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Action-Based Fiscal Consolidations and Economic Growth

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Abstract: This paper tests the hypothesis that action-based fiscal consolidations have a negative effect on GDP growth. Using the IMF's dataset on action-based fiscal consolidations, instrumental variables' regressions show that action-based fiscal consolidations have a significant positive effect on GDP growth. The instrumental variables' regressions also show that action-based fiscal consolidations significantly increase investment and productivity. The findings presented in this paper thus strongly reject the hypothesis that action-based fiscal consolidations reduce growth. The paper argues that least squares estimates presented in previous literature suffer from negative reverse causality bias: GDP growth has a significant positive effect on both the likelihood and the magnitude of action-based fiscal consolidations. To uncover causal effects of action-based fiscal consolidations, researchers need to use an instrumental variables approach.

Keywords: fiscal consolidations; GDP growth; identification; narrative approach; simultaneous systems of equations

JEL Classification: E62

1. Introduction

This paper seeks to make an empirical contribution to the literature on the macroeconomic effects of fiscal consolidations. Specifically, the paper's main aim is to improve our understanding of what are the causal effects of so-called action-based fiscal consolidations. Theoretically, there is at least one compelling reason why action-based fiscal consolidations are not exogenous to contemporaneous GDP growth: automatic stabilizers. A decrease in GDP growth reduces tax revenues, and government expenditures automatically increase when GDP growth decreases (because decreases in GDP growth are generally associated with higher unemployment rates, which means that more people are seeking unemployment and welfare payments). An instrumental variables approach is thus needed for identifying the causal effects that action-based fiscal consolidations have on GDP growth.

This is the first paper to use an instrumental variables approach for estimating the causal effects that action-based fiscal consolidations have on GDP growth. The instrumental variables' estimates presented in this paper show that the response of GDP growth to action-based fiscal consolidations is positive and significantly different from zero: over a horizon of one year, a fiscal consolidation equal to 1 percent of GDP increases GDP by about 1.8 percent; over a horizon of two and three years, the cumulative GDP gain relative to the size of the cumulative fiscal consolidation shock is equal to about 1.5 and 1.4 percent, respectively.

The paper's finding is different from the mainstream finding in the existing literature, which is discussed in Section 2. The existing literature, to date, which has used least squares regressions, has found negative effects of fiscal consolidations on GDP growth. However, as argued in this paper, the findings in the existing literature are likely to be driven by negative reverse causality bias. Contemporaneous GDP growth has a significant negative effect on action-based fiscal consolidations. Least squares regressions, where GDP growth is the dependent variable and action-based fiscal consolidations is the explanatory variable,

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suffer from negative reverse causality bias. The instrumental variables' estimates that I report in this paper do not suffer from this negative reverse causality bias.

To shed light on the mechanisms through which action-based fiscal consolidations affect GDP growth, I examine the effects that action-based fiscal consolidations have on total factor productivity growth, investment, consumption, and net-exports. My instrumental variables' estimates show that action-based fiscal consolidations have a significant positive effect on total factor productivity growth, in addition to significantly boosting private investment and net-exports. I do not find a significant effect of action-based fiscal consolidations on private consumption. Action-based fiscal consolidations significantly reduce inflation and lead to a significant depreciation of the real exchange rate.

The paper's instrumental variables approach uses exclusion restrictions to identify a system of equations. At least since the 1980s (see, e.g., Hausman et al. (1987)), it has been known that, if valid, two exclusion restrictions are sufficient to identify a simultaneous system of two equations. In this paper, the two equations are: (1) where GDP growth contemporaneously affects action-based fiscal consolidations, and (2) where action-based fiscal consolidations contemporaneously affect GDP growth. Under the exclusion restriction of a zero covariance of the error terms in Equations (1) and (2), I only need valid external instruments for the first equation; then, the residual from that estimated equation is used as an instrument in the second equation to obtain a consistent estimate of the effect that action-based fiscal consolidations have on GDP growth.

I estimate the simultaneous system of two equations in two steps. In the first step, I estimate Equation (1) using temperature changes, GDP growth of trading partners, and the international commodity price index as excluded instruments for contemporaneous GDP growth. The instrumental variables' estimates show that GDP growth has, contemporaneously, a significant negative effect on the magnitude of fiscal consolidations. On average, a one percentage point increase in annual GDP growth decreases the magnitude of an action-based fiscal consolidation by about 0.08 percent of GDP in the same year. This is a large effect: the effect is equivalent to about one-quarter of the average action-based fiscal consolidation in the sample (in the sample, the average action-based fiscal consolidation is around 0.3 percent of GDP). I document that the estimated contemporaneous effect of GDP growth on fiscal consolidations is robust to using alternative instruments; that is, all three instruments jointly, or one instrument at a time, including additional control variables, such as lags of GDP growth and lags of fiscal consolidations, and excluding from the sample the five largest economies. In the second step, I use the residual variation in fiscal consolidations that is not due to GDP growth (i.e., the residual from the estimated Equation (1)) as an instrument for fiscal consolidations in Equation (2), where the dependent variable is GDP growth.

The remainder of the paper is organized as follows. Section 2 discusses related literature and clarifies the contribution and significance of this paper to the literature. Section 3 describes the data and estimation framework. Section 4 discusses the results. Section 5 shows that, by imposing exclusion restrictions, in a simultaneous system of equations, one can identify the effects that action-based fiscal consolidations have on GDP growth. Section 6 discusses instrumental variables' estimates of the simultaneous system of equations. Section 7 concludes the paper. The Supplementary Materials contain additional results.

2. Related Literature

For estimation of causal effects that fiscal consolidations have on GDP growth, a necessary condition is that fiscal consolidations are exogenous: contemporaneous GDP growth should have no effect on the magnitude or likelihood of a fiscal consolidation. This is the contemporaneous exogeneity condition (see, e.g., Stock and Watson (2018)). The literature is very much aware of the importance of this condition. Ramey (2016, 2019) provided an overview. One approach to identifying exogenous changes in fiscal policy, that has become increasingly popular, is the so-called narrative approach. According to the narrative approach, the researcher reads policy documents—such as budgets and central bank reports—and then, based on what is written in those documents, classifies policy changes as exogenous if there is no indication in those documents that the policy change is in response to prospective economic conditions.

Does the absence of evidence—based on what is written in the policy documents—mean that the identified fiscal consolidations are exogenous to contemporaneous GDP growth? This paper provides an answer to that question. My results are for the largest dataset, in terms of country coverage, that exists: the IMF's dataset on action-based fiscal consolidations. This is a dataset where only those fiscal consolidations are recorded which, according to the narrative record, were primarily motivated by a desire to reduce the budget deficit. The first dataset on action-based fiscal consolidations was introduced in 2011 by DeVries et al. (2011). The dataset covered 17 advanced economies during the period 1978 to 2009. The data were extended to 14 countries in Latin America and the Caribbean during the period 1989 to 2016 by David and Leigh (2018). The IMF dataset covers both tax- and expenditure-based consolidations. Importantly, only those consolidations that were implemented as announced are included in the dataset.

The IMF dataset on fiscal consolidations has been widely used in the literature to estimate the effects of fiscal consolidations on GDP growth, either as the main variable (e.g., Guajardo et al. 2014; Jordà and Taylor 2016; Cloyne et al. 2020; Carrière-Swallow et al. 2021), as a robustness check (Pappa et al. 2015), or to construct fiscal plans (Alesina et al. 2015, 2018, 2019a, 2019b). In all those papers, the identifying assumption was that contemporaneous GDP growth has no effect on action-based fiscal consolidations.

Jordà and Taylor (2016) documented that year t GDP growth, as well as other macro-variables in year t, have significant effects on the year $t + 1$ likelihood of an action-based fiscal consolidation. The finding by Jordà and Taylor (2016), that action-based fiscal consolidations are predictable by GDP growth, does not imply that action-based fiscal consolidations are contemporaneously affected by GDP growth. Contemporaneous exogeneity is distinct from predictability. This point has already been made by Alesina et al. (2015, pp. 26–27), and it is worth reiterating it here. To the best of my knowledge, I am the first to examine whether action-based fiscal consolidations fulfill the contemporaneous exogeneity condition.

Providing an answer to the question of whether action-based fiscal consolidations are exogenous to contemporaneous GDP growth requires the use of an econometric model and country-specific variables that fulfill the following two conditions. First, the variables must be exogenous to GDP growth and fiscal consolidations. The second condition is that they should have a significant effect on GDP growth. Three candidate variables that likely fulfill these two conditions are: (i) year-to-year changes in temperature, (ii) the GDP growth rate of trading partners, and (iii) an international commodity price index. Among these three variables, the one that is clearly exogenous to the annual GDP growth rate of a country is the year-to-year change in the country-specific mean temperature. The second variable is exogenous to the GDP growth of a country, if that country's GDP is only a tiny fraction of the trading partners' GDP. The third variable is exogenous to the GDP growth of a country if that country is a price-taker on the international commodity market, i.e., the country exports or imports only a small fraction of the globally traded commodity.

Controlling for country and time fixed effects, my panel model estimates show that all three of these candidate variables individually have a significant effect on GDP growth, and they also individually have a significant effect on action-based fiscal consolidations. I am not the first to document that these three variables have a significant effect on annual GDP growth. There are numerous papers that have used these variables in various contexts, where one of the outcome variables is GDP growth.[1] I chose these three variables precisely because there exists a literature that has documented a significant effect of these variables on GDP growth.

A novel empirical result of this paper is that year-to-year changes in temperature, GDP growth of trading partners, and the international commodity price index have a significant contemporaneous effect on action-based fiscal consolidations. Importantly, the signs of the estimated effects are the same for all three of these variables; that is, each of these variables has a significant positive contemporaneous effect on annual GDP growth, as well as a significant negative contemporaneous effect on action-based fiscal consolidations. Taken together, these results suggest that it is highly unlikely that action-based fiscal consolidations are exogenous to contemporaneous GDP growth.

