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Fiscal Spillovers: The Case of US Corporate and Personal Income Taxes

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Abstract

This paper extends the identification of unanticipated changes in average federal corporate and personal income tax rates in the United States, as proposed in Mertens and Ravn (2013), to the end of 2019, and assesses their propagation to economies with tight links to the US economy. While cuts in both taxes lead to significant short-run expansions in the US economy, their spillover effects on other countries differ markedly. A cut in corporate taxes can produce negative spillovers, indicating that the contractionary effects associated to the reallocation of investment and jobs by multinational firms outweigh the potential positive effects of increased demand for country-specific goods through trade with the US. The spillover effects of lower personal income taxes are more heterogeneous across countries but are, on average, expansionary, depending on the country-specific monetary policy stance.

Topics: Business fluctuations and cycles; Econometric and statistical methods; Exchange rate regimes; Fiscal policy; International topics

JEL codes: H20, E32, E62, F44

1. Introduction

Since the Great Recession, with monetary policy constrained near the lower bound, countries have turned to fiscal policy to stimulate their economies and attract international investment. The fiscal responses to the economic impact of the COVID-19 pandemic is a recent example of this approach. Although there exists an extensive literature that analyzes the domestic impacts of fiscal policy, less is understood about the resulting cross-border spillovers. Such spillovers are of particular importance for small, open economies with tight links to neighboring economies, such as Canada. The important fiscal changes incorporated in the Tax Cuts and Jobs Act (TCJA) signed into law by US President Donald Trump, on December 22, 2017, have revived discussions on the spillover effects of fiscal policies. Against this context this paper analyzes how changes to US federal corporate and personal income tax policies spill over to America's main trading partners.

Even if a US tax cut stimulates the US economy, it is unclear whether it will have expansionary or contractionary cross-border spillover effects, if any. Further, these spillover effects could potentially differ between corporate and personal income tax policies and may depend on country-specific characteristics. As an example, let us consider a reduction in US corporate taxes. Several channels may give rise to spillover effects in other economies. First, as lower corporate tax rates in the US stimulate output there, the resulting increased demand for imports could lead to positive spillover effects through the trade channel. Second, a fiscal expansion in the US could potentially affect domestic prices and, therefore, the terms of trade and the real effective exchange rate. Hence, some additional spillover effects may arise through the wealth channel; that is, changes in a country's competitiveness. Whether these effects should be positive or negative is not obvious. Finally, lower corporate tax rates should incentivize multinational firms to relocate investment and jobs to the US, generating negative spillover effects for other countries. A priori it is therefore uncertain whether lower US taxes lead to positive or negative spillover effects. Given the opposing effects of the trade and investment reallocation channels, aggregate spillovers provide evidence on the relative size of these two channels. In the case of a personal income tax cut, the spillover effects are expected to largely transmit through the trade and wealth channels; however, the magnitude of the aggregate effect is uncertain.

In this paper we quantify the macroeconomic effects of historical changes in US federal income taxes on corporate and personal income. In a first step we closely fol-

low Mertens and Ravn (2013) (henceforth, MR) and analyze the effects of unexpected cuts in these two taxes on the US economy, extending their narrative shock series, that span the sample 1950Q1–2006Q4, to 2019Q4. These narrative series are then used in a proxy SVAR to identify the underlying, latent tax shocks. In a second step, we identify and quantify the spillover effects on the Canadian economy from past changes to US tax policy, and then we expand our analysis to 33 additional countries, using a panel-SVAR framework. Our approach for analyzing US spillovers to a panel of countries is therefore similar to the work of Bhattarai et al. (2020a), Bhattarai et al. (2021), and Vicondoa (2019), among others.

We confirm the results of MR in the extended sample and show that cuts to both personal and corporate taxes lead to significant short-run expansions in the US economy. Overall, we find no major qualitative differences in the dynamics estimated over our longer sample, which encompasses both the Great Recession and subsequent periods when the Federal Funds rate was at its lower bound. Hence, despite including these important events in our longer sample, the transmission of the two tax shocks remains quantitatively unaffected. We further shed light on the dynamics of open-economy variables, which differ significantly across the two tax shocks. In particular, while corporate income tax shocks generate a real exchange rate appreciation without any significant short-run effects on international trade, higher personal income tax shocks yield an insignificant depreciation of the US real exchange rate and a significant contraction in net exports. These disparities lay the grounds for differences in the spillover effects of these two tax changes. On one hand, corporate income tax cuts generate a significant short-run contraction in Canadian investment, with its peak impact materializing 6–7 quarters after the shock, consistent with an active investment reallocation channel. On the other hand, reductions in personal income taxes generate an increase in Canadian output but the stimulative effect of lower US personal income taxes takes some time to unfold. Controlling for changes in Canadian monetary policy is crucial as it accommodates essentially all of the positive spillover effects on output.

When we expand our analysis to America's main trading partners, we find that US corporate tax cuts can have significant contractionary cross-border spillover effects on certain countries but that, on average, the macroeconomic implications of such changes are rather small. On the contrary, the spillover effects stemming from US personal income tax cuts are, on average, positive and sizable.

Finally, while our baseline results are qualitatively robust when controlling for

country-specific characteristics, we document substantial heterogeneity in the spillover effects across country-specific characteristics. Specifically, we consider cross-country differences in the level of development in terms of exchange rate regimes and concerning economic ties with the US. These characteristics do not seem to play a role in explaining the spillover effects of corporate income tax shocks. However, the spillover effects stemming from reductions in personal income taxes are found to be most pronounced in emerging economies with exchange rate regimes that are not entirely flexible. The degree to which a country is connected to the US economy (either through trade or financial linkages) has a minimal impact on these effects.

Our paper is integrative and contributes to several strands of the fiscal policy literature. First, it offers empirical perspectives on the few studies that focus on model-based analyses of capital tax changes with a focus on the TCJA, such as Bhattarai et al. (2020b) and Barro and Furman (2018).

Second, it contributes to the relatively scarce but growing literature on fiscal policy spillovers. Most contributions focus on government spending shocks and document expansionary spillover effects, more so in recessionary periods (see, e.g., Auerbach and Gorodnichenko, 2013; Corsetti and Müller, 2013; Ilori et al., 2020). Less is known about the spillover effects of other fiscal instruments, specifically about tax changes, with a few exceptions. Feyrer and Shambaugh (2012) estimate the effect of total US tax shocks on the current account and on US investment in the rest of the world. They find that US tax increases likely lead to more investment abroad by increasing the pool of savings available for investment around the globe. On the other hand, Pappa et al. (2020) find that domestic savings have a small effect on the current account but a significant positive effect on the trade balance in developing countries. Cacciatore and Traum (2018) show that trade linkages play a crucial role for the international transmission of fiscal policy. In particular, they estimate a two-country model using Canadian and US data to analyze the spillover effects of US government expenditure shocks and US income tax cuts on Canada. In a concurrent paper, Natoli and Metelli (2018) estimate the effects of US tax shocks on a panel of countries. Their results are significantly different from ours, pointing to expansionary effects that stem from the trade channel conditional on both tax shocks. In accordance with our findings, Boumans et al. (2020) document the negative effects of lower corporate US taxes on investment in countries with close ties to the US.

Third, we contribute to the literature on the open-economy effects of fiscal policies.

This literature mainly focuses on the consequences of fiscal expansions that are due to increases in government expenditures. However, there is little consensus regarding the consequences of a fiscal expansion for the real exchange rate; some papers argue for a depreciation in real domestic purchasing power (see, e.g., Kim and Roubini, 2008; Corsetti and Müller, 2013; Monacelli and Perotti, 2010; Ravn et al., 2012; and Enders et al., 2011), while others document an appreciation (see, e.g., Auerbach and Gorodnichenko, 2016). The findings with respect to the consequences of fiscal expansions on the trade balance are also mixed, with some papers reporting trade balance improvements (see, e.g., Corsetti and Müller, 2013; Kim and Roubini, 2008) and others finding a worsening trade balance (see, e.g., Monacelli and Perotti, 2010; Ravn et al., 2012; García-Solanes et al. (2011)). We contribute to this debate by studying the open-economy effects of a different set of fiscal shocks, namely shocks to corporate and personal income taxes.

The remainder of this paper is structured as follows: Section 2 discusses the identification and domestic effects of federal corporate and personal income tax changes in the US. Section 3 estimates the spillover effects of these changes to the Canadian economy, and Section 4 estimates the average spillover effects over a range of different countries. We discuss the heterogeneity across countries in Section 5. Section 6 concludes.

2. Federal Tax Changes in the US - Identification and Domestic Effects

To estimate the dynamic effects of changes in corporate and personal income taxes, we follow MR and extend the narratively identified changes in federal personal and corporate income taxes from 2006Q4 to 2019Q4. We then estimate the dynamic effects of these shocks on the US economy for a quarterly sample covering 1950Q1–2019Q4.

2.1. Identification

Following MR, the narrative account of shocks to average personal and corporate tax rates for the US builds on the changes in federal US tax liabilities in Romer and Romer (2010), which are decomposed into changes in personal and corporate income tax liabilities. The following tax changes are excluded: first, insignificant tax changes that have not generated at least some public debate; second, endogenous tax changes that are motivated by current or prospective short-run economic conditions; and finally, anticipated tax changes with an implementation lag of more than one quarter. The resulting narrative measures are depicted in Figure 1 together with measures of the

average personal income tax rate (APITR) and the average corporate income tax rate (ACITR).[1] Our augmented narrative series includes information from three additional tax reforms: the Patient Protection and Affordable Care Act and the Health Care and Education Reconciliation Act of 2010, the American Taxpayer Relief Act of 2012, and the Tax Cuts and Jobs Act (TCJA) of 2017. The most significant exogenous change in recent years for both taxes relate to the TCJA, which reduced corporate income tax rates by more than three percentage points and personal income tax rates by roughly 0.4 percentage points.[2]

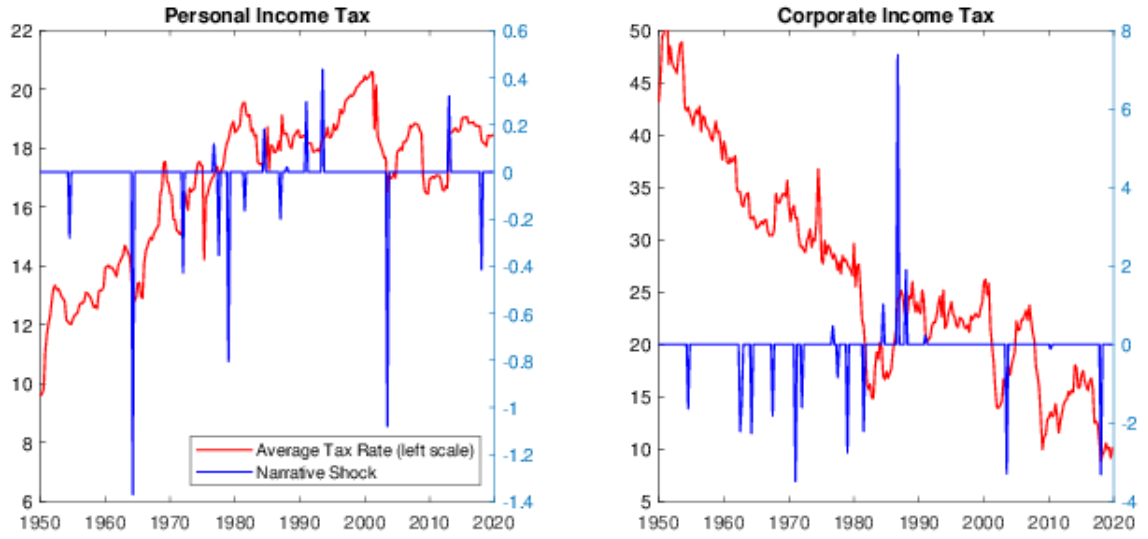

Figure 1: Average US tax rates and narrative shock measures for personal income taxes (left-hand panel) and for corporate income taxes (right-hand panel), 1950Q1–2019Q4.

Narratively identified shocks suffer from measurement errors as historical records are rarely sufficiently unambiguous to avoid judgment calls. Narrative shock series also tend to neglect minor policy interventions, and applications to taxes pose additional difficulties in measuring the exact implications of new tax legislation on effective tax rates. We therefore exploit the information contained in the two narrative tax series to identify the respective latent structural shocks in a proxy SVAR framework. Following MR, we impose two restrictions: first, that the narrative proxy shocks are correlated

[1] Appendix A provides details on the historical tax changes that are not covered in MR.

[2] In a different context, Liu and Williams (2019) extend MR's narrative series to 2017Q4. Our updated narrative series for personal income taxes slightly differs from theirs. For a detailed discussion see Appendix A.

with the latent shocks of average tax rates and, second, that the narrative measures of exogenous tax changes are uncorrelated with other structural shocks. As discussed in MR, conditional on a tax change taking place, the measured changes in personal and corporate income taxes are naturally correlated. The correlation between the narrative tax accounts in our sample is 0.5. To isolate the causal effects of changes in one of the tax rates, we control for changes in the other tax rate. Given that the responses are very similar for the different tax rate orderings, when discussing a shock to a specific tax rate, for brevity, we refer to the point estimates that result from ordering that specific tax rate last. For example, our benchmark specification used to estimate the dynamic effects of corporate income tax shocks is based on a proxy SVAR with seven variables:

$$\mathbf{Y}_t = \left[APITR_t, ACITR_t, ln(B_t^{PI}), ln(B_t^{CI}), ln(G_t), ln(GDP_t), ln(DEBT_t)\right]. \quad (1)$$

$APITR_t$ and $ACITR_t$ are the average tax rates discussed above, B_t^{PI} and B_t^{CI} are the tax bases for federal personal and corporate income taxes in real per capita terms. G_t represents government purchases of final goods at the federal level, GDP_t is the gross domestic product, and $DEBT_t$ represents federal government debt, all in real per capita terms. When we evaluate the effects of each shock on the additional macroeconomic variables - such as investment, consumption, or labor market variables - we modify our benchmark specification defined in (1) and rely on a VAR with five baseline variables,

$$\mathbf{Y}_t = \left[APITR_t, ACITR_t, ln(G_t), ln(GDP_t), ln(DEBT_t), X_t\right], \quad (2)$$

and introduce additional variables captured in X_t at the end of vector $\mathbf{Y}_t$. The description of all of the data series and their respective sources can be found in Appendix B. Based on the HQ criterion, the lag length in our VAR specifications (1) and (2) is set to four. The 95 percent confidence intervals are computed using a recursive wild bootstrap using 10,000 replications (see Gonçalves and Kilian, 2004). As a robustness check to the identification of tax shocks, in Appendix C we show that the widely used identification approach based on Blanchard and Perotti (2002) does not capture the same tax shocks and therefore leads to significantly different dynamics. As our paper does not make a contribution related to shock identification, we refer the reader to MR for further details on the estimation approach.

2.2. Dynamic Effects of Corporate Income Taxes

Figure 2 shows the effects of a one-percentage-point decrease in the average corporate income tax rate (ACITR) over the period 1950Q1–2019Q4. The unexpected shock significantly reduces average corporate income tax rates for 10 quarters. This reduction in tax rates generates a significant and persistent output expansion for more than four years, with a peak increase of 0.5 percent 11 quarters after the unexpected cut. The GDP component that reacts most significantly is investment, with an impact increase of 1.6 percent. Lower corporate tax rates reduce the rental rate of capital, incentivizing firms to increase investment and lessening the incentive for corporate entities to shift production and investment overseas. In addition to the surge in investment, corporate profits increase on impact by 2.5 percent and remain significantly above the pre-shock level for roughly one year. The lower cost of capital–resulting from the cut in the ACITR–reduces firms' marginal costs of production, which are passed onto consumers. The drop in US inflation is, however, not statistically significant. The statistically insignificant increase in consumption also suggests that second-round demand-side effects are weak.

