The Output Effects of Fiscal Adjustment Plans: Disaggregating Taxes and Spending

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What's new

1. Fiscal plans

- Fiscal policy is conducted through rare decisions and it is implemented through multi-year plans, not through isolated shifts in fiscal variables
  - fiscal foresight $\implies$ narrative identification
- How to study empirically the effect on macro variables of a fiscal plan
- What are the consequences of collapsing plans into "shocks"
- Jordà and Taylor (2013) note that shifts in fiscal variables identified through the narrative method are often predictable. This is not surprising in the context of plans, confirming that the correct implementation of narrative identification is through plans rather than isolated shocks

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   1. cutting *transfers* are recessionary, but less than raising taxes
   2. cuts in *government consumption and investment* have the least contractionary effect, in some cases non-keynesian effects are observed
   3. increasing *taxes* has the most contractionary effect. With rare exceptions *direct taxes* are more recessionary than *indirect taxes*

What's new

3. Out-of sample simulations

- simulations out-of-sample (2010-13) show that heterogeneity in the composition of fiscal adjustments explains heterogeneity in recessions

Our results have nothing to say about optimal policies. They can help inform theoretical models about the facts they should match

Fiscal adjustments are implemented through multi-year plans

- When fiscal policy is conducted through multi-year plans, fiscal adjustment in each year – say year t – consist of three components
    - unexpected shifts in fiscal variables (announced upon implementation at time t)
    - shifts implemented at time t that had been announced in previous years
    - future announced corrections (announced at time t for implementation in future years)
- Unanticipated and announced corrections *and* corrections in T and G are correlated
- Anticipations are an intrinsic element of plans
    - **narrative identification**

Reconstructing plans

- A narratively identified adjustment occurring in year t, e_t, will have 3 components (consider plans with a forward horizon of 1 year)

$$e_t : \left\{ e^u_t, \; e^a_{t,0}, \; e^a_{t,1} \right\}$$

$$e^u_t : \left\{ \tau^u_t, \; g^u_t \right\} \quad e^a_{t,0} : \left\{ \tau^a_{t,0}, \; g^a_{t,0} \right\} \quad e^a_{t,1} : \left\{ \tau^a_{t,1}, \; g^a_{t,1} \right\}$$

- e^u_t : unexpected shifts in fiscal variables (announced upon implementation at time t)
- $e^a_{t,0}$: shifts implemented at time t that had been announced in previous years. $e^a_{t,0} = e^a_{t-1,1}$, hence $e^a_{t,0}$ is predictable
- $e^a_{t,1}$: future announced corrections (announced at time t for implementation in future years)

Tax-based and spending-based plans: an example

The multi-year plan introduced in Australia (and then revised) in 1985

year	τ_t^u	$\tau_{t,0}^a$	$\tau_{t,1}^a$	$\tau_{t,2}^a$	$\tau_{t,3}^a$	g_t^u	$g_{t,0}^a$	$g_{t,1}^a$	$g_{t,2}^a$	$g_{t,3}^a$
1985	0	0	0	0	0	0.5	0	0.45	0	0
1986	0.17	0	0.19	-0.27	0	0.4	0.45	0.26	-0.08	0
1987	0	0.19	-0.27	0	0	0.45	0.26	0.37	0	0
1988	0	-0.27	0	0	0	0	0.37	0	0	0

Tax-based and spending-based plans: a second example

Stabilization plans in Italy: 1991-1993

time	$\tau^u_{i,t}$	$\tau^a_{i,t,0}$	$\tau^a_{i,t,1}$	$\tau^a_{i,t,2}$	$\tau^a_{i,t,3}$	$g^u_{i,t}$	$g^a_{i,t,0}$	$g^a_{i,t,1}$	$g^a_{i,t,2}$	$g^a_{i,t,3}$
1991	1.69	0	-1.26	0	0	1.08	0	0	0	0
1992	2.85	-1.26	-1.2	0	0	1.92	0	0	0	0
1993	3.2	-1.2	-0.57	0	0	3.12	0	0	0	0

Plans vs the existing literature

$$e_t : \left\{ e^u_t,\ e^a_{t,0},\ e^a_{t,1} \right\}$$

$$e^u_t : \left\{ \tau^u_t,\ g^u_t \right\} \quad e^a_{t,0} : \left\{ \tau^a_{t,0},\ g^a_{t,0} \right\} \quad e^a_{t,1} : \left\{ \tau^a_{t,1},\ g^a_{t,1} \right\}$$

- Romer and Romer 2010

$$f^{R\&R}_t = \tau^u_t + \tau^a_{t,1}$$

- Mertens and Ravn, 2011

$$\left\{ \tau^u_t,\ \tau^a_{t,1} \right\}$$

- Jordà&Taylor 2013, IMF 2011

$$f^{IMF}_t = e^u_t + e^a_{t,0}$$

f^{IMF}_t is predictable since $e^a_{t,0} = e^a_{t-1,1}$

Estimating and simulating plans

- Start from the Romer and Romer (2010) regression (a truncated MA representation)

$$\Delta z_t = \alpha + B(L) f_t + \chi_t + u_t$$
$$f_t = e_t^u + e_{t,1}^a$$

effect of e_t^u and $e_{t,1}^a$ assumed to be identical (e.g. no credit constraints)

Plans are rare

We pool the data from different countries allowing for two sources of heterogeneity

- **within country** heterogeneity with respect to the type of fiscal adjustments
  - *TB (further disaggregated in DTB and ITB)*
  - *EB (further disaggregated in C&IB and TrB)*
- **between country** heterogeneity in the way fiscal policy is conducted over time, *e.g.* persistence

A model to estimate and simulate plans with cross-country heterogeneity in styles (one-year horzon)

- Estimation for a panel of countries

$$\Delta z_{i,t} = \alpha + B_1(L) e^{u}_{i,t} + B_2(L) e^{a}_{i,t,0} +$$
$$+ \gamma_1 e^{a}_{i,t,1} + \lambda_i + \chi_t + u_{i,t}$$
$$e^{a}_{i,t,1} = e^{a}_{i,t+1,0}$$