The reduced-form results are important for several reasons. First, they imply that the identifying assumption of contemporaneous exogeneity is not satisfied in those papers that have used the IMF's action-based fiscal consolidations variable on the right-hand side in econometric models, estimated by least squares, where the dependent variable is annual GDP growth. This is obviously an important result, as there is currently a lot of focus on fiscal policy and its effects on GDP growth. Second, the findings speak to the general question of whether a narrative approach (i.e., reading policy documents to look for absence of evidence) is suitable for identifying policy changes that are exogenous to contemporaneous GDP growth.[2] The answer to that question is no, the narrative approach is not suitable for identifying fiscal consolidations that are exogenous to contemporaneous GDP growth when the motive for the fiscal consolidation is budget-deficit reduction.

To be clear, there is immense value in the narrative approach. By reading policy documents, one can identify announcements and the main motive for the fiscal consolidation. The issue with the narrative approach that I am pointing out is that it is wrong to assume that tax or government spending changes, which are made by policymakers to reduce a budget deficit, are exogenous to contemporaneous GDP growth. There are other motives for fiscal policy changes: for example, wars fought overseas (see, e.g., Ramey (2011) or Ramey and Zubairy (2018)). My paper's results are specific to fiscal policy changes motivated by budget-deficit reduction. No inference should be made from the results in my paper regarding changes in fiscal policy, identified from the narrative record, that are due to motives other than budget-deficit reduction.

The narrative approach is not the only approach that exists in the literature for identifying causal effects of fiscal consolidations—there are approaches in the fiscal policy literature that use national accounts' data on government spending and tax revenues. One important paper is that of Blanchard and Perotti (2002). Blanchard and Perotti identified their system of equations by assuming that, at a quarterly frequency, government spending is contemporaneously unaffected by GDP growth. They used an outside estimate of the output elasticity of tax revenues to construct the residual variation in tax revenues that is not due to GDP, which they then used as an instrument for tax revenues. Another approach to identifying causal effects is to use sign restrictions (see, e.g., Mountford and Uhlig (2009)).

Romer and Romer's (2010) main critique of these alternative approaches was that there are likely to be variables, which are omitted from the econometric model, that have a direct contemporaneous effect on both GDP growth and fiscal variables. Romer and Romer advocated for the narrative approach. Their assumption was that, if the narrative record indicates that a fiscal policy change was mainly motivated by a desire to reduce an inherited budget deficit, then the fiscal policy change identified from the narrative record is exogenous to contemporaneous GDP growth. According to my estimates, this assumption can be rejected at the conventional significance levels.

Action-based fiscal consolidations are fundamentally different in nature to variations in government expenditures and tax revenues that arise due to other factors, such as, for example, automatic stabilizers. Fiscal consolidations are associated with a variety of issues that have been pointed out by the political economy literature (see, e.g., Alesina et al. (1998) for an early contribution). In that regard, it is not straightforward to relate the findings in this paper to the general question of how large are fiscal multipliers? Recent empirical work has uncovered a difference in the effects of fiscal expansions and fiscal consolidations (see, e.g., Barnichon and Debortoli (2022)). The results in this paper are specific to action-based fiscal consolidations.

Two seminal theoretical macro-papers that are in line with the paper's empirical results are those of Giavazzi and Pagano (1990) and Blanchard (1990). Giavazzi and Pagano (1990) developed a model where an expenditure-based fiscal consolidation can have a positive effect on GDP growth. Blanchard (1990) showed that a positive effect on GDP growth is also possible for a tax-based fiscal consolidation.

An alternative, political economy explanation for why an action-based fiscal consolidation has a positive effect on GDP growth is as follows. Debt dynamics are determined by present-bias of policymakers (see, e.g., Yared (2019)). The larger the present-bias, the larger the distortions. If, throughout time, policymakers differ in their degree of present-bias, and their present-bias is private information, then a fiscal consolidation is a signal that the policymaker has a relatively low present-bias. Only those policymakers with a low present-bias will choose to reduce a budget deficit. The lower the present-bias, the higher the GDP growth.

3. Data and Estimation Framework for: Are Action-Based Fiscal Consolidations Exogenous?

3.1. Data

3.1.1. Action-Based Fiscal Consolidations

The data on action-based fiscal consolidation are from the International Monetary Fund (DeVries et al. 2011; David and Leigh 2018). The data were assembled by IMF economists following the narrative approach. In the working paper that accompanies the dataset, DeVries et al. (2011, pp. 3, 5) write:

> "We examine policymakers' intentions and actions as described in contemporaneous policy documents, and identify measures motivated primarily by deficit reduction. . .Following Romer and Romer (2010), we use the contemporaneous estimates contained in these sources since retrospective estimates are rarely available."

According to Repec[3], DeVries et al. (2011) have been cited in over 184 distinct research papers: more than 14 citations per year, on average, over a time span of 13 years since the release of the working paper. The number of citations suggests that many in the profession view the dataset as valuable. A database on discretionary fiscal policy aimed at consolidating the budget is extremely valuable. Such discretionary fiscal policies are different in nature to variations in the budget balance that arise due to automatic stabilizers. Discretionary fiscal policies aimed at consolidating the budget are actions taken by policymakers: tax-based consolidations are those actions by policymakers where tax rates are increased, while expenditure-based consolidations are those actions taken by policymakers that reduce government expenditures (broadly defined, i.e., purchases of goods and services, social transfers, and subsidies).

The IMF's database on action-based fiscal consolidations is the largest that exists. The data are publicly available and can be downloaded from the IMF's website. The dataset by DeVries et al. (2011) covers 17 advanced economies during 1978–2009, and the dataset by David and Leigh (2018) covers 14 Latin American and Caribbean economies during 1989–2016. In each dataset, there are three variables: the total value of the fiscal consolidation, tax-based fiscal consolidations, and expenditure-based fiscal consolidations. All three variables are expressed as a percent of a country's GDP. The data comprise only those fiscal consolidations that were implemented as announced. Fiscal consolidations that were announced and not implemented are not part of the dataset. The action-based fiscal consolidation data are annual.

3.1.2. Exogenous Variables

The data source for my baseline temperature variable was FAOSTAT (2021). As a robustness check, I also reported results for the temperature data of Dell et al. (2012). The baseline data on the trade-weighted GDP growth rate of trading partners and the international commodity price index were from Vegh and Vulletin (2015).[4] As a robustness check, I also reported results for an international commodity price index that was constructed by the IMF economists Gruss and Kebhaj (2019). Specifically, I used the index that is based on time-invariant average GDP shares of commodity net-exports. I also reported the results for the net-barter terms of trade. Data on the net-barter terms of trade were from the World Development Indicators (World Bank 2021).

3.1.3. Descriptive Statistics

Appendix A, Table A1 shows descriptive statistics for an unbalanced panel of 31 countries during 1978–2016. The table reports descriptive statistics for the largest sample for which data are available on action-based fiscal consolidations. The descriptive statistics for the other variables were computed for a sample with observations that were either equal to or slightly smaller than those for which data are available on action-based fiscal consolidations. For Ecuador, there are no data in the Vegh and Vulletin (2015) dataset on GDP growth of trading partners and the international commodity price index. For Belgium, data on GDP growth of trading partners are available from 1998 onward, and the data from FAOSTAT on the temperature change are available from 2000 onward.

3.2. Estimation Framework

To examine exogeneity of the IMF's action-based fiscal consolidation variable, I used a panel model:

$$FiscalConsolidation_{it} = \mathrm{a_i} + \mathrm{b_t} + \alpha \mathrm{Z_{it}} + \mathrm{u_{it}} \tag{1}$$

where *FiscalConsolidation* is the IMF's action-based fiscal consolidation variable in year t and country i. In the sections that follow, where I discuss estimates of the above equation, I have used fiscal consolidations as a short-hand for the IMF's action-based fiscal consolidation variable. The model includes country and year fixed effects, denoted by $\mathrm{a_i}$ and $\mathrm{b_t}$, respectively. Z are variables that are exogenous to fiscal consolidations. In Equation (1), rejecting the null hypothesis that $\alpha = 0$ means that the IMF's action-based fiscal consolidations are unlikely to be exogenous.

The choice of variables for Z was motivated by the literature, which has documented a significant effect of these variables on GDP growth. The three variables were: the year $t-1$ to t change in the mean annual temperature of country i, the year t growth rate of the GDP of trading partners of country i, and the year t international commodity price index for country i. To obtain an estimate of the average effect of these variables on GDP growth for the sample at hand, I estimated Equation (2) for the same number of observations as Equation (1):

$$GDPGrowth_{it} = \mathrm{c_i} + \mathrm{b_t} + \beta^* Z_{it} + e_{it} \tag{2}$$

Conditional on rejecting the null $\alpha = 0$ in Equation (1), if in Equation (2) one also rejects that $\beta = 0$, then it is unlikely that—in models where the dependent variable is GDP growth and the right-hand-side variable is fiscal consolidation—fiscal consolidations fulfill the contemporaneous exogeneity condition. The argument is straightforward. First, it is implausible to think that any of the variables in Z affect GDP growth because of their effect on fiscal consolidations. Second, it is plausible that these variables affect consolidations because of their effect on GDP growth: temperature changes affect GDP growth because of their effect on changes in agricultural productivity, GDP growth of trading partners affects the GDP growth of a country because it affects the demand for that country's exports, and the international commodity price index affects GDP growth of a country because it affects the country's terms of trade, which in turn affects the country's value of net-exports.[5]

4. Empirical Results for: Are Action-Based Fiscal Consolidations Exogenous?

4.1. Contemporaneous Effects of Temperature Changes

Table 1 shows that the year $t-1$ to t change of annual mean temperatures has significant contemporaneous effects on both the magnitude of fiscal consolidations and on GDP growth. For the estimates shown in Table 1, the temperature data were from FAOSTAT (2021).

Table 1. Contemporaneous effects of temperature changes on action-based fiscal consolidations and GDP growth.

