

Supplementary Appendix to the Paper “Action-Based Fiscal Consolidations and Economic Growth” by Markus Brueckner

Why GDP Growth has an Effect on Action-Based Fiscal Consolidations?

In this section of the appendix I provide a theoretical explanation for why contemporaneous GDP growth has an effect on action-based fiscal consolidations. The mechanism is automatic stabilizers: due to institutional design contemporaneous GDP growth has automatically a positive effect on the government's budget balance. For any given increase in the budget balance that a policy maker desires to achieve: an increase in the contemporaneous GDP growth rate requires a smaller increase in tax rates (tax-based consolidation); a smaller decrease in government expenditures (expenditure-based consolidation). In the paragraphs below I formalize this explanation.

First, note that the budget, B , is the difference between tax revenues (R) and expenditures (E), i.e. $B=R - E$. For a given tax rate, τ , and discretionary government expenditures, g , automatic stabilizers imply that an increase in GDP growth has a positive effect on the budget. Totally differentiating the budget with respect to GDP growth, y , yields $dB=(R_y - E_y)dy > 0$, where $R_y \equiv \partial R / \partial y > 0$ and $E_y \equiv \partial E / \partial y < 0$.

The signs of the two derivatives above are supported by the empirical findings of a number of papers. An early empirical contribution was Fatas and Mihov (2001). Brueckner (2012) and Brueckner et al. (2012) provided empirical evidence from instrumental variables regressions of the response of tax revenues and government expenditures to GDP growth. Galeano et al. (2021) provide a detailed analysis of the components of automatic government spending. The empirical findings in these papers are, however, for samples of countries that are not exactly the same as in this paper's analysis. That leads to the question about external validity. Is there empirical evidence for automatic stabilizers in the sample of countries underlying this paper's empirical analysis?

Appendix Table 8 documents that contemporaneous GDP growth has a significant positive

effect on the GDP share of tax revenues and a significant negative effect on the GDP share of government expenditures in the sample for which there are observations on action-based fiscal consolidations. The IV estimates in Appendix Table 8 show that a 1 percentage point increase in year t GDP growth increases the GDP share of tax revenues by more than 0.2 percentage points; a 1 percentage point increase in year t GDP growth decreases the GDP share of government expenditures by nearly 0.3 percentage points. The empirical evidence in Appendix Table 8 thus suggests that $R_y \equiv \partial R / \partial y > 0$ and $E_y \equiv \partial E / \partial y < 0$.

The definition of an action-based fiscal consolidation is that tax rates increase (tax-based consolidation), or that discretionary government expenditures decrease (expenditure-based consolidation). For a tax-based consolidation, totally differentiating the budget with respect to y and τ yields $dB = (R_y - E_y)dy + R_\tau d\tau$, where $R_\tau \equiv \partial R / \partial \tau$. It follows that $d\tau/dy = (R_y - E_y)/-R_\tau$. If the economy is to the left-side of the peak of the Laffer curve then $R_\tau > 0$. I assume that this is the relevant case since the policy maker's aim is to consolidate the budget, i.e. raise tax revenues by increasing the tax rate. Hence, $d\tau/dy = (R_y - E_y)/-R_\tau < 0$. This mathematical expression means that the faster is GDP growth ($dy > 0$) the smaller the increase in the tax rate has to be for consolidating the budget. The result is symmetric: in order to consolidate the budget, the policy maker has to increase the tax rate more the slower is GDP growth ($dy < 0$).

Now consider an expenditure-based consolidation. Totally differentiating the budget with respect to y and g yields $dB = (R_y - E_y)dy - E_g dg$, where $E_g \equiv \partial E / \partial g > 0$. It follows that $dg/dy = (R_y - E_y)/E_g > 0$. The faster is GDP growth ($dy > 0$), the less the policy maker has to reduce discretionary expenditures in order to consolidate the budget. The result is symmetric: the slower is GDP growth ($dy < 0$), the more discretionary expenditures have to be reduced by the policy maker in order to consolidate the budget.

