Macroeconomic Effects of Tax Changes: Evidence from Fiscal Consolidations

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Introduction

Tax base vs. rate changes during consolidations

- Fiscal consolidations are associated with output declines, but their composition matters
- Policy advice often assumes that tax base changes are less harmful to economic activity
- However, differences in the macroeconomic effects of tax rate and tax base changes have received less attention in the literature Literature

Main hypothesis

Is base broadening less damaging to growth than rate hikes?

- There is some (but limited) theoretical support for differences between the effects of changes to tax bases and rates Theory
  1. **Efficiency:** base broadening can be less distortive if it targets agents that are taxed less than the average
  2. **Distribution:** base broadening often targets higher-income taxpayers, for whom it is easier to smooth negative shocks
  3. **Salience:** base broadening is often implemented as a larger number of smaller, and perhaps less salient, measures

This presentation

- We extend the tax policy database with additional information for the years of fiscal consolidation identified by Devries et al. (2011) and Alesina et al. (2015)
- We include detailed information on each tax measure, including its *ex-ante* estimated revenue yield and motivation
- We find that base broadening during fiscal consolidations leads to smaller output and employment declines compared to rate increases

Outline

- Data
- Methodology
- Results
- Discussion

Data

Constructing the dataset

- We extend the work of Devries et al. (2011) and Alesina et al. (2015) across three dimensions:
  1. Individual tax measures (rather than overall tax shock)
  2. Announcement & implementation dates (rather than years)
  3. Motivation for each measure
- We also code the tax type (PIT/VAT/...), measure type (base/rate/other), and expected revenue impact of each measure
- Information taken from primary sources (budget documents, parliamentary debates, technical reports), or contemporary secondary sources (e.g., newspaper articles, Central Bank reports) Narrative record
- Current dataset includes 2,124 individual tax measures in 10 OECD countries from 1978 to 2014

How the dataset looks like

Example: UK June 2010 Budget (selected measures)

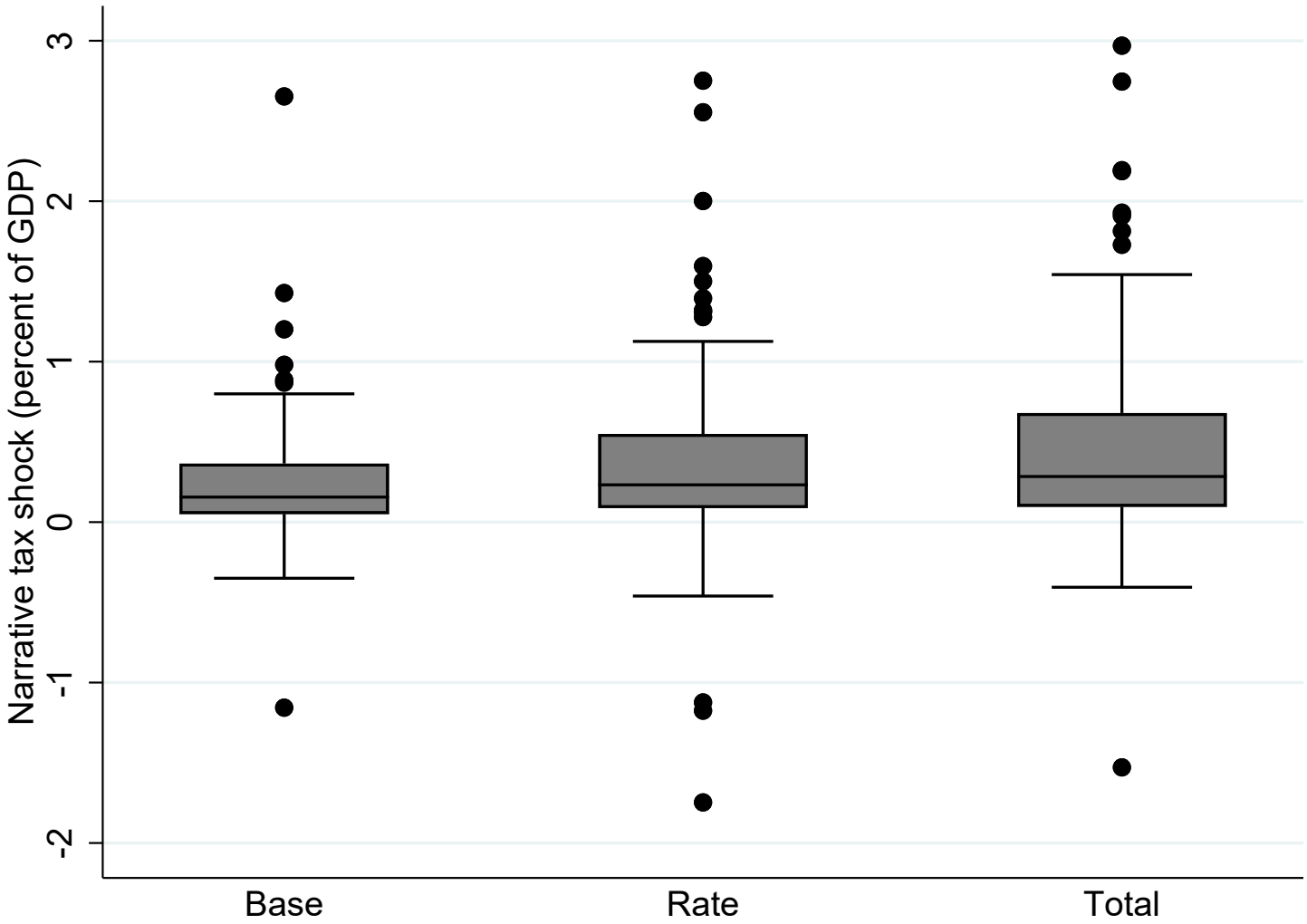
Measure	Tax	Type	t_0	t_1	t_5	Ann.	Imp.	Motivation
Increase main VAT rate to 20%	VAT	Rate	2.9	12.1	13.5	06/22/10	01/04/11	Consol.
Decrease CIT rate to 24% over 4 years	CIT	Rate	0	-0.4	-4.1	06/22/10	04/01/11	Long-Run
Lower capital & investment allowances	CIT	Base	0	0	2.7	06/22/10	04/01/12	Long-Run
Increase personal allowance by £1,000	PIT	Base	0	-3.3	-3.8	06/22/10	04/06/11	Long-Run
Increase capital gains rate to 28%	PIT	Base	0	0.7	0.9	06/22/10	06/23/10	Long-Run
Increase child tax credit	PIT	Base	0	-1.2	-2.0	06/22/10	04/06/11	Spending
Total June 2010 Budget			2.8	6.3	7.8			
% 2009 GDP			*0.2*	*0.5*	*0.6*			

Note: Expected revenue yields t_0, t_1, ... are per fiscal year, in billions of pound sterling.

Large consolidations are common

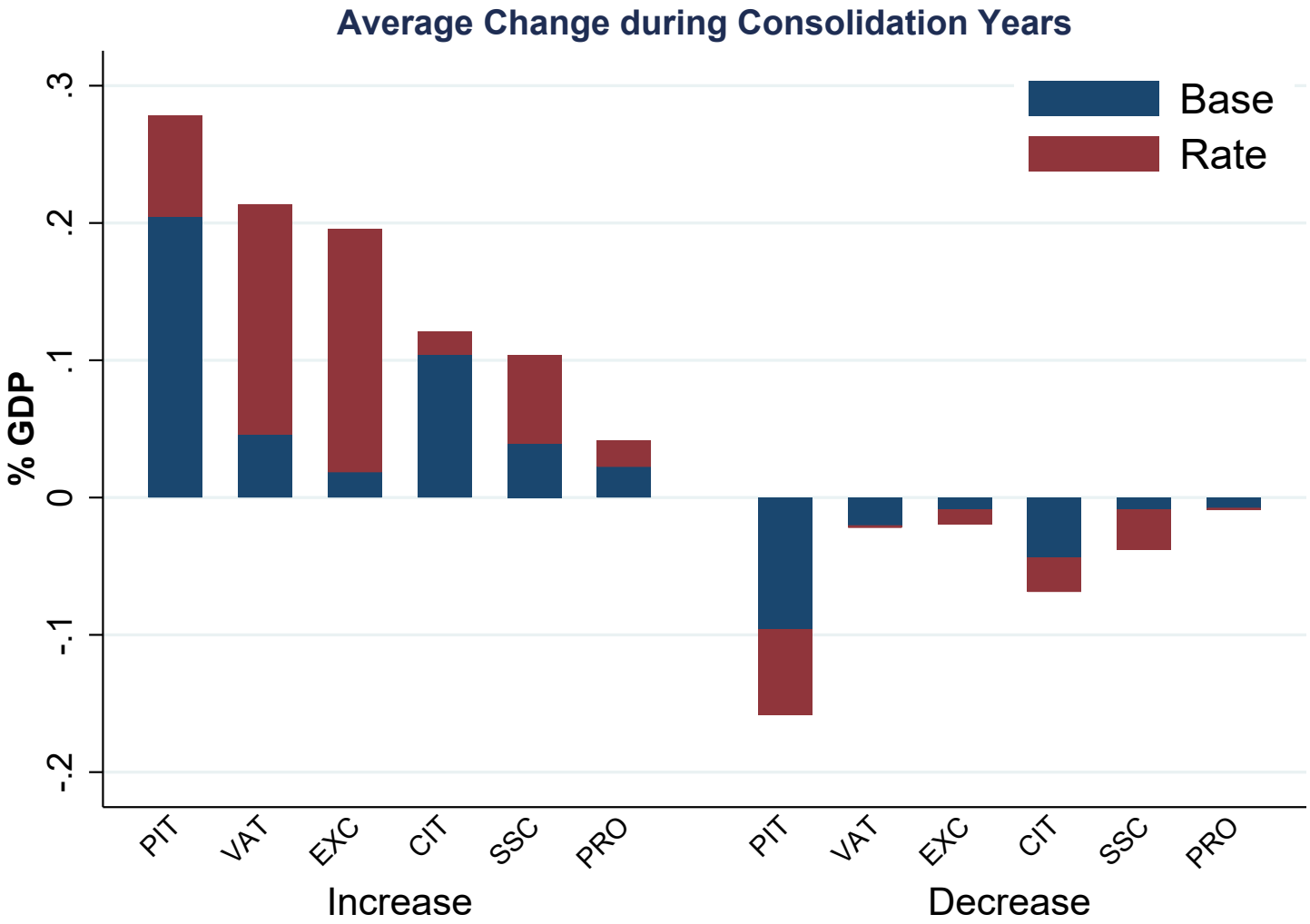
Consolidation years often include both tax increases and decreases

