	0.12	0.87	0.52	0.30
Italy	-0.22	2.83**	0.87	0.31	2.99	1.92	0.53
Luxembourg	0.01	0.10**	0.06***	-0.02**	0.05	0.02	0.24
Netherlands	0.13	0.72	0.49	0.37	1.75**	1.06	0.43
Portugal	0.04***	0.50***	0.22***	-0.32	-0.05***	-0.20	0.04
Spain	0.14*	1.49*	0.80	-1.65	-0.30	-1.21	0.09

Notes: See Table A2.

**Table A 44: USA—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference
	Min	Max	Avg	Min	Max	Avg	<i>p-val</i>
Austria	0.01	0.09	0.03	-0.00	0.17***	0.09**	0.30
Belgium	-0.03	0.10*	0.04	-0.07	0.01	-0.03	0.16
Finland	-0.09	0.03	-0.02	0.01	0.20**	0.14*	0.01
France	-0.44	0.16	-0.17	0.01	0.82**	0.44	0.19
Greece	-0.20**	1.43***	0.52**	-6.20**	0.21*	-3.54**	0.01
Ireland	-0.76	0.45	-0.15	-0.00	0.25	0.10	0.57
Italy	0.03	0.63	0.28	-0.06	0.39	0.21	0.88
Luxembourg	-0.01	-0.00	-0.01	-0.03***	0.00	-0.02**	0.43
Netherlands	-0.08	0.45**	0.21	-0.03	0.17	0.09	0.54
Portugal	0.02***	0.13**	0.09**	0.01	0.25***	0.11**	0.67
Spain	-1.17**	-0.12	-0.74**	0.13**	0.48	0.37*	0.00

Notes: See Table A2.

**Table A 45: USA—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference
	Min	Max	Avg	Min	Max	Avg	<i>p-val</i>
Austria	-0.10***	0.01	-0.03**	0.01**	0.04***	0.03*	0.00
Belgium	-0.15***	-0.01**	-0.07**	-0.02	0.01	-0.00	0.12
Finland	-0.01	0.07**	0.03**	-0.01	0.07	0.04	0.73
France	-0.45*	-0.02	-0.28*	0.09***	0.35***	0.23***	0.00
Greece	-0.05	0.03***	-0.01	-0.30*	1.44	0.50	0.31
Ireland	-2.87*	0.11	-1.28	-0.10	0.05***	-0.01	0.21
Italy	-0.74	0.30***	-0.21	-0.13	0.10	0.00	0.45
Luxembourg	-0.01**	0.00	-0.00	-0.00	0.00	-0.00	0.90
Netherlands	-0.05	0.43*	0.17	-0.10**	-0.01	-0.06	0.24
Portugal	-0.14***	-0.01***	-0.07***	0.01	0.04***	0.02**	0.00
Spain	-0.30	-0.01	-0.17	-0.14	0.03	-0.04	0.41

Notes: See Table A2.

**Table A 46: Germany—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.01	0.22***	0.11	-0.64	-0.17	-0.30	0.22
Belgium	-0.03	0.09	0.04	-0.57	-0.15	-0.30	0.34
Finland	-0.39**	0.03	-0.17*	0.07	0.55**	0.31*	0.01
France	-1.41*	0.28	-0.43	-2.87	0.63	-0.98	0.70
Greece	-1.21***	0.01	-0.57***	-0.06	1.46	0.64	0.01
Ireland	0.13	0.58**	0.33*	0.05	1.41**	0.72	0.57
Italy	-1.84	0.03	-0.71	0.05	1.99*	1.41	0.14
Luxembourg	-0.05	0.06***	-0.00	-0.03**	0.04***	-0.01	0.64
Netherlands	0.11*	0.64***	0.37**	-0.43	0.64	0.11	0.72
Portugal	-0.17	0.03	-0.07	-0.48***	-0.06	-0.32**	0.06
Spain	0.19**	0.74	0.50	0.22	2.29	1.70	0.29

Notes: See Table A2.

**Table A 47: Germany—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.00	0.40**	0.24**	-0.67**	-0.04	-0.27	0.00
Belgium	-0.15	0.44***	0.21**	-0.26***	-0.02	-0.14	0.02
Finland	-0.36	-0.03	-0.14	-0.02	0.29***	0.20	0.22
France	-1.35	-0.20	-0.76	-2.79	0.40	-1.13	0.83
Greece	-0.15*	0.85***	0.18	-2.14	-0.10	-0.92	0.30
Ireland	-1.70	-0.20	-0.58	-0.41	0.53*	0.09	0.42
Italy	-1.96***	0.21	-0.51	-1.20	-0.32	-0.74	0.84
Luxembourg	0.02***	0.12***	0.08***	-0.10**	0.00	-0.04	0.00
Netherlands	-0.44	0.26	-0.06	-1.95	-0.59**	-1.28	0.23
Portugal	-0.24***	-0.00	-0.08**	-0.25***	0.01	-0.11*	0.69
Spain	-0.82	0.59*	0.16	-1.08	0.01	-0.52	0.21

Notes: See Table A2.

**Table A 48: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Hikes**

Country	Non-Recession			Recession			Difference <i>p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	-0.33	0.21	-0.08	0.10	4.94***	2.94***	0.00
Belgium	-0.28	0.40**	0.12	-2.26***	0.36	-1.09**	0.01
Finland	-0.51**	0.07	-0.24	-3.91***	-0.22	-2.33***	0.01
France	-6.11**	0.86	-2.33*	-3.00	2.79*	0.33	0.69
Greece	-6.64***	-0.52***	-3.17***	-0.78**	1.08	-0.05	0.00
Ireland	-1.83*	-0.06	-0.99	-1.83**	0.22	-0.81	0.86
Italy	-6.15***	0.43	-2.11**	-14.73**	-0.37	-7.54*	0.21
Luxembourg	-0.17***	0.02	-0.09***	-0.03	0.37*	0.23	0.02
Netherlands	-2.25***	-0.23	-1.14**	-2.08**	0.65	-0.43	0.31
Portugal	-1.76***	0.04	-0.64**	-0.65***	0.06	-0.34***	0.28
Spain	-5.55***	-0.46*	-3.66***	0.38	14.36**	7.99**	0.00

Notes: See Table A2.

**Table A 49: United Kingdom—Asymmetric Tax Shocks, State Dependency, Tax Cuts**

Country	Non-Recession			Recession			<i>Difference p-val</i>
	Min	Max	Avg	Min	Max	Avg	
Austria	0.01	0.34*	0.14	0.07	0.80***	0.45**	0.09
Belgium	-0.08	0.34	0.09	0.04	0.41	0.26	0.60
Finland	-0.23	0.20	0.03	0.00	0.31	0.17	0.73
France	-0.77	0.00	-0.40	0.83*	6.37*	4.39**	0.04
Greece	-1.66**	0.43	-0.88*	0.12	3.65	1.82	0.03
Ireland	-0.57	6.02*	3.89*	-0.02	1.53*	0.44	0.05
Italy	-0.93	2.02	0.27	-0.00	2.06	1.20	0.62
Luxembourg	0.02***	0.11**	0.06***	-0.03**	0.11**	0.06**	0.90
Netherlands	-0.02	0.86***	0.40	0.48	1.89**	1.31**	0.18
Portugal	0.04***	0.34**	0.16**	-1.28***	-0.06*	-0.76***	0.00
Spain	-0.04	0.62	0.25	-1.68	-0.08	-1.02	0.43

Notes: See Table A2.