Note that automatic stabilizers are active at any time frequency. The action-based fiscal consolidations data are annual, and so the time frequency for this paper's empirical analysis is

annual. What about quarterly data? The narrative approach has been applied to several countries, in particular the US, where the time frequency was quarterly (see Ramey, 2016, 2019 for a discussion of these papers). Because automatic stabilizers are active at any time frequency, quarterly tax and expenditure shocks – identified from the narrative record, with the selection criteria that these policy changes were made by policy makers with a primary objective to reduce a budget deficit – are also endogenous to contemporaneous GDP growth.

Omitted Variables

There are variables other than GDP growth that have a direct contemporaneous effect on the budget. For the empirical analysis the issue is then omitted variables bias. The theoretical framework above is useful for pinning down the sign of the omitted variables bias.

My IV estimates of the effect that action-based fiscal consolidations have on GDP growth are subject to omitted variables bias if there is a variable, omitted from the model, that: (i) has an effect on the budget beyond its effect on GDP growth; and (ii) the variable has an effect on GDP growth beyond its effect on the budget. Both of these conditions, (i) and (ii), have to be satisfied for there to be an omitted variables bias. (Variables that only affect the budget through their effect on GDP growth do not lead to omitted variables bias. And, there is also no omitted variables bias from variables that affect the budget directly but these variables have no effect on real GDP growth.)

I will argue below that it is very likely that the sign of the omitted variables bias is negative. That is, due to omitted variables bias, my IV estimates are a lower bound of the true positive effect that action-based fiscal consolidations have on GDP growth. Here is why.

Four omitted variables from the econometric model are: the unemployment rate, the interest rate set by the central bank, the level of public debt, and the old-age dependency ratio. All four of these variables are very likely to have a direct negative contemporaneous effect on the budget. An increase in the unemployment rate implies that more people seek unemployment benefits, and pay

less income tax. With regard to the interest rate set by the central bank: an increase in the interest rate set by the central bank increases the deficit because interest payments on government debt increase. Similarly, the higher the level of public debt, the larger the debt service costs and hence the larger the deficit. An increase in the share of the population that is retired means that income tax revenues decline, and government expenditures automatically increase due to an automatic increase in pension payments.

When faced with larger unemployment rates, a higher nominal interest rate, larger public debt, and an increase in the old-age dependency ratio: a policy maker who wants to reduce a budget deficit has to increase tax rates more, and cut back more on discretionary expenditures. This implies that unemployment, the interest rate, debt, and the old-age dependency ratio – all four of these variables have a positive effect on the magnitude of action-based fiscal consolidations. It is also very likely that unemployment, the interest rate, debt, and the old-age dependency ratio have a direct negative contemporaneous effect on GDP growth.

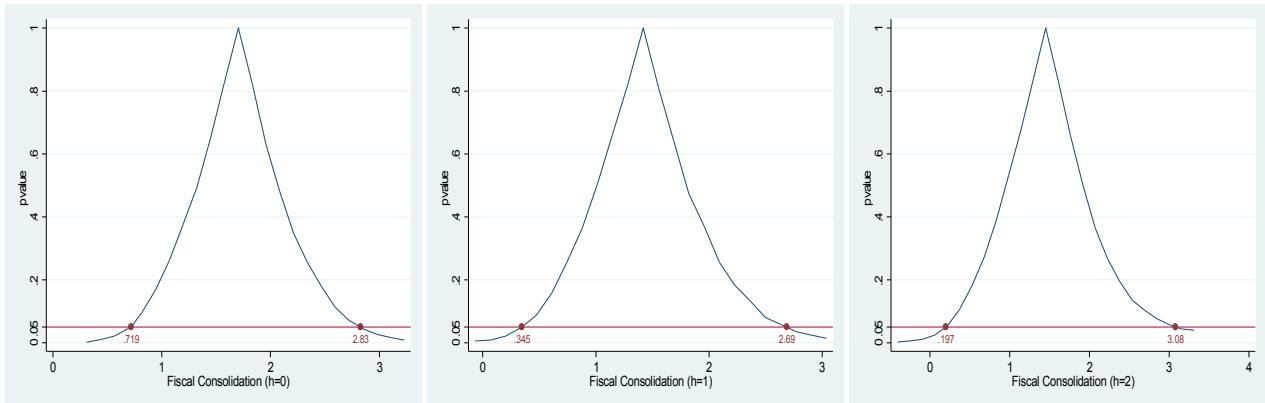
Thus, with regard to my IV estimates of the effects that action-based fiscal consolidations have on GDP growth: these estimates are very likely to be downward-biased due to omitted variables. In the framework of Section 4, this means that $cov(u,e) < 0$. To see this formally, extend both equations in Section 4 by a variable X : (1) $FiscalConsolidation = \alpha GDPGrowth + rX + u'$; (2) $GDPGrowth = \beta * FiscalConsolidation + fX + e'$. That is: $u = rX + u'$ and $e = fX + e'$. It follows that $cov(u,e) = rfVar(X)$. (If X is a vector then also the covariances between the X s matter. For the four variables discussed above, the correlations are either positive or very close to zero.) For unemployment, the interest rate, debt, and the old-age dependency ratio: it is plausible to assume that $r > 0$, and $f < 0$. Hence, $cov(u,e) < 0$. From this expression, it immediately follows that OLS estimates of the effects of action-based fiscal consolidations on GDP growth are also subject to an omitted variables bias. The sign of the omitted variables bias is the same for the IV estimator and the OLS estimator.