	Fiscal Consolidation	**Fiscal Consolidation**	**GDP Growth**	**GDP Growth**
	(1) Whole Sample	(2) Excluding Large Economies	(3) Whole Sample	(4) Excluding Large Economies
Temperature Change, t	−0.07 **	−0.10 **	0.71 ***	0.75 ***
	(0.04)	(0.04)	(0.2)	(0.22)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	986	805	986	805
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, the United Kingdom, and the 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, and *** 1 percent level.

The first two columns of Table 1 show that temperature changes have a significant negative contemporaneous effect on the magnitude of fiscal consolidations. Specifically, in column (1) of Table 1, one can see that the estimated coefficient on temperature changes is around −0.07. The estimated coefficient has a standard error of around 0.04. Thus, one can reject the hypothesis that the coefficient is equal to zero at the 10 percent significance level (p-value 0.06). Column (2) reports estimates for the sub-sample that excludes the five largest economies. One can see that in this sub-sample, the contemporaneous effect of temperature changes on fiscal consolidations is somewhat larger in absolute. That is, in column (2), the coefficient on temperature changes is around −0.10 and has a standard error of 0.04. Therefore, one can reject the hypothesis that this coefficient is equal to zero at the 5 percent level (p-value 0.02). Quantitatively, the estimates reported in columns (1) and (2) suggest that a one standard deviation increase in the year $t-1$ to t change in temperature decreases the magnitude of a fiscal consolidation in year t by around 0.04 to 0.06 percent of GDP.

Columns (3) and (4) of Table 1 show that temperature changes have a significant positive contemporaneous effect on GDP growth in the sample in which temperature changes have a significant negative contemporaneous effect on fiscal consolidations. The country–year observations in columns (3) and (4) are the same as in columns (1) and (2), respectively. In column (3) of Table 1, one can see that the estimated coefficient on temperature changes is around 0.71. The estimated coefficient has a standard error of around 0.20. Thus, one can reject the hypothesis that the coefficient is equal to zero at the 1 percent significance level (p-value 0.00). Column (4) reports the estimated coefficient on temperatures for the sub-sample that excludes the five largest economies. One can see that in this sub-sample, the contemporaneous effect of temperature changes on GDP growth is somewhat larger in absolute. That is, in column (4), the coefficient on temperature changes is 0.75 and has a standard error of 0.22. Hence, one can reject the hypothesis that this coefficient is equal to zero at the 1 percent level (p-value 0.00). Quantitatively, the estimates reported in columns (3) and (4) suggest that a one standard deviation increase in the year $t-1$ to t change in temperature increases GDP growth in year t by around 0.4 percentage points.

4.2. Contemporaneous Effects of GDP Growth of Trading Partners

Table 2 shows that the GDP growth rate of trading partners has significant contemporaneous effects on both the magnitude of fiscal consolidations and on GDP growth. The first two columns of Table 2 show that the GDP growth rate of trading partners has a significant negative contemporaneous effect on the magnitude of fiscal consolidations. Specifically, in column (1) of Table 2, one can see that the estimated coefficient on GDP growth of trading partners is around −0.25. The estimated coefficient has a standard error of around 0.08. Therefore, one can reject the hypothesis that the coefficient is equal to zero at the 1 percent significance level (p-value 0.01). Column (2) shows that the estimated coefficient on GDP growth of trading partners is similar for the sub-sample that excludes the five largest economies. One can see in column (2) that the coefficient on GDP growth of trading partners is around −0.25 and has a standard error of 0.09. Thus, one can reject the hypothesis that this estimated coefficient is equal to zero at the 1 percent level (p-value 0.01). Quantitatively, the estimates reported in columns (1) and (2) suggest that a one standard deviation increase in GDP growth of trading partners in year t decreases the magnitude of a fiscal consolidation in year t by around 0.13 percent of GDP.

Table 2. Contemporaneous effects of GDP growth of trading partners on action-based fiscal consolidations and GDP growth.

	Fiscal Consolidation	**Fiscal Consolidation**	**GDP Growth**	**GDP Growth**
	(1) Whole Sample	(2) Excluding Large Economies	(3) Whole Sample	(4) Excluding Large Economies
GDP Growth of Trading Partners, t	−0.25 ***	−0.25 ***	2.65 ***	2.61 ***
	(0.08)	(0.09)	(0.45)	(0.46)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	913	733	913	733
Countries	30	25	30	25

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, the United Kingdom, and the 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, and *** 1 percent level.

Columns (3) and (4) of Table 2 show that GDP growth of trading partners has a significant positive contemporaneous effect on GDP growth in the sample in which GDP growth of trading partners has a significant negative contemporaneous effect on fiscal consolidations. The country–year observations in columns (3) and (4) are the same as those in columns (1) and (2), respectively. In column (3) of Table 2, one can see that the estimated coefficient on GDP growth of trading partners is around 2.65. The estimated coefficient has a standard error of around 0.45. Thus, one can reject the hypothesis that the coefficient is equal to zero at the 1 percent significance level (p-value 0.00). Column (4) reports the estimated coefficient on GDP growth of trading partners for the sub-sample that excludes the five largest economies. The estimated coefficient is 2.61 and has a standard error of 0.46. Therefore, one can reject the hypothesis that this coefficient is equal to zero at the 1 percent level (p-value 0.00). Quantitatively, the estimates reported in columns (3) and (4) suggest that a one standard deviation increase in the GDP growth of trading partners in year t increases GDP growth in year t by around 1.4 percentage points.

4.3. Contemporaneous Effects of an International Commodity Price Index

Table 3 shows that a country-specific international commodity price index has significant contemporaneous effects on both the magnitude of fiscal consolidations and on GDP growth. For the estimates shown in Table 3, the country-specific international commodity price index is from Vegh and Vulletin (2015).

Table 3. Contemporaneous effects of an international commodity price index on action-based fiscal consolidations and GDP growth.

	Fiscal Consolidation	**Fiscal Consolidation**	**GDP Growth**	**GDP Growth**
	(1)	(2)	(3)	(4)
	Whole Sample	Excluding Large Economies	Whole Sample	Excluding Large Economies
Commodity Price	−0.02 **	−0.02 **	0.20 ***	0.18 ***
Index, t	(0.01)	(0.01)	(0.06)	(0.07)
Country Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	908	728	908	728
Countries	30	25	30	25

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, the United Kingdom, and the 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, and *** 1 percent level.

The first two columns of Table 3 show that the commodity price index has a significant negative contemporaneous effect on the magnitude of fiscal consolidations. Specifically, in column (1) of Table 1, the estimated coefficient on the commodity price index is −0.017. The estimated coefficient has a standard error of 0.007. Thus, one can reject the hypothesis that this coefficient is equal to zero at the 5 percent significance level (p-value 0.03). Column (2) reports estimates for the sub-sample that excludes the five largest economies. In this sub-sample, the contemporaneous effect of the commodity price index is slightly larger in absolute. That is, in column (2), the coefficient on the commodity price index is around −0.018 and has a standard error of 0.008. Therefore, one can reject the hypothesis that this estimated coefficient is equal to zero at the 5 percent level (p-value 0.04). Quantitatively, the estimates reported in columns (1) and (2) suggest that a one standard deviation increase in the commodity price index in year t decreases the magnitude of a fiscal consolidation in year t by around 0.10 percent of GDP.

Columns (3) and (4) of Table 3 show that the commodity price index has a significant positive contemporaneous effect on GDP growth in the sample in which the commodity price index has a significant negative contemporaneous effect on fiscal consolidations. The number of observations in columns (3) and (4) are the same as in columns (1) and (2), respectively. In column (3) of Table 3, one can see that the estimated coefficient on the commodity price index is around 0.20. The estimated coefficient has a standard error of around 0.06. Thus, one can reject the hypothesis that the estimated coefficient is equal to zero at the 1 percent significance level (p-value 0.01). Column (4) reports the estimated coefficient for the sub-sample that excludes the five largest economies. In this sub-sample, the coefficient on the commodity price index is 0.18 and has a standard error of 0.06. Therefore, one can reject the hypothesis that this coefficient is equal to zero at the 1 percent level (p-value 0.01). Quantitatively, the estimates reported in columns (3) and (4) suggest that a one standard deviation increase in the commodity price index in year t increases GDP growth in year t by around 1 percentage point.

5. Estimation Framework: Identification of a Simultaneous System of Two Equations

Consider the simplest possible simultaneous system of two equations:

(1) $FiscalConsolidation = \alpha GDPGrowth + u$,

(2) $GDPGrowth = \beta^{*} FiscalConsolidation + e$,

where I have dropped subscripts to keep the notation as simple as possible. In the spirit of the Frisch–Waugh–Lovell theorem, one can think of the above variables as the residuals obtained from separate regressions of GDP growth and fiscal consolidations on a set of control variables, such as country and time fixed effects, past GDP growth, and past fiscal consolidations.

Under the assumption that cov(u,e) = 0, the least squares estimate of β in Equation (2) is:

(I) $\beta^{LS} = \beta + cov(FiscalConsolidation,u) = \beta + \alpha(1 - \alpha\ \beta)^{-1}\sigma^2(e)/\sigma^2(F)$,

where $\sigma^2(e)$ is the variance of the error term e and $\sigma^2(F)$ is the variance of fiscal consolidations. Hence, only if α is equal to zero does the least squares estimation of Equation (2) yield a consistent estimate of β.

To identify the simultaneous system of two equations, I need at least one variable, denoted here by Z, that satisfies the following conditions: (i) Z is exogenous to GDP growth and fiscal consolidations, (ii) Z affects GDP growth, and (iii) Z affects fiscal consolidations through its effect on GDP growth:

(2′) $GDPGrowth = \beta^{*} FiscalConsolidation + \varphi Z + e'$

Under conditions (i)–(iii), Z can be used as an instrument for GDP growth to obtain a consistent estimate of α in Equation (1).

Note that from Equations (1) and (2′), it follows that the reduced-form effect of Z on fiscal consolidations is $\alpha\varphi$. Conditional on GDP growth, the effect of Z on fiscal consolidations is 0. That is, Z only affects fiscal consolidations through GDP growth. There is no direct effect of Z on fiscal consolidations.