- Simulation (also for a panel)

$$e^{a}_{i,t,1} = \varphi_{i,1} \; e^{u}_{i,t} + v_{i,t,1}$$

  - The R&R specification is modified to allow flexibility in the effect of plans upon announcement and implementation (as in Mertens and Ravn, 2011)
  - No distributed lag for the effect of future announced plans because the effect over time of announcements is followed through the plan
  - Simulations constructed using country-specific φ_i

▸ A model that emphasizes "news"

Cross-country heterogeneity in styles and heterogeneity between EB and TB plans

Countries are different and plans are different

$$\Delta z_{i,t} = \alpha + B_1(L)e^u_{i,t} * TB_{i,t} + B_2(L)e^a_{i,t,0} * TB_{i,t} + \\ C_1(L)e^u_{i,t} * EB_{i,t} + C_2(L)e^a_{i,t,0} * EB_{i,t} + \\ + \gamma_1 e^a_{i,t,1} * EB_{i,t} + \delta_1 e^a_{i,t,1} * TB_{i,t} + \lambda_i + \chi_t + u_{i,t}$$

$$\begin{aligned} if \ \left(\tau^u_t + \tau^a_{t,0} + \tau^a_{t,1}\right) > \left(g^u_t + g^a_{t,0} + g^a_{t,1}\right) &\Longrightarrow TB_t = 1 \\ otherwise \ TB_t &= 0 \\ EB_t &= 1 - TB_t \end{aligned}$$

$$\begin{aligned} e^a_{i,t,1} &= \varphi_{i,1} \ e^u_{i,t} + v_{i,t,1} \\ e^a_{i,t,1} &= e^a_{i,t+1,0} \end{aligned}$$

Cross-country heterogeneity in styles and heterogeneity between plans: 4-level disaggregation

$$\Delta z_{i,t} = \alpha + \sum_{j=1}^{2} B_{1,j}(L) e^{u}_{i,t} * TB_{i,t} * D^{TB}_{i,j,t} + \sum_{j=1}^{2} B_{2,j}(L) e^{a}_{i,t,0} * TB_{i,t} * D^{TB}_{i,j,t} +$$

$$\sum_{j} C_{1,j}(L) e^{u}_{i,t} * EB_{i,t} * D^{EB}_{i,j,t} + \sum_{j} C_{2,j}(L) e^{a}_{i,t,0} * EB_{i,t} * D^{EB}_{i,j,t} +$$

$$+ \sum_{j=1}^{2} \gamma_j e^{a}_{i,t,1} * EB_{i,t} * D^{EB}_{i,j,t} + \sum_{j=1}^{2} \delta_j e^{a}_{i,t,1} * TB_{i,t} * D^{TB}_{i,j,t} + \lambda_i + \chi_t + u_{i,t}$$

- $D^{TB}_{1,j,t}$ describes plans based on direct taxes
- $D^{TB}_{2,j,t}$ describes plans based on indirect taxes
- $D^{EB}_{1,j,t}$ describes plans based on govt consumption and investment
- $D^{EB}_{2,j,t}$ describes plans based on transfers

Cross-country heterogeneity in styles and heterogeneity between plans: 4-level disaggregation (cont.)

$$e^{a}_{i,t,1} = \varphi_{i,1}\ e^{u}_{i,t} + v_{i,t,1}$$

$$e^{a}_{i,t,1} = e^{a}_{i,t+1,0}, \quad e^{a}_{i,t,j} = e^{a}_{i,t-1,j+1} + \left(e^{a}_{i,t,j} - e^{a}_{i,t-1,j+1}\right) \quad for \quad j \geqslant 1$$

$$e^{u}_{i,t} = \tau d^{u}_{i,t} + \tau i^{u}_{i,t} + gci^{u}_{i,t} + tr^{u}_{i,t} \quad etc$$

Putting the model at work

1. Simulate, within sample (1978-2009), the output effect of *the average adjustment plan* (*i.e.* compute impulse responses using the estimated $\varphi_i' s$)

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Putting the model at work

1. Simulate, within sample (1978-2009), the output effect of *the average adjustment plan* (*i.e.* compute impulse responses using the estimated $\varphi_i' s$)
2. Simulate, out of sample (2010-13), the effect of a specific plan
    - auxiliary system (φ_i) non-necessary but useful to check that the simulated plan is not too different from the average plan in the estimation sample

Discussion: analyzing shocks when fiscal policy is conducted through plans

- Suppose the data generating process is

$$
\begin{aligned}
y_t &= \alpha + \beta_1 e_t^u + \beta_2 e_{t,1}^a + \beta_3 e_{t,0}^a + \epsilon_t \\
e_{t,1}^a &= \varphi e_t^u + v_t \\
e_{t,0}^a &= e_{t-1,1}^a
\end{aligned}
$$

- If you overlook plans and estimate

$$y_t = \alpha + \beta e_t^u + \zeta_t$$

$$p \lim \left(\alpha_{OLS}\right) = \left(\beta_1 + \varphi \beta_2\right)$$

- α_{OLS} captures the intertemporal dimension of the plan, not only the effect of the innovation e_t^u

Analyzing shocks when fiscal policy is conducted through plans (cont.)

- The data generating process is

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\end{aligned}
$$

- You estimate

$$y_t = \alpha_1 e_t^u + \alpha_2 e_{t,1}^a + \zeta_t$$

$$p\lim\left(\alpha_{1OLS}\right) = \beta_1$$

$$p\lim\left(\alpha_{2OLS}\right) = \beta_2$$

- Using α_{1OLS} to simulate the output effect of an innovation e_t^u would be wrong: $\frac{dy_t}{de_t^u} = \beta_1 + \beta_2 \varphi$ and φ cannot be set to 0 in simulation

Overlooking the correlation between shifts in G and T

- Suppose the data generating process is

$$y_t = \beta_1 \tau_t + \beta_2 g_t + \epsilon_t$$
$$g_t = \varphi \tau_t + v_t$$

- You estimate

$$y_t = \alpha \tau_t + \zeta_t$$
$$p \lim \left(\alpha_{OLS} \right) = \left(\beta_1 + \varphi \beta_2 \right)$$

- Estimate of the total response to an exogenous fiscal correction is unbiased. But it would be wrong to interpret α_{OLS} as the effect of (e.g.) a tax cut: it is the effect of a tax cut paired with a coordinated change in g

Overlooking the correlation between shifts in G and T (cont.)