I have pinned down the sign of the omitted variables bias by using basic economic reasoning. I believe this is a fruitful strategy. At the country level, there is no random variation in fiscal policy variables. Because at the country-level there is no randomization of fiscal policy variables, omitted variables bias is always an issue. By acknowledging omitted variables bias and using basic economic reasoning, I have established that my estimates are likely to be a lower bound of the true positive effect that action-based fiscal consolidations have on GDP growth.

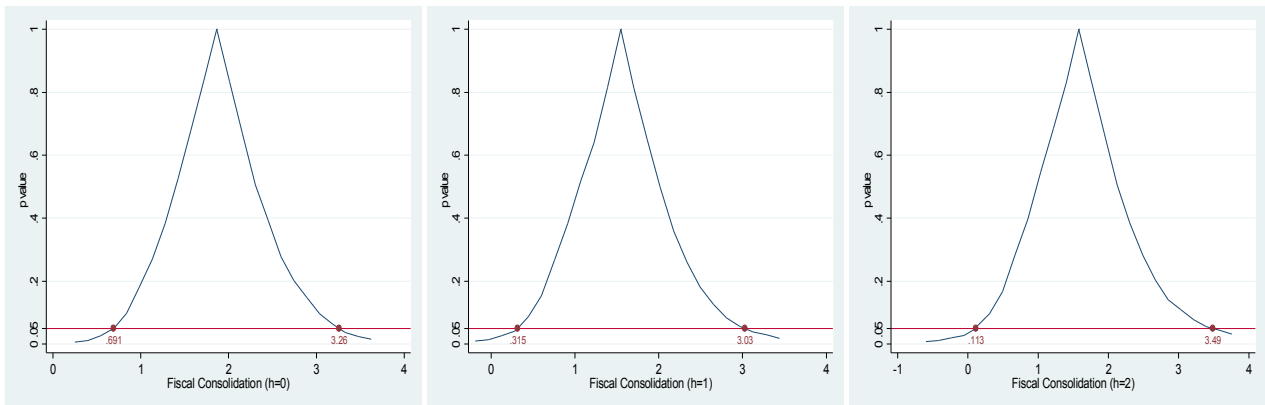
I note that one cannot just include unemployment, the interest rate, debt, and the old-age dependency ratio in year t as right-hand-side controls in the model. These variables are not exogenous. Including these variables in year t on the right-hand side without instrumenting would be the typical case of bad controls, see e.g. Angrist and Pischke (2009, p. 64). One can include lags of these variables, though that does not entirely resolve the issue of omitted variables bias. To go part way in empirically addressing this issue, I have estimated models that included lags of the following variables: the central government debt-to-GDP ratio, a government fractionalization index, the share of the population aged 65 and above, the unemployment rate, and the real internal rate of return. These variables were included on the right-hand-side in $t-1$ and $t-2$. The models also included as controls $t-1$ and $t-2$ GDP growth and $t-1$ and $t-2$ fiscal consolidations. I found that these models delivered significant positive effects of fiscal consolidations on GDP growth; quantitatively, the effects were slightly larger than the effects reported in Table 9. For example, the model that included the full set of control variables mentioned above showed that a fiscal consolidation equal to 1 percent of GDP increases GDP in the same year by around 2.4 percent.