An expansion of firms' capital stock renders workers more productive, putting upward pressure on wages and firms' demand for labor. Therefore, this labor market tightening occurs more gradually. The employment response peaks six quarters after the shock and the biggest contraction in the unemployment rate occurs one year after the cut in the ACITR. While hours worked, labor force participation and employees' compensation all expand, we find no evidence for the statistical significance of these effects (not shown).

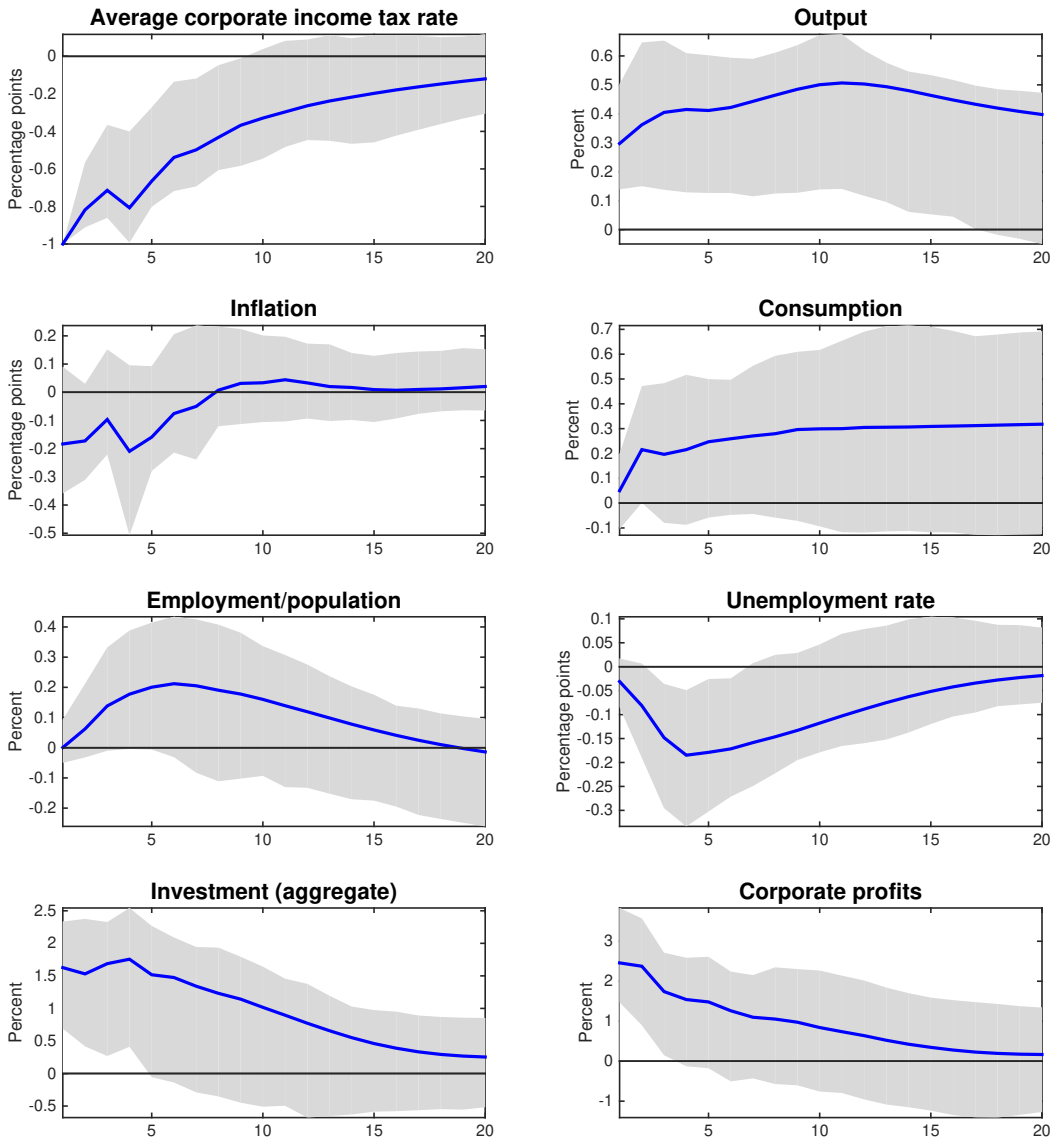

Figure 2: Dynamic effects of a one-percentage-point cut in the ACITR, 1950Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

In addition to the variables considered in MR, we further study the open-economy aspects of the two tax shocks, by analyzing the dynamics of the real effective exchange rate (REER), net exports, the terms of trade and the current account. As the REER is only available from 1969Q1, we focus on the period 1969Q1-2019Q4. As shown in Appendix D, the macro dynamics discussed above, are almost identical for this shorter sample. Figure 3 shows that a cut in corporate taxes leads to a significant short-run appreciation of the US REER (by one percent on impact), rendering the US

consumption basket relatively cheaper. Changes in corporate taxes do not, however, significantly affect international trade. Specifically, neither US imports and exports nor the terms of trade show significant short-run responses to a reduction in corporate income tax rates. In the medium term, net exports to GDP slightly contract, with a peak impact of -0.1 percentage points nine quarters after the shock, leading to a deterioration in the current-account-to-GDP ratio. Overall, the expansionary fiscal measure boosts demand for domestically produced and imported goods in the medium run without having significant effects on the terms of trade.

Finally, as further discussed in Section 2.4, we find no evidence for changes in government spending or adjustments in the short-term nominal interest rate, which rules out the possibility that the responses to either tax shock are confounded by changes in government spending and/or monetary policy.

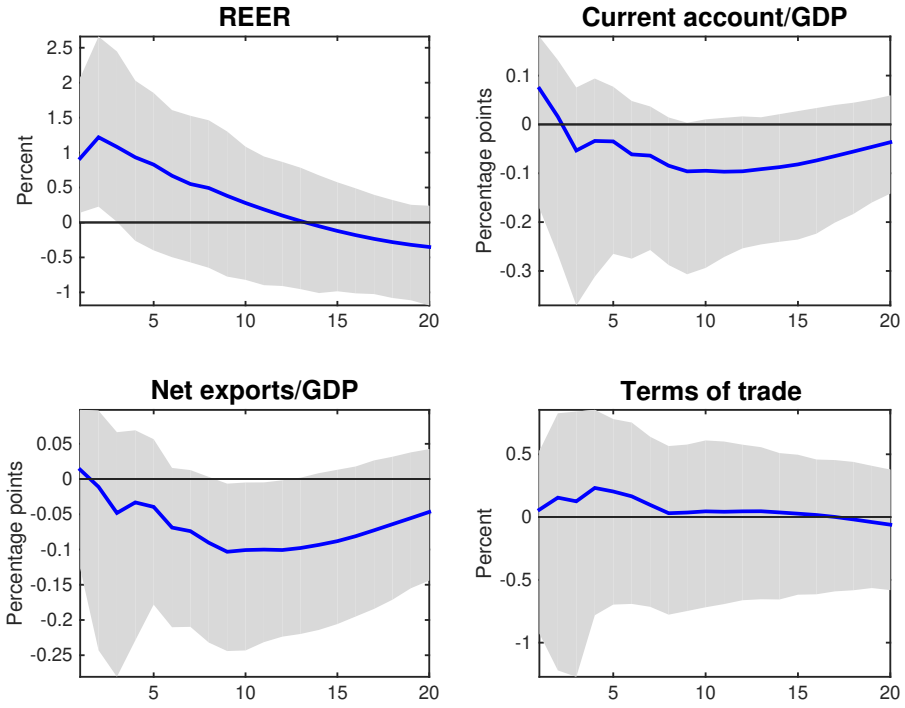

Figure 3: Dynamic effects of a one-percentage-point cut in the ACITR for open-economy variables, 1969Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

2.3. Dynamic Effects of Personal Income Taxes

The narrative series for the average personal income tax rate (APITR) used to identify the respective shocks is based on unanticipated changes in individual income

tax liabilities and employment taxes. Both of these categories encompass adjustments to marginal rates and changes to various deductions and tax credits. Figure 4 shows the effects of a one-percentage-point decrease in personal income taxes over the period 1950Q1–2019Q4.

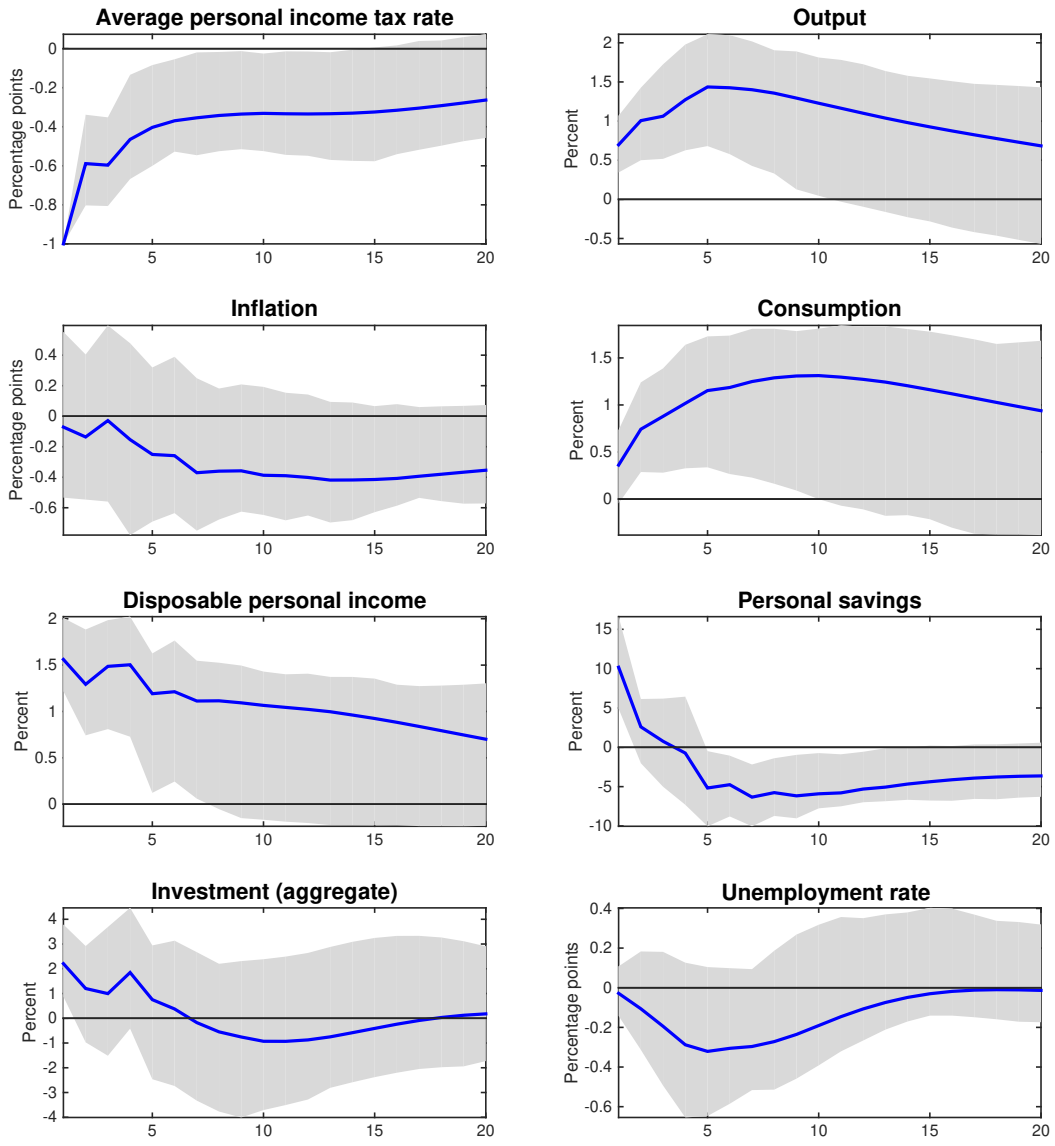

Figure 4: Dynamic effects of a one-percentage-point cut in the APITR, 1950Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

The shock significantly reduces the APITR to below its pre-shock level for approximately a three-year period. Cuts in average personal income taxes provide substantial and persistent expansions in output, compared to cuts in average corporate income

taxes. Given the longer-lasting reduction in average personal income taxes, economic activity increases significantly for 11 quarters, with a peak increase of 1.4 percent occurring five quarters after the tax cut. Lower levels of personal income tax rates further increase disposable income and stimulate both consumption and personal savings. Interestingly, the persistent and significant expansion of aggregate consumption does not result in upward price pressure.

Figure 5: Dynamic effects of a one-percentage-point cut in the APITR on US labor market variables, 1950Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

In comparison to cuts in the ACITR, the investment response is not only less persistent and smaller but–except for the impact response–also statistically insignificant. The investment surge on impact (relative to the output stimulus) is three times bigger after a cut in corporate income taxes. Figure 5 shows that labor market adjustments take place along the extensive and participation margins, without a significant response in hours worked per worker. Cuts in personal income taxes boost employment and labor force participation (with significant increases of 0.24 and 0.21 percent, respectively).[3] The increase in labor force participation can be explained as a more persistent reduction in personal income taxes providing a longer-lasting incentive to enter the labor

[3]As in MR, we document that the increase in total employment is composed of a stronger positive private sector employment response and a temporary drop in public sector employment.

force. Employees' compensation also goes up (with a peak of 1.1 percent after four quarters), pointing to the increase in personal disposable income as being driven both by lower taxes and higher labor income.

Finally, as shown in Figure 6, a decrease in the APITR generates a depreciation in the real exchange rate, both on impact and in the medium run. Contrary to the effect of the corporate income tax shock, the real exchange rate response remains insignificant at all horizons. On the trade front, a one-percentage-point decrease in the APITR leads to an increase in both imports and exports, with the latter being more pronounced and sustained (not shown). As for the reduction in the ACITR, net exports to GDP contract, with a peak response of -0.4 percentage points one year after the shock. Both import and export prices increase, with the raise in import prices being more pronounced and persistent. Consequently, in the short run, the terms of trade deteriorate by as much as 3.5 percent two quarters after the shock. In turn, the current account deterioration is persistent, and significantly so, for about six quarters.

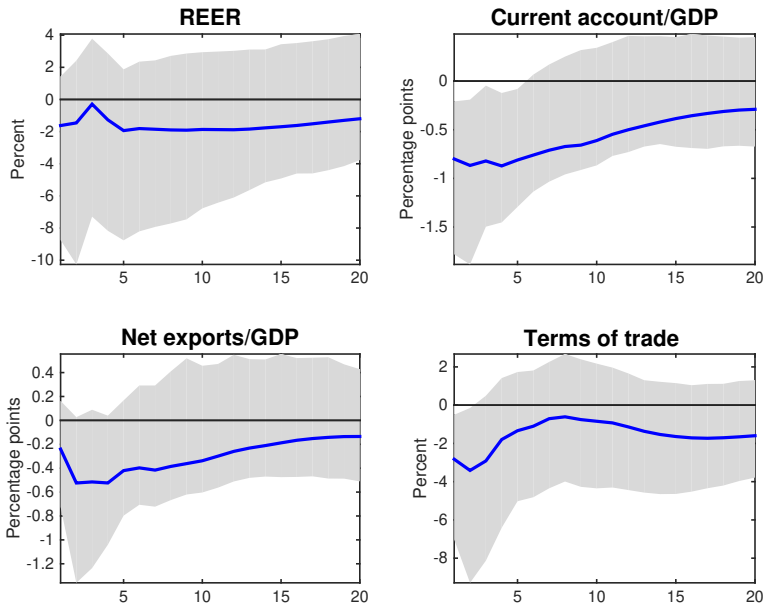

Figure 6: Dynamic effects of a one-percentage-point cut in the APITR for open-economy variables, 1969Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

2.4. Full Sample (1950-2019) vs MR Sample (1950-2006)

This section compares impulse responses following ACITR and APITR shocks in two subsamples: the baseline sample between 1950Q1 and 2019Q4, and a shorter

sample ending in 2006Q4 that corresponds to the time period covered in MR. The extended sample encompasses both the Global Financial Crisis and the subsequent period when the Federal Funds rate was at its zero lower bound. Given the size and historic novelty of these episodes, it would be unsurprising if results meaningfully differed between the two periods. As shown below, however, the results are remarkably similar across the two samples following both an ACITR and APITR shock.[4]

2.4.1. Average corporate income tax rate

Figure 7 plots the dynamics for selected macroeconomic variables conditional on an ACITR shock across both samples. Qualitatively, the results are similar across the two samples, suggesting that the Global Financial Crisis did not have a meaningful impact on the macroeconomic response to a corporate tax shock. Nonetheless, the impulse responses between the two samples do differ quantitatively. The significant decline in the ACITR following a shock in the extended sample is almost twice as long as that in the shorter period and results in a more pronounced expansion of the respective tax base. At the same time, the expansion in output is relatively weaker in the longer sample, while the responses in government purchases and the Federal Funds rate are largely insignificant. The biggest difference between the two samples lies in the relative response of investment to output, which is twice as big in our full sample relative to the period MR covers.