Direction



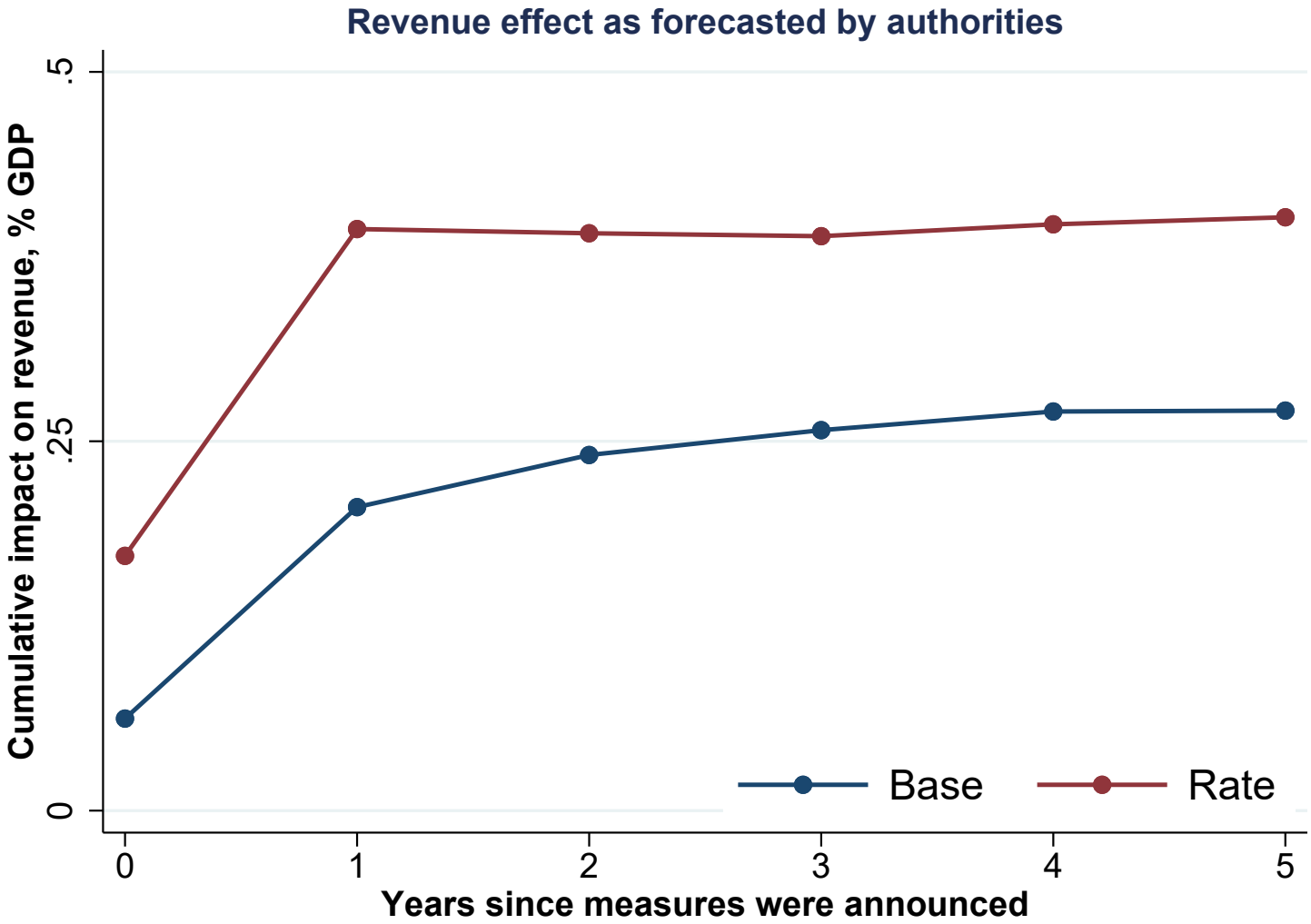
Consolidation relies heavily on indirect taxes

But they also feature large increases and decreases in direct taxes Net



Consolidations aim for permanent tax increases

Base broadening represents about 40% of expected revenue increase



Methodology

Empirical Approach

Multipliers | Identification | Sample Balance

Local Projections with Instrumental Variables (Stock and Watson, 2018)

- Estimate the response of output to a change in tax revenue ratio

$$Y_{i,t+h} - Y_{i,t-1} = \alpha_i + \delta_t + \beta_h \triangle \text{Tax}_{i,t} + \theta_h' \mathbf{X}_{i,t} + \varepsilon_{i,t+h}$$

- $\triangle \text{Tax}_{i,t}$ is instrumented with the narrative tax shock

$$\text{Tax Shock}_{i,t} = \frac{\text{Intended Revenue Effect}_{i,t}}{\text{GDP}_{i,t-1}}$$

- The coefficient β_h captures the response of $Y_{i,t}$ to a 1% of GDP tax increase
- The baseline specification controls for lagged growth, inflation, government spending, tax revenue, debt ratio, and tax shocks.

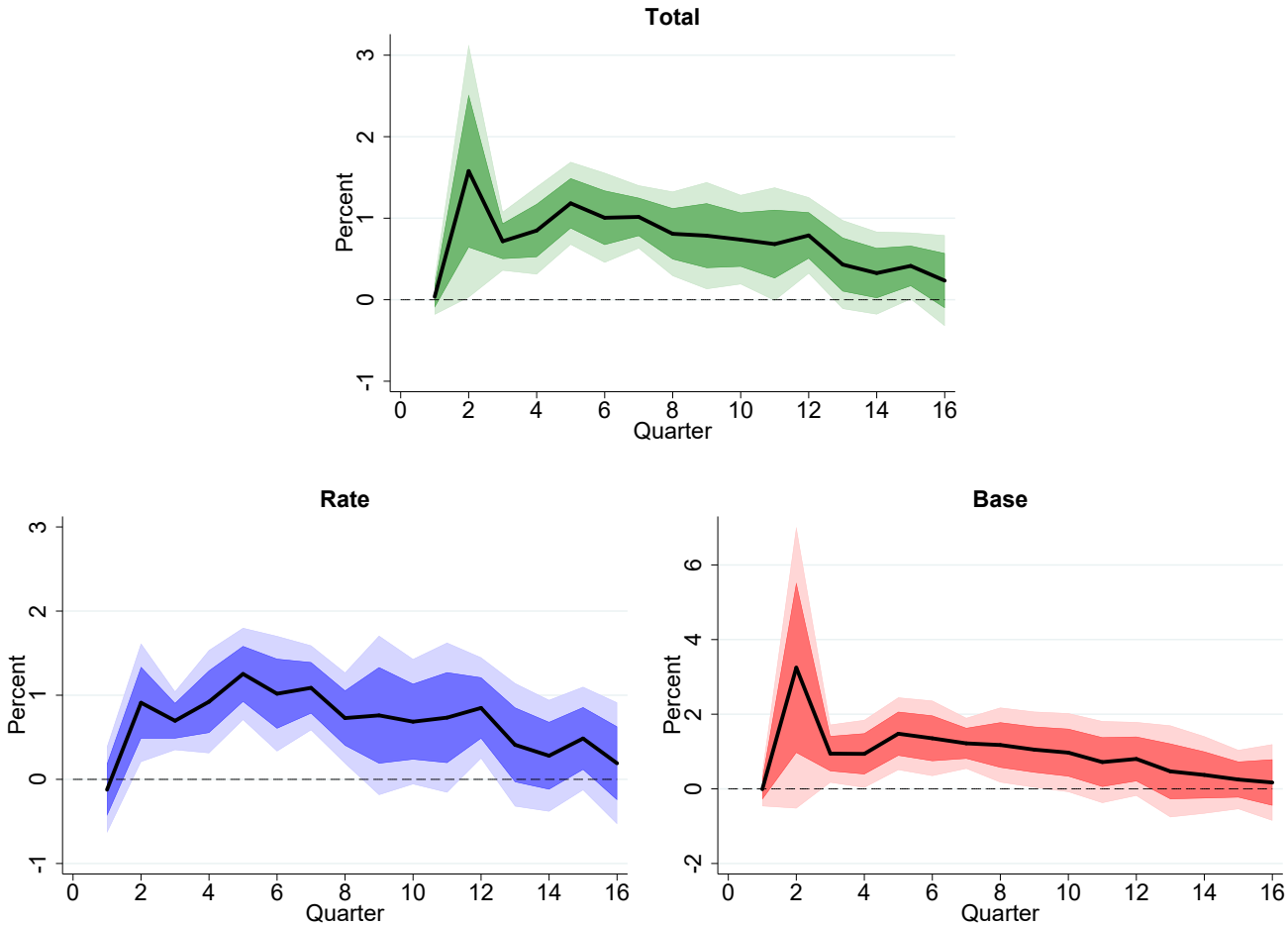
Results

(All taxes)

Tax ratios increase after either Rate or Base shocks

The improvement in tax ratios is often not permanent

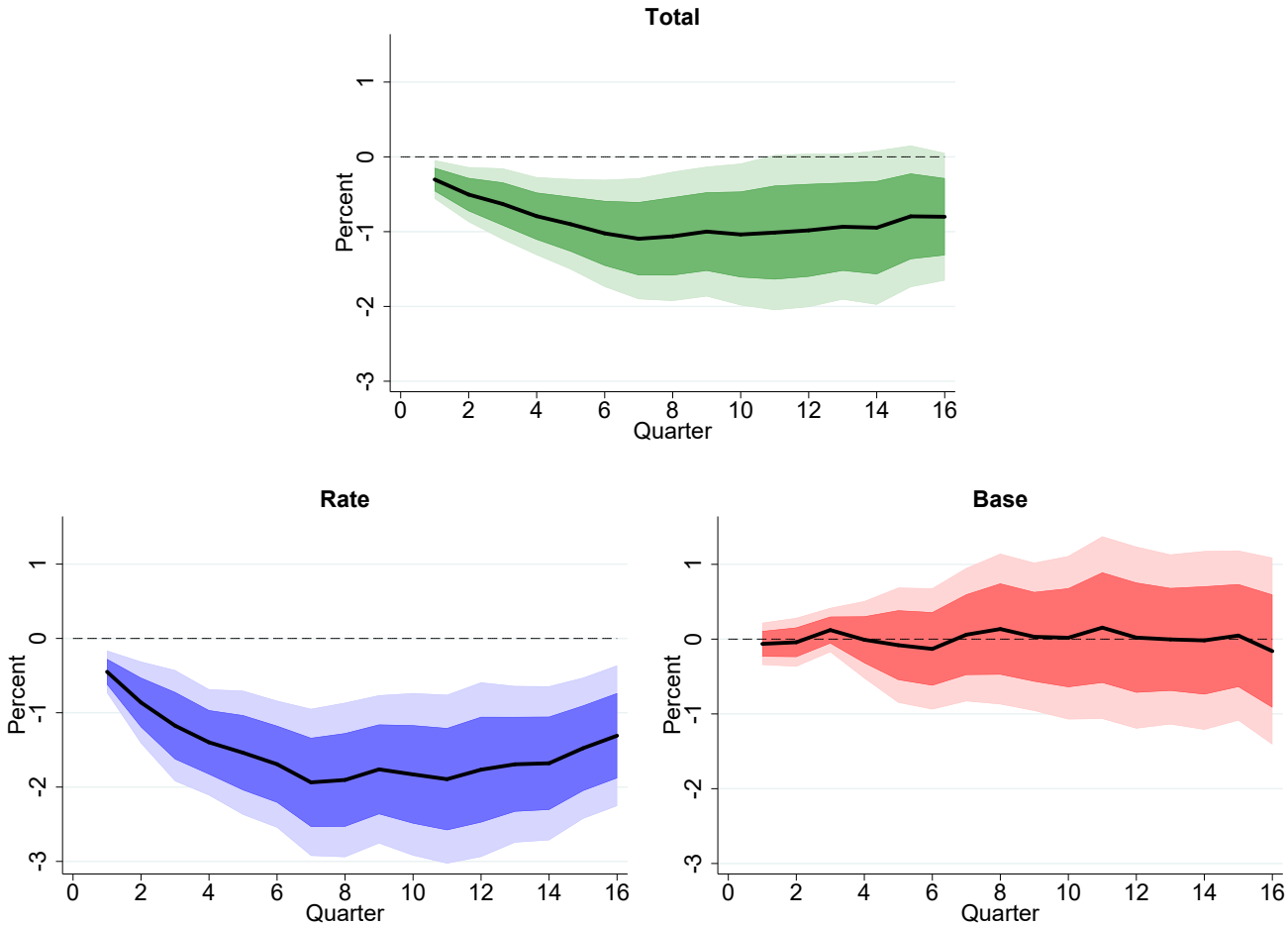
Annual



Note: Shocks equivalent to a 1% of GDP announced tax increase. Standard errors clustered by country and time. Dark (light) areas show 68% (90%) confidence intervals.