Figure S1. Confidence Curves

Panel A: Whole Sample



Panel B: Sample that Excludes the 5 Largest Economies



Note. The confidence curves are for the IV regressions of Panel A in Table 9. The confidence curves were generated using a wild restricted efficient bootstrap with 1000 draws, clustered at the country level; the auxiliary random variable for the bootstrapping was drawn from a Rademacher distribution. Panel A (B) of Appendix Figure 1 shows the confidence curves for the whole sample (sample that excludes the 5 largest economies).

Table S1. Descriptive Statistics

Variable	Source	Mean	Stdv.	Obs.
Fiscal Consolidation	DeVries et al. (2011); David and Leigh (2018)	0.32	0.74	1016
Tax-based	DeVries et al. (2011); David and Leigh (2018)	0.15	0.44	984
Expenditure-based	DeVries et al. (2011); David and Leigh (2018)	0.16	0.44	984
Temperature Change	FAOSTAT (2021)	0.68	0.60	994
Temperature Change	Dell et al. (2012)	0.03	0.65	745
GDP Growth of Trading Partners	Vegh and Vuletin (2015)	0.66	0.51	913
Commodity Price Index	Vegh and Vuletin (2015)	0.83	3.62	908
Commodity Price Index	Gruss and Kebhaj (2019)	100.5	3.99	995
Terms of Trade	World Bank (2021)	99.6	18.5	1012
GDP Growth	PWT version 10.0	3.41	4.24	1016
Total Factor Productivity Growth	PWT version 10.0	0.39	2.11	1016
Investment Growth	PWT version 10.0	3.46	10.7	1016
Consumption Growth	PWT version 10.0	3.31	3.75	1016
Change in GDP Share of Net Exports	PWT version 10.0	-0.02	3.27	1016
Inflation	PWT version 10.0	2.82	10.15	1016
Real Effective Exchange Rate Growth	World Bank (2021)	-0.08	617.0	836
GDP Share of Tax Revenues	Vegh and Vuletin (2015)	21.8	8.8	793
GDP Share of Government Expenditures	PWT version 10.0	16.0	4.3	1016

Table S2. Robustness: Temperature Data from Dell et al. (2012)

	Fiscal Consolidation	Fiscal Consolidation	GDP Growth	GDP Growth
	(1)	(2)	(3)	(4)
	Whole Sample	Excluding Large Economies	Whole Sample	Excluding Large Economies
Temperature Change, t (Dell et al., 2012 data)	-0.07** (0.04)	-0.10** (0.04)	0.78*** (0.22)	0.92*** (0.25)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	745	600	745	600
Countries	31	26	31	26

Note: The dependent variable in columns (1) and (2) is *Fiscal Consolidation* in year t ; in columns (3) and (4) the dependent variable is *GDP growth* in year t . The method of estimation is least squares. Columns (1) and (3) show estimates for the whole sample; columns (2) and (4) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S3. Robustness: International Commodity Price Index from Gruss and Kebhaj (2019)

	Fiscal Consolidation	Fiscal Consolidation	GDP Growth	GDP Growth
	(1)	(2)	(3)	(4)
	Whole Sample	Excluding Large Economies	Whole Sample	Excluding Large Economies
Commodity Price Index, t (Gruss and Kebhaj, 2019)	-0.03* (0.02)	-0.03* (0.02)	0.31*** (0.09)	0.28*** (0.09)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	995	810	995	810
Countries	31	26	31	26

Note: The dependent variable in columns (1) and (2) is *Fiscal Consolidation* in year t ; in columns (3) and (4) the dependent variable is *GDP growth* in year t . The method of estimation is least squares. Columns (1) and (3) show estimates for the whole sample; columns (2) and (4) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S4. Robustness: Net Barter Terms of Trade from the World Bank (2021)

	Fiscal Consolidation	Fiscal Consolidation	GDP Growth	GDP Growth
	(1)	(2)	(3)	(4)
	Whole Sample	Excluding Large Economies	Whole Sample	Excluding Large Economies
Terms of Trade, t	-0.006** (0.003)	-0.006** (0.003)	0.097** (0.044)	0.092** (0.046)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	1008	823	1008	823
Countries	31	26	31	26