2.4.2. Average personal income tax rate

Figure 8 compares impulse responses to a one-percentage-point cut in the APITR over our extended sample to the shorter sample period covered by MR. Like the ACITR shock, the estimated dynamics are qualitatively similar across the two periods, although there exist some quantitative differences. Following a shock to the APITR, the response of the tax rate itself is more persistent in the extended sample, with an almost identical response in the personal income tax base, consumption (not shown) and output. The investment response, however, is much weaker in the longer sample. As for corporate income tax shocks, both government purchases and the Federal Funds rate show no

[4]Notably, our results over the 1950Q1 to 2006Q4 sample differ slightly from those presented in MR. The differences can largely be attributed to the data. More specifically, we use the population series from the Bureau of Labor Statistic's (BLS) current population survey, while MR uses the population series from Francis and Ramey (2009). These differences are most pronounced in the impulse responses of labor market variables as our labor market variables are obtained from the BLS rather than from Francis and Ramey (2009).

significant response. Hence, the responses to both tax shocks are not confounded by changes in either government spending or monetary policy.

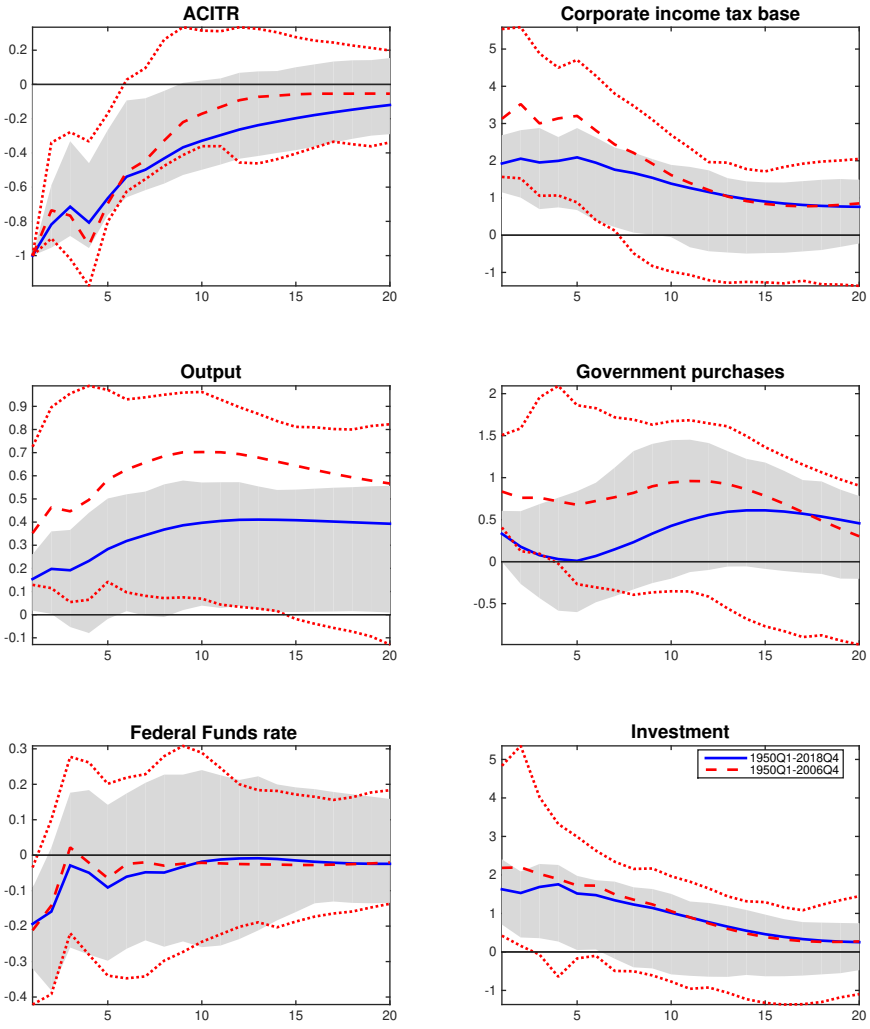

Figure 7: Dynamic effects of a one-percentage-point cut in the ACITR. Solid blue lines are point estimates for the baseline sample 1950Q1 to 2019Q4; grey areas indicate 95 percent confidence intervals. Dashed red lines are point estimates for the Mertens and Ravn (2013) sample 1950Q1 to 2006Q4; broken red lines indicate the corresponding 95 percent confidence intervals.

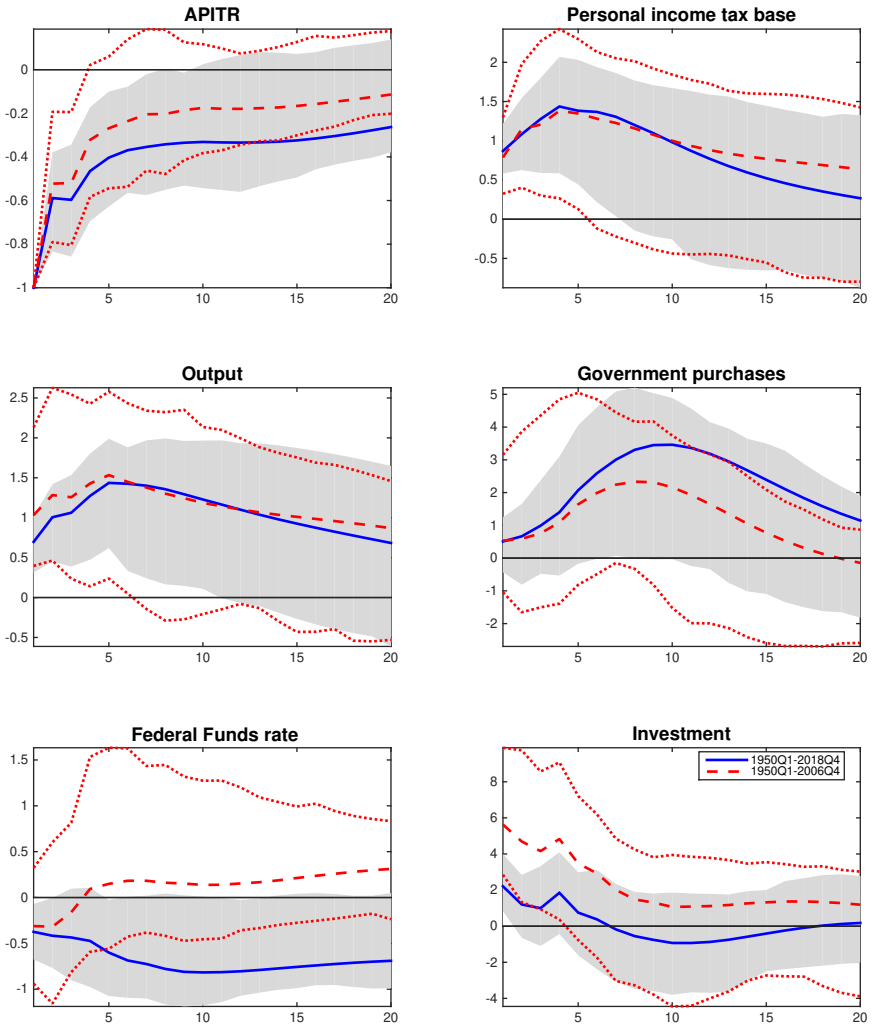

Figure 8: Dynamic effects of a one-percentage-point cut in the APITR. Solid blue lines are point estimates for the baseline sample 1950Q1 to 2019Q4; grey areas indicate 95 percent confidence intervals. Dashed red lines are point estimates for the Mertens and Ravn (2013) sample 1950Q1 to 2006Q4; broken red lines indicate the corresponding 95 percent confidence intervals.

3. Spillover Effects of US Tax Changes on Canada

As the Canadian and US economies are highly interconnected, we start by analyzing the economic impact of changes to US tax legislation on the Canadian economy. As argued above, the size and direction of these spillover effects are a priori unclear because there may be different channels at work with potentially opposing effects. In this section we augment the baseline VAR laid out in Section 2, using Canadian variables to estimate the dynamic effects of changes in US corporate and personal income tax

rates on the Canadian economy. Specifically, let $\mathbf{Y}_{CAN,t}$ be a $K\times 1$ vector of endogenous variables for each period $t = 1, ..., T$. The variables $k_1 < K$ are for the US, whereas $k_2 = K - k_1$ denote Canadian variables. Denoting the vectors $k_1 \times 1$ as $\mathbf{y}_t^{US}$, and $k_2 \times 1$ as $\mathbf{y}_t^{CAN}$, we have

$$\mathbf{Y}_{CAN,t} = \left(\left(\mathbf{y}_t^{US} \right)' \left(\mathbf{y}_t^{CAN} \right)' \right)'. \tag{3}$$

We then estimate the reduced form proxy SVAR

$$\mathbf{Y}_{CAN,t} = c + \sum_{j=1}^{p} A_j \mathbf{Y}_{CAN,t-j} + u_t, \tag{4}$$

where A_j is a $K \times K$ matrix of the own and cross effects of the j-th lag of the variables on their current observations, c is a $K \times 1$ vector of constants, and u_t is a $K \times 1$ vector of the reduced form errors. The corresponding structural model is then defined as

$$B^{-1}\mathbf{Y}_{CAN,t} = B^{-1}c + \sum_{j=1}^{p} B^{-1}A_j \mathbf{Y}_{CAN,t-j} + B^{-1}u_t, \tag{5}$$

where B is a diagonal matrix so that u_t is a vector of the orthogonal i.i.d. shocks to corporate and personal income taxes; i.e. $\mathbb{E}u_t = 0$ and $\mathbb{E}\left[u_t u_t'\right] = 0$. We impose the same restrictions as in MR to estimate the coefficients in A and B. Our benchmark specification is based on the following vectors of observables:

$$\begin{aligned} \mathbf{y}_t^{US} &= [APITR_t, ACITR_t, ln(G_t), ln(GDP_t), ln(DEBT_t)], \\ \mathbf{y}_t^{CAN} &= \left[RER_t^{US-CAN}, ln(GDP_t^{CAN}), ln(C), ln(I_t), ln(X_t^{CAN-US}), ln(M_t^{CAN-US}), X_t\right], \end{aligned} \tag{6}$$

where RER_t^{US-CAN} denotes the bilateral real exchange rate between the US and Canada and is defined as the log of the ratio of the bilateral nominal exchange rate (the price of a Canadian dollar in US dollars), multiplied by the US CPI relative to Canada's CPI. Hence, an increase in this variable represents a real depreciation of the US dollar with respect to the Canadian dollar. GDP_t^{CAN}, C_t^{CAN}, and I_t^{CAN} capture the gross domestic product, personal consumption and investment in Canada, respectively. EX_t^{CAN-US} and M_t^{CAN-US} represent bilateral exports and imports between Canada and the US. All variables are expressed in real per capita terms. Additional variables (such as the Canadian policy rate) are collected in X_t^{CAN} and are added to the end of

the vector $\mathbf{y}_t^{CAN}$. All of our results are robust to including the two tax bases, $\ln(B_t^{PI})$ and $\ln(B_t^{CI})$, as in our baseline specification for the US defined in (1).

Overall, the results suggest that the spillover effects of corporate and personal income tax cuts are generally positive, although the timing of these spillovers differ. A US corporate tax cut has a negligible impact on Canadian output in the short run but positive spillover effects in the long run. In contrast, personal income tax cuts tend to have positive spillover effects in the medium run that then slowly die out. These results also point to the importance of a monetary policy that leans against spillovers from both types of tax shocks.

3.1. Corporate Income Taxes

A corporate tax cut in the US can spill over to the Canadian economy through a few distinct channels. First, as we previously documented, a cut in corporate income taxes increases US output and therefore boosts demand for Canadian goods (trade channel). If the American fiscal expansion also causes the US dollar to appreciate against the Canadian dollar then Canadian exports become relatively cheaper, further stimulating their demand (wealth channel). All else being equal, both the trade and wealth channels should have expansionary impacts on the Canadian economy. Counteracting these is the investment reallocation channel, where lower corporate tax rates in the US incentivize multinational firms to reallocate investment domestically and away from Canada. As this investment channel is contractionary, the net impact of a US corporate tax cut on the Canadian economy is a priori unclear.

Figure 9 plots the average effect of a one-percentage-point decrease in US corporate income tax rates on Canadian variables over the sample period 1979Q2–2016Q4. The spillover effects differ between the short- (up to two years) and long-run (more than two years) horizons, with there being little impact on Canadian GDP in the short run but expansionary effects in the long run.

We start by analyzing the short-run effects of a US corporate tax cut on Canada. Following a one-percentage-point cut, Canadian investment falls significantly, consistent with the investment reallocation channel, and reaches a trough of about -0.6 percent seven quarters after the shock. Over the same horizon, the Canadian dollar depreciates against the US dollar, making Canadian exports relatively cheaper. Interestingly, real exports to the US decline, although not significantly. These results provide evidence in favor of the wealth channel but against an expansionary trade

channel in the short run. These results are also consistent with the insignificant effects of a US corporate tax shock on international trade, as documented in Section 2. Despite the negative responses of investment and exports, the impact on GDP is largely insignificant in the short run.

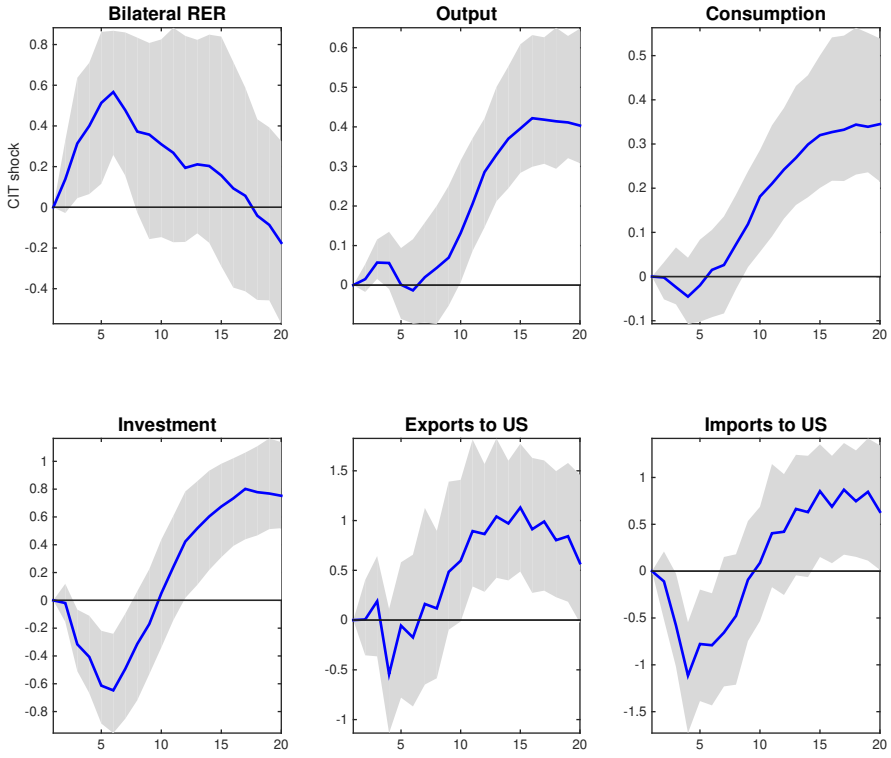

Figure 9: **Spillover effects of the ACITR on Canada:** Dynamic effects of a one-percentage-point cut in US average corporate income tax rates (ACITR) on a set of Canadian variables. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

Over the long run, a cut to US corporate tax rates has an expansionary impact on the Canadian economy, with output increasing by about 0.4 percent at peak roughly four years after the shock. The significant and protracted US output stimulus following a cut in corporate income taxes therefore spills over and increases Canadian output with some lag. This positive spillover effect on the Canadian economy is driven not only by bilateral trade–as exports start to grow ten quarters after the tax cut and then peak at about a one-percent increase–but also by a significant recovery in Canadian consumption and investment, starting roughly two and three years after the shock, respectively.