GDP declines more strongly after Rate shocks

Second-stage regression estimated by IV OLS Annual Components

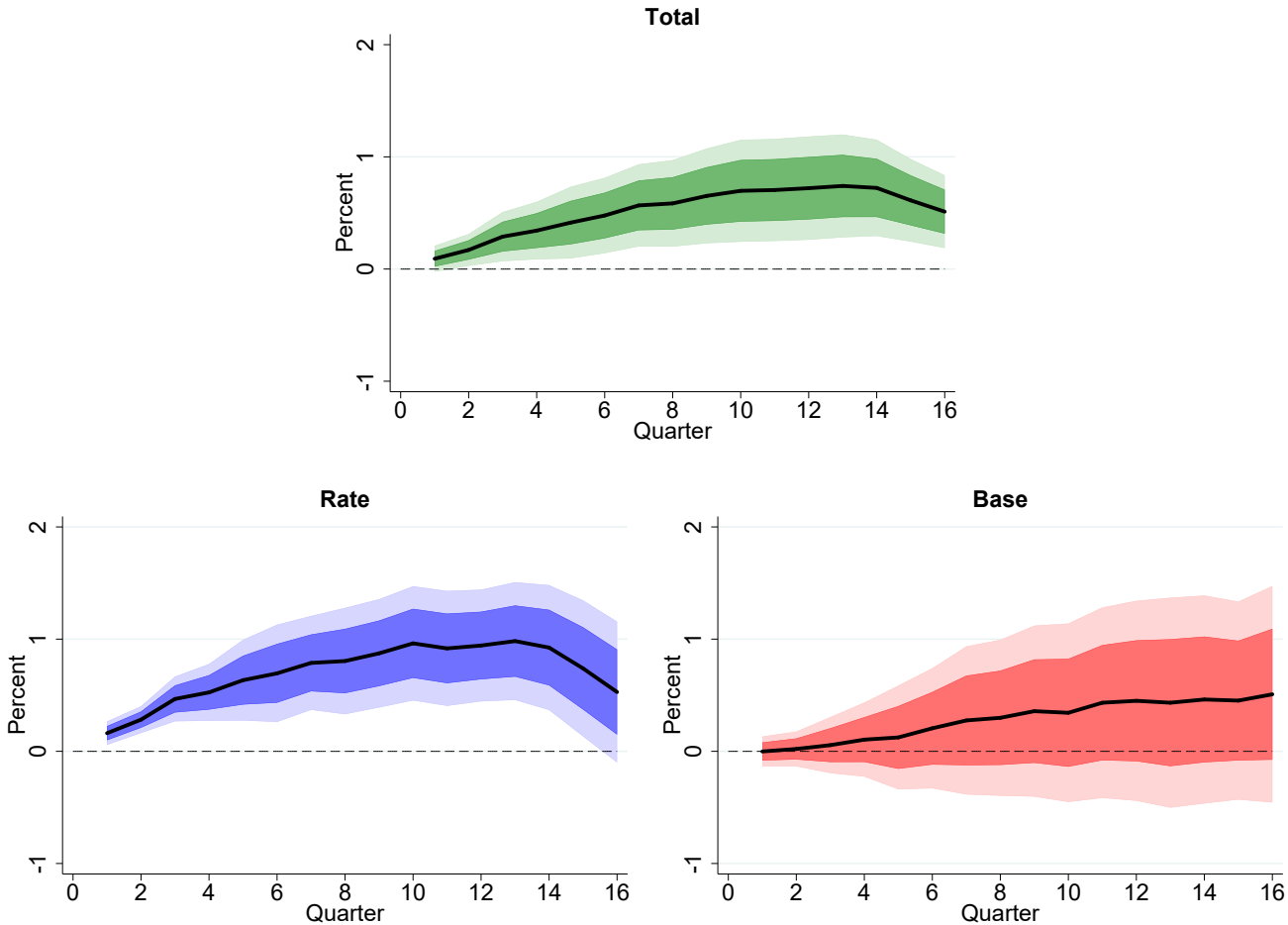


Note: Shocks equivalent to a 1% of GDP tax increase. Standard errors clustered by country and time. Dark (light) areas show 68% (90%) confidence intervals.

Unemployment increases less after a Base shock

Second-stage regression estimated by IV

Employment



Note: Shocks equivalent to a 1% of GDP tax increase. Standard errors clustered by country and time. Dark (light) areas show 68% (90%) confidence intervals.

Tax multipliers

Base multipliers are smaller than Rate multipliers

Table: Year 1 Contemporaneous Multipliers

	$\triangle \text{Tax}_t$			$\triangle \text{Output}_t$		
	All	Rate	Base	All	Rate	Base
Tax Shock$_t$	1.18***	1.52***	1.84***			
	(0.31)	(0.38)	(0.56)			
$\triangle \text{Tax}_t$				-0.90**	-1.23**	-0.39
				(0.37)	(0.42)	(0.39)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic				47.65	37.03	28.32
R^2	0.42	0.41	0.41	0.61	0.54	0.66
Obs	1,183	1,183	1,183	1,183	1,183	1,183

All Robustness Annual Cumulative

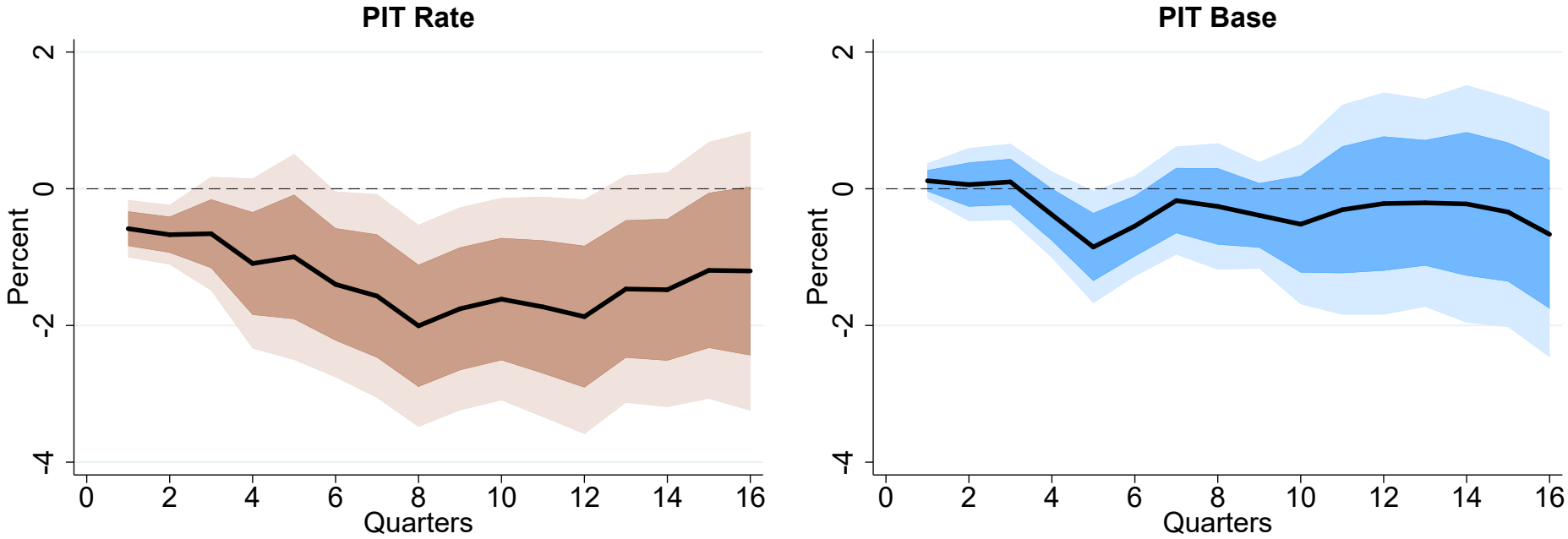
Results

(Responses by Tax Type)

Personal income tax

PIT base broadening leads to smaller output declines

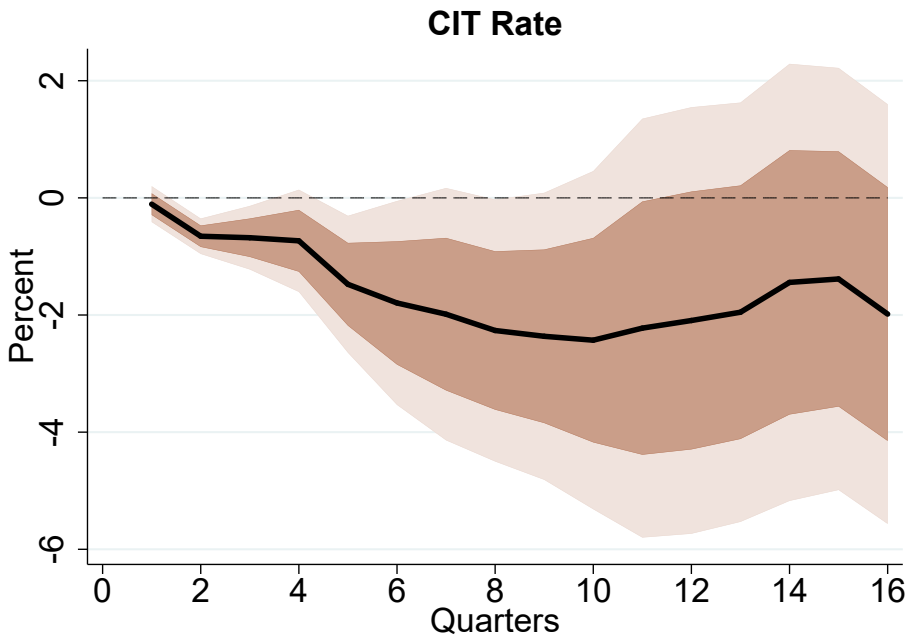
Estimation

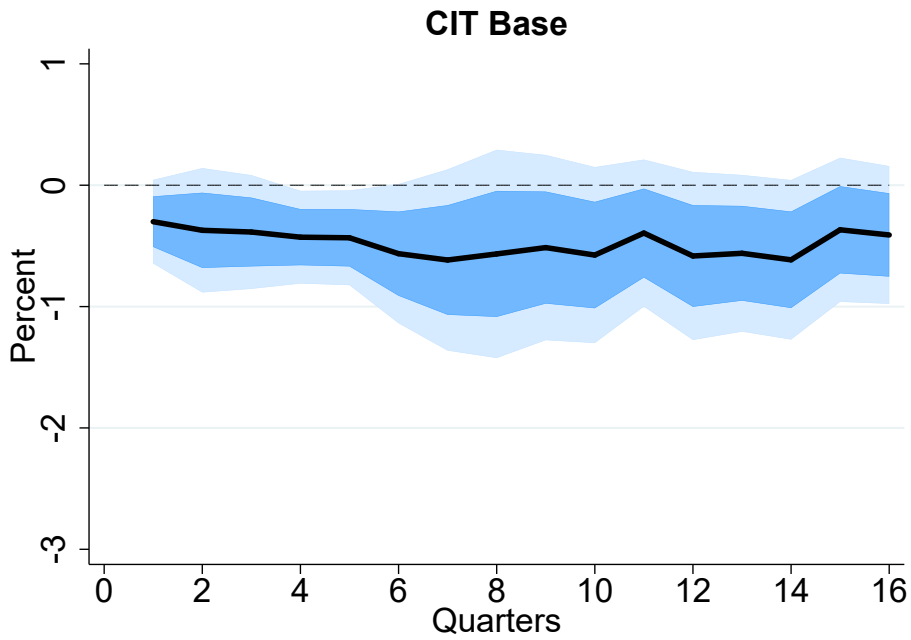


Note: Shocks equivalent to a 1% increase in the effective PIT rate. Two (four) year cumulative multiplier for a PIT rate shock is 1.5 (1.8), and for a PIT base shock is 0.4 (0.8)

Corporate income tax

CIT rate hikes also have a larger impact on output, but are not estimated precisely