Based on previous literature, I have used three variables as candidates for Z: temperature changes, the trade-weighted GDP growth rate of trading partners, and an international commodity price index. In the context of estimating the effects of annual GDP growth on fiscal variables, there are a number of papers that have used these variables as instruments for GDP growth. However, in none of those papers was the outcome variable the IMF's action-based fiscal consolidations variable. Brueckner (2012) used an international commodity price index as an instrument for GDP growth to estimate the elasticity response of tax revenues to GDP growth for a panel of 33 Sub-Saharan African countries during the period 1980–2000. Brueckner et al. (2012) used an international oil price index as an instrument for GDP growth to estimate the contemporaneous elasticity response of government spending to GDP growth. Vegh and Vulletin (2015) used the GDP growth rate of trading partners and an international commodity price index as instruments for GDP growth when estimating the contemporaneous effect of GDP growth on tax rates, and their panel consisted of 62 countries during the period 1960–2013. In all the above papers, the assumption was that the commodity price index and GDP growth of trading partners only affect fiscal variables through their effect on GDP growth.

Once an estimate of α is obtained (from an instrumental variables' regression, where GDP growth is instrumented by Z), the next step is to construct the residual variation in fiscal consolidations that is not due to GDP growth, i.e., $u_{res} = FiscalConsolidation - \alpha^{hat,IV} GDPGrowth$. Then, u_{res} is used as an instrument for fiscal consolidations in Equation (2). This yields the following instrumental variables' estimator:

(II)
$$\begin{aligned}
\beta^{IV} &= cov(u_{res},GDPGrowth)/cov(u_{res},FiscalConsolidation) \\
&= \beta + cov(u_{res},e)/cov(u_{res},FiscalConsolidation) \\
&= \beta + cov(u,e)/cov(u,FiscalConsolidation) \\
&= \beta
\end{aligned}$$

where line three demonstrates that $\alpha^{hat,IV} = \alpha$, and hence u_{res} = u. The last line follows from the assumption that cov(u,e) = 0. This is the same assumption that I made to derive the OLS estimator in Equation (I).

Note that this instrumental variables strategy to identify a simultaneous system of two equations yields consistent estimates if one has at least one valid instrument, Z. One cannot identify the simultaneous system of equations by using least squares estimation of Equation (1), computing the residual, and then using that residual as an instrument in Equation (2). The reason why this will yield inconsistent estimates of β is that $\alpha^{hat,LS} \neq \alpha$, from which it follows that $u'_{res} = FiscalConsolidation - \alpha^{hat,LS} GDPGrowth \neq u$, and thus $cov(u'_{res}, e) \neq 0$.

6. Instrumental Variables' Estimates of the Simultaneous System of Equations

6.1. The Contemporaneous Effect of GDP Growth on Fiscal Consolidations

6.1.1. Overidentified Model

Table 4 reports two-stage least squares estimates of the contemporaneous effect that GDP growth has on the magnitude of fiscal consolidations. The models in Table 4 are overidentified: there is one endogenous variable—GDP growth, and three instruments, namely, temperature changes, the GDP growth rate of trading partners, and the international commodity price index. The top panel of Table 4 reports the second-stage estimates (the effect that GDP growth in year *t* has on the magnitude of fiscal consolidations in year *t*), while the bottom panel reports the first-stage estimates (of the effect that the instruments have on GDP growth).

The main message of the IV estimates reported in Table 4 is that contemporaneous GDP growth has a significant negative effect on the magnitude of fiscal consolidations. Column (1) of Table 4 reports estimates for the largest sample considering the available data. In that column, the estimated coefficient on year *t* GDP growth is −0.07 and has a standard error of 0.02. Thus, one can reject the hypothesis that the coefficient is equal to zero at the 1 percent significance level (*p*-value 0.003). The Anderson–Rubin test rejects that the coefficient on GDP growth in column (1) is equal to zero at the 5 percent level (*p*-value 0.031). Quantitatively, the estimated coefficient of −0.07 suggests that, on average, a one percentage point increase in annual GDP growth in year *t* decreases the magnitude of a fiscal consolidation by around 0.07 percent of GDP.

Standard test diagnostics suggest that the 2SLS estimates are based on instruments that are relevant and valid. The Kleibergen–Paap F-stat and Cragg–Donald F-stat for the hypothesis that the first-stage effects of the three instruments are jointly equal to zero is 17.0 and 19.7, respectively. The *p*-value of the Hansen J test, showing that the three instruments are jointly uncorrelated with the second-stage error term, is 0.99.

Column (2) of Table 4 reports two-stage least squares estimates for the sub-sample that excludes the five largest economies. Excluding the five largest economies led to a slightly larger negative effect of GDP growth on fiscal consolidations. In column (2), the coefficient on GDP growth is −0.08 and has a standard error of 0.03. Therefore, one can reject the hypothesis that the coefficient in column (2) is equal to zero at the 1 percent significance level (*p*-value 0.002). The Anderson–Rubin test rejects that the coefficient on GDP growth in column (2) is equal to zero at the 5 percent level (*p*-value 0.037).

Contemporaneous GDP growth has a significant negative effect on both tax- and expenditure-based fiscal consolidations. This can be seen from the estimates in columns (3)–(6) of Table 4. Contemporaneous GDP growth has a somewhat larger negative effect on tax-based consolidations than on expenditure-based consolidations. A one percentage point increase in year *t* GDP growth reduces the magnitude of a tax-based fiscal consolidation by around 0.05 percent of GDP. That is, for the purpose of consolidating the budget, tax rates must increase when GDP growth decreases. For an expenditure-based consolidation, this effect amounts to around 0.03 percent of GDP. That is, for the purpose of consolidating the budget, discretionary government expenditures must decrease when GDP growth decreases.

Table 4. Contemporaneous effects of GDP growth on action-based fiscal consolidations.

	Fiscal Consolidation (Tax and Expenditure)	**Fiscal Consolidation (Tax and Expenditure)**	**Fiscal Consolidation (Tax)**	**Fiscal Consolidation (Tax)**	**Fiscal Consolidation (Expenditure)**	**Fiscal Consolidation (Expenditure)**
	(1) Whole Sample	(2) Excluding Large Economies	(3) Whole Sample	(4) Excluding Large Economies	(5) Whole Sample	(6) Excluding Large Economies
GDP Growth, *t*	−0.07 **	−0.08 ***	−0.05 **	−0.05 **	−0.03 **	−0.03 *
	(0.02)	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)
Cragg–Donald F-Stat	19.7	13.9	19.7	13.9	19.7	13.9
Kleibergen–Paap F-Stat	17	13.7	17	13.7	17	13.7
Hansen J, *p*-value	0.99	0.75	0.87	0.79	0.63	0.37
			First-Stage Estimates for GDP Growth, *t*			
GDP Growth of Trading Partners, *t*	2.21 ***	2.13 ***	2.21 ***	2.13 ***	2.21 ***	2.13 ***
	(0.51)	(0.52)	(0.51)	(0.52)	(0.51)	(0.52)
Commodity Price Index, *t*	0.17 **	0.14 *	0.17 **	0.14 *	0.17 **	0.14 *
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Temperature Change, *t*	0.71 ***	0.71 ***	0.71 ***	0.71 ***	0.71 ***	0.71 ***
	(0.22)	(0.26)	(0.22)	(0.26)	(0.22)	(0.26)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	850	670	850	670	850	670
Countries	29	24	29	24	29	24

Note: The method of estimation is two-stage least squares. Huber robust standard errors (shown in parentheses) are clustered at the country level. Columns (1), (3), and (5) show estimates for the whole sample. Columns (2), (4), and (6) show estimates for the sub-sample that excludes France, Germany, Japan, the United Kingdom, and the United States. * Significantly different from zero at the 10 percent level, ** 5 percent level, and *** 1 percent level.

6.1.2. Just-Identified Model

Instrumental variables' estimation provides a local average treatment effect. The question arises, then, whether the finding in the previous section, which was obtained from an overidentified model, is due to the nature of any one of the three instruments. To provide an answer to that question, Table 5 reports estimates of just-identified models. In these models, the dependent variable is the magnitude of fiscal consolidations in year t, and the endogenous right-hand-side variable is GDP growth in year t.

Table 5. Contemporaneous effects of GDP growth on action-based fiscal consolidations (two-stage least squares with one instrument for GDP growth).

	Fiscal Consolidation					
	(1) Whole Sample	(2) Excluding Large Economies	(3) Whole Sample	(4) Excluding Large Economies	(5) Whole Sample	(6) Excluding Large Economies
GDP Growth, t	−0.09 ***	−0.10 ***	−0.08 **	−0.10 **	−0.10 *	−0.14 **
	(0.03)	(0.03)	(0.04)	(0.05)	(0.05)	(0.06)
Cragg–Donald F-Stat	48.8	13.7	27.9	13.7	8.7	7
Kleibergen–Paap F-Stat	33.65	13.9	9.1	13.9	12.9	11.1
	First-Stage Estimates for GDP Growth, t					
GDP Growth of Trading Partners, t	2.65 ***	2.61 ***				
	(0.45)	(0.45)				
Commodity Price Index, t			0.20 ***	0.18 ***		
			(0.07)	(0.07)		
Temperature Change, t					0.71 ***	0.75 ***
					(0.19)	(0.22)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	913	733	908	728	990	670
Countries	30	24	30	25	31	24

Note: The dependent variable is *Fiscal Consolidation* in year t. The method of estimation is two-stage least squares. Huber robust standard errors (shown in parentheses) are clustered at the country level. Columns (1), (3), and (5) show estimates for the whole sample. Columns (2), (4), and (6) show estimates for the sub-sample that excludes France, Germany, Japan, the United Kingdom, and the United States. * Significantly different from zero at the 10 percent level, ** 5 percent level, and *** 1 percent level.