It is expected that monetary policy will significantly affect the economic impacts of

fiscal policy. Controlling for a potential monetary policy response in Canada is therefore crucial. Figure 10 illustrates this point. Canadian monetary policy significantly leans against the short-run negative spillovers of the US corporate tax cut, with a prolonged reduction in the policy rate. Accounting for this reaction, however, does not substantially change our main result. Canadian investment still falls in the short run and then rebounds in the long run, along with output and consumption.

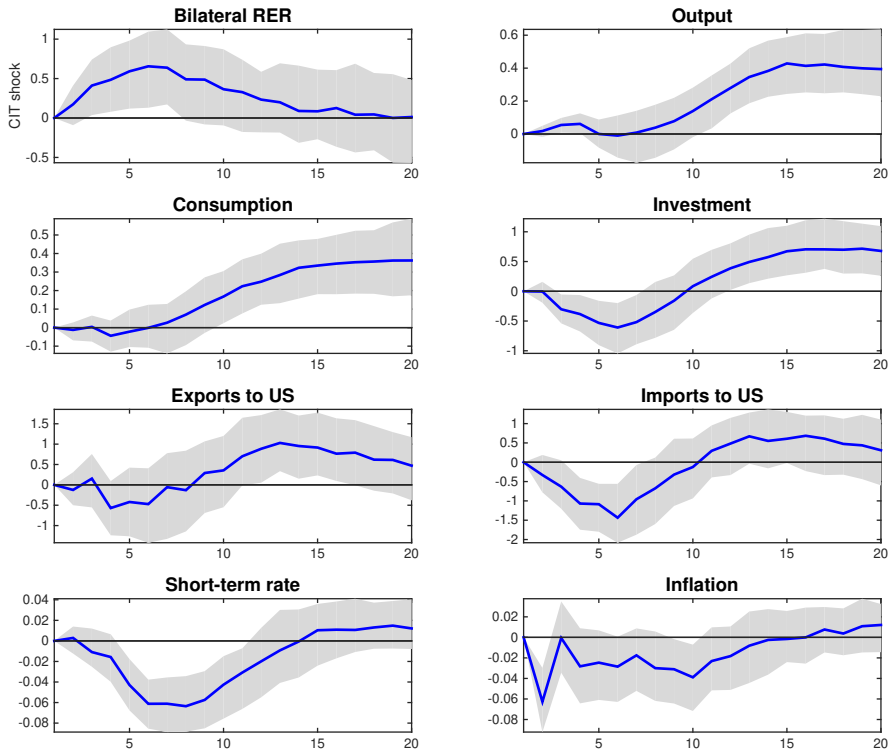

Figure 10: **Spillover effects of the ACITR on Canada, controlling for Canadian monetary policy response:** Dynamic effects of a one-percentage-point cut in US average corporate income tax rates (ACITR), when controlling for changes in Canadian short-term rates. Solid blue lines are point estimates; broken lines indicate 95 percent confidence intervals.

3.2. Personal Income Taxes

Unlike corporate taxes, a US personal income tax cut is largely expected to transmit to the Canadian economy through the trade and wealth channels through an increase in demand for Canadian goods. However, the magnitude of these spillover effects is unclear.

Figure 11 plots the average response of the Canadian economy to a one-percentage-point cut in US personal tax rates over the 1979Q2 to 2016Q4 period. The spillover effects are positive, although the stimulative effect of lower US personal income taxes

on the Canadian economy takes some time to unfold. Specifically, the response of Canadian GDP is insignificant in the short term, becoming sizable and statistically significant between seven and thirteen quarters after the shock. Following a cut in US corporate tax rates, cross-border trade increases, with exports to the US and imports to Canada both growing significantly. However, the latter increases by slightly more than the former, pushing down Canadian net exports. Note that the Canadian dollar also appreciates against the US dollar, although this is largely insignificant. This appreciation provides evidence against the wealth channel but could be a potential explanation for the relatively stronger increase in imports to Canada. As demand for Canadian goods picks up so does investment, with the latter reaching a peak response of two percent seven quarters after the shock.

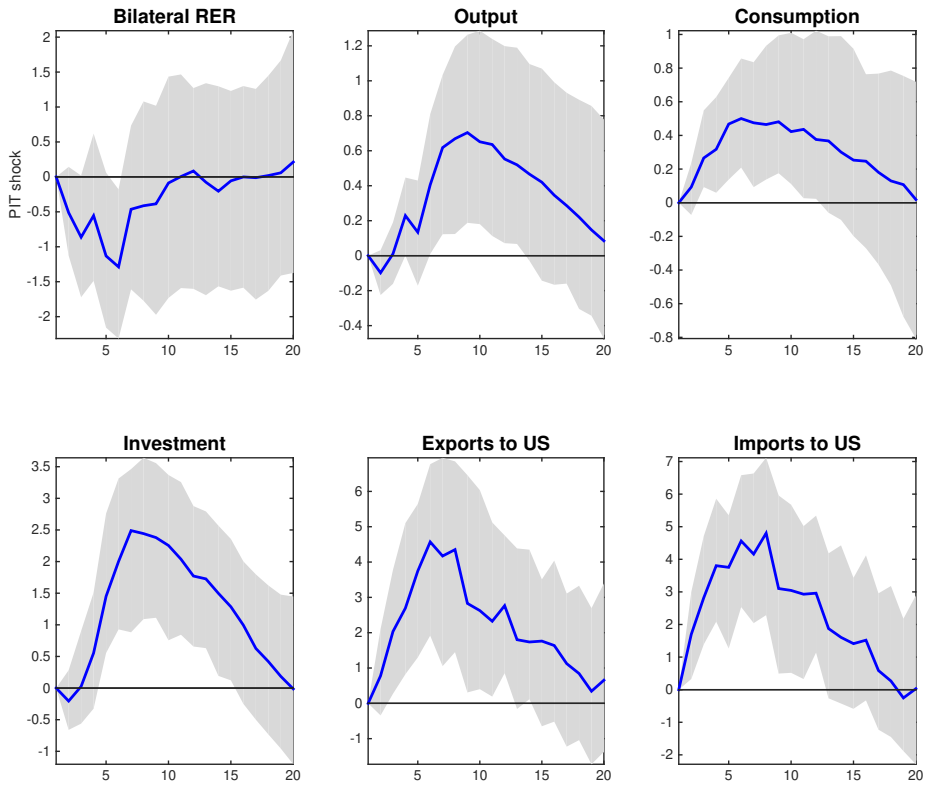

Figure 11: **Spillover effects of the APITR on Canada:** Dynamic effects of a one-percentage-point cut in US personal income tax rates (APITR). Solid blue lines are point estimates; broken lines indicate 95 percent confidence intervals.

Controlling for changes in the Canadian overnight rate is even more important for this shock as it is likely to predominantly work through demand channels. Indeed, monetary policy is key in determining the strength of the demand effect related to the US personal income tax shock. Figure 12 shows that Canadian monetary policy essentially accommodates all of the positive effects. In particular, when controlling for movements in the overnight rate, Canadian investment only increases significantly in the medium term. Output falls slightly over the short run and then becomes insignificant, while consumption is insignificant throughout.

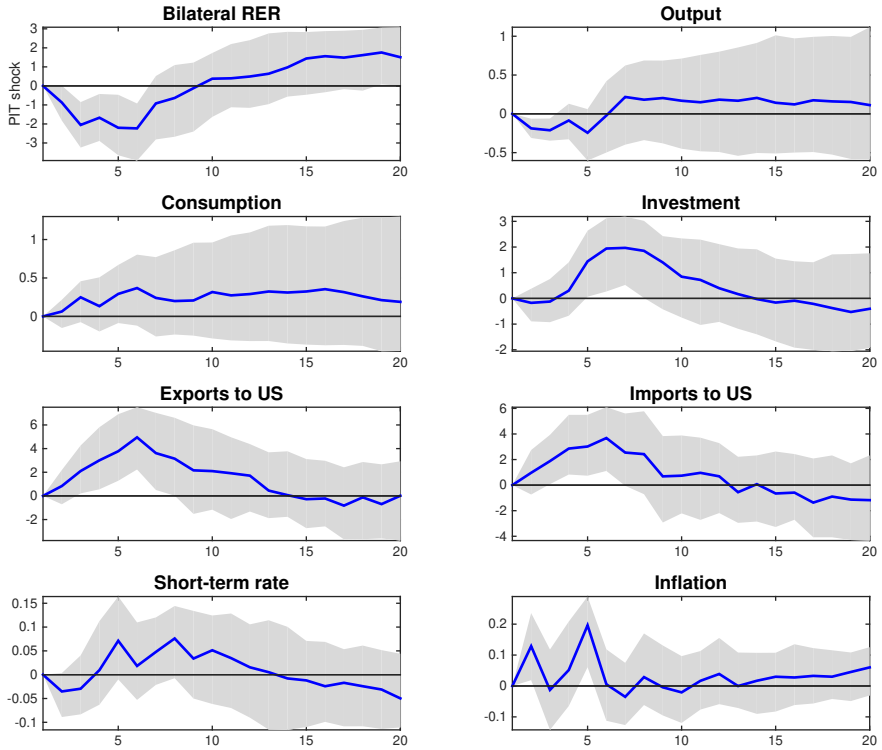

Figure 12: **Spillover effects of the APITR on Canada, controlling for Canadian monetary policy:** Dynamic effects of a one-percentage-point cut in US average personal income tax rates (APITR), when controlling for changes in Canadian short-term rates. Solid blue lines are point estimates; broken lines indicate 95 percent confidence intervals.

3.3. Robustness

Our estimates for the spillover effects of changes in US average tax rates on the Canadian economy are robust to alternative definitions of the vector of the observables, $\mathbf{Y}_{CAN,t}$, and to restricting our analysis to different subsamples. Specifically, our results remain robust to including additional control variables for Canada, such as the commodity price index, government spending per capita, or average personal/corporate

income tax rates. Moreover, given a break in the conduct of Canadian monetary policy, we further confirm that the spillover effects do not change with the introduction of an explicit inflation-targeting regime in 1995.

4. Spillover Effects of US Tax Changes on a Range of Countries

Are the results presented so far specific to Canada or can they carry over to other US trading partners? In order to investigate the generality of the Canadian spillover effects documented in Section 3, we broaden our focus and estimate the spillover effects of changes in US corporate and personal income tax rates to a set of 33 different countries for the period 1979Q2-2016Q4. We therefore estimate a series of two-country VARs–as for the case of Canada–combining a vector of US variables with observables for each of the 33 countries in our sample (see Table 1).

Asia and Pacific	**North America**	**Europe**
Australia	Canada	Austria
China	Mexico	Belgium
India	United States	Finland
Indonesia		France
Japan	**South America**	Germany
Korea	Argentina	Italy
Malaysia	Brazil	Netherlands
New Zealand	Chile	Norway
Philippines	Peru	Spain
Singapore		Sweden
Thailand	**Middle East and Africa**	Switzerland
	Saudi Arabia	Turkey
	South Africa	United Kingdom

Table 1: List of 33 countries under consideration

We follow the approach of Canova and Pappa (2007) and estimate each bilateral proxy SVAR separately, computing the average spillover effect by taking the mean of all country-specific impulse responses.[5] The two tax shocks are scaled based on each country's specific bilateral trade intensity with the US. Specifically, we calculate bilateral trade intensity using country-specific ratios of net exports to the US to GDP. Hence, a US shock has a greater impact on Canada and Mexico than on Taiwan and Malaysia as the latter have weaker trade links to the US economy. We use the country

[5]We check that the identified shocks in all country-specific VAR specifications are identical.

with the tightest trade link to normalize this index to one.[6] Given that the time horizon of our sample is large, the average of the estimated country-specific responses in each bilateral VAR is consistent with the mean response; i.e. in a panel VAR.

The VAR specification estimated for Canada is generalized as follows. Let $\mathbf{Y}_{n,t}$ be a $K \times 1$ vector of endogenous variables, with variables $k_1 < K$ being specific to the US (summarized in vector $\mathbf{y}_t^{US}$), and $k_2 = K - k_1$ denoting the variables of the n-th country in the panel (summarized in vector $\mathbf{y}_t^n$), with $n = 1, ..., 33$. We can then write

$$\mathbf{Y}_{n,t} = \left(\left(\mathbf{y}_t^{US} \right)' \left(\mathbf{y}_t^n \right)' \right)'. \tag{7}$$

For each n, we estimate the reduced form VAR model as

$$\mathbf{Y}_{n,t} = c_n + \sum_{j=1}^{p} A_{n,j} \mathbf{Y}_{n,t-j} + u_{n,t}, \tag{8}$$

where c_n captures the across-country fixed effects and $A_{n,j}$ captures the transmission of shocks across countries. The corresponding structural model then reads as follows:

$$B^{-1}\mathbf{Y}_{n,t} = B^{-1}c_n + \sum_{j=1}^{p} B^{-1}A_{n,j}\mathbf{Y}_{n,t-j} + B^{-1}u_{n,t}, \tag{9}$$

where we impose the same identification assumptions as described in Section 3. We use quarterly data from 1979Q2–2016Q4 for a panel of 33 countries–as defined in Table 1–taken from Mohaddes and Raissi (2018). For the purposes of the VAR dimensionality and computational efficiency, our benchmark specification differs slightly from (6), although our results are robust to our original specification. Specifically, the benchmark specification now consists of the following:

$$\begin{aligned} \mathbf{y_t^{US}} &= [APITR_t, ACITR_t, ln(GDP_t)] \\ \mathbf{y_t^{n}} &= [RER_t^{US-n}, ln(GDP_t^n), X_t^n] \end{aligned} \tag{10}$$

where X_t^n varies by specification and consists of either consumption and investment,

[6] Our results are robust to scaling the shocks using bilateral capital flows and to using unweighted shocks.

bilateral exports and imports, the current account, or the short-term interest rate.[7] Finally, to calculate the confidence bands for the unit-by-unit estimator, we report the bootstrapped impulse responses to tax shocks implied by the average responses of the bilateral regressions, together with the plus/minus one standard error deviation confidence bands obtained by bootstrapping (1,000 draws). Note that when bootstrapping the estimates from the ex-post-pooled panel VAR, we sample from all residuals and not only from the residuals for a specific country. In this way, we account for the uncertainty that comes from the dispersion of the individual country estimates around the mean-group parameters. Figures 13 and 14 plot the estimated average spillover effects from changes in US corporate and personal income tax rates with and without the country-specific policy rates, respectively.