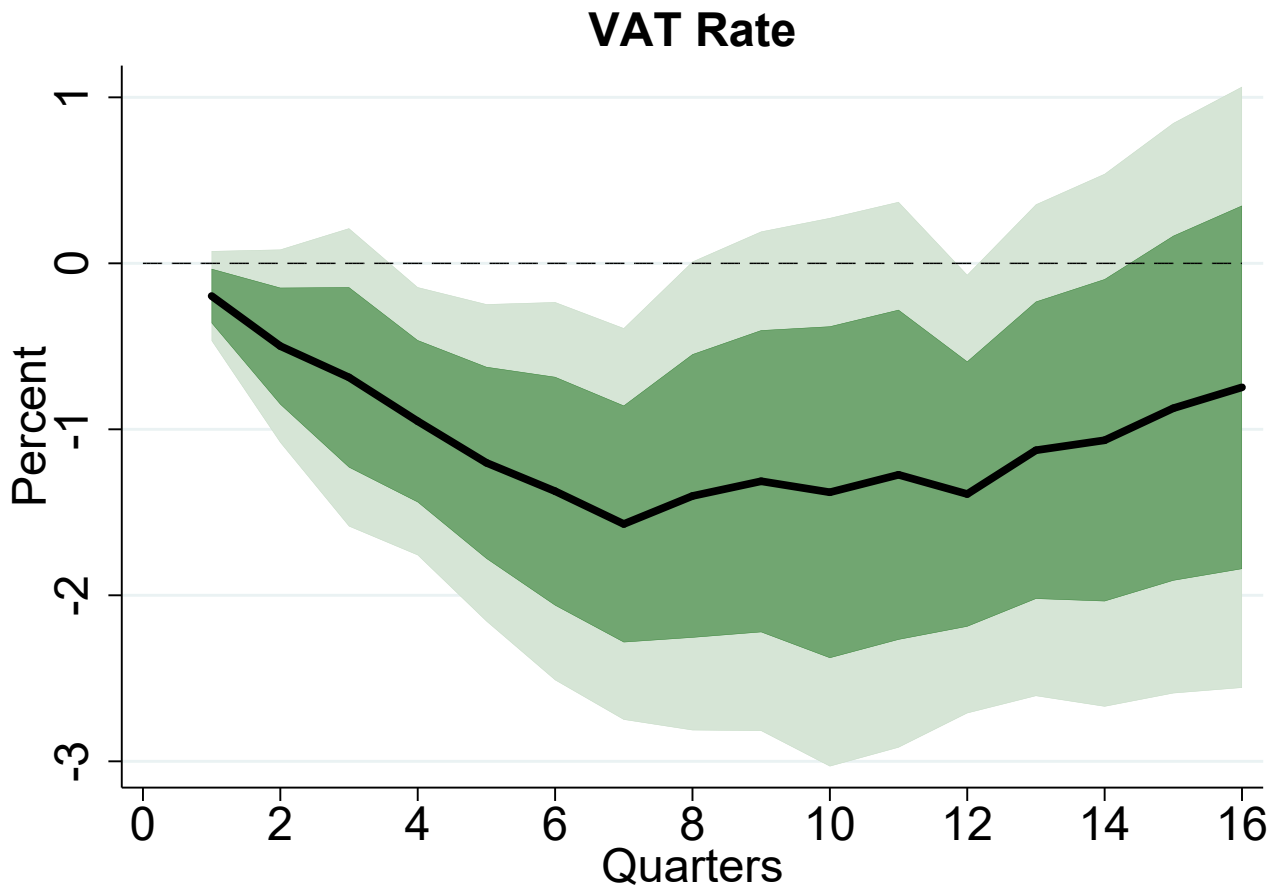




Note: Shocks equivalent to a 1% increase in the effective CIT rate. The impact of CIT shocks on tax revenue is close to zero, so it makes little sense to compute tax multipliers (a similar issue arises in Mertens and Ravn (2013))

Value added tax

VAT rate hikes associated with large and persistent declines in output



Note: Shocks equivalent to a 1% increase in the effective VAT rate. Two (four) year cumulative multiplier for a VAT rate shock is 2.6 (2.3).

Conclusion

- We construct a narrative dataset of tax measures during consolidation years
- We find that base broadening leads to smaller output and employment declines than rate increases during fiscal consolidations
- Our findings suggest base broadening can raise additional tax revenue while being less detrimental to growth

Next Steps

Guiding question: are all base measures growth-friendly?

1. Extending the dataset
   - Include all years (not just consolidation years)
   - Expand to 16 OECD countries
   - Ongoing: 4,000 measures and counting...
2. Classifying base measures
   - Which types of base measures increase efficiency of the tax system?
   - Which ones don't?

Appendix

Related Literature return

- **Narrative tax datasets:**
  - Country-specific: Romer and Romer (2010), Cloyne (2013), Uhl (2013), Lopes (2015), Pereira and Wemans (2015), Gechert et al. (2016), Gil et al. (2018)
  - Cross-country: Devries et al. (2011), Alesina et al. (2015, 2017), Gunter et al. (2017), David and Leigh (2018)
- **Macroeconomic effects of specific taxes:**
  - All taxes: Blanchard and Perotti (2002), Barro and Redlick (2011), Guajardo et al. (2014), Jordà and Taylor (2016)
  - Specific taxes: Mertens and Ravn (2013), Riera-Chricton et al. (2016), Gunter et al. (2017)
- **Local projections with IV**:
  - Jordà and Taylor (2016), Fieldhouse et al. (2017), Stock and Watson (2018), Mertens and Olea (2017), Ramey and Zubairy (2018)

Main Hypothesis

return

Base broadening can increase the efficiency of the tax system

- **Efficiency argument**
  - Base broadening tends to make taxation across sectors, firms or activities more homogenous, contrary to rate increases
  - This helps to re-allocate resources to those projects with the highest pre-tax return
  - This improves economic efficiency (2017 Spring Fiscal Monitor; Gale and Samwick, 2016) and thereby partially offsets adverse demand-driven output effects

Main Hypothesis

return

Base broadening may be less salient than rate increases

- **Tax perception argument**
  - Agents may misperceive their tax liabilities or not understand their tax schedules (e.g., Gemmell et al., 2004; Chetty et al. 2011)
  - This can affect taxpayer behavior, in particular when tax systems are complex or revised frequently
  - As base changes are more difficult to understand and may be perceived differently (or not at all), base changes could have different effects

Example: Budget reports

UK June 2010 Budget

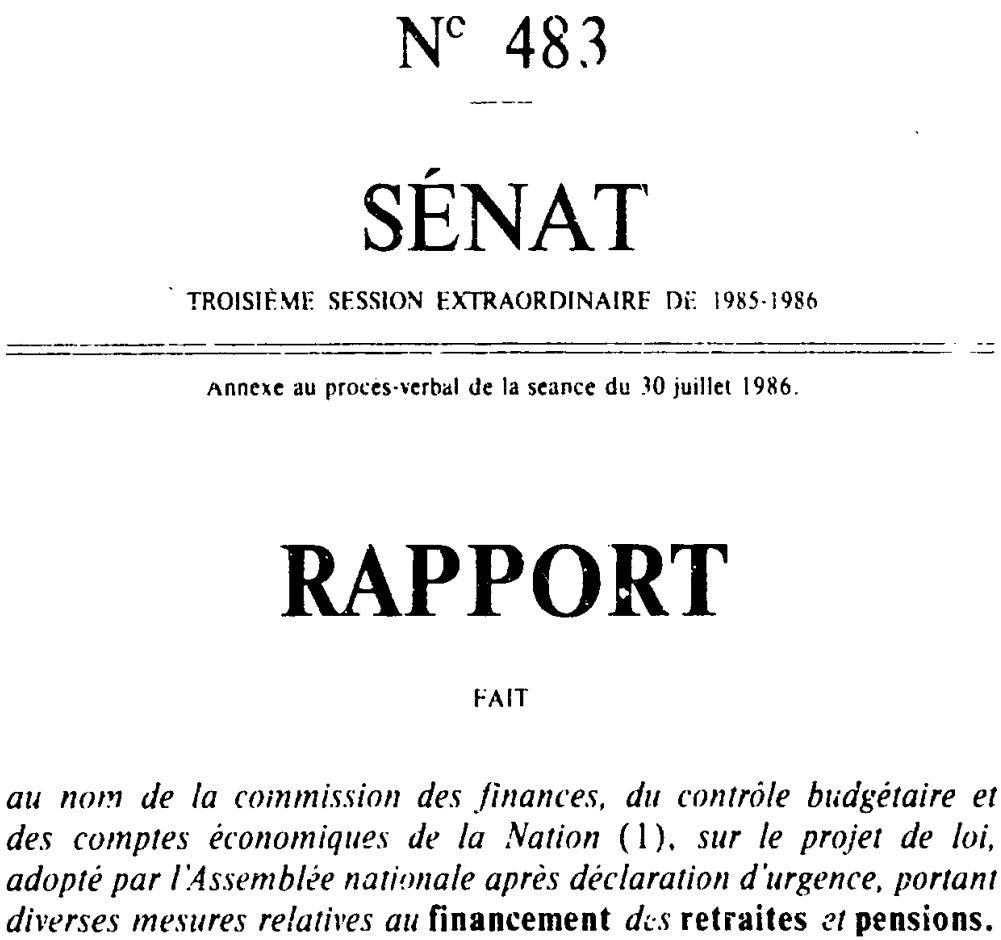
return

Table 2.1: Budget policy decisions[1]

		£ million				
		2010-11	2011-12	2012-13	2013-14	2014-15
Tax measures announced at this Budget						
	1. Deficit Reduction					
1	VAT: increase main rate to 20% from 4 January 2011	+2,850	+12,100	+12,500	+12,950	+13,450
2	Insurance Premium Tax: increase standard rate to 6% and higher rate to 20% from 4 January 2011	+115	+455	+445	+455	+455
	2. Enterprise and growth					
3	Corporation Tax: decrease to 27% in 2011-12, 26% in 2012-13, 25% in 2013-14 and 24% from 2014-15 [2]	–10	–400	–1,200	–2,100	–2,700
4	Small Profits Rate: decrease to 20% from 2011-12	0	–100	–1,000	–1,300	–1,400
5	Capital allowances: decrease main rate to 18% and special rate to 8% from 2012-13	0	0	+1,000	+1,900	+1,800
6	Annual Investment Allowance: decrease to £25,000 from 2012-13	0	0	+100	+1,200	+1,000
7	Video games tax relief: not introduce	0	+40	+50	+50	+50
8	Bank Levy: introduce from January 2011	0	+1,150	+2,320	+2,500	+2,400
9	Business rates: backdated bills in 2011-12[3]	+30	–70	–15	–15	–15
10	Employer NICs: relief for new businesses in targeted regions	–50	–320	–390	–180	0
11	Employer NICs: increase threshold in 2011-12	0	–3,130	–3,150	–3,510	–3,720
	3. Fair taxes					
12	Personal allowance: increase by £1,000 in 2011-12, with adjustments to basic rate limit and upper earnings limit	0	–3,490	–3,700	–3,770	–3,910
13	Basic rate limit: freeze in 2013-14	0	0	0	+320	+740
14	Capital Gains Tax: increase rate for higher rate taxpayers to 28% and increase Entreprenuers' Relief to £5 million from 23 June 2010	0	+725	+825	+850	+925
15	Council Tax: reduction to receipts due to a one year freeze in 2011-12[4]	0	–625	–630	–635	–640
16	Landline duty: not introduce	–90	–175	–175	–175	–175
17	Cider duty: reverse increase	–10	–15	–15	–15	–20
18	Furnished holiday lettings: reverse plans to repeal existing rules	–5	–30	–15	–10	–10
19	Managed payment plans: not introduce	0	+140	0	0	0
	Total tax policy decisions	**+2,830**	**+6,255**	**+6,950**	**+8,515**	**+8,230**

Example: Senate reports

1st Plan Séguin, 1986 return



N° 483

SÉNAT

TROISIÈME SESSION EXTRAORDINAIRE DE 1985-1986

Annexe au procès-verbal de la séance du 30 juillet 1986.

RAPPORT

FAIT

au nom de la commission des finances, du contrôle budgétaire et des comptes économiques de la Nation (1), *sur le projet de loi, adopté par l'Assemblée nationale après déclaration d'urgence, portant diverses mesures relatives au* **financement** *des* **retraites** *et* **pensions.**

Example: Newspaper articles

Australia 1993 budget

return

SUPPLEMENT TO THE CANBERRA TIMES, August 18, 1993 — 1

8 PAGE LIFTOUT

BUDGET '93

$$$
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Increase in indirect taxes to offset reduction in income taxes

Tax hikes hit fuel, wine, smokes

TAXES

Fringe benefits net spread wider

By IAN DAVIS, Finance Editor

The self-employed will now be subject to the same fringe-benefits tax for car parking that caused uproar when it was imposed on employees in last year's Budget.

The Budget also extends the FBT to a wide range of benefits often included in executive salary packages and not previously fully caught by the tax. This extension had been widely anticipated.

However the imposition of the FBT on car parking for the self-employed is a surprise.

The new measure affecting the self-employed will take effect from July 1, 1994, and is expected to raise an additional $70 million in tax revenue in 1995-96 and $30 million the following year.