- The data generating process is

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Collapsing plans into shocks

$$f_t^{IMF} = e_t^u + e_{t,0}^a$$

"Shocks" become predictable (Jordà and Taylor, 2013)

$$\begin{aligned} Cov\left(f_t^{IMF}, f_{t-1}^{IMF}\right) &= Cov\left(\left(e_t^u + e_{t,0}^a\right), \left(e_{t-1}^u + e_{t-1,0}^a\right)\right) \\ &= Cov\left(\left(e_t^u + e_{t-1,1}^a\right), \left(e_{t-1}^u + e_{t-1,0}^a\right)\right) \\ &= \varphi Var\left(e_{t-1}^u\right) \end{aligned}$$

J&T propose a technique to "clean them up". But the fact that shocks are predictable does not necessarily imply that they are endogenous: in fact they are not. Not surprising the J&T results are almost identical to IMF 2011

▸ Exogeneity and Predictability ▸ Jordà and Taylor

Data and narrative identification

- Romer and Romer (2010) use official documentation, such as Congressional reports, etc. to identify the size, timing, and principal motivation for all major postwar tax policy actions
    - legislated tax changes are classified into *endogenous* (induced by short-run countercyclical concerns) and *exogenous*, taken to deal with an inherited budget deficit, or driven by concerns about long-run economic growth, or politically motivated

The exogenous fiscal consolidations identified by Devries&al (IMF, 2011)

- 17 OECD countries, 1978-2009 (we only use 14)
- Among all stabilization episodes authors select those designed to reduce a budget deficit and put the public debt on a sustainable path. As a result, they are unlikely to be systematically correlated with other developments affecting output, and thus they can be considered as exogenous for the estimation of the short-term output effects of fiscal consolidation
- Isolated shifts in fiscal variables are identified à la R&R. Data sources: Budget Reports, EU Stability Programs, IMF Reports, OECD Surveys, etc.
  - both shifts in G and T (general government except US, CA, AUS)
    - shifts in G : relative to projections (as in the "Sequester")
    - shifts in T: estimated revenue effect (as in R&R)
  - unanticipated and anticipated shifts in G and T
    - 563 individual shifts in G or T (unanticipated and anticipated)
- "If the motivation of the fiscal consolidation is primarily to expand domestic demand, we do not include it in our database"

Constructing plans and extending the data

- We go back to the original Devries&al sources and
  - separate out unanticipated, anticipated and implemented (but previously announced) shifts in taxes and spending
  - organize the data into plans
  - extend the data and construct plans that cover the period 2010-2013 (so far for 11 countries)
  - disaggregate expenditure in government consumption and investments and transfers, and revenues in direct and indirect taxes
  - while doing this we double check the Devries&al identification

Disaggregation

Taxes

- Direct Taxes: taxes on net income of individuals, on profits of corporations and enterprises, on capital gains and taxes, on individual and corporate properties
- Indirect Taxes: taxes on transactions, goods and services (e.g. VAT, excise duties, stamp duty, services tax)

Spending

- Government consumption and investment: current expenditures for consumption of goods and services, public sector salaries, costs of state provided services (e.g. public education and health) plus all government fixed capital formation expenditures
- Transfers: money transferred by the government to households (e.g. pensions and unemployment benefits) and corporations (without expecting an economic gain, e.g. subsidies), plus tax credits and tax deductions

Labelling of plans

We define 4 types of plans. Plans mostly based on

- Direct Tax (DB)
- Indirect Tax (IB)
- Government consumption and investment (CB)
- Transfers (TRB)

We label plans in two steps

1. we evaluate whether the plan mainly consists in spending measures (EB) or tax measures (TB)

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We label plans in two steps

1. we evaluate whether the plan mainly consists in spending measures (EB) or tax measures (TB)
2. if the plan is EB, we assess whether it consists mostly of consumption and investment or transfers measures. If TB whether direct or indirect taxes prevail

Yet unresolved data issues

- Cuts in central government trasfers to regions and cities
- Tax credits and tax deductions: should they be considered as lower taxes or higher transfers?

Average plans

	Number of plans	Average composition (% of GDP)				
2 components - (1979-2007)		*Plan*	*Tax*	*Spending*		
Spending Based	84	1.46	0.21	1.25		
		(0.08)	(0.05)	(0.05)		
Tax Based	51	1.11	0.87	0.25		
		(0.12)	(0.05)	(0.09)		
2 components - (2009-2013)						
Spending Based	27	3.53	1.28	2.25		
		(0.37)	(0.19)	(0.20)		
Tax Based	11	2.71	1.64	1.07		
		(0.78)	(0.32)	(0.49)		
4 components - (1979-2007)		*Plan*	*Direct*	*Indirect*	*Consumption*	*Transfer*
Direct Tax Based	21	1.06	0.63	0.15	0.1	0.04
		(0.21)	(0.06)	(0.05)	(0.07)	(0.08)
Indirect Tax Based	23	1.18	0.15	0.77	0.09	0.09
		(0.2)	(0.06)	(0.04)	(0.06)	(0.08)
Consumption Based	41	1.26	0.07	0.09	0.77	0.19
		(0.15)	(0.05)	(0.04)	(0.03)	(0.06)
Transfer Based	40	1.79	0.09	0.16	0.33	0.88
		(0.14)	(0.05)	(0.04)	(0.04)	(0.05)

Average episodes

Styles of fiscal adjustments

$$e^a_{i,t,j} = \varphi_{j,i}\ e^u_{i,t} + v_{i,t,j} \quad \textit{for} \quad j = 1, 2, 3$$

Styles of plans

	AU	OE	BG	CA	DK	DEU	FR
$\varphi_{1,i}$	0.39 (0.16)	0.36 (0.08)	0.04 (0.19)	1.3 (0.18)	0.49 (0.1)	−0.11 (0.14)	0.38 (0.12)
$\varphi_{2,i}$	−0.27 (0.14)	0	0	0.513 (0.12)	0	−0.01 (0.09)	−0.08 (0.05)
$\varphi_{3,i}$	−0.02 (0.01)	0	0	0.19 (0.09)	0	0.04 (0.03)	−0.04 (0.04)