[7]Our baseline results are robust to including different vectors of the US variables that are used when estimating the international spillover effects. Specifically, in addition to our benchmark specification that includes the three US variables as specified in (10), we consider specifications with five US variables (as in our benchmark specification (6) in Section 3) and with seven US variables (the US APITR, ACITR, PITB, CITB, Government Consumption, real GDP, debt). Moreover, our results are robust to excluding episodes where the US Federal Funds rate is constrained by its lower bound.

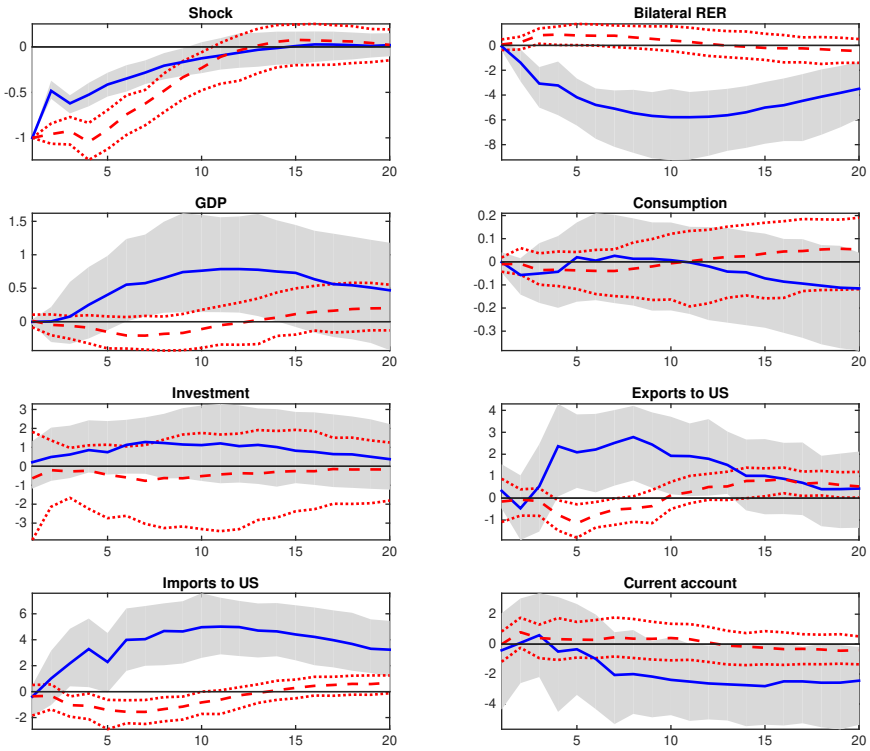

Figure 13: **Average spillover effects of the APITR vs ACITR:** Average dynamic spillover effects over 33 countries to a one-percentage-point cut in US average personal income tax rates (APITR, solid blue lines represent the mean response, and grey areas are one-standard-deviation confidence bands) and in US average corporate income tax rates (ACITR, dashed red lines represent the mean response, and broken red lines are one-standard-deviation confidence bands).

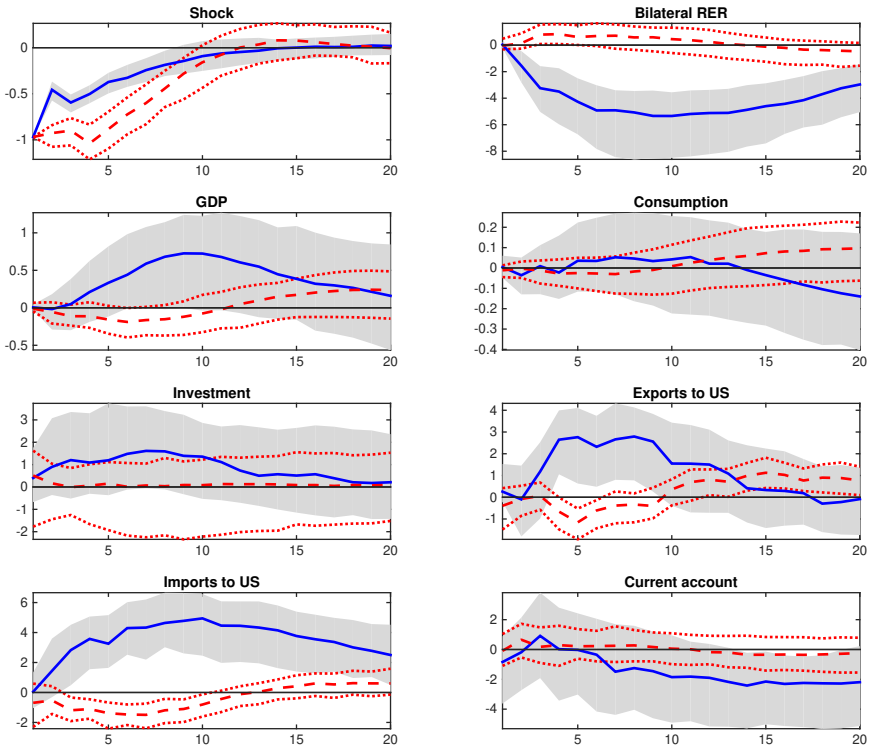

Figure 14: **Average spillover effects of the APITR vs ACITR controlling for monetary policy:** Average dynamic spillover effects over 33 countries to a one-percentage-point cut in US average personal income tax rates (APITR, solid blue lines represent the mean response, and grey areas are one-standard-deviation confidence bands) and in US average corporate income tax rates (ACITR, dashed red lines represent the mean response, and broken red lines are one-standard-deviation confidence bands).

4.1. Shock to the ACITR

The average response across countries following a reduction in the US ACITR differs somewhat from the Canadian spillover effects discussed in Section 3.1. Specifically, we find that the average spillover effect on output from changes in US corporate tax rates is negative in the medium run, although not statistically significant. The average spillover effect on consumption is largely insignificant, while the estimated average investment dynamics point to a weak investment reallocation channel. Similar to the dynamics documented for Canada, we estimate an average depreciation of the bilateral exchange rate that renders exports to the US economy relatively less expensive. These dynamics are consistent with the documented appreciation of the US real exchange rate in Section 2. Despite the depreciation in the real exchange rate, the average short-run contraction in bilateral exports to the US generalizes the evidence against an expansionary trade channel to a broader set of countries. The lack of evidence for

a strong, positive short-run trade channel is therefore not specific to Canada. Finally, as for the case of Canada, our results are robust to controlling for changes in country-specific monetary policy that, on average, accommodate the negative spillover effects through substantial cuts in the policy rate.

4.2. Shock to the APITR

The average spillover effects stemming from a one-percentage-point cut in US personal income tax rates are expansionary, and–as for the case of Canada–the stimulative effect takes some time to unfold. Cross-border trade increases after the shock, bringing about an appreciation of the domestic currency relative to the US dollar. This average currency appreciation provides further evidence against the wealth channel. While the average output stimulus is similar in magnitude to the estimates for Canada, the effects on consumption and investment are more muted. Controlling for monetary policy remains important, although less so than in the Canadian case. Central banks on average lean against the expansionary spillover effects of lower personal income tax rates in the US, causing the positive output response to become statistically insignificant.

4.3. Average Spillover Effects of US Tax Shocks

In sum, the average spillover effects crucially differ across the different types of US tax shocks. On one hand, we document a significant output expansion following lower personal income tax rates, that–as documented in Section 2–generate a significant expansion in the US economy. The bulk of this expansionary effect is driven by increased bilateral trade with the US; i.e., higher US demand for goods produced in other countries. On the other hand, an unexpected reduction in US corporate income tax rates gives rise to an expansion that is relatively smaller than the one related to personal income tax shocks. The average spillover effects are negative. While output and investment contract, we do not find significant evidence for the general importance of the investment reallocation channel and our estimates point toward the absence of positive spillover effects related to the trade channel.

The documented differences between the Canadian dynamics and the average impact over a range of countries highlight potentially important heterogeneity in the spillover effects of US tax shocks. Section 5 further analyses country-specific characteristics accounting for this heterogeneity.

5. Heterogeneous Spillover Effects Across Countries

To shed more light on the potential heterogeneity of these spillover effects across countries, we analyze the importance of three country-specific characteristics. Specifically, we consider different subgroups of the set of 33 countries under consideration, according to these countries' level of development, differentiating between exchange rate regimes and considering different degrees of trade and financial integration. Overall, we find that the results presented in Section 4 are qualitatively robust, with some qualitative nuances.

5.1. Level of Development

In a first step, we analyze the importance of countries' degree of development by comparing the average spillovers of OECD countries to those of emerging economies.[8] Figure 15 illustrates that the short-run contractionary spillover effects from US corporate income tax changes do not significantly differ with each country's level of development. The expansionary spillover effects stemming from lower personal income tax rates, however, seem to be driven exclusively by emerging economies. We estimate these positive effects to be largest for countries that are important producers of US consumer or intermediate goods, such as China, Japan, and Thailand. Consistently, we estimate a significant expansion in bilateral exports to the US for these countries.

Interestingly, the average currency appreciation in developing countries relative to the US dollar is less pronounced compared to OECD members. In particular, the difference in terms of the peak impact–unfolding roughly 10 quarters after the US shock–is 1.5 percentage points.[9] A possible explanation for these dynamic dissimilarities are differences in exchange rate regimes across countries, which we analyze in the next section.

[8]OECD member countries in our panel are Australia, Austria, Belgium, Canada, Chile, Finland, France, Germany, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, Turkey, UK, and USA; emerging economies are Argentina, Brazil, China, India, Indonesia, Malaysia, Peru, Philippines, Saudi Arabia, Singapore, South Africa, and Thailand.

[9]The appreciation we estimate for emerging economies is roughly two percent 10 quarters after a negative US APITR shock, while the corresponding number for OECD member countries is around 3.5 percent.

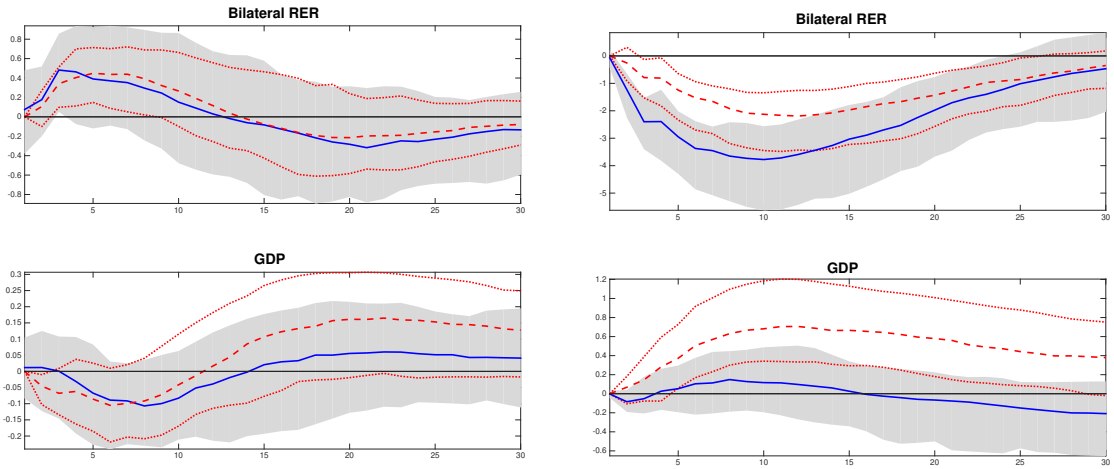

Figure 15: **OECD member countries vs. emerging economies**: Average dynamic effects in bilateral exports to the US (in percent) and bilateral imports to the US (in percent) to a one-percentage-point cut in the US ACITR (left-hand panel) and in the US APITR (right-hand panel). Solid blue (dashed red) lines correspond to responses of OECD (emerging) countries. Shaded areas (broken red lines) are confidence bands of one standard deviation.

5.2. Exchange Rate Regimes

This section tests whether our baseline results depend on countries' exchange rate regimes. Following the IMF classification, we consider the following four exchange rate regimes, each of them capturing a different degree of exchange rate flexibility: flexible exchange rate regimes, managed-floating regimes, intermediate regimes (e.g., a crawling peg), and currency unions (in our case, the euro area).[10] As illustrated in Figure 16, the spillovers remain largely insignificant across the different exchange rate regimes for corporate income tax shocks. Conditional on a negative US APITR shock, we find that positive spillover effects are driven by countries with managed floats (in red), followed by countries with intermediate regimes (in blue). When analyzing the single countries in these groups, there is an overlap with the group of emerging economies (with some exceptions, for example Switzerland). Our results therefore suggest that the expansionary effect from US APITR reductions is most pronounced in emerging economies with exchange rate regimes that are not entirely flexible (managed floats or intermediate regimes).

[10]The countries in the four groups are: Australia, Canada, Chile, Japan, Mexico, Norway, Sweden and the UK for the flexible exchange rate regimes; Indonesia, Korea, New Zealand, Peru, Philippines, Saudi Arabia, South Africa, Thailand, and Turkey for the managed-floating regimes; China, Malaysia, Singapore, and Switzerland for the intermediate regimes; and Austria, Belgium, Finland, Italy, Netherlands, and Spain for the Euro Area.

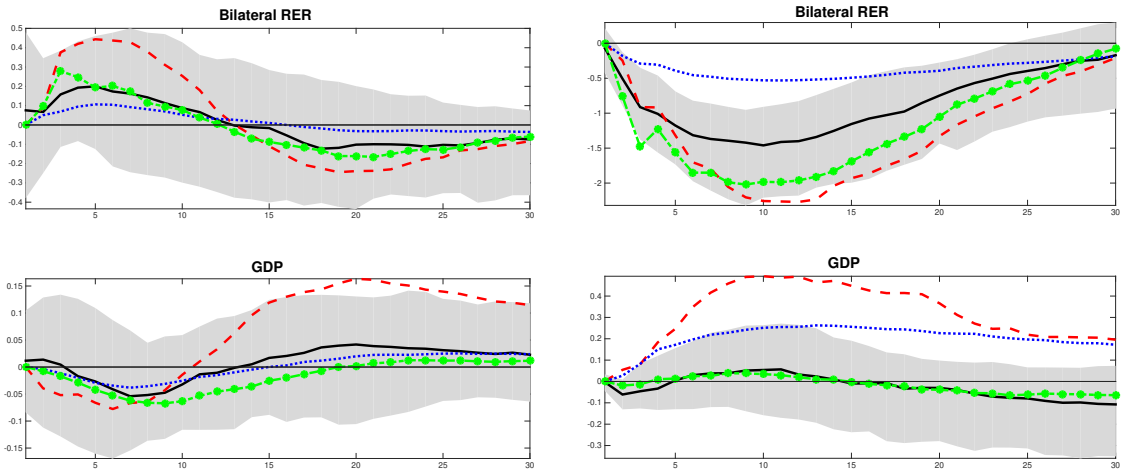

Figure 16: **Exchange rate regimes**: Average dynamic output effects (in percent) to a one-percentage-point cut in the US ACITR (left-hand panel) and in the US APITR (right-hand panel). Black lines correspond to flexible exchange rate regimes, red dashed lines represent managed-floating regimes, blue dotted lines are intermediate regimes, and green dotted lines capture the euro area. Shaded areas are confidence bands of one standard deviation.

5.3. Trade and Financial Integration

A third important country-specific characteristic that explains the spillover effects of US tax shocks is a country's economic link with the US. In the spirit of Ilzetzki et al. (2013), we exploit the cross section of our 33 countries and condition on the country-specific characteristics that proxy for trade and capital-account openness. For each proxy, we then assign all countries under consideration into two groups: a subsample of countries that display relatively high degrees of economic ties with the US (above the mean over all 33 countries) and another group of countries with relatively low degrees of openness (below the mean).[11]

We consider differences in countries' trade openness, captured by the share of bilateral net exports to GDP. Figure 17 illustrates that countries' trade openness does not significantly affect the spillover effects stemming from US corporate tax shocks. This provides further evidence for the absence of a significant and strongly positive trade channel conditional on corporate tax cuts. While our results conditional on changes in

[11] Alternatively, one could rely on the median instead of the mean to categorize countries. Given the high degree of heterogeneity across countries, relying on the median leads to subgroups that differ significantly in terms of the number of countries; i.e., one group with the most countries vs. one group with very few countries. For example, considering current-account openness results in only two countries in the high-openness subgroup.

personal income taxes point to minor qualitative differences in the resulting appreciation of countries currencies' real exchange rates relative to the US dollar, the spillover effects in terms of output are very similar. This allows us to conclude that countries' trade links with the US do not significantly shape the spillover effects related to personal income tax shocks. Recall that we have, a priori, focused on a set of countries that have tight trade linkages with the US. The same patterns emerge when classifying countries into two groups according to the GDP shares of their current accounts and net portfolio inflows.