The extension of the FBT to recover employee benefits not presently fully caught by the FBT net will yield an additional $984 million in tax revenue in 1994-95, the Government estimates, and $293 million in following years.

People who are self-employed will have to pay FBT on the cost or value of their own car-parking spaces if the parking space is at or near the person's work place, the car is used for travel to or from work, the vehicle is parked near the place of work for more than four hours a day and there is a commercial parking station within a kilometre of where the car is parked.

This is identical to the provisions applied from July this year to car parking provided to employees.

The fringe-benefit tax rate on all fringe benefits will rise by 0.15 per cent to 48.4 per cent to reflect the increase in the Medicare levy from 1.25 per cent to 1.4 per cent which took effect on July 1, 1993.

Entertainment expenses, club fees, the provision of sport and leisure facilities, travel expenses for a relative accompanying an employee on business travel and employer payments of the Higher Education Contribution Scheme and Student Financial Supplement Scheme will all become subject to FBT from April 1, 1994.

Previously, all these expenses were regarded as "non-deductible" by the em-

By IAN DAVIS, Finance Editor, and SIMON GROSE

The Government will raise an additional $1360 million this year from sweeping increases in taxes on petrol, wine, cigarettes and rises in tax rates on the full range of goods subject to sales tax.

The big increases in indirect tax this year will almost completely offset the $1660 million reduction in income taxes from bringing forward the previously announced income tax cuts from July, 1994, to November this year.

However the major impact of the indirect tax rises will not be felt until 1994-95 and subsequent years. The changes announced in last night's Budget are forecast to raise an additional $2.3 billion in 1994-95 and an additional $3.4 billion in 1996-97.

The main indirect tax changes are:

- An increase of 3c a litre in the tax on all petrol products from midnight last night and further increases so that by February, 1995, the tax on leaded petrol will increase by a total of 10c a litre and 5c a litre for unleaded petrol.
- All wholesale sales tax rates will rise by 1 percentage point from midnight last night and by a further percentage point from July 1, 1995.
- The wholesale sales tax on wine and alcoholic cider will rise from 20 per cent to 31 per cent from last night and to 32 per cent from July 1, 1995.
- Excise taxes on cigarettes and other tobacco products will rise by three per cent immediately.

The changes will help boost indirect tax collections, with sales tax revenue forecast to rise by 10.6 per cent to $10.2 billion in 1993-94, tax revenue from petroleum products by 15.4 per cent to $8.4 billion and total indirect tax collections to rise by 9.1 per cent $24.3 billion.

The price of unleaded petrol will rise by 5c per litre over the next year and leaded petrol will rise by 10c per litre over the coming 18 months.

The price of diesel fuel and all other dutiable petroleum products will also rise 5c by August, 1994, in line with unleaded fuel.

The Government says these measures will add $790 million to total revenue in 1993-94, rising to $1.38 billion in 1994-95 and $1.5 billion in the following year.

Referring to these measures and other indirect tax rises, the Treasurer said in his press conference yesterday that sometimes a politician must "suspend his political instincts" in order to do what he said was the "decent thing".

He said the fuel excise measures will boost inflation by up to .75 per cent in the current year and by around 1 per cent over the next two years.

Only aviation fuels have been spared from the taxman's increased attention in the largest single revenue-raising initiative in the 1993-94 Budget. The Government sought to defend the measures on the basis that Australian fuel prices will remain low by international standards.

"Even if all these increases in fuel excises were implemented overnight, Australia would still have the third lowest petrol prices in the industrialised world — and among the lowest fuel taxes," Mr Dawkins said in the Budget speech last night.

The Treasurer said that the higher increase to be imposed on leaded fuel "recognises the harmful effect of lead in petrol and will accelerate the conversion of the motor vehicle fleet to unleaded petrol".

Excise on all petroleum products except aviation fuels will rise by 3c immediately and a further 2c in a year's time.

An additional 1c per litre will be added to the price of leaded fuel in February next year, beginning a staged extra increase in excise on leaded fuel of a full 5c by February, 1995. Wine drinkers and tobacco smokers will also pay more under the increases in wholesales tax and excise announced last night.

Wine and alcoholic cider will remain exempt from excise but will jump to the top rate of Wholesales Sales Tax, rising from 20 per cent to 31 per cent. This should cost consumers $70 million in the 1993-94, $95 million in 1994-95 and $105 million the following year.

Earlier starting date for tax cuts

By TOM CONNORS, Economics Writer

Tax cuts for middle-income earners have been brought forward to November 1 this year, eight months ahead of the original starting date of July, 1994.

Announcing this in his Budget Speech last night, Treasurer John Dawkins said the early payment had been made possible by higher dividend payments to the Government from Telecom and the Reserve Bank and it was only right, he said, that taxpayers should benefit from the higher earnings of these publicly-owned bodies.

However, the main reason is the

a week now had real disposable incomes 21 per cent higher than previously. He said that the Government had cut income tax at the bottom and boosted family support. However, the Treasurer was not denying that for this year the lower-income groups were getting the rough end of the tax changes.

The president of the Australian Council of Social Service, Merle Mitchell, said she was disappointed that the tax cuts were being funded by higher indirect taxes and warned that the additional excise on leaded fuel would hit those who could not afford to upgrade their cars.

Middle-income earners Mr

Impact of Tax Measures on Taxpayers Compared with 1992-93 Tax Scales

Measure	Estimated Impact on Taxpayers (a) 1993-94	1994-95	1995-96	1996-97
	$m	$m	$m	$m
First tranche of personal tax cuts	1660	2900	3120	3450
Income tax rebate for low income earners	-	340	330	320
Income tax: base broadening and other measures (b)	-101	-767	-616	-641
Indirect Tax Changes				
Wine and cider - WST rate increases	-70	-95	-105	-110
Other WST rate changes	-440	-595	-1217	-1355
Petroleum products - excise rate increases (c)	-735	-1225	-1295	-1350
Tobacco products - excise rate increases	-45	-120	-180	-185

(a) Does not include the effect of deferring the second round of personal tax cuts.
(b) Adjusted for the abolition of the dependent spouse rebate and the adjustment of the beneficiary rebate, which are offset by outlays for the new Home Child Care Allowance.
(c) Adjusted for the associated increase in outlays through the diesel fuel rebate. Includes the effect of changes to the administration of petroleum products excise collection.

COMMENT

Margo Kingston

Official looking and ever so honest

The Government inserted yesterday an official looking but very political document into the Budget papers in a unique move designed to prove to us all that it is capable of delivering at least some of its promises.

Called "Government action on election commitments", it detailed action on 95 spending promises on everything from child-care to setting up a cultural heritage protection program for Aboriginal rock art.

They will cost $1805 million in 1994-95.

The booklet is so honest it even includes a section on the promises not yet met, delayed or broken.

These include the promise, first made in 1989 as part of its much-trumpeted retirement-incomes policy and repeated in the election campaign, that all age pensioners would pay no income tax by 1995. That one was ditched soon after the election.

The promise to let people access their superannuation funds to help put together a home deposit is also on hold.

Unfortunately for those waiting on that one to take advantage of low interest rates, it is deferred pending "consultation with interested parties to ensure that funds released are appropriately targeted, having regard to both the Government retirement-incomes and housing-policy objectives".

Having all the kept promises together in this booklet will be one weapon in the Government's war with the Senate as well as its search for a mandate.

Of course, it does not include all those measures that were not only not promised in the election, but in most cases denied as even being under consideration.

Things such as a hike in the petrol excise, to raise $790 million this financial year and $1380 million the next.

That alone is enough to pay for the promises.

INSIDE:

What's in the wholesale tax net

UP FROM 10 TO 11pc

ITEMS in this group include biscuits, fruit juice, ice cream, confectionery, furniture, electrical appliances, heating and cooling appliances, bathroom fittings, crockery, drapery, bedding.

UP FROM 15 TO 16pc

Non-luxury cars.

UP FROM 20 TO 21pc

ITEMS in this group include toys, cosmetics, toilet paper, pet food, non-luxury four-wheel-drive vehicles, utilities, commercial vehicles, bicycles, motor bicycles, tyres, oils, construction equipment, swimming pools, lawn mowers, soft drinks, umbrellas.

UP FROM 30 TO 31pc

ITEMS in this group include jewellery, furs, cameras, radios, televisions, luxury cars, watches, clocks, poker machines, record and compact-disc players.

Tourism funded for overseas marketing

Tourism gets a major boost in the Budget.

The Australian Tourist Commission gets $38 million over four years for overseas marketing.

Also, $10 million will be provided for a national ecotourism strategy.

The Budget provides $42 million over four years for a Tourism Forecasting Council and to develop tourism in "regional and rural Australia", according to a statement issued with the Budget papers by the Minister for Tourism, Michael Lee.

This is intended to help the rural, backpacker and cruise-ship markets.

Mr Lee said there was "a need to create jobs and long-term alternatives to a largely agricultural economic base".

Applications for the first round of rural and regional tourist grants would be sought next month.

Mr Lee said that 174,000 backpackers came to Australia in 1990 with an average stay of 80 days. They spent an average of $3557 compared to an average of $1839 for all visitors. The Government support would help provide better accommodation information to backpackers.

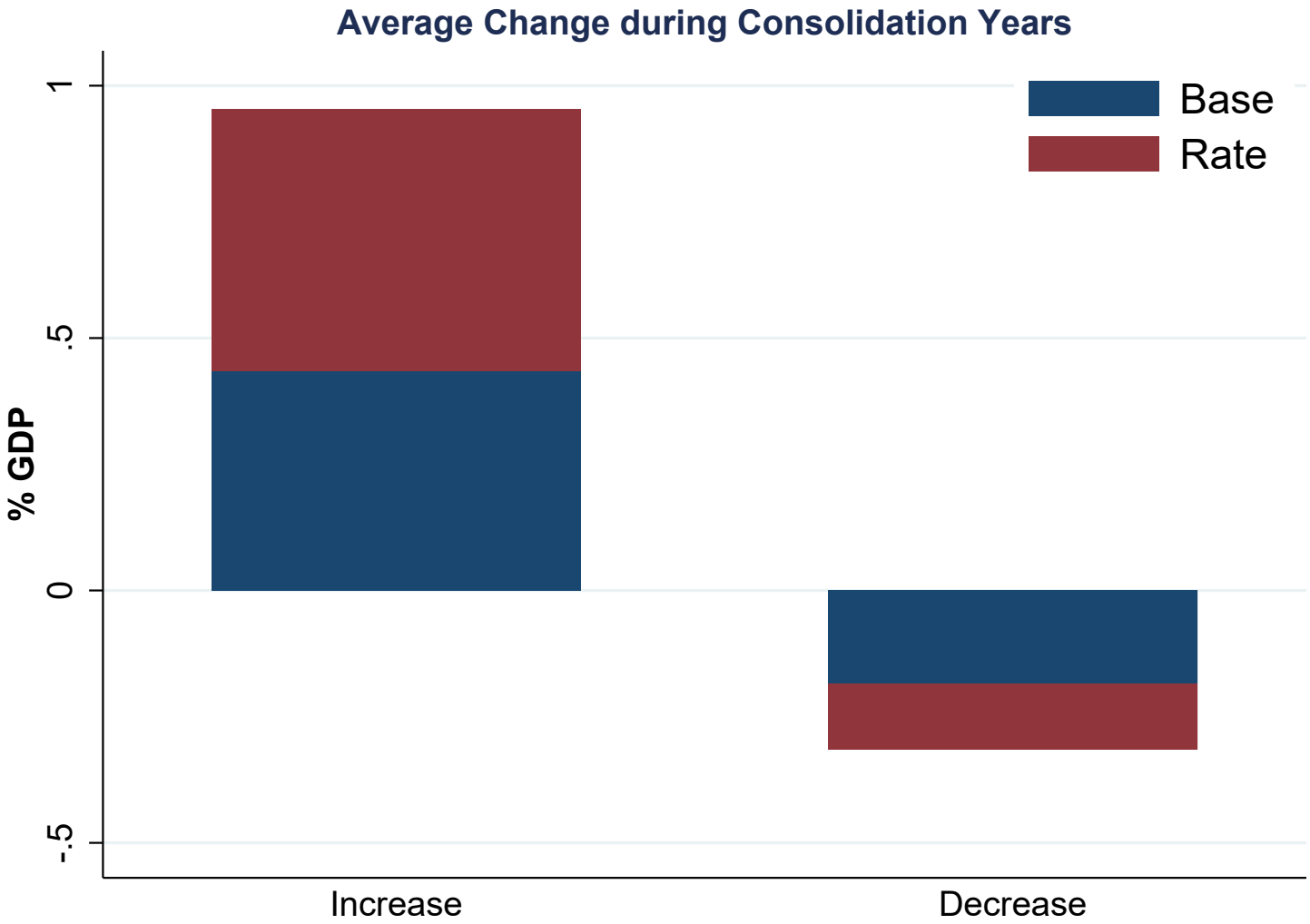
On ecotourism, he said a draft strategy would soon be issued for public comment.