The estimated models in Table 5 are just-identified models: there is one instrument for one endogenous variable, GDP growth. Specifically, in columns (1) and (2) of Table 5, the instrument for GDP growth in year t is the GDP growth rate of trading partners in year t. In columns (3) and (4), the instrument for year t GDP growth is the year t international commodity price index. In columns (5) and (6), the instrument for year t GDP growth is the year $t-1$ to t change in temperature change. Columns (1), (3), and (5) show results for the largest sample, and columns (2), (4), and (6) show results for the sample that excludes the five largest economies. The top panel of Table 5 reports the estimated second-stage coefficient on GDP growth. The bottom panel reports the first-stage effect that the instrument has on GDP growth.

From the top panel of Table 5, one can see that the second-stage estimates on GDP growth in the just-identified 2SLS regressions are similar—both quantitatively and statistically—across the three different instruments. In column (1), where the excluded instrument is the GDP growth rate of trading partners, the estimated coefficient on year t GDP growth is −0.09 and has a standard error of 0.03. In column (3), where the excluded instrument is the international commodity price index, the estimated coefficient on year t GDP growth is −0.08 and has a standard error of 0.04. When the instrument is the temperature change (see column (5)), the estimated coefficient on year t GDP growth is −0.10 and has a standard error of 0.05. Repeating the same regressions for the sub-sample that excludes the five largest economies yields estimated coefficients on GDP growth of −0.10, −0.10, and −0.14, respectively (see columns (2), (4), and (6)).

The similarity of the estimated coefficients on GDP growth in the just-identified models, as shown in Table 5, suggests that the estimates of the overidentified models, as shown in Table 4, are not driven by a particular instrument. If it were the case that a negative effect of GDP growth on fiscal consolidations is due to the nature of any one of the three instruments, then one would see very different estimates on GDP growth in just-identified models depending on what instrument was used. Table 5 demonstrates that this is not the case.

6.1.3. Tests for Direct Effects of the Instruments on Fiscal Consolidations

There are exclusion restrictions underlying the instrumental variables' regressions, namely, that the instruments only affect fiscal consolidations through GDP growth. Tables 1–3 showed that there are significant negative reduced-form effects of each instrument on fiscal consolidations. The exclusion restriction of no direct effect means that conditional on GDP growth, temperature changes, GDP growth of trading partners, and the international commodity price index have no effect on fiscal consolidations. Testing this requires at least one instrument for GDP growth that is relevant (i.e., has a significant effect on GDP growth), exogenous to GDP growth and fiscal consolidations, and only affects fiscal consolidations through GDP growth. Tests of direct effects of the instruments can only be made conditional on the assumption that a sub-set of the instruments are relevant and valid.

Table 6 shows that GDP growth of trading partners, the international commodity price index, and temperature changes have no significant direct effects on fiscal consolidations. This is the case for the largest sample (columns (1)–(3)) and the sub-sample that excludes the five largest economies (columns (4)–(6)). Conditional on GDP growth, the estimated effects that GDP growth of trading partners, the international commodity price index, and temperature changes have on fiscal consolidations are quantitatively small and are not significantly different from zero at the conventional significance levels.

Table 6. Contemporaneous effects of GDP growth on action-based fiscal consolidations (examination of the exclusion restrictions).

	Fiscal Consolidation					
	(1)	(2)	(3)	(4)	(5)	(6)
	Whole Sample			Excluding Large Economies		
GDP Growth, *t*	−0.08 ***	−0.09 *	−0.07 **	−0.08 **	−0.11 **	−0.07 **
	(0.02)	(0.05)	(0.03)	(0.02)	(0.06)	(0.03)
Temperature Change, *t*	0.01			−0.01		
	(0.04)			(0.04)		
GDP Growth of Trading Partners, *t*		0.04			0.1	
		(0.17)			(0.2)	
Commodity Price Index, *t*			−0.00			−0.01
			(0.01)			(0.01)
Hansen J, *p*-value	0.73	0.68	0.98	0.61	0.86	0.61
Cragg–Donald F-Stat	29.3	11.1	21.7	20.9	7.3	17
Kleibergen–Paap F-Stat	16.1	10.4	23	14	7.4	21
	First-Stage Estimates for GDP Growth					
Temperature Change, *t*		0.73 ***	0.73 ***		0.74 ***	0.74 ***
		(0.21)	(0.21)		(0.25)	(0.25)
GDP Growth of Trading Partners, *t*	2.28 ***		2.28 ***	2.25 ***		2.25 ***
	(0.47)		(0.47)	(0.49)		(0.49)
Commodity Price Index, *t*	0.16 ***	0.16 **		0.13 *	0.13 *	
	(0.07)	(0.07)		(0.07)	(0.07)	
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	882	882	882	702	702	702
Countries	30	30	30	25	25	25

Note: The dependent variable is *Fiscal Consolidation* in year *t*. The method of estimation is two-stage least squares. Huber robust standard errors (shown in parentheses) are 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, the United Kingdom, and the United States. * Significantly different from zero at the 10 percent level, ** 5 percent level, and *** 1 percent level.

Consider the estimates shown in column (1) of Table 6. In that column, one can see that (i) the coefficient on year t GDP growth is -0.08 and has a standard error of 0.02, and (ii) the coefficient on the year $t-1$ to t temperature change is 0.01 and has a standard error of 0.04. While one can reject the null hypothesis that the coefficient on GDP growth is equal to zero at the 1 percent level (p-value 0.00), one cannot reject the null hypothesis that the coefficient on temperature changes is equal to zero at the conventional significance levels (p-value 0.85). Note that in column (1) of Table 6, GDP growth is instrumented with the GDP growth rate of trading partners and the international commodity price index, both variables from Vegh and Vulletin (2015). For comparison purposes, recall that in the reduced form, the coefficient on temperature changes is -0.07 and has a standard error of 0.04 (see column (1) of Table 1). In terms of the size of these coefficients, the estimated reduced-form effect is about seven times larger than the direct effect. In terms of standard errors, these are about the same for the estimated reduced-form and the estimated direct effect. Not rejecting the null of zero direct effect of temperature changes on fiscal consolidations is thus due to a small coefficient, and not due to a large standard error.

In column (2) of Table 6, one can see that (i) the coefficient on GDP growth is -0.09 and has a standard error of 0.05, and (ii) the coefficient on GDP growth of trading partners is 0.04 and has a standard error of 0.17. While one can reject the null hypothesis that the coefficient on GDP growth is equal to zero at the 10 percent level (p-value 0.07), one cannot reject the null hypothesis that the coefficient on GDP growth of trading partners is equal to zero at the conventional significance levels (p-value 0.81). In column (2) of Table 6, the instruments for GDP growth are temperature changes and the international commodity price index. For comparison purposes, recall that in reduced form, the coefficient on GDP growth of trading partners is -0.25 and has a standard error of 0.08 (see column (1) of Table 1). In terms of the size of the coefficients, in absolute value, the reduced-form effect is about six times larger than the direct effect. In terms of standard errors, the standard error on the estimated direct effect is about twice as large as the reduced-form effect. Not rejecting the null hypothesis of a zero direct effect of GDP growth of trading partners on fiscal consolidations is thus mostly due to a smaller estimated coefficient, and not so much to a larger standard error.

Column (3) of Table 6 shows that (i) the coefficient on GDP growth is -0.07 and has a standard error of 0.03, and (ii) the coefficient on the international commodity price index is -0.005 and has a standard error of 0.012. While one can reject the null hypothesis that the coefficient on GDP growth is equal to zero at the 5 percent level (p-value 0.02), one cannot reject the null hypothesis that the coefficient on the international commodity price index is zero at the conventional significance levels (p-value 0.69). In column (3) of Table 6, the instruments for GDP growth are temperature changes and the GDP growth rate of trading partners. For comparison, in the reduced form, the estimated coefficient on GDP growth of trading partners is -0.017 and has a standard error of 0.007 (see column (1) of Table 3). In terms of the size of the estimated coefficients, in absolute value, the reduced-form effect is about three times larger than the direct effect. In terms of standard errors, the standard error on the estimated direct effect is about twice as large as the reduced-form effect. Not rejecting the null hypothesis of a zero direct effect of international commodity prices on fiscal consolidations is thus mostly due to a smaller estimated coefficient, and not so much to a larger standard error.

6.1.4. A Dynamic Simultaneous System of Equations

The dynamic version of the simultaneous system of two equations is:

(1) $FiscalConsolidation_{it} = a_i + b_t + \alpha GDPGrowth_{it} + \Gamma_1 X_{it-1} + \Gamma_2 X_{it-2} + u_{it}$

(2) $GDPGrowth_{it} = c_i + d_t + \beta FiscalConsolidation_{it} + \Pi_1 X_{it-1} + \Pi_1 X_{it-2} + \Theta Z_{it} + e_{it}$

where subscript i refers to country i and t refers to year t. In the above system, X_{it-1} and X_{it-2} are vectors that include GDP growth and fiscal consolidations in years $t-1$ and $t-2$, respectively. Z are the same instrumental variables for GDP growth as in Section 6.1.1.

The main purpose of writing out a dynamic version of the simultaneous system of two equations is to facilitate comparison to the literature that has estimated dynamic effects of fiscal consolidations on GDP growth. I have provided estimates using local projection methods. Local projection methods are widely used in the empirical macro-literature. A recent paper by Plagborg-Møller and Wolf (2021) showed that local projections and VARs estimate the same impulse responses. Montiel and Plagborg-Møller (2021) showed that lag-augmented local projections yield standard errors that are asymptotically valid.

In this section, I only discuss estimates of the contemporaneous effect that GDP growth in year t has on fiscal consolidation in year t. From now on, I refer to these estimates as the contemporaneous effect of GDP growth on fiscal consolidations over a horizon of one year. In the next section, I will discuss estimates over horizons that exceed one year, e.g., two and three years.

The dynamics in the model above follow an autoregressive process of order 2. I have specified the dynamics of the model as such in order to facilitate comparison to previous literature, i.e., Guajardo et al. (2014) and Carrière-Swallow et al. (2021), where Equation (2) is specified as an AR(2) model. To examine the sensitivity of the results to lag selection, I also report estimates from a more parsimonious AR(1) model.