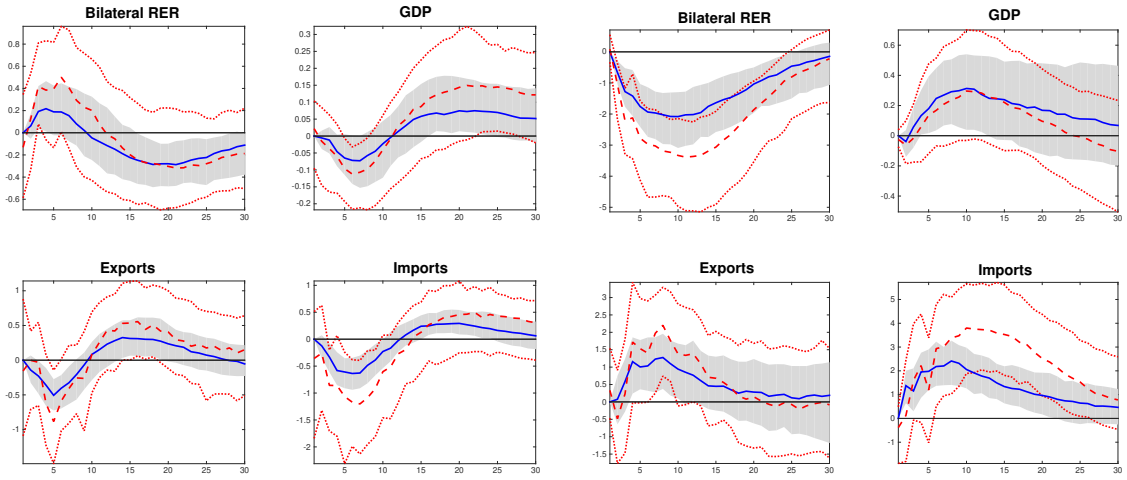

Figure 17: **Trade openness**: Average dynamic output effects (in percent) to a one-percentage-point cut in the US ACITR (left-hand panel) and in the US APITR (right-hand panel). Solid blue (dashed red) lines correspond to responses of countries with high (low) shares of bilateral net exports to GDP. Shaded areas (broken red lines) are the respective confidence bands of one standard deviation.

6. Conclusion

This paper extends the narrative shock series for corporate and personal income tax rates first constructed in Mertens and Ravn (2010) to 2019Q4 and assesses the spillover effects of these tax changes on a range of 33 countries. Even over the longer sample, the estimated short-run output effects of changes in average tax rates are large and they are relatively larger for reductions in personal income tax rates, compared to corporate income tax rates. The documented differences between these two tax shocks on the US economy further translate into spillover effects, on various countries, that vary over the two tax instruments. The spillover effects following a cut in corporate income tax rates generate, on average, short-run contractions. The fall in output and investment is not statistically significant for the average response over all 33 countries

under consideration, but this negative effect is significant for some countries, such as Canada. Combined with the lack of evidence for the presence of a significant and strongly positive trade channel conditional on corporate tax cuts, our results point to these negative spillovers being driven by investment reallocation. For personal income tax cuts, on the other hand, the trade channel plays a predominant role, together with monetary policy that leans against expansionary spillover effects in at least some countries. The effects of a reduction in personal income taxes are on average expansionary with an intensification of trade with the US.

Finally, we analyze to what extent these spillovers differ depending on country-specific characteristics. We find that the expansionary effects from APITR reductions are most pronounced in emerging economies with exchange rate regimes that are not entirely flexible. The degree to which a country is connected to the US economy (either through trade or financial linkages) does not have a significant impact on these effects. The country-specific characteristics we analyzed do not seem to play a role in explaining the spillover effects from the ACITR. But we find that the magnitude of the short-run investment contraction and, therefore, the importance of the investment reallocation channel differs across countries.

There are several interesting avenues for future research. First, it would be interesting to confront these findings with macroeconomic models and assess to what extent and under what assumptions these models are able to replicate the documented patterns. Moreover, a more detailed analysis of the disaggregated effects of the two tax shocks–both in the US and in other countries–would help shed more light on the underlying mechanisms that are driving the documented aggregated effects. We leave a thorough assessment of these issues for future research.

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Appendix A. Narrative Tax Changes

We follow the methodologies of Romer and Romer (2010) and Mertens and Ravn (2013). Changes in the total tax liabilities of various legislative actions that were implemented less than a quarter after they had been ratified are decomposed into various subcomponents: corporate income tax liabilities (CI), individual income liabilities (II), employment taxes (EM), and a residual category with other changing provisions (OT). We rely on the same sources as Romer and Romer (2010) and Mertens and Ravn (2013) and only describe the historical tax changes that are covered therein. All revenue estimates are expressed at an annual rate. The revenue effects are assigned to the quarter when tax liabilities are actually changed. If an action takes effect before the middle of a quarter, then we assign it to that quarter. If it takes effect after the middle of the quarter, then we assign it to the next quarter.

Appendix A.1. Patient Protection and Affordable Care Act and the Health Care and Education Reconciliation Act of 2010

- Signed into law on March 23, 2010
- Change in liabilities: -$2 billion (2010Q1)
- Classification: Exogenous (primarily ideological); -$2 billion (CI)

Signed into law on February 23, 2010, the "Affordable Care Act" was a major element of the Obama Administration and was designed to bring comprehensive health insurance coverage to a wider subset of the US population.[12] Within the coverage reforms, a number of provisions consisted of tax credits for small businesses and individuals and put in place individual and employer responsibility requirements.

The "Small Business Health Care Tax Credit" for businesses with fewer than 25 full-time workers and an average annual wage bill below $50K aimed to help bear the cost of providing business health insurance to these businesses' workers. In addition, a tax credit was made available to cover up to 35 percent of health insurance premium costs, increasing to 50 percent for any two years, starting in 2014. This tax credit was retroactive to January 1, 2010. Notably, non-medicare-related health insurance is not

[12]The term "Affordable Care Act" is used for the Patient Protection and Affordable Care Act (P.L. 111-148, enacted March 23, 2010) and the provisions of the Health Care and Education Reconciliation Act of 2010 (P.L. 111-152, enacted March 30, 2010) that are related to health care.

on the IRS's list of employment taxes.

The motivation for this act was largely ideological, as the 2011 Economic Report of the President states (see p.111) that "Over the next decade, these reforms are expected to expand coverage to 32 million Americans, make health care more affordable, and improve the quality of care."

Appendix A.2. American Taxpayer Relief Act (ATRA) of 2012

- Signed into law on January 2, 2013
- Change in liabilities: +$40.82 billion (2013Q1)
- Classification: Exogenous (primarily ideological); +$36.57 billion (II) and +$4.25 billion (OT)

The ATRA was signed into law on January 2, 2013, largely in response to a variety of temporary provisions that had expired on December 31, 2012. Although this act retroactively extended many of these provisions, some were further modified. The main modifications included can be summarized as follows:[13]

1. An increase in the top income tax rate from 35 to 39.6 percent for taxpayers with taxable income over $400K ($450K for joint filers).
2. An increase in the capital gains and dividends tax rate from 15 to 20 percent for taxpayers with taxable income over $400K ($450K for joint filers).
3. Reductions in itemized deductions and personalized exemptions claimed by taxpayers with annual gross incomes over $250K ($300K for joint filers).
4. An increase in the top estate tax rate from 35 to 40 percent, with the exemption amount equal to $5M per decedent.

The first three modifications reflect what would have happened had the previous tax provisions expired for individuals in the top tax brackets. However, the fourth modification maintained the exemption amount per decedent at $5M. Had previous estate tax provisions expired, this amount would have fallen to $1M.

The 2013 Economic Report of the President (see p.27) cites two main reasons for these modifications: "*[R]educing the deficit and returning more fairness to the tax*

[13]For further details, see *An overview of the tax provisions in the American Taxpayer Relief Act of 2012, Congressional Research Service (Table 1).*

code." Related to deficit reduction, the 2014 budget (p.35) states "*Over the past few years, Democrats and Republicans have cut the deficit by more than $2.5 trillion through a mix of spending cuts and tax reform including over $600 billion in new revenue in the ATRA from raising income tax rates on the highest income Americans.*" With respect to fairness, the 2013 Economic Report of the President (see p.35) states that the ATRA rolls back some of the inequality that has built up since the 1980s and marks the beginning of the return to a tax code that reflects the basic principles of fairness and the critical importance of the middle class to the nation's overall economic health. Therefore, we classify it as exogenous and both deficit-driven and ideological.

To quantify the modifications that are due to the ATRA, we rely on two main documents and verify them with a third. In August 2012, the Congressional Budget Office (CBO) released "*An Update to the Budget and Economic Outlook: Fiscal Years 2012 to 2022,*" in which they considered an alternative scenario where most tax provisions set to expire in December 2012 were extended (Table 1-5, p.66-65), including all tax provisions modified by the ATRA. A supplementary table of the more detailed estimates can be found here. On January 1, 2013, the Joint Committee on Taxation (JCT) also released detailed estimated revenue effects of the revenue provisions contained in the ATRA (for details, see here). The revenue effects of the modified tax provisions in the ATRA were compared to the estimated revenue effects under the assumption that all provisions would be extended to arrive at a revenue impact of the modified provisions. To check our estimates, we use the following statement from the 2013 Economic Report of the President (see p.28): "*ATRA reduces the deficit by more than $700 billion over the next ten years.*" We also calculate the 10-year revenue impact of these modifications, using the same tables used to estimate the single-year impact and we verify that they are indeed over $700B.

Appendix A.3. Tax Cuts and Jobs Act 2017 (TCJA)

- Signed into law on December 22, 2017
- Change in liabilities: -$135.7 billion (2018Q1)
- Classification: Exogenous (primarily ideological with long-run aim to increase growth); -$71.3 billion (II), -$65.2 billion (CI), +$3.2 billion (EM), and -$2.4 billion (OT)

The TCJA was signed into law on December 22, 2017, as part of the pro-growth policy agenda of the Trump administration; it had four main goals:[14]

1. Direct and indirect tax relief for middle income families: direct relief by lowering marginal tax rates, and indirect relief through, e.g., higher standard deductions and an increased child tax credit
2. Simplification of individual tax filing, mostly through the elimination of itemized deductions
3. Stimulating economic growth through business tax relief, prominently by reducing the top marginal federal corporate tax rate from 35 to 21 percent, but also through other provisions (e.g., introducing 20 percent deductions on pass-through income, immediate full expensing for certain types of investment)
4. Repatriation of overseas earnings through a shift from a worldwide taxation system toward a territorial system

The underlying reasons for these modifications as laid out in the 2018 Economic Report of the President are the fairness and simplicity of the tax code and the competitiveness of the corporate tax system (see, e.g., "*Policies for a Pro-Growth Agenda*," p.4). We therefore classify this tax legislation as exogenous and mostly ideologically driven but also one that aims to stimulate long-run growth.

To quantify the effects of the TCJA on tax liabilities, we mostly rely on the detailed estimated revenue effects from the JCT that can be found here. The JCT classifies the different provisions into three groups: (I) Individual Tax Reform, (II) Business Tax Reform, and (III) International Tax Reform. We attribute provisions in (1) to II and provisions in (2) and (3) to CI, with the following exceptions:

- I.D.5. Repeal exclusion for employer-provided qualified moving expense reimbursement other than for members of the Armed Forces (EM)
- I.F. Double estate, gift, and GST tax exemption amounts (OT)
- I.I.8. Retirement plan and casualty loss relief for any area with respect to which a major disaster has been declared by the President, under section 401 of the Robert T. Stafford Relief and Emergency Assistance Act, during 2016 (OT)

[14] See 2018 Economic Report of the President, Chapter 1: Taxes and Growth, pp.31–71 for details.

- II.E.2. Limitation on employers' deductions for expenses for fringe benefits (EM)
- II.G.1. Modification of credit for clinical testing expenses for certain drugs for rare diseases or conditions (OT)
- II.H. Banks and Financial Instruments (OT)
- II.I.2. A 21 percent excise tax on excess tax-exempt organizations' executive compensation (certain exceptions provided to non-highly compensated employees and for certain medical services) (OT)
- II.J. Insurance (OT)
- II.L.1. Excise tax based on investment income of private colleges and universities with endowments per student of at least $500,000 (OT)
- II.L.3. Charitable deduction not allowed for amounts paid in exchange for college athletic event seating rights (OT)
- II.M.3. Craft beverage modernization and tax reform (OT)
- III.C.1. Elimination of inclusion of foreign-based companies' oil-related income (OT)
- III.G.1. Restrictions on insurance business exceptions for companies with passive foreign investment rules (OT)

The JCT's overall estimated revenue effect of -$135.7 billion for the fiscal year 2018 is also cited in the 2018 Economic Report of the President: "*The Joint Committee on Taxation (JCT 2017) estimated that the TCJA's static effect (i.e., without macroeconomic feedback) would lower revenues by $136 billion in fiscal year 2018*" (p.415).

Appendix A.4. Differences in the updated shocks compared to Liu and Williams (2019)

There are two differences between our updated shocks for personal income taxes and those of Liu and Williams (2019) (henceforth, LW):

1. LW classify the 2010 Tax Relief, Unemployment Insurance Re-authorization and Job Creation Act as an exogenous tax change, while we classify it as endogenous. The 2012 Economic Report of the President mentions that this act was introduced largely to encourage economic recovery following the financial crisis. It lays out

how this act will help counteract high levels of unemployment. According to the original definition in Romer and Romer (2010), if policymakers are predicting an act's impact on unemployment, the act is to be classified as endogenous. LW argue that because the economy was already recovering, this act aims to effect long-run growth rather than to counteract cyclical factors.

2. LW estimate a small negative impact of the ATRA, while we estimate a positive impact. Our positive shock to personal income taxes comes from higher personal income taxes on individuals in top income tax brackets. Note that these higher taxes were due to previous tax provisions having expired. But because it was largely expected that these provisions would be extended for an additional year (and tax provisions for lower tax brackets were extended), we counted this as a shock.

Appendix B. Data Definitions and Sources

Appendix B.1. US Data

- **Population** is the civilian non-institutional population age 16 and above from the Bureau of Labor Statistics (BLS). Note that this differs from the population measure used by Mertens and Ravn (2013), which came from Francis and Ramey (2009).

- The **personal income tax base** is personal income obtained from the Bureau of Economic Analysis (BEA) National Income and Product Accounts (NIPA) Table 2.1 line 1, less government transfers (NIPA Table 2.1 line 17) plus contributions to government social insurance (NIPA Table 3.2 line 11), deflated by the GDP deflator (NIPA Table 1.1.9 line 1) and divided by the population.

- The **corporate income tax base** is corporate profits (NIPA Table 1.12, line 13) less Federal Reserve Bank profits (NIPA Table 1.16 B, C and D, line 11), deflated by the GDP deflator and divided by the population.

- The **average personal income tax rate** is federal current taxes plus contributions to government social insurance (NIPA Table 3.2 line 11) divided by the personal income tax base.

- The **average corporate income tax rate** is federal taxes on corporate income (NIPA Table 3.2 line 9) divided by corporate profits less Federal Reserve Bank profits (NIPA Table 1.12 line 13 less NIPA Table 1.16 B, C, D line 11).