The extra money for overseas marketing was recognition of tourism's contribution to foreign exchange earnings. In 1992-93 it was $8 billion or 11 per cent of export earnings.

Biggest decisions look like non-decisions

Consolidations involve a large increase in taxation

Tax increases are partially offset by tax decreases return



Consolidation by Tax Type

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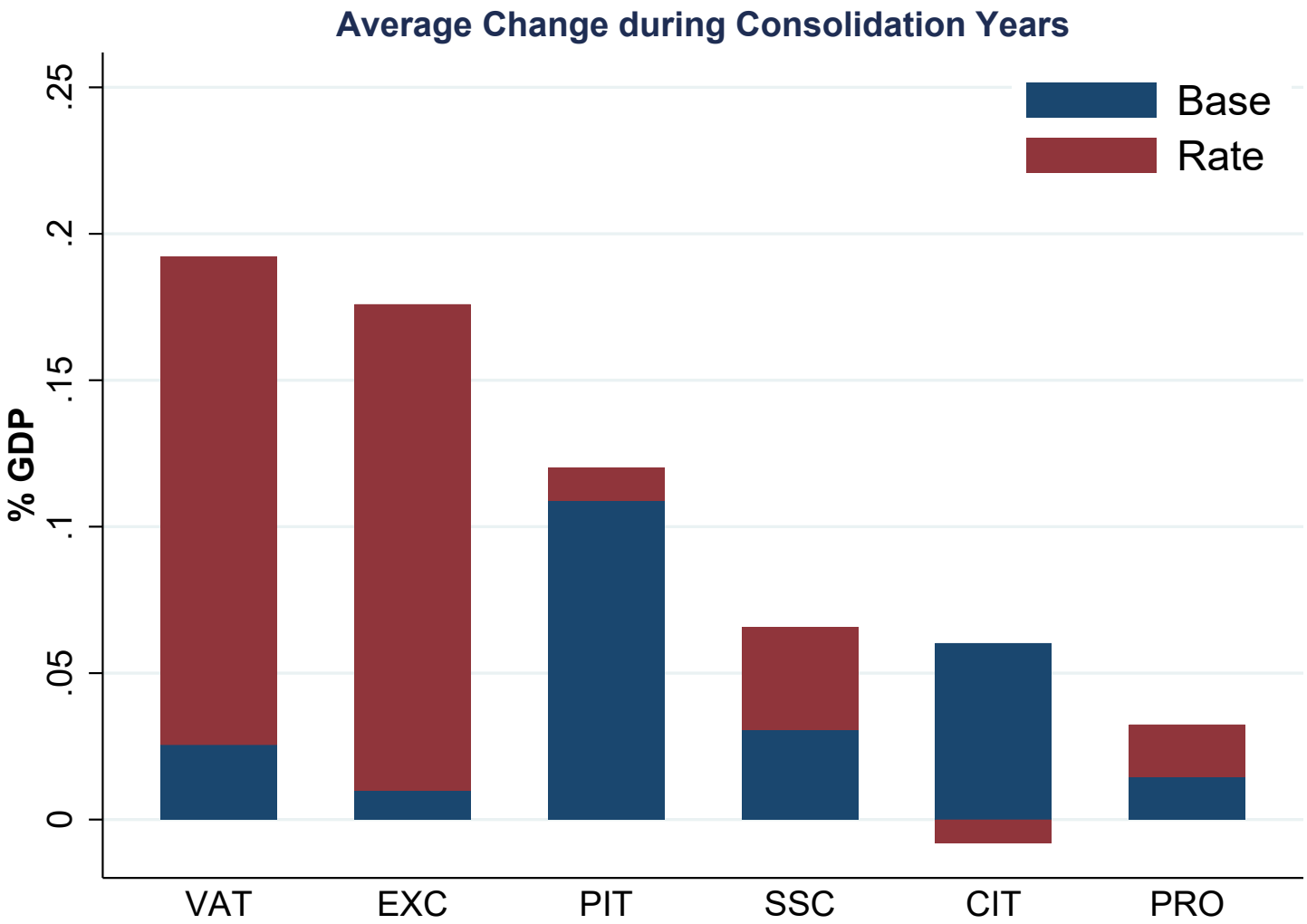


Estimating multipliers

return

Contemporaneous v. cumulative multipliers

- A first approach is proposed by Barro and Redlick (2011), and estimates the contemporaneous multiplier:

$$Y_{i,t+h} - Y_{i,t-1} = \alpha_i + \delta_t + \beta_h \left(\text{Tax}_{i,t+h} - \text{Tax}_{i,t-1}\right) + \theta_h' \mathbf{X}_{i,t} + \varepsilon_{i,t+h}$$

- An alternative approach based on cumulative changes is suggested by Uhlig (2010) and Ramey and Zubairy (2018):

$$\sum_{j=0}^{h} \triangle^j Y_{i,t+j} = \alpha_i + \delta_t + \beta_h \sum_{j=0}^{h} \triangle^j \text{Tax}_{i,t+j} + \theta_h' \mathbf{X}_{i,t} + \varepsilon_{i,t+h}$$

- In both cases, the change in tax is instrumented with the narrative tax shock

Truncation of narrative tax shock

return

IV addresses measurement error and truncation concerns

- Standard IV identification assumptions (Stock and Watson, 2018)

$$\mathrm{E}\left[\text{Tax Shock}_{i,t} \times \triangle\text{Tax Rate}_{i,t} \mid \mathbf{X}_{i,t-1}\right] \neq 0 \qquad \text{(Relevance)}$$

$$\mathrm{E}\left[\text{Tax Shock}_{i,t} \times \varepsilon_{i,t+h} \mid \mathbf{X}_{i,t-1}\right] = 0 \qquad \text{(Exogeneity)}$$

- Narrative measures are only coded for consolidation years

$$\text{Tax Shock}_{i,t} = \begin{cases} \text{Tax Shock}^{*}_{i,t} & \text{if t is a consolidation year} \\ 0 & \text{if t is not a consolidation year} \end{cases}$$

- This truncation may bias OLS estimators (Kilian and Vigfusson, 2011)
- However, a truncated instrument still identifies β_h under a stronger version of the exogeneity assumption

$$\text{Tax Shock}_{i,t} \perp\!\!\!\perp \varepsilon_{i,t+h} \mid \mathbf{X}_{i,t-1} \qquad \text{(Exogeneity}^{*}\text{)}$$

Measurement Error

return

IV addresses measurement error and truncation concerns

- Revenue forecasts may suffer from measurement error (e.g., optimistic projections).

$$\text{Tax Shock}_{i,t} = \text{Tax Shock}^{*}_{i,t} + v_{i,t}$$

- Measurement error will bias OLS estimator downwards. However, IV estimator will remain consistent provided that the measurement error $v_{i,t}$ is uncorrelated with innovations to output $\varepsilon_{i,t+h}$
- By a similar argument, measurement error in $\text{Tax Rate}_{i,t}$ is addressed by using an IV estimator

Granger-causality tests

return

Regressor:	Output	Inflation	Interest rate	Govt. Debt	Govt. Purchases	Tax
All shocks	1.21	1.17	0.93	1.61	8.47***	0.97
	(0.37)	(0.38)	(0.49)	(0.25)	(0.00)	(0.47)
Motivation						
Consolidation	0.60	1.25	1.22	2.21	3.29*	0.47
	(0.67)	(0.36)	(0.37)	(0.15)	(0.06)	(0.76)
Long-Run	0.43	0.46	0.35	0.89	0.36	0.45
	(0.73)	(0.71)	(0.84)	(0.48)	(0.83)	(0.77)
Measure Type						
Rate	2.38	0.57	1.09	0.64	3.34*	0.70
	(0.13)	(0.69)	(0.42)	(0.65)	(0.06)	(0.61)
Base	0.83	1.73	1.32	1.47	1.51	0.96
	(0.54)	(0.23)	(0.34)	(0.29)	(0.28)	(0.47)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Each entry is the F-statistic for the null hypothesis that lags of the control variable are jointly equal to zero (p-value in brackets). All models include four lags of the narrative tax shock. Standard errors are clustered by country and time.

Granger-causality tests

return

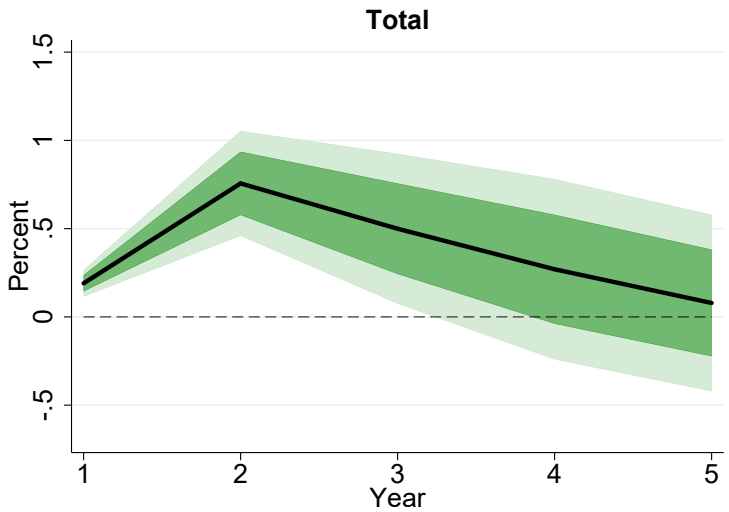
Regressor:	Output	Inflation	Interest rate	Govt. Debt	Govt. Purchases	Tax
Personal Income Tax						
Rate	1.86	1.92	1.51	0.19	3.55*	0.67
	(0.20)	(0.19)	(0.28)	(0.94)	(0.05)	(0.63)
Base	0.77	2.93*	1.77	1.86	1.01	0.13
	(0.57)	(0.08)	(0.22)	(0.20)	(0.45)	(0.97)
Corporate Income Tax						
Rate	1.55	0.75	1.32	0.51	1.05	1.55
	(0.27)	(0.58)	(0.33)	(0.73)	(0.43)	(0.27)
Base	1.53	0.82	0.46	2.06	0.40	9.76***
	(0.27)	(0.54)	(0.76)	(0.17)	(0.80)	(0.00)
Value Added Tax						
Rate	1.32	3.57*	1.01	1.10	0.52	0.71
	(0.33)	(0.05)	(0.45)	(0.41)	(0.73)	(0.60)
Base	13.55***	0.24	1.51	0.51	0.35	0.63
	(0.00)	(0.91)	(0.28)	(0.73)	(0.84)	(0.65)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

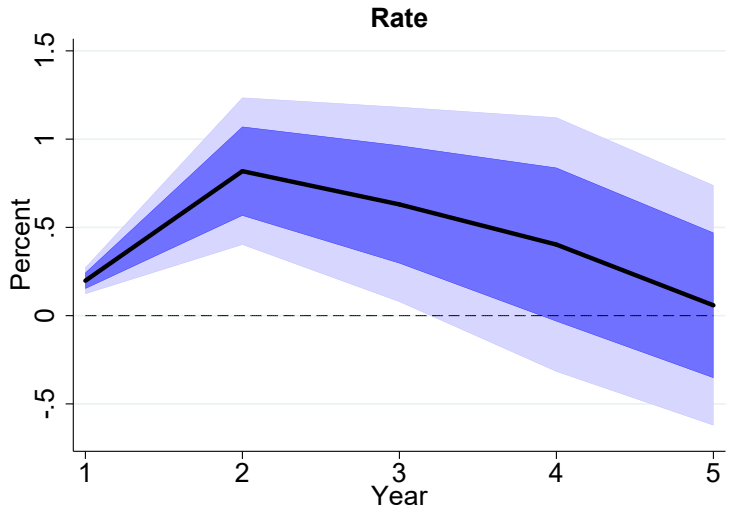
Note: Each entry is the F-statistic for the null hypothesis that lags of the control variable are jointly equal to zero (p-value in brackets). All models also include lags of the narrative tax shock. Standard errors clustered by country and time.