Including X_{it-1} and X_{it-2} as controls means that the estimated coefficients β and α are the effects of "shocks". Throughout their papers, Guajardo et al. (2014) and Carrière-Swallow et al. (2021) used the term "fiscal consolidation shocks". The term fiscal consolidation shock simply means that the innovation in the fiscal consolidation variable in year t is not forecastable by past events. As such, a fiscal consolidation shock is not necessarily exogenous to contemporaneous GDP growth, although that was the assumption made in previous literature that estimated the effects of fiscal consolidations on GDP growth using the IMF's data on action-based fiscal consolidations. That is, literature that used the IMF's fiscal consolidation variable estimated Equation (2) by OLS, assuming that, in Equation (1), $\alpha = 0$. If in the dynamic model specified above $\alpha \neq 0$, then OLS of Equation (2) yields an inconsistent estimate of β. If $\alpha < 0$, then $\beta^{OLS} < \beta$.

Table 7 reports instrumental variables' estimates of α. These estimates are obtained by two-stage least squares estimations of the dynamic panel models. Column (1) of Table 7 reports estimates for Equation (1), exactly as specified in this section. The estimates reported in column (1) are for the largest sample in the available data. One can see that the estimated coefficient on year t GDP growth is −0.08, with a standard error of 0.03. Thus, one can reject the null hypotheses that the coefficient is equal to zero at the 1 percent significance level (p-value 0.004).

Table 7. Contemporaneous effects of GDP growth on action-based fiscal consolidations (dynamic model).

	Fiscal Consolidation					
	(1)	(2)	(3)	(4)	(5)	(6)
		Whole Sample			Excluding Large Economies	
GDP Growth, t	−0.08 ***	−0.07 ***	−0.07 ***	−0.09 ***	−0.08 ***	−0.08 ***
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
CONTROL VARIABLES						
Fiscal Consolidations, $t-1$	0.40 ***	0.40 ***	0.40 ***	0.40 ***	0.41 ***	0.41 ***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Fiscal Consolidations, $t-2$	−0.00	0.01		−0.00	0.01	
	(0.07)	(0.06)		(0.07)	(0.07)	
GDP Growth, $t-1$	0.02			0.02		
	(0.01)			(0.01)		
GDP Growth, $t-2$	−0.02 **			−0.02 **		
	(0.01)			(0.01)		
Hansen J, p-value	0.97	0.99	0.98	0.89	0.72	0.83
Cragg–Donald F-Stat	13	20.4	22	9.4	14.7	15.5
Kleibergen–Paap F-Stat	14	13.7	13.8	12.6	12.4	12.1

Table 7. *Cont.*

	Fiscal Consolidation					
	First-Stage Estimates for GDP Growth, t					
Temperature Change	0.60 ***	0.60 ***	0.58 ***	0.63 ***	0.60 ***	0.59 **
	(0.2)	(0.21)	(0.21)	(0.24)	(0.26)	(0.26)
GDP Growth of Trading Partners	1.64 ***	2.16 ***	2.04 ***	1.61 ***	2.14 ***	1.99 ***
	(0.37)	(0.49)	(0.49)	(0.38)	(0.51)	(0.51)
Commodity Price Index	0.14 **	0.20 ***	0.22 ***	0.13 *	0.18 **	0.20 ***
	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)	(0.06)
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 two-stage least squares. Huber robust standard errors (shown in parentheses) are 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, the United Kingdom, and the United States. * Significantly different from zero at the 10 percent level, ** 5 percent level, and *** 1 percent level.

The IV estimate on year t GDP growth that is obtained from the dynamic model is similar to the static model (see Table 4 for comparison). There are fewer observations in Table 7 than in Table 4 because including lags of fiscal consolidations means that the first and second initial observations are lost. Re-estimating the static model on the same number of observations as in column (1) of Table 7 yields a coefficient on year t GDP growth of -0.07 and a standard error of 0.02.

Concerning the estimated coefficients on the control variables, column (1) of Table 7 shows that the coefficient on year $t-1$ fiscal consolidations is positive and significantly different from zero. The coefficient on year $t-2$ fiscal consolidations is quantitatively small and not significantly different from zero at the conventional significance levels. The coefficient on year $t-1$ GDP growth is positive and not significantly different from zero, while the coefficient on year $t-2$ GDP growth is negative and significantly different from zero at the 5 percent level.

Column (2) of Table 7 shows estimates of the dynamic model, but without including GDP growth in years $t-1$ and $t-2$ as controls. Comparing column (2) to column (1), one can see that including lags of GDP growth has negligible effects on the estimated effect of year t GDP growth on fiscal consolidations. In column (2), the coefficient on year t GDP growth is -0.07 and has a standard error of 0.02.

Column (3) of Table 7 reports estimates of a more parsimonious model that only includes the first lag of fiscal consolidations as a control variable. The dynamic model in column (3) is an AR(1) model. The motivation for reporting estimates of a more parsimonious model in column (3) is that from columns (1) and (2), one can see that only the coefficient on $t-1$ fiscal consolidations is significantly different from zero—the coefficient on $t-2$ fiscal consolidations is not significantly different from zero. In column (3), the coefficient on $t-1$ fiscal consolidations is 0.40 and has a standard error of 0.05. Column (3) also shows that the estimated coefficient on GDP growth in year t is negative and significantly different from zero at the conventional significance levels. In column (3), the coefficient on GDP growth in year t is -0.07 and has a standard error of 0.02.

Comparing columns (1)–(3), one can see that the coefficient on GDP growth in year t is quantitatively similar in size across the different model specifications. This is also the case when re-estimating these models for the sub-sample that excludes the five largest economies (see columns (4)–(6)).

The instrumental variables' estimates in Table 7 are of high quality. Each instrument individually has a significant effect on GDP growth in year t. The Kleibergen–Paap F-statistic is above 10 in all specifications. According to the Hansen J test, one cannot reject, at the conventional significance levels, the null hypothesis that the instruments are uncorrelated with the second-stage error term.

6.1.5. Integral Multipliers

The fiscal policy literature has computed so-called "integral multipliers" (see, e.g., Ramey (2016)). The dynamic simultaneous equations model for integral multipliers is:

(1) $FiscalConsolidation(h)_{it} = a_i + b_t + \alpha^h GDPGrowth(h)_{it} + \Gamma_1 X_{it-1} + \Gamma_2 X_{it-2} + u_{it}$

(2) $GDPGrowth(h)_{it} = c_i + d_t + \beta^h FiscalConsolidation(h)_{it} + \Pi_1 X_{it-1} + \Pi_1 X_{it-2} + \Theta Z(h)_{it} + e_{it}$

where $GDPgrowth(h)_{it}$ is defined as the change in the log of GDP between years $t + h$ and $t - 1$, i.e., $\log\text{GDP}_{\text{it+h}} - \log\text{GDP}_{\text{it}-1}$, and $FiscalConsolidation(h)_{it}$ is the sum of fiscal consolidations between years $t + h$ and t. X_{it-1} and X_{it-2} are vectors that include GDP growth and fiscal consolidations in years $t - 1$ and $t - 2$, respectively. $Z(h)_{it}$ is a vector that includes the sum of each instrument between years t + h and $t - 1$. The coefficient α^h is the cumulative effect of GDP growth over h years on the sum of fiscal consolidations over h years. The cumulative effect of the sum of fiscal consolidations over h years on GDP growth over h years is β^h.

For each horizon h, I identified Equation (1) by using $Z(h)$ as instruments for $GDPgrowth(h)$. The instruments are temperature changes, GDP growth of trading partners, and the international commodity price index, computed at the relevant horizon. In the instrumental variables' regressions of the effect that $GDPgrowth(h)$ has on $FiscalConsolidation(h)$, I computed $Z(h)$ for horizon h as the sum of each instrument between t and $t + h$. I reported instrumental variables' estimates for h = 0, 1, 2 (note that the time unit is years). This is the same number of horizons as in Carrière-Swallow et al. (2021).

Table 8 shows that α^h is negative for all horizons: h = 0, 1, 2. Column (1) of Table 8 shows the effect of GDP growth on fiscal consolidations for h = 0 (note that this is just a replication of column (1) of Table 7). Column (2) shows the effect of GDP growth on fiscal consolidations for h = 1, and column (3) shows the effect for h = 2. Thus, one can reject the null hypothesis that the coefficient on $GDPgrowth(h)$ is equal to zero at the 1 percent significance level for h = 0, 1, and 2.

Quantitatively, the effects of GDP growth over horizon h on the sum of fiscal consolidations over horizon h are similar in size for h = 0, 1, and 2. In columns (1)–(3) of Table 8, the coefficients on $GDPgrowth(h)$ are −0.08, −0.07, and −0.07 for h = 0, 1, and 2, respectively. The interpretation of these estimated coefficients is as follows:

i. For h = 0, a one standard deviation (equivalent to 4.2) increase in contemporaneous GDP growth over a horizon of one year reduces the magnitude of a fiscal consolidation over a horizon of one year by about 0.3 percent of GDP. This is equivalent to about 0.5 standard deviations.
ii. For h = 1, a one standard deviation (equivalent to 7.2) increase in contemporaneous GDP growth over a horizon of two years reduces the magnitude of a fiscal consolidation over a horizon of two years by 0.5 percent of GDP. This is equivalent to about 0.4 standard deviations.
iii. For h = 2, a one standard deviation (equivalent to 9.5) increase in contemporaneous GDP growth over a horizon of three years reduces the magnitude of a fiscal consolidation over a horizon of three years by 0.7 percent of GDP. This is equivalent to about 0.5 standard deviations.

Results are similar for the sub-sample that excludes the five largest economies (see columns (4)–(6) of Table 8). For the sub-sample that excludes the five largest economies, the estimated coefficients on $GDPgrowth(h)$ are −0.09, −0.06, and −0.06 for h = 0, 1, and 2, respectively. For each of these estimated coefficients, one can reject the null hypothesis that the coefficient is equal to zero at the 1 percent significance level.