	IR	IT	JP	PT	SP	UK	US
$\varphi_{1,i}$	0	−0.24 (0.04)	0.26 (0.03)	0.33 (0.16)	0.06 (0.06)	0.37 (0.09)	0.43 (0.36)
$\varphi_{2,i}$	0	0	−0.0005 (0.003)	0	0	0.1 (0.05)	0.32 (0.28)
$\varphi_{3,i}$	0	0	0	0	0	0	0.17 (0.24)

Computing impulse responses

- Heterogeneity in styles implies that an initial correction of 1% of GDP will generate plans of different size across countries
- We compute impulse responses to a plan of the size of 1% of GDP, while traditional impulse responses are computed with respect to a shock of 1% of GDP

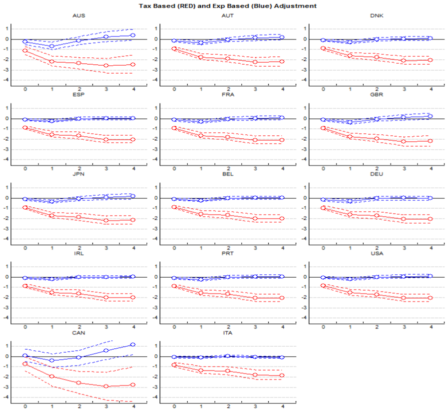
$$e^u_{i,t} + e^a_{i,t,1} + e^a_{i,t,2} = 1$$

$$\hat{e}^a_{i,t,j} = \hat{\varphi}_{i,j} e^u_{i,t} \quad \text{for} \quad j = 1, 2$$

$$e^u_{i,t} = \frac{1}{1 + \hat{\varphi}_{i,1} + \hat{\varphi}_{i,2}}$$

as an example for Italy, where $\hat{\varphi}_1 = -0.24$ and $\hat{\varphi}_2 = 0$ we simulate $e^u_t = 1.32$, $e^a_{t,1} = -0.32$, $e^a_{t,2} = 0$

Two-level disaggregation: TB and EB (64% confidence bounds)



The effect of TB and EB adjustments on output growth

▸ Coefficients ▸ Alternative restrictions ▸ Consumption ▸ Investment ▸ Confidence

Four-level disaggregation

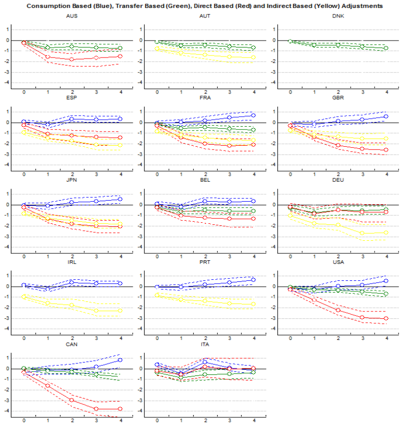


Figure: The effect of DB, IB, CB and TRB adjustments on output growth

▸ Consumption ▸ Investment ▸ Confidence

Disaggregation in four components: stock market

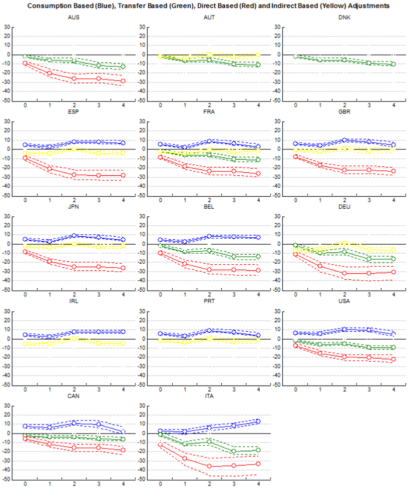


Figure: The effect of DB, IB, CB and TRB adjustments on annual total stock market returns (percentage change)

Extensions, robustness

- Monetary policy and the ZLB
- Is the choice between TB and EB plans related to the cycle, or to accompanying reforms?

Fiscal policy when monetary policy does not respond

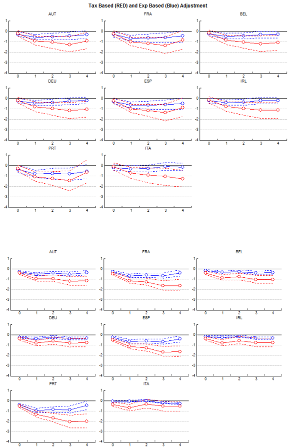
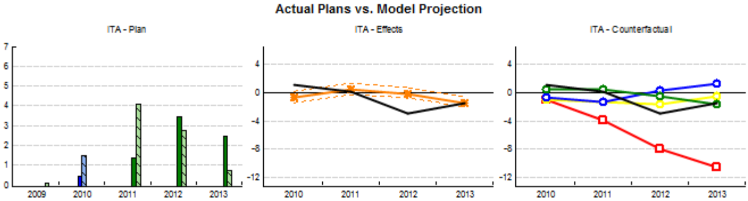


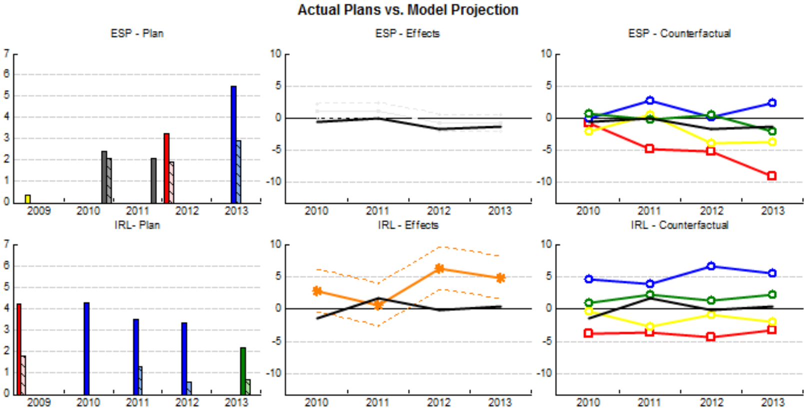
Figure: On output growth - above: Euro area coefficients (1999-2013), below: baseline coefficients (1981-2013)