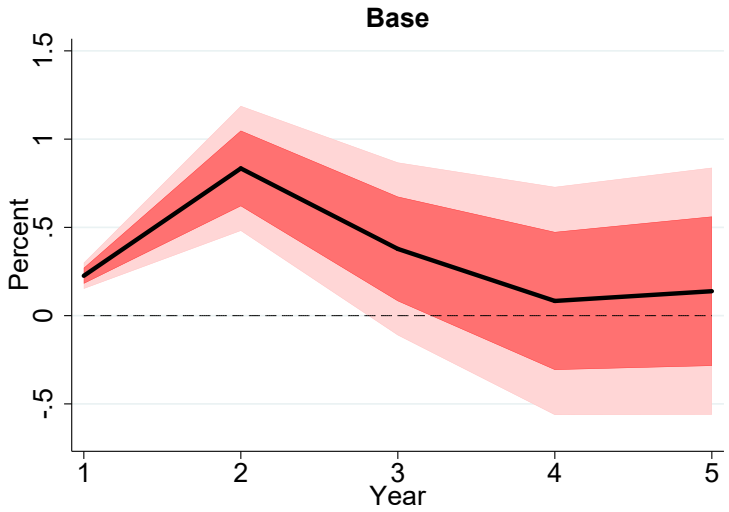
Tax ratios increase after Rate and Base shocks

Robustness of first stage regression to using annual data

return



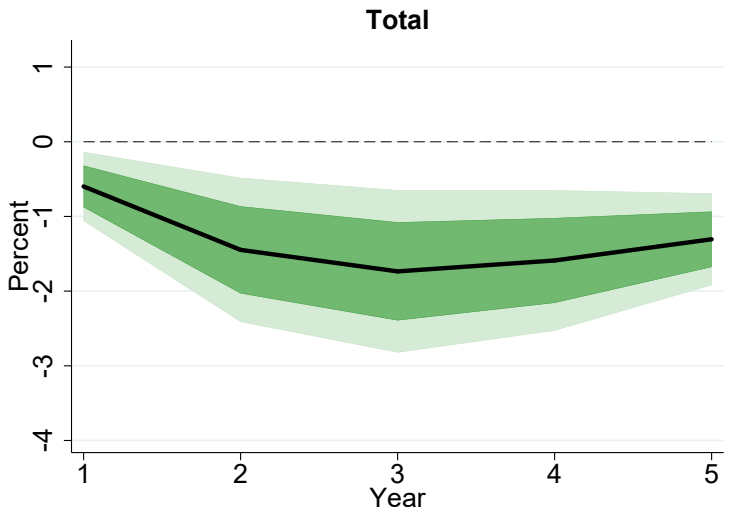


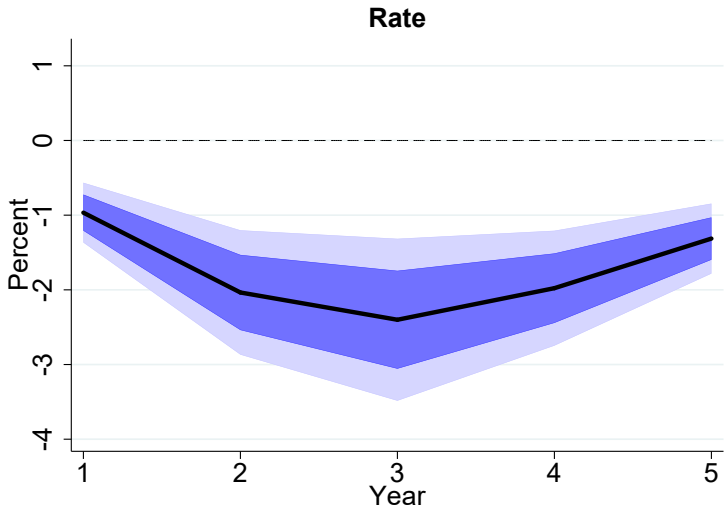


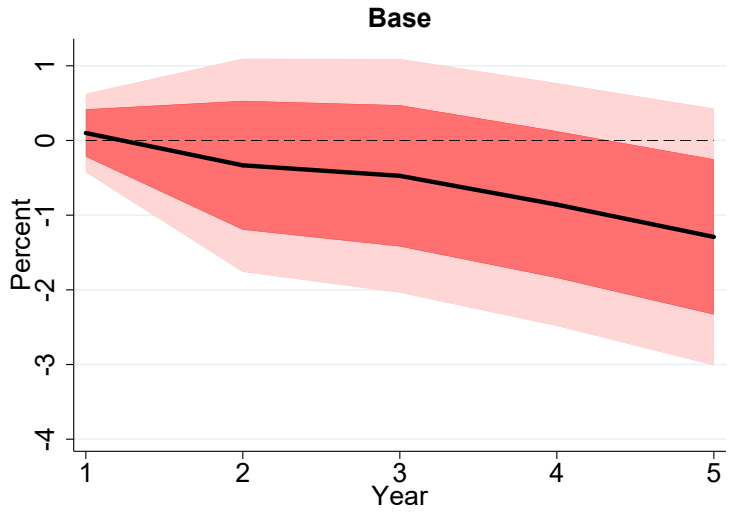
GDP declines more strongly after Rate shocks

Robustness of second stage regression to using annual data

return



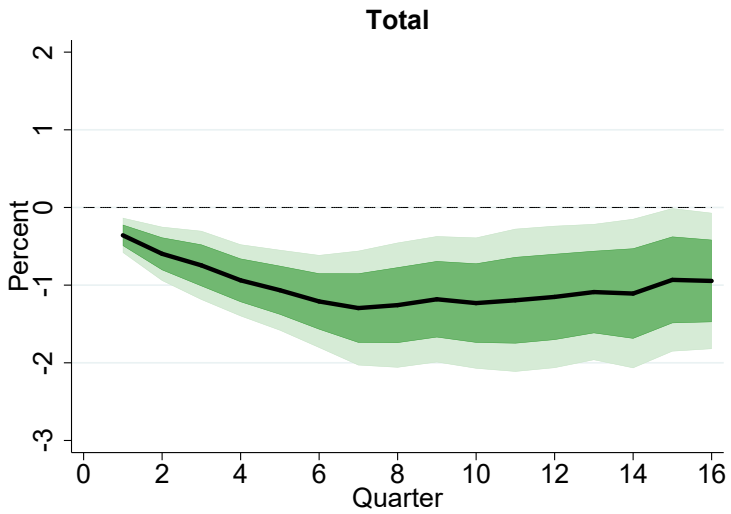


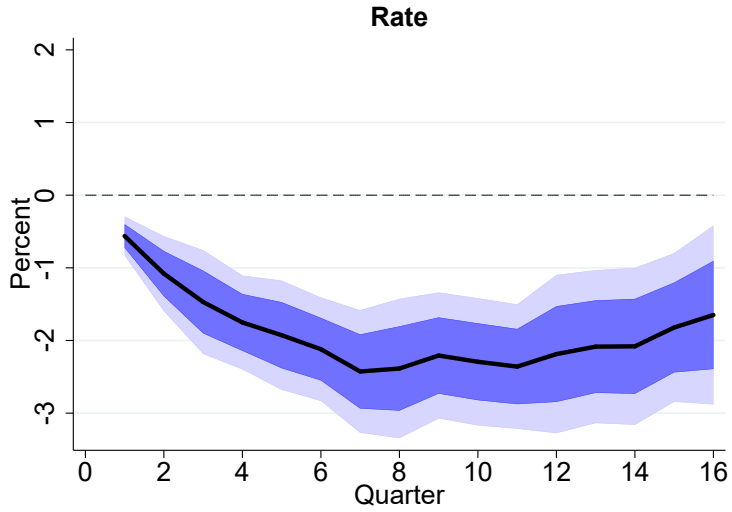


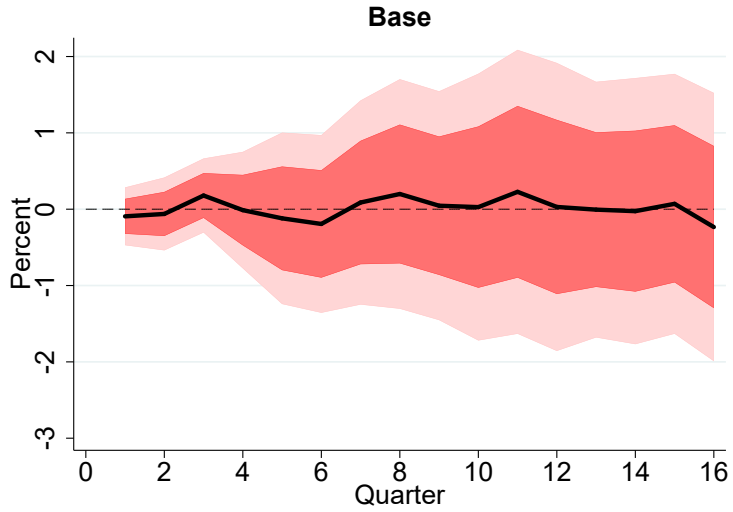
GDP declines more strongly after Rate shocks

Robustness to using OLS instead of IV estimation

return







Tax multipliers

Return

Robustness to using all exogenous shocks during consolidation years

	$\triangle$Tax$_t$			$\triangle$Output$_t$		
	All	Rate	Base	All	Rate	Base
Tax Shock$_t$	1.06**	0.97**	1.55**			
	(0.34)	(0.34)	(0.48)			
$\triangle$Tax$_t$				-0.73*	-1.13**	-0.23
				(0.36)	(0.42)	(0.39)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic				41.55	20.57	26.77
R^2	0.41	0.40	0.40	0.63	0.56	0.66
Obs	1,183	1,183	1,183	1,183	1,183	1,183

Tax multipliers

return

Robustness to different sets of controls

	No Controls			Monetary Policy			Spending Shock		
	All	Rate	Base	All	Rate	Base	All	Rate	Base
$\triangle \text{Tax}_t$	-0.59	-0.90*	-0.22	-0.69*	-1.13**	-0.13	-0.67*	-1.05**	-0.21
	(0.36)	(0.43)	(0.30)	(0.38)	(0.42)	(0.43)	(0.36)	(0.44)	(0.39)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	52.93	24.98	34.88	39.87	20.49	24.59	40.60	19.77	26.59
R^2	0.57	0.50	0.60	0.64	0.56	0.66	0.64	0.58	0.66
Obs	1,247	1,247	1,247	1,183	1,183	1,183	1,183	1,183	1,183

Tax multipliers

return

Robustness to using annual data

	$\triangle$Tax$_t$			$\triangle$Output$_t$		
	All	Rate	Base	All	Rate	Base
Tax Shock$_t$	0.82***	0.94***	0.81***			
	(0.18)	(0.26)	(0.23)			
$\triangle$Tax$_t$				-1.06**	-1.23***	-0.68
				(0.43)	(0.35)	(0.77)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic				36.87	28.44	10.63
R^2	0.56	0.55	0.53	0.73	0.70	0.77
Obs	339	339	339	339	339	339