- **Output** is real GDP obtained from NIPA Table 1.1.3 line 1 divided by the population.

- **Government spending** is real federal government consumption expenditures and gross investment (NIPA Table 1.1.3 line 23) divided by the population.

- **Debt** is the federal debt held by the public (FRED series FYGDPUN) divided by the population and the GDP deflator. The series, which starts in 1970, is extended back to 1950, using the debt series in Mertens and Ravn (2013).

- The **Federal Funds rate** is the effective Federal Funds rate (FRED series EFFR). The series is merged with the Federal Funds rate from Mertens and Ravn (2013) prior to 2000.

- **Non-borrowed reserves** are the Federal Reserve's non-borrowed reserves of depository institutions (FRED series BOGNONBR) extended back to 1950 by subtracting borrowed reserves from total reserve balances (FRED RESBALNS BORROW).

- **Inflation** is measured with the implicit price deflator for personal consumption expenditures (NIPA Table 1.1.9 line 2).

- **Personal consumption expenditure** is personal consumption expenditures obtained from NIPA Table 1.1.3 line 2 divided by the population.

- **Personal consumption expenditure on durable goods** is obtained from NIPA Table 1.1.3 line 4 divided by the population.

- **Personal consumption expenditure on non-durable goods and services** is the sum of real personal consumption expenditure on non-durable goods (NIPA Table 1.1.5 line 5, deflated by NIPA Table 1.1.9 line 5) and real personal consumption expenditures on services (NIPA Table 1.1.5 line 6 deflated by NIPA Table 1.1.9 line 6), divided by the population.

- **Disposable personal income** is obtained from NIPA Table 2.1 line 27 deflated by the GDP deflator and divided by the population.
- **Personal savings** data is obtained from NIPA Table 2.1 line 34 deflated by the GDP deflator and divided by the population.
- The **employment to population** ratio is civilian employment age 16 and over, obtained from the BLS household survey, divided by the population.
- The **labor force** to population ratio is the sum of civilian employment and the number of unemployed (FRED UNEMPLOY) divided by the population.
- The **unemployment rate** represents the number of unemployed as a percentage of the labor force (FRED UNRATE).
- **Hours per worker** is the total economy hours worked, obtained from the BLS (Haver series LXEHL@USECON), divided by employment.
- **Compensation of employees** is obtained from NIPA Table 2.1 line 2 deflated by the GDP deflator and divided by the population.
- **Wages and salaries** are obtained from NIPA Table 2.1 line 3 deflated by the GDP deflator and divided by the population.
- **Hourly compensation** is economy-wide compensation per hour (Haver Series LEXCL@USECON) deflated by the GDP deflator.
- **Unit labor costs** are obtained from the non-farm business sector unit labor cost index (FRED series ULCNFB).
- **Investment** is real gross private domestic investment (NIPA Table 1.1.3 line 7) divided by the population.
- **Non-residential fixed investment** is obtained from NIPA Table 1.1.3 line 9 and divided by the population.
- **Residential fixed investment** is obtained from NIPA Table 1.1.3 line 13 and divided by the population.
- **Terms of trade** is the gross domestic product terms of trade index obtained from the BEA (FRED series W369RG3Q066SBEA).

- **Exports and Imports** are real exports and imports obtained from NIPA Table 1.1.3 lines 16 and 19 and divided by the population.

Appendix B.2. Canadian and Panel Data

- **GDP** is taken from Mohaddes and Raissi's GVAR dataset (2016 vintage). Data cover the 1979Q2–2016Q4 period.

- **Investment** is measured as real, seasonally adjusted gross fixed capital formation. Data are collected from each country's national accounts, using Haver. Starting periods are uneven across countries and summarized in Table B.2

- **Consumption** is measured as real, seasonally adjusted private consumption. Data are collected from each country's national accounts, using Haver. Starting periods are uneven across countries and summarized in Table B.3

- **The current account balance** is collected from each country's balance of payments in Haver. It is then deflated by a given country's GDP deflator and multiplied by the bilateral exchange rate to convert it to real US dollars. Note that this variable enters the VAR as a percent of GDP. Starting periods are uneven across countries and summarized in Table B.4

- **Real exports and imports to the US** are collected from the US Census Bureau Trade in Goods (Census Basis) by World Area and Selected Country. US imports of selected countries are labelled as exports to the US from selected countries in our dataset, and vice versa. Series are then deflated by a given country's price of exports or imports to express them in real terms. Note that series enter the VAR as a percent of GDP. Starting periods are uneven across countries and summarized in Tables B.5 and B.6

- **Real bilateral exchange rates** are taken from Mohaddes and Raissi's GVAR dataset (2016 vintage). Data cover the 1979Q2–2016Q4 period.

- **Nominal short-run interest rates** are taken from Mohaddes and Raissi's GVAR dataset (2016 vintage). Data cover the 1979Q2–2016Q4 period.

Data start date	Country
1979	France, UK, Australia, Korea, South Africa, Canada, Taiwan, Germany, Norway
1980	Japan, Peru, Switzerland
1981	Italy, Sweden, Philippines
1983	Indonesia
1987	New Zealand
1990	Finland
1991	Brazil, Costa Rica, Denmark
1993	Mexico, Thailand
1995	Austria, Belgium, Bulgaria, Cyprus, Estonia, Greece, Hungary, Iceland, Ireland, Latvia, Lithuania, Portugal, Romania, Slovakia, Slovenia, Spain, Poland
1996	Chile, Czech Republic, Netherlands, India
2000	Croatia, Malta
2004	Argentina
2005	Colombia
2010	Malaysia
2011	Russia
No data	China, Luxembourg, Uruguay, Vietnam

Table B.2: Start dates for investment data by country

Data start date	Country
1979	France, UK, Australia, Korea, South Africa, Canada, Germany, Netherlands, Norway
1980	Japan, Peru, Switzerland
1981	Italy, Sweden
1982	Taiwan
1983	Indonesia
1987	New Zealand
1990	Finland
1991	Brazil, Costa Rica, Denmark
1993	Mexico, Thailand
1995	Austria, Belgium, Bulgaria, Cyprus, Estonia, Greece, Hungary, Iceland, Ireland, Latvia, Lithuania, Luxembourg, Portugal, Romania, Slovakia, Slovenia, Spain, Poland
1996	Chile, Czech Republic, India
1998	Philippines
2000	Croatia, Malta
2004	Argentina
2005	Colombia
2010	Malaysia
2011	Russia
No data	China, Uruguay, Vietnam

Table B.3: Start dates for consumption data by country

Data start date	Country
1979	UK, Australia, South Africa, New Zealand, Switzerland, Indonesia
1980	Brazil, Finland, Korea, Peru, Philippines
1981	Canada, Ireland, Norway, Taiwan
1982	Sweden
1985	Thailand
1990	Iceland, Spain
1991	Germany
1993	Croatia
1994	Romania, Russia, Slovenia
1995	Austria, Italy, Luxembourg, Malta, Mexico
1996	Bulgaria, Columbia, Japan, Portugal
1997	Poland
1999	Costa Rica, Estonia, Malaysia
2000	Latvia
2001	Lithuania
2002	Greece
2003	Chile, Czech Republic, Netherlands
2005	Denmark
2006	Hungary
2008	Belgium, Cyprus, France, Slovakia
2010	China
2012	Uruguay
No data	Argentina, India, Vietnam

Table B.4: Start dates for current account data by country

Data start date	Country
1979	Brazil, Canada, China, France, Germany, India, Italy, Japan, Korea, Mexico, Netherlands, Taiwan, UK
1984	Indonesia
1985	Argentina, Australia, Austria, Belgium, Chile, Colombia, Finland, Hungary, Ireland, Malaysia, Norway, Philippines, Poland, South Africa, Spain, Sweden, Switzerland, Thailand
1992	Russia
1993	Czech Republic
No data	Bulgaria, Costa Rica, Croatia, Cyprus, Denmark, Estonia, Greece, Iceland, Latvia, Lithuania, Luxembourg, Malta, New Zealand, Peru, Portugal, Romania, Slovakia, Slovenia, Uruguay, Vietnam

Table B.5: Start dates for imports from the US by country

Data Start Date	Country
1979	Brazil, Canada, China, France, Germany, India, Italy, Japan, Korea, Mexico, Taiwan, UK
1985	Argentina, Australia, Austria, Belgium, Chile, Colombia, Finland, Hungary, Ireland, Malaysia, Norway, Philippines, Poland, South Africa, Spain, Sweden, Switzerland, Thailand, Indonesia, Netherlands
1993	Czech Republic
No data	Bulgaria, Costa Rica, Croatia, Cyprus, Denmark, Estonia, Greece, Iceland, Latvia, Lithuania, Luxembourg, Malta, New Zealand, Peru, Portugal, Romania, Slovakia, Slovenia, Uruguay, Vietnam, Russia

Table B.6: Start dates for exports to the US by country

Appendix B.3. Currency Regime Details by Country

Flexible	Managed Float	Intermediate Regime	Currency Union
Australia	Indonesia	China	Euro area
Canada	Korea	Malaysia	
Chile	New Zealand	Singapore	
Japan	Peru	Switzerland	
Mexico	Philippines		
Norway	South Africa		
Sweden	Saudi Arabia		
UK	Thailand		
	Turkey		

Table B.7: Currency Regime by Country

Appendix C. Alternative Identification of Corporate Tax Shocks: Blanchard and Perotti (2002)

A widely used identification methodology for total tax shocks is the one proposed in Blanchard and Perotti (2002). We adapt the methodology to identify corporate tax shocks. Specifically, we rely on the following VAR specification:

$$Y_t = A(L)Y_{t-1} + U_t, \tag{C.1}$$

where $Y_t \equiv [G_t, CT_t, Y_t, X_t, I_t]'$ is a vector of the following five variables (at quarterly frequencies and in logarithms): government spending (G_t), corporate tax revenues (CT_t), GDP (Y_t), various macro indicators interchanged as the fourth variable (X_t), and nominal interest rates (I_t).[15] The macro indicators considered in X_t are inflation, employment, unemployment, wages, investment, industrial production, exports, imports, and consumption. $A(L)$ is a four-quarter distributed lag polynomial and $U_t \equiv [g_t, ct_t, y_t, x_t, i_t]'$ is the corresponding vector of reduced form residuals, which in general have non-zero cross correlations. Without loss of generality, the relation between the reduced form residuals and the underlying structural shocks can be written

[15]All nominal variables are deflated with the GDP deflator, with the exception of the nominal interest rate.

as follows:

$$
\begin{aligned}
g_t &= \alpha_1 y_t + \alpha_2 x_t + e_t^g && \text{(C.2)} \\
ct_t &= \beta_1 y_t + \beta_2 x_t + \beta_3 e_t^g + e_t^{ct} && \text{(C.3)} \\
y_t &= \gamma_1 g_t + \gamma_2 ct_t + e_t^y && \text{(C.4)} \\
x_t &= \delta_1 g_t + \delta_2 ct_t + \delta_3 y_t + e_t^x && \text{(C.5)} \\
i_t &= \epsilon_1 g_t + \epsilon_2 ct_t + \epsilon_3 y_t + \epsilon_4 x_t + e_t^i && \text{(C.6)}
\end{aligned}
$$

where e_t^{ct}, e_t^g, e_t^y, and e_t^x are mutually uncorrelated structural shocks. Coefficients α_1, α_2, β_1 and β_2 are estimated using information outside of the SVAR. The use of quarterly data virtually eliminates any discretionary adjustment made to a fiscal policy that is in response to unexpected events within the quarter. α_1 and β_1 thus represent the automatic effects of output on government spending and corporate tax revenues and can therefore be interpreted as the elasticity of government spending and corporate tax revenues to output. Government spending does not respond to output within the quarter, so that we set $\alpha_1 = 0$. We estimate $\beta_1 = 3.5$ as the product of the elasticity of the corporate tax base to GDP and the elasticity of corporate tax revenues to the corporate tax base. To estimate the elasticity of corporate taxes to their tax base, tax receipts are regressed on tax accruals using data from quarters 1, 3 and 4. Quarter 2 was left out as the tax code allows corporations to make partial payments throughout the year and make up for the difference in the second quarter. The elasticity of government spending to the fourth variable is represented by α_2 and is estimated for all variables separately. Estimated coefficients are summarized in Table C.8. The SVAR results are robust to the coefficients used.

Variable	Government Spending	Corporate Tax Revenue
Inflation	1.25	0
Employment	-0.03	16.6
Unemployment	0.03	-1.9
Wages	0	2.8
Investment	0	1.02
Industrial Production	0	3.5
Exports	0	1.9
Imports	0	1.9
Consumption	-0.07	6.26

Table C.8: Estimated elasticities of corporate tax revenue and government spending to a selection of macro variables.

The Blanchard and Perotti (2002) identification strategy allows for the identification of shocks to tax revenues but not to tax rates directly, as in the narrative approach presented in the main text. For a clean interpretation of these corporate tax revenue shocks, it is important to understand the relationship between corporate tax revenues and the average corporate tax rate. There is evidence to suggest that multinational firms shift profits to lower tax jurisdictions to reduce their overall tax liabilities (see, e.g., Devereux (2007)). Indeed, Mertens and Ravn (2013) find that cuts to corporate tax rates are largely self-financing, suggesting that firms alter their behavior in response to such policy changes. This evidence suggests that a reduction in the average corporate tax rate should be consistent with a growing corporate tax base over history and, thus, a potential increase in corporate tax revenues. The results from our SVAR indicate that the average corporate tax rate declines conditional on a positive shock to corporate tax revenues. Including the average corporate tax rate in place of the fourth, rotating variable in our SVAR, we estimate a significant reduction in the average corporate tax rate. Following a one-percent positive shock to corporate tax revenues, the average corporate tax rate falls by an average of two percent in the 10 quarters after the shock; i.e., dropping from an average 30 percent to 29.4 percent (see Figure C.18).

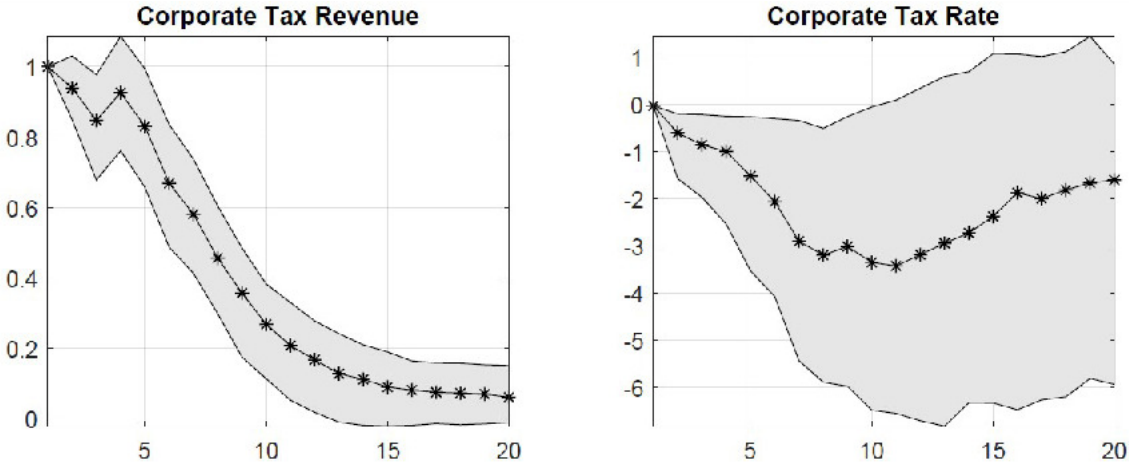

Figure C.18: A positive corporate tax revenue shock lowers average corporate tax rates.