▸ Model ▸ Figure 2

Out-of-sample and counterfactual simulations: Italy - 4 components



Out-of-sample and counterfactual simulations: Spain and Ireland - 4 components



Conclusions

- Fiscal policy is conducted through rare decisions and is implemented through multi-year plans, not through isolated shifts in fiscal variables
    - "shocks" could be predictable
    - fiscal foresight $\Longrightarrow$ narrative identification
    - plans allow to analyze the macroeconomic impact of different styles of fiscal adjustments
        - styles can be heterogenous across countries both in their intertemporal and intratemporal dimension
- Fiscal multipliers depend on the composition of a fiscal correction: not only TB and EB based adjustments generate different multipliers but also the multipliers of the main components of G and T are different
- Simulations out-of-sample (2009-13) show that heterogeneity in the composition of fiscal adjustments explains heterogeneity in recessions

A model to estimate and simulate plans with cross-country heterogeneity in styles. A specification that emphasized "news"

our model (one-year horizon)

$$\Delta z_{i,t} = \alpha + B_1(L)e^{u}_{i,t} + B_2(L)e^{a}_{i,t,0} + \gamma_1 e^{a}_{i,t,1} + \lambda_i + \chi_t + u_{i,t}$$

$$e^{a}_{i,t,1} = e^{a}_{i,t+1,0}$$

$$e^{a}_{i,t,1} = \varphi_{i,1}\ e^{u}_{i,t} + v_{i,t,1}$$

"news specification" (R&R 2010)

$$\Delta z_{i,t} = \alpha + B_1(L)e^{u}_{i,t} + B_2(L)e^{a}_{i,t,1} + \lambda_i + \chi_t + u_{i,t}$$

$$e^{a}_{i,t+1} = \varphi_{i,1}\ e^{u}_{i,t} + v_{i,t,1}$$

For the two to be equivalent in the news specification $e^{u}_{i,t}$ must include, among the surprises, any deviation from announcements: $e^{a}_{i,t,0} - e^{a}_{i,t-1,1}$ Back

Exogeneity and Predictability

- Predictability of f_t^{IMF} by their own past does not necessarily imply violation of exogeneity. Consider, for the sake of illustration, this simple representation

$$
\begin{aligned}
\Delta y_t &= \beta_0 + \beta_1 f_t^{IMF} + u_{1t} \\
f_t^{IMF} &= \rho_1 f_{t-1}^{IMF} + \rho_2 \Delta y_{t-1} + u_{2t} \\
\begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix} &\sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{pmatrix} \right]
\end{aligned}
$$

- The condition required for f_t^{IMF} to be weakly exogenous for the estimation of β_1 is $\sigma_{12} = 0$,
- The condition(s) required for strong exogeneity is weak exogeneity and $\rho_2 = 0$. They can be both verified even if $\rho_1 \neq 0$.

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An alternative strategy, Jordà and Taylor (2013)

- Our strategy
  - Once we have constructed fiscal plans, decomposing fiscal adjustments into their expected and unexpected parts, we simulate the effect of a plan giving an impulse to the unexpected (and not predictable) component, using the estimated style of the plan (the $\varphi's$) to build "artificial" announcements to unanticipated shocks, and finally constructing the response of output to the plan
- Jordà and Taylor (2013)
  - Use e_t^{IMF} "shocks" and measure their effect using the Local Projections Method after having purged them from predictability. They need to do this because the autocorrelation of e_t^{IMF} is problematic for the application of the Local Projections Method

An alternative strategy, Jordà and Taylor (2013)

- e_t^{IMF} are purged of predictability implementing the following correction
  - redefine e_t^{IMF} innovations as a 0/1 dummy variable
  - estimate a *propensity score* deriving the probability with which a correction is expected by regressing it on its own past and predictors
  - use propensity scores to derive an Average Treatment Effect based on Inverse Probability Weighting

Discussion

- Replacing e_t^{IMF} innovations with a 0/1 dummy variable overlooks relevant information on the intensity and the nature of the adjustment
- The links between the announced and anticipated part of a stabilization plan are lost.
- Fiscal plans are different across countries because the style of fiscal adjustments differs across countries: thus they cannot be assimilated to an identical common treatment administered to many patients.

ATE based on Local Projection Method

Consider first the case in which the narrative identified shocks satisfy the exogeneity property (selection on observables). In this case the average policy effect

$$E\left[\left(y_{t,h}\left(d_j\right)-y_t\right)-\left(y_{t,h}\left(d_0\right)-y_t\right) \mid w_t\right]=\theta^h$$

can be calculated by the LPM (which is based again on a simplified MA representation)

$$y_{t+h}-y_t=\alpha^h+\theta^h e_t^{IMF}+\gamma^{h'} w_t+v_{t+h}$$

What is LPM ?

Consider the following simple VAR, augmented with the observable, narratively identified, e_t^{IMF} shocks

$$Y_t = AY_{t-1} + \beta_1 e_t^{IMF} + \epsilon_t$$

The MA if the VAR truncated at lag h is

$$\begin{aligned} Y_{t+h} &= A^{h+1} Y_{t-1} + A^h \beta_1 e_t^{IMF} + v_{t+i} \\ v_{t+i} &= \beta_1 e_{t+h}^{IMF} + \ldots A^{h-1} \beta_1 e_{t+1}^{IMF} + A^h \beta_1 e_t^{IMF} + \\ &+ \epsilon_{t+h} + A\epsilon_{t+h-1} + \ldots A^i \epsilon_t \end{aligned}$$

The impulse response

$$E\left(Y_{t+h} \mid e_t^{IMF} = 1, I_t\right) - E\left(Y_{t+h} \mid e_t^{IMF} = 0, I_t\right) = \frac{\partial Y_{t+h}}{\partial e_t^{IMF}} = A^i \beta_1$$

can be obtained by a series of regressions

$$y_{t+h} = \pi_h' Y_{t-1} + \theta^h e_t^{IMF} + v_{t+i}$$

What is LPM ?