Cumulative Tax Multipliers

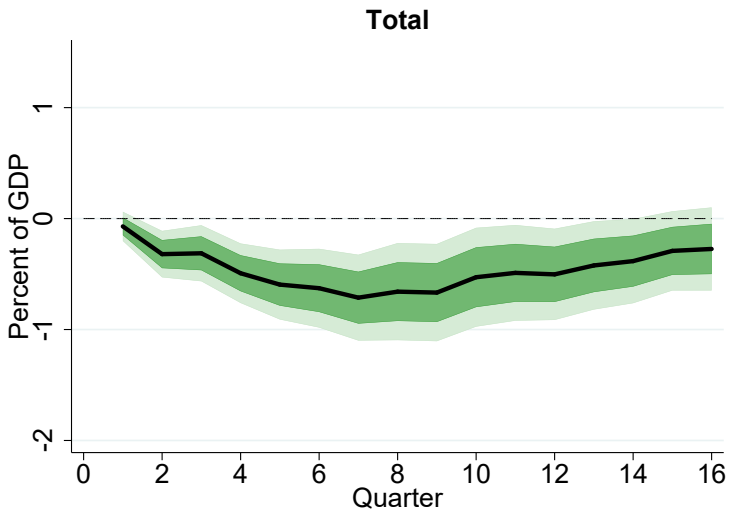
return

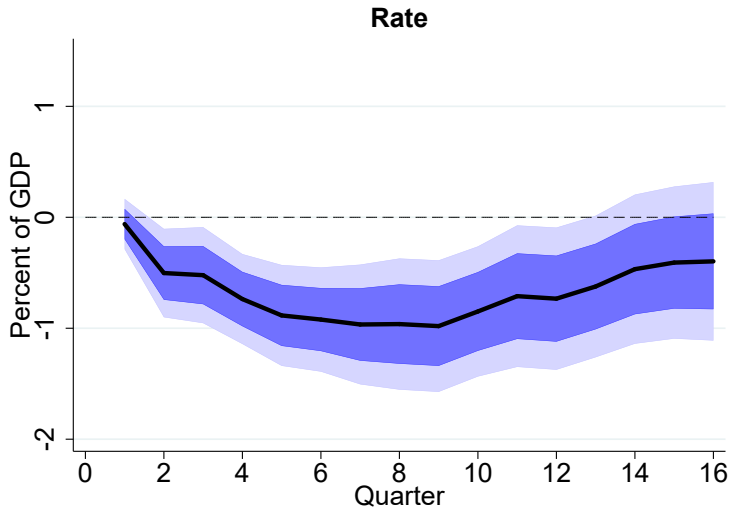
Robustness to computing multipliers using Uhlig (2010) integral method

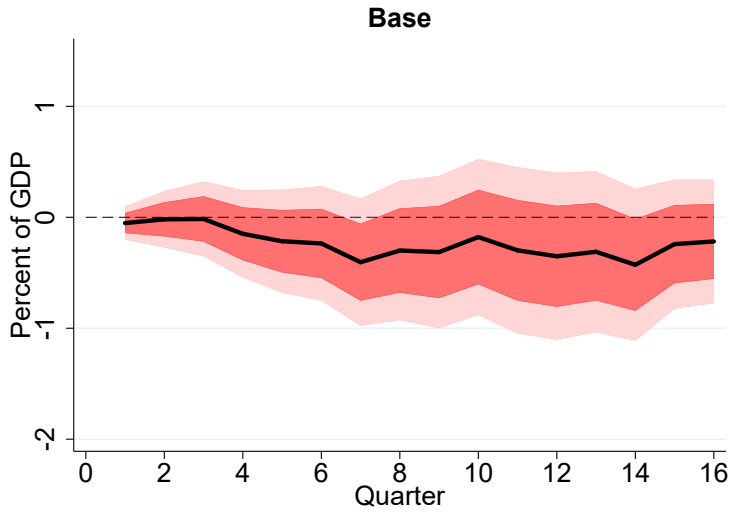
	2 Year Multiplier			4 Year Multiplier		
	All	Rate	Base	All	Rate	Base
$\triangle \text{Tax}_t$	-0.85	-1.53**	-0.17	-0.87	-1.49	-0.26
	(0.49)	(0.57)	(0.38)	(0.66)	(0.83)	(0.68)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	43.82	17.79	35.22	21.41	8.32	18.19
R^2	0.79	0.72	0.81	0.71	0.63	0.72
Obs	1,183	1,183	1,183	1,103	1,103	1,103

Consumption declines after a Rate shock

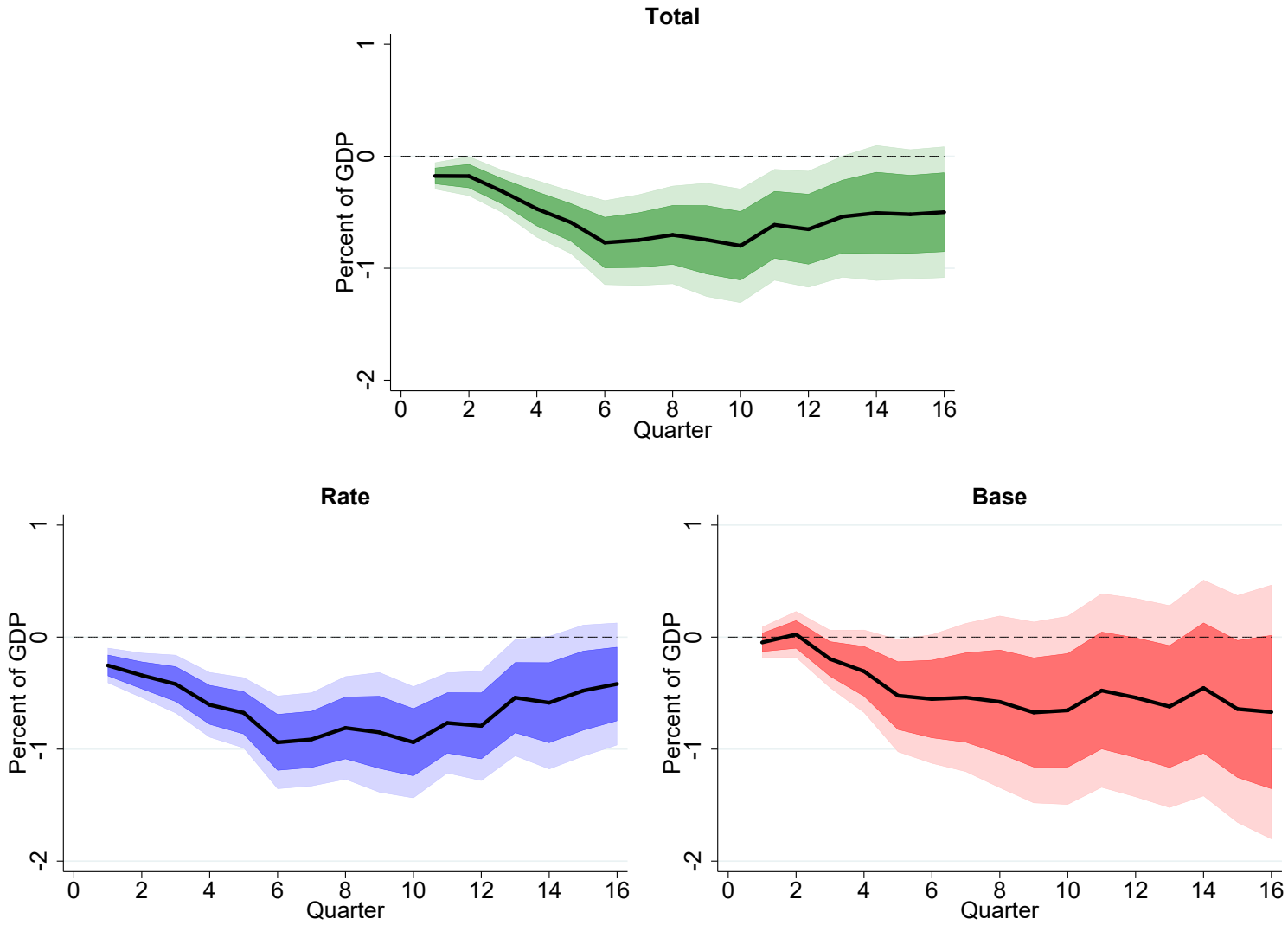
return





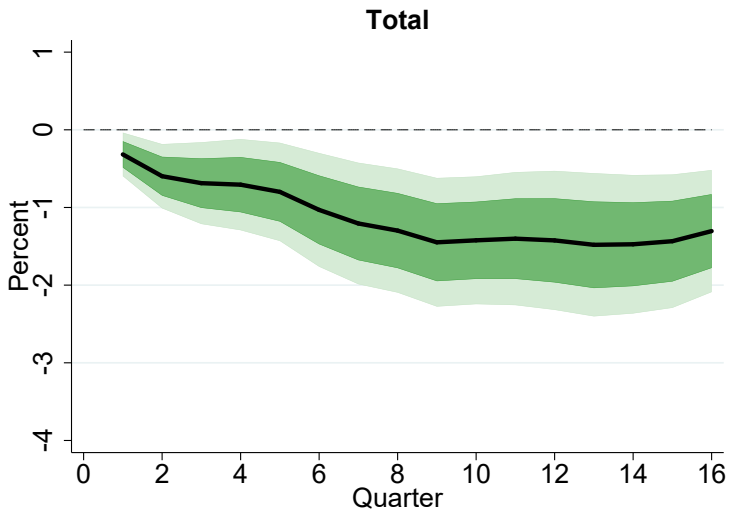


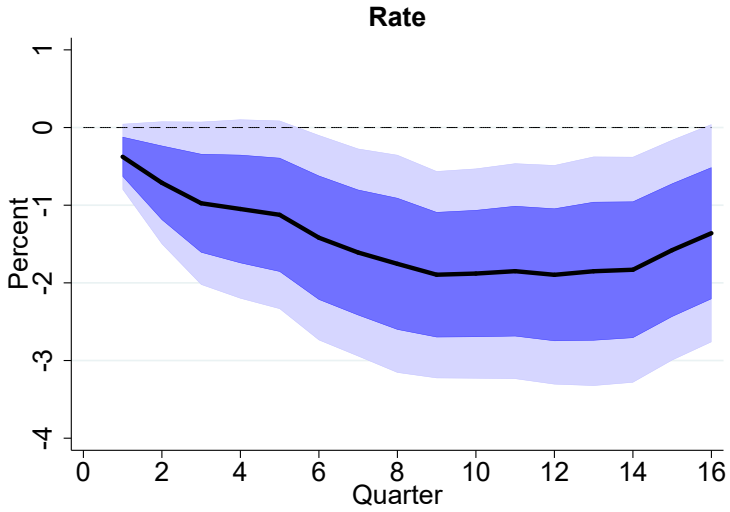
Investment declines more strongly after a Rate shock

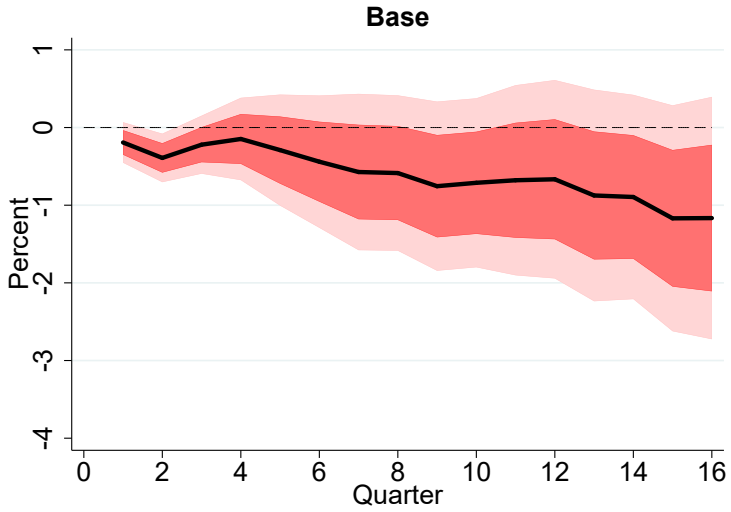


Employment per capita

return







Empirical Approach

return

Dynamic effects of specific taxes during consolidations

- Same specification as before

$$Y_{i,t+h} - Y_{i,t-1} = \alpha_i + \delta_t + \beta_h \triangle \text{Tax}_{i,t} + \theta_h' \mathbf{X}_{i,t} + \varepsilon_{i,t+h}$$

- However, $\triangle \text{Tax}_{i,t}$ now refers to the change in the effective or statutory tax rate for a specific tax type (PIT/VAT/...)
- This is instrumented with the narrative shock for that tax type
- We control for shocks to other tax types announced in the same or previous four quarters, and for lags of the PIT / CIT / VAT statutory tax rates
- Responses are scaled to equal a 1% shock to the effective tax rate