Compared to the dynamics conditional on the narratively identified shocks in the main text–both for the shorter time period considered in Mertens and Ravn (2013) and the full time period up to 2019Q4–these dynamics are substantially different. In particular, the cut in average corporate income tax rates induces a large and significant increase in the corporate income tax base. This increase in the tax base is sufficiently

large to prevent a reduction in the respective tax revenues. However, the response of corporate tax revenues is insignificant at every horizon. This points to reductions in corporate income taxes being approximately self-financing. These differences suggest that the identified shocks that are based on a Blanchard and Perotti (2002)'s identification scheme with corporate income tax revenues are not the same as the narratively identified shocks that are based on the methodology of Mertens and Ravn (2013).

Based on the results from our SVAR estimated over the 1947Q1–2019Q4 period, an unexpected temporary one-percent increase in corporate tax revenues raises US output, investment, wages, imports, exports and inflation in the short run (see Figure C.19). This suggests that a positive corporate tax shock has a short-run expansionary impact on the American economy. The relatively smaller impact of the Blanchard and Perotti (2002) shocks on tax rates explains the more muted output expansion. Additionally, there are two crucial differences in the US dynamics compared to the conditional responses on the narratively defined shocks in the main text: first, given the more muted expansion of output, the investment response is much softer. Second, both imports and exports significantly increase. Both of these differences are determinant for the understanding of cross-country spillover effects.

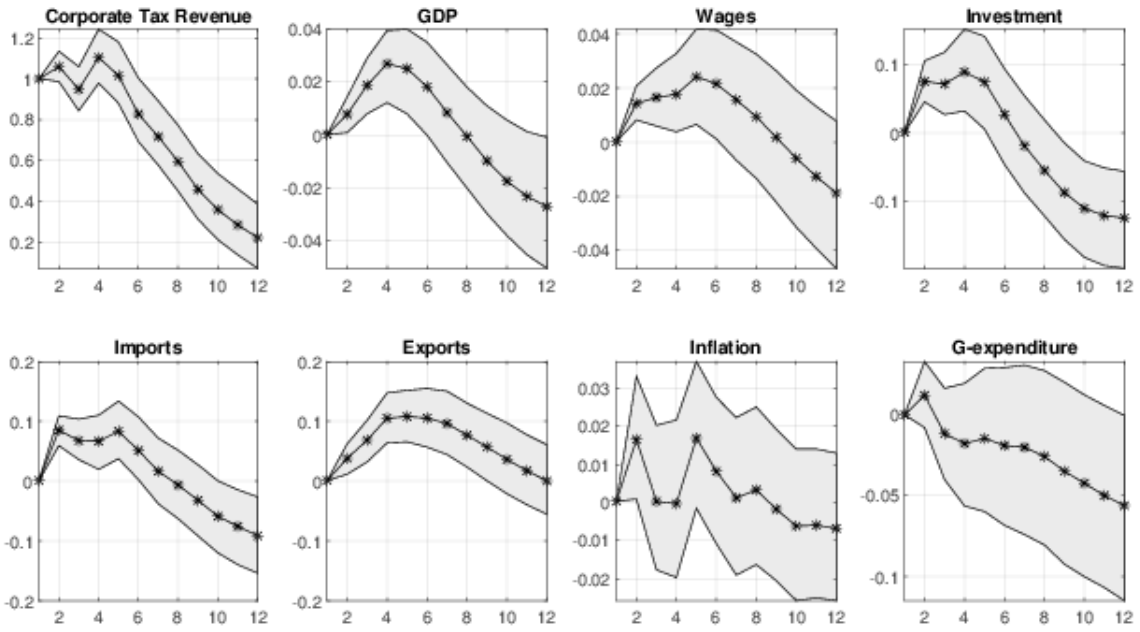

Figure C.19: Estimated dynamics conditional on a one-percent increase in corporate tax revenues over the 1949Q1–2019Q4 period.

Appendix C.1. Impulse Responses Controlling for Anticipation

Fiscal policy actions may be anticipated given the existence of both legislative and implementation lags. This implies that agents receive signals about future changes in taxes and government spending well before these changes actually take place (see, e.g., Yang, 2005; Mertens and Ravn, 2010; Leeper et al., 2013; Forni and Gambetti, 2016). In order to control for the anticipation effects, we follow the recent trend in the literature and include forecasts for US real GDP and corporate profits in our baseline SVAR. The data is taken from the Survey of Professional Forecasters. Controlling for agents' anticipation does not affect our baseline results. Figure C.20 plots the dynamics to a one-percent increase in US corporate tax revenues in the specification including one-quarter-ahead mean forecasts for real GDP. The short-run expansionary effect of the shock (illustrated by the increase in GDP) is almost identical to the benchmark specification and mimics agents' expectations of future GDPs. The same holds true when accounting for agents' expectations of corporate profits (see Figure C.21). The mean one-quarter-ahead forecast of corporate profits increases significantly in response to the shock but does not change the short-run dynamics of our macro variables of interest.

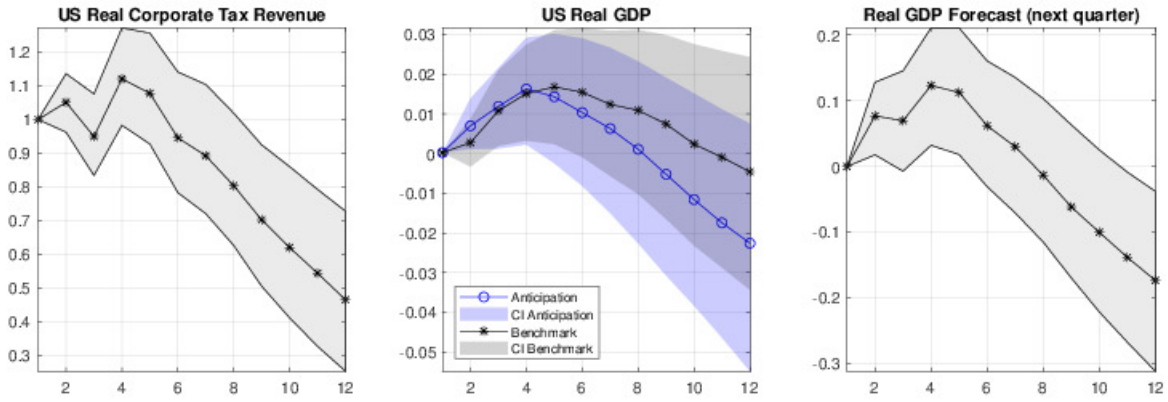

Figure C.20: Estimated dynamics conditional on a one-percent increase in corporate tax revenues over the 1970Q1–2019Q4 period.

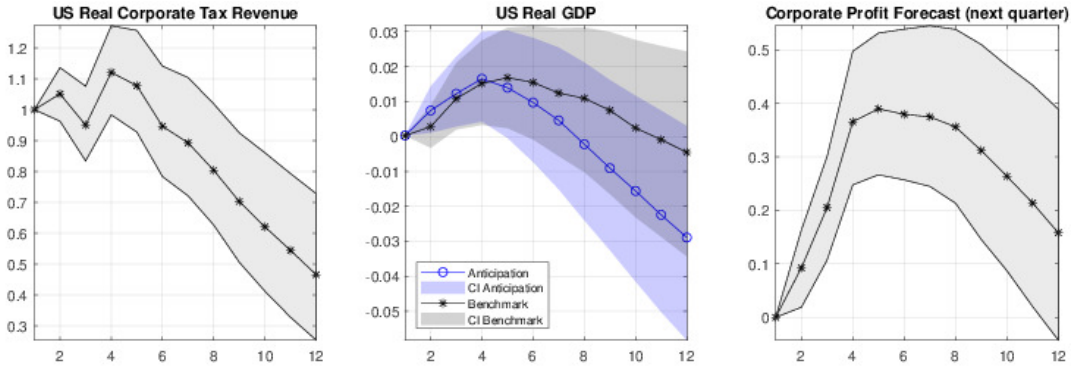

Figure C.21: Estimated dynamics conditional on a one-percent increase in corporate tax revenues over the 1970Q1–2019Q4 period.

Appendix D. Macroeconomic Dynamics Conditional on Both Tax Shocks for 1969Q1–2019Q4

As not all open-economy variables under consideration are available for the full period 1950Q1–2019Q4 considered in Section 2, we estimate the open-economy dynamics for the shorter time period 1969Q1–2019Q4. As shown in the following two figures, the macroeconomic dynamics discussed in Sections 2.2 and 2.3 are almost identical for this shorter sample.

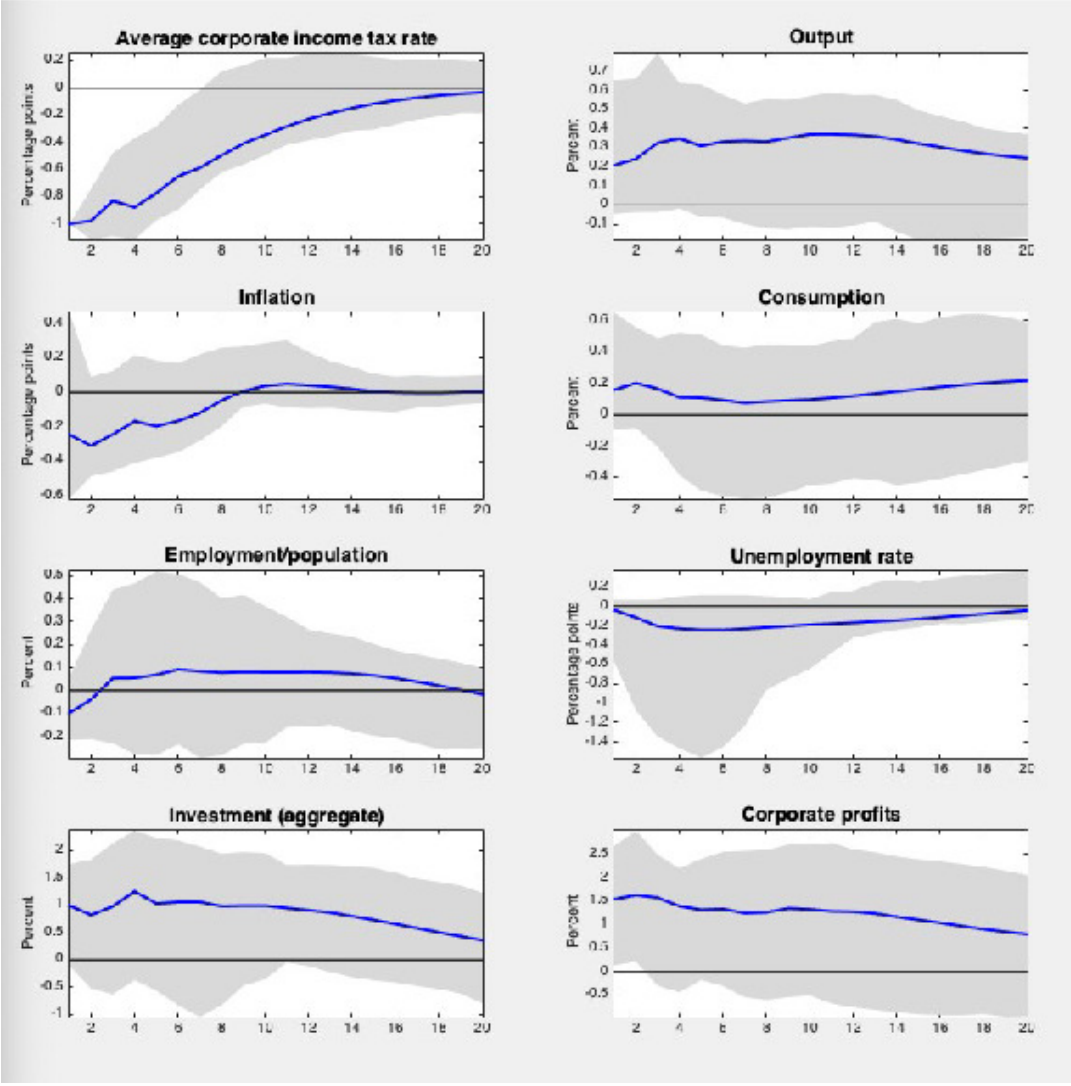

Figure D.22: Dynamic effects to a one-percentage-point cut in the ACITR on a set of macro variables for the shorter time period 1969Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.

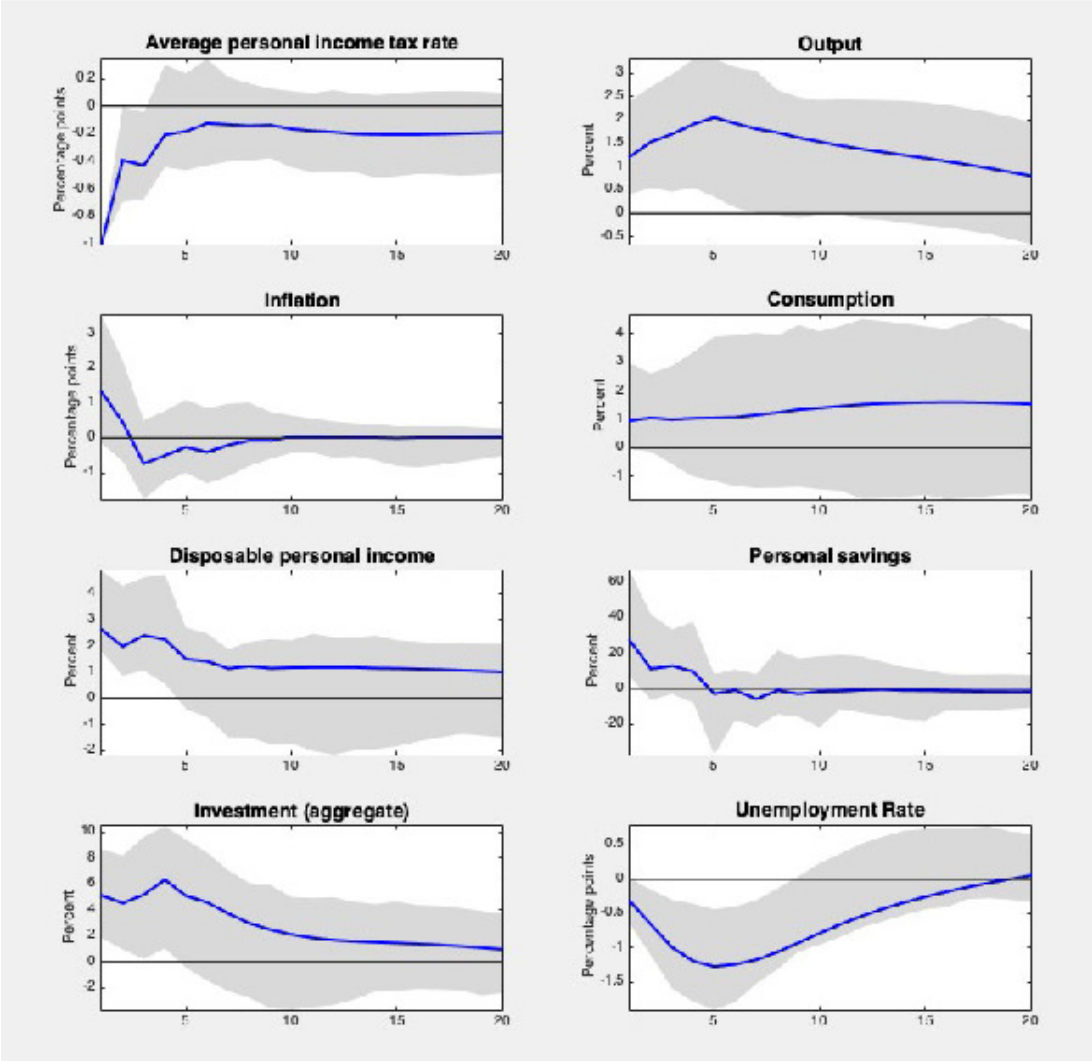

Figure D.23: Dynamic effects to a one-percentage-point cut in the APITR on a set of macro variables for the shorter time period 1969Q1–2019Q4. Solid blue lines are point estimates; grey areas indicate 95 percent confidence intervals.