Note: The dependent variable in columns (1) and (2) is *Fiscal Consolidation* in year t ; in columns (3) and (4) the dependent variable is *GDP growth* in year t . The method of estimation is least squares. Columns (1) and (3) show estimates for the whole sample; columns (2) and (4) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S5. Poisson Estimates

	Fiscal Consolidation							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Whole Sample				Excluding Large Economies			
Temperature Change, t	-0.22** (0.11)			-0.18* (0.10)	-0.29*** (0.10)			-0.22** (0.09)
GDP Growth of Trading Partners, t		-0.82*** (0.25)		-0.62** (0.29)		-0.86*** (0.26)		-0.64** (0.30)
Commodity Price Index, t			-0.09** (0.04)	-0.08* (0.04)			-0.09** (0.04)	-0.08* (0.04)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	888	789	768	764	777	681	660	656

Note: Fixed effects Poisson model estimates. The dependent variable is *Fiscal Consolidation* in year *t*. In parentheses are Huber robust errors which are clustered at the country level. Columns (1)-(4) show estimates for the whole sample; columns (5)-(8) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S6A. System-GMM Estimates

	Fiscal Consolidation					
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample			Excluding Large Economies		
Panel A: System-GMM						
GDP Growth, t	-0.06*** (0.02)	-0.06*** (0.02)	-0.08*** (0.02)	-0.06*** (0.02)	-0.06*** (0.03)	-0.08*** (0.03)
CONTROL VARIABLES						
Fiscal Consolidations, t-1	0.80*** (0.30)	0.84*** (0.29)	0.66*** (0.20)	0.89*** (0.29)	0.95*** (0.28)	0.71*** (0.21)
Fiscal Consolidations, t-2	-0.12 (0.16)	-0.13 (0.15)		-0.19 (0.15)	-0.21 (0.14)	
GDP Growth, t-1	0.00 (0.01)			0.00 (0.01)		
GDP Growth, t-2	-0.01 (0.01)			-0.01 (0.01)		
AR (1) test, p-value	0.03	0.02	0.00	0.02	0.01	0.00
AR (2) test, p-value	0.50	0.48	0.83	0.32	0.29	0.75
Sargan test, p-value	0.43	0.52	0.29	0.54	0.66	0.29
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	797	797	824	627	627	649
Countries	29	29	29	24	24	24

Note: The dependent variable is *Fiscal Consolidation* in year t . The method of estimation is system-GMM. GMM-style instruments for fiscal consolidations in $t-1$ and $t-2$ are third and higher order lags. GDP growth in year t is specified as an endogenous variable: the instrument set includes temperature changes, GDP growth rate of trading partners, and the international commodity price index. GDP growth in $t-1$ and $t-2$ is specified as a pre-determined variable. In parentheses are Huber robust errors clustered at the country level. Columns (1)-(3) show estimates for the whole sample; columns (4)-(6) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S6B. Difference-GMM Estimates

	Fiscal Consolidation					
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample			Excluding Large Economies		
GDP Growth, t	-0.08*** (0.02)	-0.08*** (0.03)	-0.08*** (0.03)	-0.08*** (0.02)	-0.07** (0.03)	-0.08*** (0.03)
CONTROL VARIABLES						
Fiscal Consolidations, $t-1$	0.45 (0.28)	0.58* (0.31)	0.48*** (0.22)	0.59** (0.27)	0.74** (0.29)	0.57*** (0.22)
Fiscal Consolidations, $t-2$	-0.08 (0.18)	-0.10 (0.16)		-0.15 (0.16)	-0.19 (0.13)	
GDP Growth, $t-1$	-0.03* (0.01)			-0.02* (0.01)		
GDP Growth, $t-2$	-0.02*** (0.01)			-0.02** (0.01)		
AR (1) test, p-value	0.03	0.04	0.01	0.02	0.01	0.01
AR (2) test, p-value	0.40	0.64	0.93	0.32	0.25	0.84
Sargan test, p-value	0.37	0.41	0.28	0.54	0.47	0.19
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	768	768	795	603	603	625
Countries	29	29	29	24	24	24