The instrumental variables' estimates in Table 8 are of high quality. Each instrument individually has a significant effect on $GDP\ growth(h)$ for h = 0, 1, and 2. The Kleibergen–Paap F-statistic is above 10 in all specifications. According to the Hansen J test, one cannot reject, at the conventional significance levels, the hypothesis that the instruments are uncorrelated with the second-stage error term.

Table 8. Contemporaneous effects of GDP growth on action-based fiscal consolidations (at different time horizons).

	Fiscal Consolidation (h)					
	(1) $h = 0$	(2) $h = 1$	(3) $h = 2$	(4) $h = 0$	(5) $h = 1$	(6) $h = 2$
		Whole Sample			Excluding Large Economies	
GDP Growth (h)	−0.08 *** (0.03)	−0.07 *** (0.02)	−0.07 *** (0.02)	−0.09 *** (0.03)	−0.06 *** (0.02)	−0.06 *** (0.02)
CONTROL VARIABLES						
Fiscal Consolidation, $t-1$	0.40 *** (0.05)	0.53 ** (0.11)	0.54 *** (0.13)	0.41 *** (0.05)	0.55 ** (0.12)	0.56 *** (0.14)
Fiscal Consolidation, $t-2$	−0.00 (0.06)	−0.02 (0.07)	−0.00 (0.07)	−0.00 (0.06)	−0.03 (0.07)	−0.01 (0.07)
GDP Growth, $t-1$	0.02 (0.02)	0.01 (0.02)	−0.01 (0.02)	0.02 (0.02)	−0.00 (0.02)	−0.02 (0.02)
GDP Growth, $t-2$	−0.02 ** (0.00)	−0.03 ** (0.01)	−0.04 *** (0.02)	−0.02 ** 0	−0.04 *** (0.02)	−0.05 *** (0.02)
			First-Stage Estimates for GDP Growth (h)			
Temperature Change (h)	0.60 *** (0.2)	0.76 ** (0.37)	1.41 *** (0.54)	0.63 *** (0.24)	0.68 * (0.4)	1.21 ** (0.06)
GDP Growth of Trading Partners (h)	1.64 *** (0.37)	2.35 *** (0.56)	3.01 *** (0.73)	1.61 *** (0.38)	2.34 *** (0.57)	3.08 *** (0.74)
Commodity Price Index (h)	0.14 ** (0.07)	0.21 *** (0.07)	0.22 *** (0.08)	0.13 * (0.07)	0.19 *** (0.07)	0.20 *** (0.07)
Cragg–Donald F-Stat	14	16.5	19.1	9.4	15.9	23.01
Kleibergen–Paap F-Stat	13	22.7	32.1	12.6	16.5	23.76
Hansen J, p-value	0.97	0.58	0.42	0.89	0.43	0.27
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	797	768	739	627	603	579
Countries	29	29	29	24	24	24

Note: The dependent variable is *Fiscal Consolidation(h)*, where h refers to the horizon, $h = 0$, 1, and 2. The method of estimation is two-stage least squares. Huber robust standard errors (shown in parentheses) are 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, the United Kingdom, and the United States. * Significantly different from zero at the 10 percent level, ** 5 percent level, and *** 1 percent level.

6.2. The Response of GDP Growth to Fiscal Consolidations

The literature, see in particular Guajardo et al. (2014) and Carrière-Swallow et al. (2021), reported estimates of β^h from OLS estimations of Equation (2). The identifying assumption that previous literature made is that $\alpha^h = 0$ for all h. A necessary condition for OLS to yield consistent estimates of β^h is that in the simultaneous system of equations, $\alpha^h = 0$. The instrumental variables' estimates in Table 8 showed that α^h is negative for all horizons, $h = 0$, 1, and 2. Hence, OLS estimation of Equation (2) yields responses of GDP growth (cumulated over horizon h) to fiscal consolidation shocks (cumulated over horizon h) that are downward-biased for all h.[6]

To correct for the downward bias, one needs an instrument when estimating Equation (2). In this section, I report instrumental variables of Equation (2), where the instrument for fiscal consolidations is the residual variation in fiscal consolidation that is not due to GDP growth, i.e., $u^{res} = Fiscalconsolidation(h) - \alpha^{h,IV}\ GDPGrowth(h)$, where $\alpha^{h,IV}$ is the instrumental variables' estimate of the coefficient on *GDPGrowth(h)* from Table 8. As shown in Section 4, this instrumental variables strategy is immune to the downward bias that arises in OLS estimation of Equation (2) due to $\alpha^h < 0$.

Panel A of Table 9 shows instrumental variables' estimates of the response of GDP growth to fiscal consolidation shocks. Regarding horizons and sample size, Table 9 is organized exactly as Table 8. That is, column (1) of Table 9 shows the estimated response of GDP growth to contemporaneous fiscal consolidation shocks at horizon $h = 0$. Columns (2) and (3) show the estimates for $h = 1$ and $h = 2$, respectively. Columns (4)–(6) report results for the sub-sample that excludes the five largest economies.

Table 9. Effects of action-based fiscal consolidations on GDP growth.

	GDP Growth (*h*)					
	(1) $h = 0$	(2) $h = 1$	(3) $h = 2$	(4) $t = 0$	(5) $t = 1$	(6) $t = 2$
	Whole Sample			Excluding Large Economies		
	Panel A: Two-Stage Least Squares					
Fiscal Consolidation (*h*)	1.84 ***	1.46 ***	1.38 **	2.00 ***	1.61 ***	1.52 **
	(0.51)	(0.55)	(0.61)	(0.58)	(0.62)	(0.7)
	[Wild Restricted Efficient Cluster Bootstrapped 95% Confidence Interval]					
	[0.72, 2.83]	[0.35, 2.69]	[0.20, 3.08]	[0.67, 3.26]	[0.31, 3.01]	[0.11, 3.49]
	First Stage for Fiscal Consolidation (*h*)					
u^{res}	0.88 ***	0.91 ***	0.91 ***	0.86 ***	0.90 ***	0.89 ***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.05)
Cragg–Donald F-Stat	4253.7	5376.2	4590.9	2878.5	3467.7	2830.2
Kleibergen–Paap F-Stat	807.4	887.7	633	550.9	569.5	378.2
	Panel B: Least Squares					
Fiscal Consolidation (*h*)	−0.44 ***	−0.57 **	−0.74 ***	−0.45 **	−0.60 **	−0.80 ***
	(0.15)	(0.22)	(0.27)	(0.19)	(0.24)	(0.28)
	Controls and Observations in Panels A and B					
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	827	797	767	657	632	607
Countries	30	30	30	25	25	25

Note: The method of estimation in Panel A is two-stage least squares, and in Panel B, least squares. Robust standard errors (shown in parentheses) are clustered at the country level. The 95% confidence intervals [shown in square brackets] are obtained using the wild restricted efficient bootstrap with 1000 draws, clustered at the country level. The auxiliary random variable was drawn from a Rademacher distribution, and bootstrapping was performed over the t-statistic. The endogenous variable in Panel A is *FiscalConsolidation(h)*, where the h refers to the horizon, $h = 0$, 1, and 2. The instrument is the residual variation in *FiscalConsolidation(h)* that is not due to *GDPGrowth(h)*, i.e., $u^{res} = FiscalConsolidation(h)\text{-}\alpha^{IV} GDPGrowth(h)$, where α^{IV} is the estimated coefficient on *GDPGrowth(h)* from Table 8. Additional controls, with estimates not reported, are GDP growth in $t-1$ and $t-2$, fiscal consolidations in $t-1$ and $t-2$, and computed for each horizon, $h = 0$, 1, and 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, and *** 1 percent level.

According to the instrumental variables' estimates, fiscal consolidation shocks have a positive effect on GDP growth. Column (1) of Panel A shows that the instrumental variables' estimate on *FiscalConsolidation(h = 0)* is 1.84 and has a standard error of 0.51. Thus, one can reject the null hypothesis that this estimated coefficient is equal to zero at the 1 percent significance level (p-value 0.000). Columns (2) and (3) show that the instrumental variables' estimates for horizons $h = 1$ and $h = 2$ are 1.46 and 1.38, respectively. Thus, one can reject the hypothesis that these effects are equal to zero at the 1 and 5 percent levels, respectively (the p-values are 0.007 and 0.023, respectively). The quantitative interpretation is as follows: over a horizon of one year ($h = 0$), a fiscal consolidation equal to 1 percent of GDP increases GDP by about 1.8 percent, while over a horizon of two years ($h = 1$) and three years ($h = 2$), the cumulative GDP gain relative to the size of the cumulative fiscal consolidation is equal to about 1.5 and 1.4 percent, respectively.

Effects are similar for the sub-sample that excludes the five largest economies (see columns (4)–(6) of Table 9). For the sub-sample that excludes the five largest economies, the estimated coefficients on *FiscalConsolidation(h)* are 2.00, 1.61, and 1.52, respectively, for $h = 0$, 1, and 2. For each of these estimated coefficients, one can reject the null hypothesis that the effect is equal to zero at the conventional significance levels (the p-values are 0.001, 0.010, and 0.030, respectively).

Panel B of Table 9 reports OLS estimates. For all horizons, h = 0, 1, and 2, the OLS estimates of β^h are negative. This means that OLS regressions suggest that fiscal consolidations reduce GDP growth. Specifically, according to the OLS estimates in columns (1)–(3) of Table 9, a fiscal consolidation equal to 1 percent of GDP decreases GDP by about 0.44 percent over a horizon of 1 year (h = 0), while over a horizon of two years (h = 1) and three years (h = 2), GDP decreases by about 0.57 and 0.74 percent, respectively. This is the same result as in previous literature that used OLS to estimate Equation (2). However, as argued above, OLS estimates of the response of GDP growth to action-based fiscal consolidations are downward-biased.