In practice the conditioning set Y_{t-1} can be augmented in LPM as LPM is based on a single equation estimation (after the identification of the shocks) and more degrees of freedom are available:

$$y_{t+h} = \gamma^h w_t + \theta^h e_t^{IMF} + v_{t+i}$$

LPM regressions omit $e_{t+h}^{IMF}, ..., e_{t+1}^{IMF}$.This omitted variables problem would not lead to inconsistent estimates of the parameters of $A^i\beta_1$ $(p\lim \hat{h_i} = A^i\beta_1)$ only if e_t^{IMF} were orthogonal to all omitted variables. Unfortunately, this orthogonality is lost when fiscal policy is implemented through plans because, as shown above, the very nature of plans generates a correlation in e_t^{IMF}. The hope for the LPM method is that w_t captures the relevant variation in all omitted variables.

ATE based on Local Projection Method and IPW

- If e_t^{IMF} can be predicted by controls, and controls are correlated with output, there is an allocation bias problem. Moving from shocks to plans is our route to solve this problem
- Jordà and Taylor (2013) proceed in a different way and try to apply the LPM after having purged the shocks from predictability
  - redefine e_t^{IMF} innovations as a 0/1 dummy variable
  - estimate a *propensity score* deriving the probability with which a correction is expected by regressing it on its own past and predictors
  - use the propensity score to derive an Average Treatment Effect based on Inverse Probability Weighting

ATE based on Local Projection Method and IPW

- Denote the policy propensity score $p^j(w, \psi)$ *for* $j = 1, 0$ (the predicted values from a probit projections of the policy indicator on the set of predictors w).

$$\theta^h = E\left[\left(y_{t,h}(d_1) - y_t\right) - \left(y_{t,h}(d_0) - y_t\right) \mid w_t\right]$$
$$= E\left[\left(y_{t,h} - y_t\right)\left(\frac{1\{D_t = d_1\}}{p^1(w,\psi)} - \frac{1\{D_t = d_0\}}{1 - p^1(w,\psi)}\right) \mid w_t\right]$$

$$\hat{\theta}^h = \frac{1}{T}\sum\left(y_{t,h} - y_t\right)\hat{\delta}_t$$
$$\hat{\delta}_t = \frac{1\{D_t = d_1\}}{\hat{p}^1(w,\psi)} - \frac{1\{D_t = d_0\}}{1 - \hat{p}^1(w,\psi)}$$

ATE based on Local Projection Method and IPW

In the LP framework ATE can be combined with LP in the following estimator LP-IWPRA estimator

$$\hat{\theta}^{h} = \frac{1}{T}\sum\left[\left(y_{t,h}-y_{t}\right)\hat{\delta}_{t}-\hat{\phi}_{t}m\left(w_{t},\gamma^{h}\right)\right]$$

$$\hat{\phi}_{t} = \frac{1\left\{D_{t}=d_{1}\right\}-\hat{p}^{1}\left(w,\psi\right)}{\hat{p}^{1}\left(w,\psi\right)}-\frac{1\left\{D_{t}=d_{0}\right\}-\left(1-\hat{p}^{1}\left(w,\psi\right)\right)}{1-\hat{p}^{1}\left(w,\psi\right)}$$

where $m\left(w_{t},\gamma^{h}\right)$ is the mean of $\left(y_{t,h}-y_{t}\right)$ predicted by the LP

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Average episodes

	Number of episodes	Average composition (% of GDP)				
2 components - (1979-2007)		*Episode*	*Tax*	*Spending*		
Spending Based	107	1.39 (0.07)	0.23 (0.04)	1.15 (0.04)		
Tax Based	70	0.95 (0.12)	0.72 (0.05)	0.23 (0.09)		
2 components - (2009-2013)						
Spending Based	32	3.19 (0.34)	1.14 (0.17)	2.05 (0.19)		
Tax Based	10	2.71 (0.78)	1.64 (0.32)	1.07 (0.49)		
4 components - (1979-2007)		*Episode*	*Direct*	*Indirect*	*Consumption*	*Transfer*
Direct Tax Based	33	0.85 (0.18)	0.54 (0.05)	0.12 (0.04)	0.07 (0.05)	0.03 (0.07)
Indirect Tax Based	26	1.1 (0.19)	0.11 (0.06)	0.74 (0.04)	0.09 (0.07)	0.08 (0.0.07)
Consumption Based	45	1.22 (0.14)	0.07 (0.05)	0.09 (0.04)	0.71 (0.03)	0.19 (0.06)
Transfer Based	61	1.5 (0.11)	0.12 (0.0.04)	0.12 (0.03)	0.25 (0.04)	0.71 (0.04)

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Estimation: results with no disaggregation

Coefficients estimated in the benchmark specification

	Coefficient	Std. Error	t-Statistic
$e^u_{i,t} * TB_{i,t}$	-0.879723***	0.114489	-7.683905
$e^u_{i,t} * EB_{i,t}$	-0.115265	0.075279	-1.531166
$e^a_{i,t} * TB_{i,t}$	-0.484525*	0.285855	-1.695002
$e^a_{i,t} * EB_{i,t}$	-0.344987*	0.179673	-1.920084
$e^u_{i,t-1} * TB_{i,t-1}$	-0.623768***	0.116860	-5.337734
$e^u_{i,t-1} * EB_{i,t-1}$	-0.117574	0.079345	-1.481801
$e^a_{i,t-1} * TB_{i,t-1}$	-0.174587	0.298896	-0.584108
$e^a_{i,t-1} * EB_{i,t-1}$	0.306099*	0.169529	1.805586
$e^u_{i,t-2} * TB_{i,t-2}$	-0.118379	0.118397	-0.999852
$e^u_{i,t-2} * EB_{i,t-2}$	0.209932**	0.083388	2.517537
$e^a_{i,t-2} * TB_{i,t-2}$	0.082704	0.357215	0.231525
$e^a_{i,t-2} * EB_{i,t-2}$	0.505489***	0.172553	2.929471
$e^u_{i,t-3} * TB_{i,t-3}$	-0.348970***	0.122697	-2.844161
$e^u_{i,t-3} * EB_{i,t-3}$	0.017926	0.078940	0.227081
$e^a_{i,t-3} * TB_{i,t-3}$	0.118452	0.339582	0.348817
$e^a_{i,t-3} * EB_{i,t-3}$	0.256666	0.170707	1.503546
$e^a_{i,t,1} * TB_{i,t}$	-0.206790	0.263327	-0.785297
$e^a_{i,t,1} * EB_{i,t}$	-0.125764	0.174064	-0.722519
$e^a_{i,t,2} * TB_{i,t}$	0.576258	0.844609	0.682277
$e^a_{i,t,2} * EB_{i,t}$	0.552432	0.848592	0.650998