Note: The dependent variable is *Fiscal Consolidation* in year t . The method of estimation is Diff-GMM. GMM-style instruments for fiscal consolidations in $t-1$ and $t-2$ are third and higher order lags. GDP growth in year t is specified as an endogenous variable: the instrument set includes temperature changes, GDP growth rate of trading partners, and the international commodity price index. GDP growth in $t-1$ and $t-2$ is specified as a pre-determined variable. In parentheses are Huber robust errors clustered at the country level. Columns (1)-(3) show estimates for the whole sample; columns (4)-(6) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S7A. IV-Probit Estimates

Type of Consolidation	Pr(Fiscal Consolidation>0)			
	Tax-Based		Spending-Based	
	(1)	(2)	(3)	(4)
GDP Growth, t	-0.13** (0.06)	-0.16*** (0.04)	-0.11* (0.06)	-0.12** (0.02)
Lagged Dependent Variable		1.14*** (0.23)		1.73*** (0.23)
First Stage for GDP Growth				
GDP Growth of Trading Partners, t	1.44** (0.47)	1.25** (0.52)	1.44** (0.47)	1.25** (0.52)
Commodity Price Index, t	0.20*** (0.07)	0.26*** (0.07)	0.20*** (0.07)	0.26*** (0.07)
Temperature Change, t	0.67*** (0.19)	0.58*** (0.19)	0.67*** (0.19)	0.58*** (0.19)
Country Fixed Effects	No	No	No	No
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	821	795	821	795
Countries	29	29	29	29

Note: The table reports IV-probit estimates. Huber robust standard errors (shown in parentheses) are clustered at the country level. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S7B. IV-Poisson Estimates

	Fiscal Consolidations			
	(1)	(2)	(3)	(4)
	Whole Sample		Excluding Large Economies	
GDP Growth, t	-0.11*** (0.03)	-0.09** (0.04)	-0.11*** (0.03)	-0.09** (0.04)
Fiscal Consolidations, t-1	0.72*** (0.05)	0.70*** (0.06)	0.72*** (0.05)	0.70*** (0.05)
GDP Growth, t-1		-0.03 (0.02)		-0.04* (0.02)
	First Stage for GDP Growth, t			
GDP Growth of Trading Partners, t	2.30*** (0.32)	2.03*** (0.26)	2.05*** (0.36)	1.85*** (0.28)
Commodity Price Index, t	0.25*** (0.07)	0.21*** (0.06)	0.25** (0.07)	0.21*** (0.07)
Temperature Change, t	0.46*** (0.17)	0.46** (0.18)	0.50*** (0.20)	0.52** (0.22)
Cragg Donald F-Stat	51.6	43.0	35.5	30.4
Kleibergen Paap F-Stat	23.9	25.9	18.1	19.8
Country Fixed Effects	No	No	No	No
Time Fixed Effects	No	No	No	No
Observations	857	857	682	682
Countries	30	30	25	25

Note: The table reports IV-poisson estimates. Columns (1)-(2) show estimates for the whole sample; columns (3)-(4) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States.

*Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S8: Automatic Stabilizers

	GDP Share of Tax Revenues	GDP Share of Tax Revenues	GDP Share of Government Expenditures	GDP Share of Government Expenditures
	(1)	(2)	(3)	(4)
	Whole Sample	Excluding Large Economies	Whole Sample	Excluding Large Economies
GDP Growth, t	0.24** (0.11)	0.32*** (0.10)	-0.28*** (0.09)	-0.29*** (0.10)
Cragg Donald F-Stat	15.7	11.0	19.4	13.7
Kleibergen Paap F-Stat	16.6	12.8	17.0	13.9
Hansen J, p-value	0.18	0.15	0.34	0.33
First Stage Estimates for GDP Growth, t				
GDP Growth of Trading Partners, t	2.02*** (0.54)	1.91*** (0.55)	2.21*** (0.51)	2.13*** (0.52)
Commodity Price Index, t	0.16** (0.07)	0.14* (0.08)	0.17** (0.07)	0.14* (0.07)
Temperature Change, t	0.73*** (0.21)	0.78*** (0.26)	0.71*** (0.22)	0.71*** (0.26)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	737	577	850	670
Countries	29	24	29	24