Figure 1 plots the OLS and 2SLS estimates of β^h and their 95 confidence bands. The figure visualizes the results of columns (1)–(3) of Table 9. Recall that the coefficient β^h is the integral multiplier at horizon h, i.e., the ratio of the cumulative change in GDP over the cumulative change in fiscal consolidations. From Figure 1, one can see that the 2SLS estimates of the integral multipliers are positive, while the OLS estimates are negative. OLS and 2SLS estimates of β^h are significantly different. For h = 0, 1, and 2, the 95 percent confidence bands around the OLS and 2SLS estimates of β^h are non-overlapping. The Hausman test rejects the null hypothesis that OLS and 2SLS estimates of β^h are the same, for h = 0, 1, and 2, at the 1 percent level.

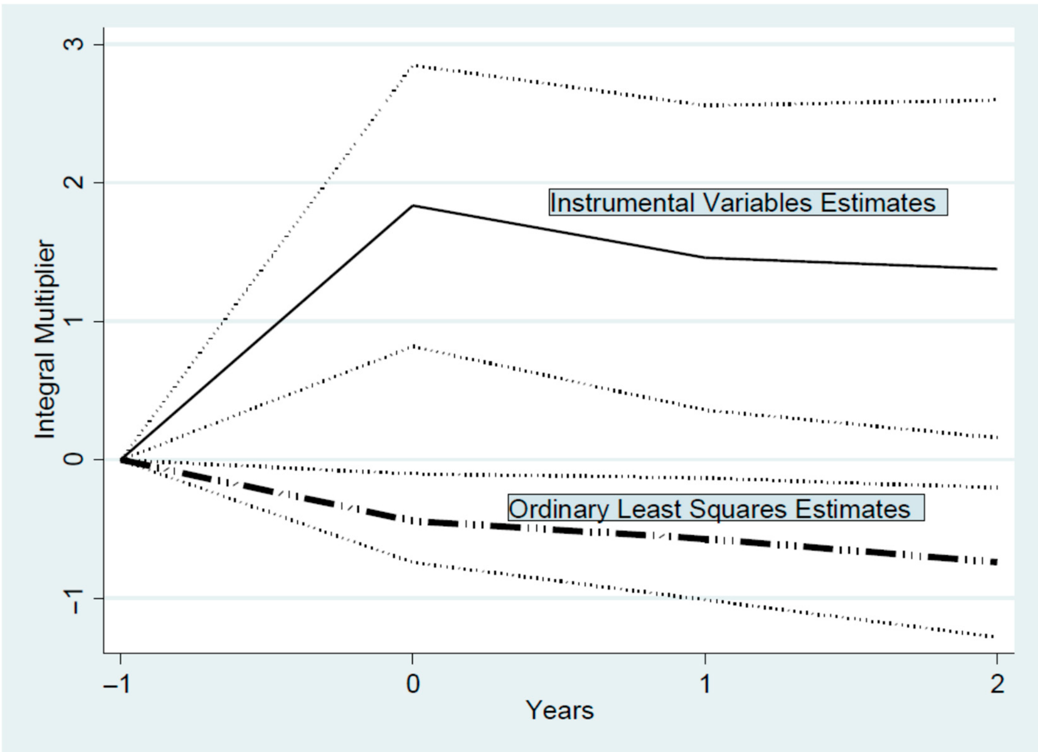

Figure 1. Estimated effect of a 1% of GDP fiscal consolidation on real GDP. Note: The figure shows estimates of the coefficient β^h in Equation (2). The letter h in the superscript refers to the horizon, in years. The solid lines in the above figure are the β^h coefficients obtained from instrumental variables' regressions. The thick, long-dash-dotted lines are the β^h coefficients obtained from ordinary least squares regressions. The thin, tight-dotted lines are the 95% confidence bands.

6.3. Mechanisms

Table 10 shows that action-based fiscal consolidations have a significant positive effect on total factor productivity. Table 10 also shows that action-based fiscal consolidations have a significant positive effect on investment and the trade balance. The estimated effect of action-based fiscal consolidations on private consumption is positive but not significantly different from zero at the conventional significance levels. Quantitatively, the estimates in Table 10 show that a fiscal consolidation in year t equal to 1 percent of GDP increases total factor productivity growth in year t by around 0.6 percentage points, increases investment growth in year t by around 2.2 percentage points, and increases the GDP share of net-exports by around 0.8 percentage points. These effects are significantly different from zero at the 5 percent level or higher.

Table 10. Effects of action-based 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 **	2.34 **	0.48	0.81 ***
	(0.26)	(1.08)	(0.41)	(0.24)
Cragg–Donald F-Stat	3799.3	3826.8	3999.3	3840.4
Kleibergen–Paap F-Stat	690	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 **	2.35 **	0.42	0.82 ***
	(0.28)	(1.15)	(0.42)	(0.25)
Cragg–Donald F-Stat	2963.2	2989.8	3146.3	2997.2
Kleibergen–Paap F-Stat	603.3	609.5	622	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, and 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, the United Kingdom, and the United States. Huber robust standard errors (shown in parentheses) are clustered at the country level. Additional controls, with 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, and *** 1 percent level.

To shed more light on the mechanisms, in particular regarding the role of prices, in Table 11, I report the effects that fiscal consolidations have on inflation and the real exchange rate. If prices are very sticky, then one should see an insignificant effect of fiscal consolidations on inflation. If, on the other hand, prices are flexible, then one should see a decrease in inflation. Table 11 shows that fiscal consolidations have a significant negative effect on inflation. The real exchange rate depreciates significantly. Specifically, from Table 11, one can see that a fiscal consolidation in year t equal to 1 percent of GDP decreases the growth rate of the GDP deflator in year t by around 2.3 percentage points, and decreases the year t growth rate of the real exchange rate by around 1.0 percentage points. These effects are significantly different from zero at the 5 percent level or higher. Overall, the results do not support a (New-)Keynesian argument that there may be negative effects of fiscal consolidations on GDP growth.

Table 11. Effects of action-based 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	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, and in 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, the United Kingdom, and the United States. Huber robust standard errors (shown in parentheses) are clustered at the country level. Additional controls, with 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, and *** 1 percent level.

7. Conclusions

The latest IMF Fiscal Monitor states that: “durable and credible fiscal consolidation is needed to reestablish sound public finances, to build budgetary space for priority investments, and to deal with future shocks” (International Monetary Fund 2024, p. xi). This call for fiscal consolidation is understandable. In advanced economies, on average, general government debt in 2023 was around 110 percent of the GDP. For the world, on average, general government debt was around 93 percent. These are very high levels of debt. If governments choose to reduce budget deficits, what should one expect to be the effect on GDP growth?

The empirical results presented in this paper suggested that GDP growth would increase if governments were to implement discretionary fiscal policies that reduce budget deficits. Instrumental variables’ estimates showed that action-based fiscal consolidations have a significant positive effect on GDP growth. Action-based fiscal consolidations significantly increase investment, boost the trade balance, and lead to an increase in total factor productivity. A political economy explanation for why the effects of action-based fiscal consolidations on economic growth are positive is that only those politicians who have less (no) present-bias will choose to implement them.

Previous literature, based on OLS, found negative effects of action-based fiscal consolidations on GDP growth. I confirmed this result for the most up-to-date data on GDP growth: OLS regressions yielded negative effects of action-based fiscal consolidations on GDP growth. However, OLS estimates of the effects of action-based fiscal consolidations on GDP growth were downward-biased. This is because GDP growth has a negative contemporaneous effect on the magnitude of fiscal consolidations. My instrumental variables’ estimates of the effects of action-based fiscal consolidations on GDP growth do not suffer from this negative reverse causality bias.

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Appendix A

Table A1. Descriptive statistics.

Variable	Source	Mean	Std. Dev.	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	0.6	994
Temperature Change	Dell et al. (2012)	0.03	0.65	745
GDP Growth of Trading Partners	Vegh and Vulletin (2015)	0.66	0.51	913
Commodity Price Index	Vegh and Vulletin (2015)	0.83	3.62	908
Commodity Price Index	Gruss and Kebhaj (2019)	100.5	3.99	995
Terms of Trade	World 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	836
GDP Share of Tax Revenues	Vegh and Vulletin (2015)	21.8	8.8	793
GDP Share of Government Expenditures	PWT version 10.0	16	4.3	1016

Notes

1. For temperature, examples of papers that document a significant effect on GDP growth are Dell et al. (2012), Burke et al. (2015b), and Gallic and Vermandel (2020). In IV estimations of the contemporaneous effects of annual GDP growth on tax rates, Vegh and Vulletin (2015) showed that GDP growth of trading partners and an international commodity price index are relevant instruments for GDP growth. There are many other papers that have documented a significant effect of these variables on GDP, such as Kose (2002), Acemoglu et al. (2008), Brueckner et al. (2012), and Fernandez et al. (2017).
2. The narrative approach was pioneered by Friedman and Schwartz (1963) and has since been applied to monetary policy, fiscal policy, and macroprudential policy. See Ramey (2016) for a discussion of recent papers that have applied a narrative approach to various types of economic policy.
3. See https://ideas.repec.org/r/imf/imfwpa/2011-128.html (accessed on 15 January 2024).
4. For more details on how these variables are constructed and justification for why they are exogenous to GDP growth, see page 351 of Vegh and Vulletin (2015).
5. Vegh and Vulletin (2015) also used the US real interest rate as an instrument for GDP growth. I do not report results for the US real interest rate because my panel models include time fixed effects. The US real interest rate is perfectly collinear with the time fixed effects. I have estimated panel models without time fixed effects and included the US real interest rate on the right-hand side. I found a significant positive effect of the US real interest rate on the magnitude of action-based fiscal consolidations in the sample that excludes the US economy: a one percentage point increase in the US real interest rate in year t increases the magnitude of an action-based fiscal consolidation by about 0.03 percent of GDP.
6. Carrière-Swallow et al. (2021) included, in addition to the first and second lags of GDP growth and fiscal consolidations, current and lagged values of a commodity price index. Carrière-Swallow et al. (2021) did not include temperature changes or GDP growth of trading partners in Equation (2). Note that even with a commodity price index as a control variable in Equation (2), OLS of Equation (2) still yields a downward-biased estimate of β^h if, in Equation (1), $\alpha^h < 0$.

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