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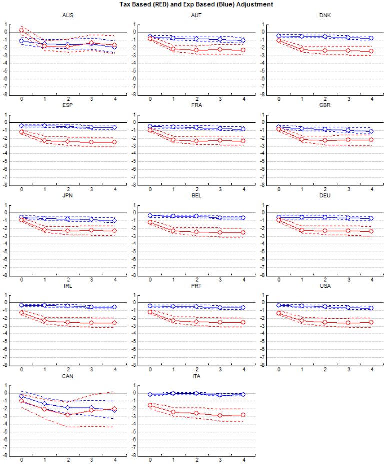
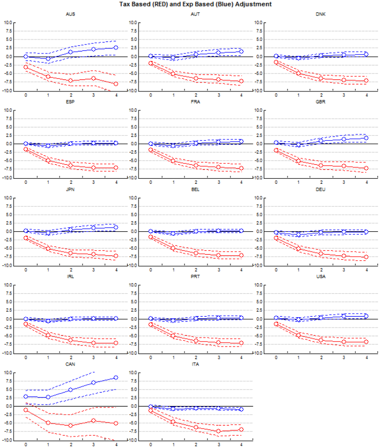
Baseline results: consumption



The effect of TB and EB adjustments on consumption growth

Baseline results: investments



The effect of TB and EB adjustments on fixed capital formation growth

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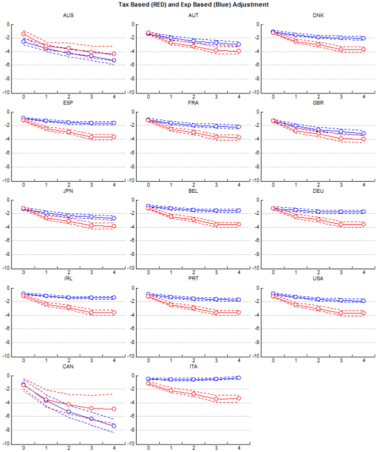
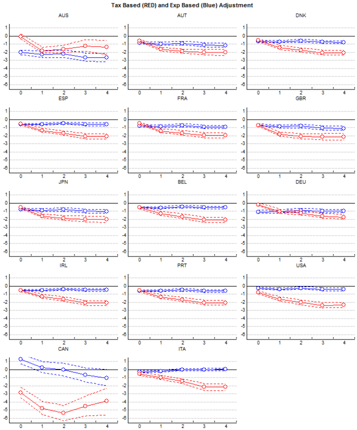
Baseline results: consumer confidence



The effect of TB and EB adjustments on ESI Consumer Confidence

Baseline results: business confidence



The effect of TB and EB adjustments on ESI Business Confidence

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Disaggregation in four components: consumption

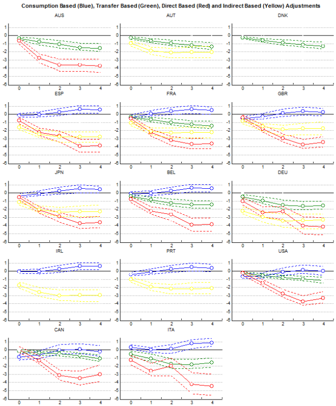

Figure: The effect of DB, IB, CB and TRB adjustments on consumption growth

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Disaggregation in four components: investment

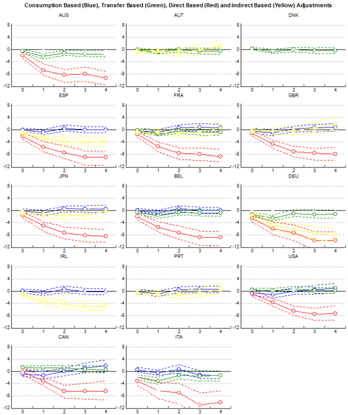

Figure: The effect of DB, IB, CB and TRB adjustments on fixed capital formation growth

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Disaggregation in four components: consumer confidence

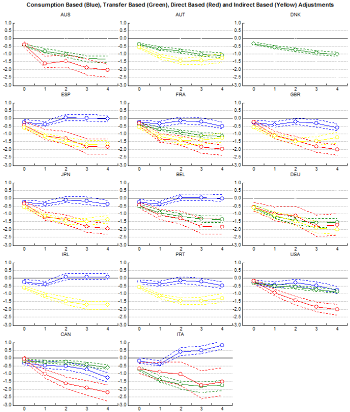

Figure: The effect of DB, IB, CB and TRB adjustments on ESI Consumer confidence

Disaggregation in four components: business confidence

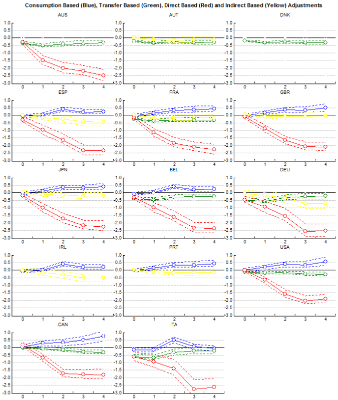

Figure: The effect of DB, IB, CB and TRB adjustments on ESI Business confidence

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Overlooking plans: direct estimation of t and g

An alternative way to impose restrictions on the more general specification: studying the response to tax and spending shocks directly, overlooking plans