Note: The dependent variable in columns (1) and (2) is the GDP share of total tax revenues; in columns (3) and (4) the dependent variable is the GDP share of government expenditures. The method of estimation is two-stage least squares. Columns (1) and (3) show estimates for the whole sample; columns (2) and (4) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. Huber robust standard errors (shown in parentheses) are clustered at the country level. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S9: Effects of Fiscal Consolidations on Total Factor Productivity, Investment, Consumption and Net-Exports

	Total Factor Productivity Growth	Investment Growth	Consumption Growth	Change in Net- Exports GDP Share
	(1)	(2)	(3)	(4)
Panel A: Whole Sample				
Fiscal Consolidation, t	0.62** (0.26)	2.34** (1.08)	0.48 (0.41)	0.81*** (0.24)
Cragg Donald F-Stat	3799.3	3826.8	3999.3	3840.4
Kleibergen Paap F-Stat	690.0	689.7	701.9	690.8
Observations	797	797	797	797
Countries	29	29	29	29
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes
Panel B: Excluding 5 Largest Economies				
Fiscal Consolidation, t	0.62** (0.28)	2.35** (1.15)	0.42 (0.42)	0.82*** (0.25)
Cragg Donald F-Stat	2963.2	2989.8	3146.3	2997.2
Kleibergen Paap F-Stat	603.3	609.5	622.0	608.5
Observations	627	627	627	627
Countries	24	29	29	29
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes

Note: The dependent variable in column (1) is the total factor productivity growth; column (2) investment growth; column (3) private consumption growth; column (4) the year $t-1$ to t change in the GDP share of net-exports. The method of estimation is two-stage least squares. Panel A shows estimates for the whole sample; Panel B shows estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. Huber robust standard errors (shown in parentheses) are clustered at the country level. Additional controls, estimates not reported, are the dependent variable in $t-1$ and $t-2$, GDP growth in $t-1$ and $t-2$, and fiscal consolidations in $t-1$ and $t-2$.

*Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S10: Effects of Fiscal Consolidations on Inflation and the Real Exchange Rate

	Inflation	Inflation	Real Exchange Rate	Real Exchange Rate
	(1)	(2)	(3)	(4)
	Whole Sample	Excluding 5 Largest Economies	Whole Sample	Excluding 5 Largest Economies
Fiscal Consolidation, t	-2.33*** (0.75)	-2.44*** (0.82)	-0.95** (0.46)	-1.10** (0.48)
Cragg Donald F-Stat	3793.9	2976.4	3604.4	2758.9
Kleibergen Paap F-Stat	676.1	600.4	918.0	893.9
Observations	797	627	674	517
Countries	29	25	25	20
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes

Note: The dependent variable in columns (1) and (2) is the growth rate of the GDP price deflator; columns (3) and (4) the growth rate of the real exchange rate. The method of estimation is two-stage least squares. Columns (1) and (3) show estimates for the whole sample; columns (2) and (4) show estimates for the sub-sample that excludes France, Germany, Japan, United Kingdom, and United States. Huber robust standard errors (shown in parentheses) are clustered at the country level. Additional controls, estimates not reported, are the dependent variable in $t-1$ and $t-2$, GDP growth in $t-1$ and $t-2$, and fiscal consolidations in $t-1$ and $t-2$. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S11. Effects of Tax-Based vs. Expenditure-Based Fiscal Consolidations on GDP Growth

	GDP Growth		
	(1)	(2)	(3)
	Latin America and the Caribbean	Advanced Economies	AE, Without 5 Largest Economies
Panel A: Tax-Based			
Fiscal Consolidation, t	4.00** (1.69)	0.88*** (0.23)	0.75*** (0.20)
Kleibergen Paap F-Stat	197	8318	10730
Panel B: Expenditure-Based			
Fiscal Consolidation, t	8.28*** (2.92)	1.17*** (0.27)	1.05*** (0.27)
Kleibergen Paap F-Stat	186	15649	14396
Observations and Controls in Panels A and B			
Observations	291	506	336
Countries	13	16	11
Country Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes

Note: The dependent variable is year t GDP growth. The method of estimation is two-stage least squares. Column (1) shows estimates for Latin America and the Caribbean; column (2) advanced economies; column (3) advanced economies without France, Germany, Japan, United Kingdom, and United States. Panel A reports estimates of the effects that tax-based consolidations in year t have on GDP growth in year t ; Panel B reports effects for expenditure-based consolidations. Huber robust standard errors (shown in parentheses) are clustered at the country level. Additional controls, estimates not reported, are GDP growth in $t-1$ and $t-2$, and fiscal consolidations in $t-1$ and $t-2$. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S12. Effects of Fiscal Consolidations on GDP Growth through the
Cyclically-Adjusted Budget Balance

	GDP Growth(<i>h</i>)					
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>h</i> =0	<i>h</i> =1	<i>h</i> =2	<i>t</i> =0	<i>t</i> =1	<i>t</i> =2
	Whole Sample			Excluding Large Economies		
Cyclically-Adjusted Budget Balance(<i>h</i>)	2.28*** (0.75)	2.02*** (0.72)	2.15** (0.85)	2.21*** (0.62)	2.12*** (0.79)	2.29** (0.97)
First Stage for Cyclically-Adjusted Budget Balance(<i>h</i>)						
u^{res}	0.72*** (0.14)	0.72*** (0.13)	0.67*** (0.15)	0.76*** (0.15)	0.75*** (0.14)	0.66*** (0.15)
Cragg Donald F-Stat	56.6	74.7	74.6	55.9	68.3	63.0
Kleibergen Paap F-Stat	27.3	30.0	20.3	25.0	30.2	18.7
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	639	609	579	491	488	463
Countries	30	30	30	25	25	25

Note: The method of estimation is two-stage least squares. Robust standard errors (shown in parentheses) are clustered at the country level. The endogenous variable is *Cyclically-Adjusted Budget Balance(h)*, where the *h* refers to the horizon, *h*=0, 1, 2. The instrument is the residual variation in *FiscalConsolidation(h)* that is not due to *GDPGrowth(h)*, i.e. $u^{res}=FiscalConsolidation(h)-\alpha^{IV}GDPGrowth(h)$ where α^{IV} is the estimated coefficient on *GDPGrowth(h)* from Table 8. Additional controls, estimates not reported, are GDP growth in *t*-1 and *t*-2, the cyclically-adjusted budget balance in *t*-1 and *t*-2, fiscal consolidations in *t*-1 and *t*-2, and, computed for each horizon *h*=0, 1, 2, temperature changes(*h*), GDP growth of trading partners(*h*), and the international commodity price index(*h*). *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.

Table S13. The Effects of Austerity Plans on GDP Growth

	GDP Growth			
	(1)	(2)	(3)	(4)
Method of Estimation	2SLS	2SLS	OLS	OLS
Type of Austerity Plan	Tax-Based	Spending-Based	Tax-Based	Spending-Based
Austerity Plan, t	1.06*** (0.27)	0.60*** (0.18)	-0.35** (0.18)	-0.08 (0.13)
Cragg Donald F-Stat	5681.9	18395.5		
Kleibergen Paap F-Stat	3425.6	21110.5		
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes
Observations	506	506	506	506
Countries	16	16	16	16

Note: The dependent variable is GDP growth in year t . The method of estimation in columns (1) and (2) is two-stage least squares; columns (3) and (4) least squares. Columns (1) and (3) show estimates for tax-based austerity plans; columns (2) and (4) show estimates for spending-based austerity plans. Robust standard errors (shown in parentheses) are clustered at the country level. The instrument in the 2SLS regression is the residual variation in the austerity plan in year t that is not due to GDP growth in year, i.e. $u^{\text{res}} = \text{AusterityPlan}_t - \alpha^{IV} \text{GDPGrowth}_t$ where α^{IV} is the estimated coefficient on GDPGrowth_t from a two-stage least squares regression where temperature changes, the international commodity price index, and GDP growth of trading partners are used as excluded instruments for GDP growth. Additional controls, estimates not reported, are GDP growth in $t-1$ and $t-2$, the austerity plan in $t-1$ and $t-2$, GDP growth of trading partners, temperature changes, and the international commodity price index. *Significantly different from zero at the 10 percent level; **5 percent level; ***1 percent level.