- pros
  - comparison with other studies, avoid potential mis-specifications for plans close to a 50/50 split
- cons
  - preserving the correlation between τ and g and between unanticipated and anticipated shifts requires estimating a very large number of $\varphi's$
- vast majority of the plans in our sample are far from a 50/50 split
  - in only 2 plans (over 44) the share of spending is between 49 and 51% of the total consolidation
  - in only 8 cases the share is between 45% and 55%

Alternative restrictions

$$\Delta z_{i,t} = \alpha + B_1(L)\tau^u_{i,t} + B_2(L)\tau^a_{i,t,0} + C_1(L)g^u_{i,t} + C_2(L)g^a_{i,t,0} + + \sum_{j=1}^{3}\gamma^a_j \tau^a_{i,t,j} + \sum_{j=1}^{3}\delta_j g^a_{i,t,j} + \lambda_i + \chi_t + u_{i,t}$$

$$\begin{aligned}
\tau^a_{i,t,t+1} &= \varphi_{1,i}\ \tau^u_{i,t} + v_{1,i,t} & \tau^a_{i,t,t+1} &= \varphi_{7,i}\ g^u_{i,t} + v_{7,i,t}\\
\tau^a_{i,t,t+2} &= \varphi_{2,i}\ \tau^u_{i,t} + v_{2,i,t} & \tau^a_{i,t,t+2} &= \varphi_{8,i}\ g^u_{i,t} + v_{8,i,t}\\
\tau^a_{i,t,t+3} &= \varphi_{3,i}\ \tau^u_{i,t} + v_{3,i,t} & \tau^a_{i,t,t+3} &= \varphi_{9,i}\ g^u_{i,t} + v_{9,i,t}\\
g^a_{i,t,t+1} &= \varphi_{4,i}\ g^u_{i,t} + v_{4,i,t} & g^a_{i,t,t+1} &= \varphi_{10,i}\ \tau^u_{i,t} + v_{10,i,t}\\
g^a_{i,t,t+2} &= \varphi_{5,i}\ g^u_{i,t} + v_{5,i,t} & g^a_{i,t,t+2} &= \varphi_{11,i}\ \tau^u_{i,t} + v_{11,i,t}\\
g^a_{i,t,t+3} &= \varphi_{6,i}\ g^u_{i,t} + v_{6,i,t} & g^a_{i,t,t+3} &= \varphi_{12,i}\ \tau^u_{i,t} + v_{12,i,t}\\
g^u_{i,t} &= \varphi_{13,i}\ \tau^u_{i,t} + v_{13,i,t}
\end{aligned}$$

- we estimate three $\varphi' s$ parameters instead of thirteen and then distinguish between tax-based and expenditure based

Estimation: results

Direct estimation of τ and g

Variable	Coefficient	Standard Error	T-statistics
τ_t^u	-0.648793***	0.153449	-4.228065
$\tau_{t,0}^a$	-1.021318***	0.248409	-4.111446
τ_{t-1}^u	-0.436015***	0.147131	-2.963445
$\tau_{t-1,0}^a$	-0.094866	0.250728	-0.378363
τ_{t-2}^u	-0.120252	0.155715	-0.772256
$\tau_{t-2,0}^a$	0.099802	0.257854	0.387051
τ_{t-3}^u	-0.352745**	0.157988	-2.232727
$\tau_{t-3,0}^a$	0.354216	0.231010	1.533334
$\tau_{t,t+1}^a$	-1.104238***	0.249919	-4.418380
$\tau_{t,t+2}^a$	1.053898	0.912886	1.154468
g_t^u	-0.087041	0.141932	-0.613258
$g_{t,0}^a$	-0.293784	0.373823	-0.785892
g_{t-1}^u	-0.027610	0.140893	-0.195964
$g_{t-1,0}^a$	0.153334	0.387605	0.395594
g_{t-2}^u	0.297646**	0.140203	2.122964
$g_{t-2,0}^a$	0.047956	0.400446	0.119758
g_{t-3}^u	0.037966	0.136347	0.278456
$g_{t-3,0}^a$	-0.150175	0.368451	-0.407585
$g_{t,t+1}^a$	0.506932	0.389358	1.301969
$g_{t,t+2}^a$	0.337680	1.180079	0.286150

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Fiscal policy at the ZLB: the estimated model

$$\Delta z_{i,t} = \alpha + \sum_{k=1}^{2} B_{1k}(L) e^{u}_{i,t} * TB_{i,t} * D_k + \sum_{k=1}^{2} B_{2k}(L) e^{a}_{i,t,0} * TB_{i,t} * D_k +$$
$$\sum_{k=1}^{2} C_{1k}(L) e^{u}_{i,t} * EB_{i,t} * D_k + \sum_{k=1}^{2} C_{2k}(L) e^{a}_{i,t,0} * EB_{i,t} * D_k +$$
$$+ \sum_{k=1}^{2} \gamma_{1k} e^{a}_{i,t,1} * EB_{i,t} * D_k + \sum_{k=1}^{2} \delta_{1k} e^{a}_{i,t,1} * TB_{i,t} * D_k$$
$$+ \lambda_i + \chi_t + u_{i,t}$$

$$e^{a}_{i,t,1} = \varphi_{i,1} \; e^{u}_{i,t} + v_{i,t,1}$$
$$e^{a}_{i,t,0} = e^{a}_{i,t-1,1}$$
$$D_1 = 1 \; if \; EMU$$
$$D_2 = 1 \; if \; non \; EU \; plus \; EU \; before \; EMU, \; (D_2 = 1 - D_1)$$

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Mimicking fiscal policy at the ZLB

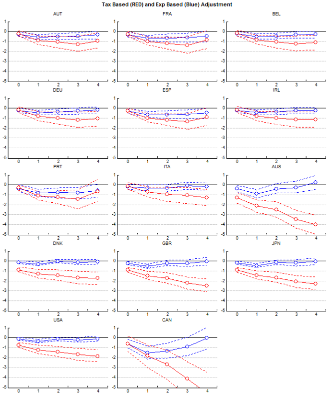

Figure: On output growth - two groups: Euro countries in 1999-2013 and non-Euro countries in 1981-2013 plus Euro countries in 1981-1998

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