# Integrative Mechanisms for Addressing Spatial Justice and Territorial Inequalities in Europe

## Working Paper 2: The Regional Effects of Fiscal Adjustments

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# Acronyms and Abbreviations

| | | |
|---|---|---|
| AIPW | | Augmented inverse probability weighted |
| ATE | | Average Treatement Effect |
| CAPB | | Cyclically adjusted primary balance |
| GDP | | Gross Domestic Product |
| GFC | | Global Financial Crisis |
| GVA | | Gross Value Added |
| MLD | | Mean Log Deviation |
| NUTS | | Nomenclature of Territorial Units for Statistics |
| OECD | | Organisation for Economic Co-operation and Development |
| WP | | Work Package |

# Non-Technical Summary

Following period of extended financial crises during which governments have intervened to mitigate their adverse effects, there has been calling for fiscal austerity to reverse the crisis-period expansion. In this context, regional income disparities due to fiscal adjustment programs are bound to emerge as a topic of policy interest. The question is whether a fiscal austerity program, which leads to a contraction of national output, generates recessions in different regions that are much diverse relative to the national average. The aim of this paper is to analyze the effect of fiscal austerity on regional output as well as between-region inequality in 14 OECD economies, 12 of which are members of the European Union.

Employing an augmented inverse probability weighted (AIPW) methodology, we provide estimates of the dynamic effect of fiscal adjustment policies on regional income and between-region inequality: these have the interpretation of (dynamic) *average treatment effects* (ATEs). The data on fiscal adjustments draw on the recent work by Alesina *et al.* (2019), who put together a narrative dataset of austerity *programs* rather than identifying government policy surprises alone. The benefit of using such data is that it allows us to define when a *new* adjustment program is implemented in a consistent way, rather than basing this decision on ad hoc rules.

The results presented here suggest that such policies tend to generate reductions in regional income between −5.94% for all OECD countries and -6.80% for the EU27 countries (the effect for Eurozone countries is about −6.08%) when the adjustment program is implemented while the economy has entered a phase of recession. These estimates which are much larger compared to the national level reported by Jordà and Taylor (2016) for a similar sample of OECD economies (−3.54%) – the disparity can of course be attributed to the different time periods analyzed. The effects a new consolidation program are also found to be larger, the higher the share of gross value added (GVA) of Agriculture (−6.79% vs. −4.62% when the share of agriculture is relatively small); or the higher the GVA share of Construction (−6.85% vs. −5.21% when the share of construction is relatively small). Instead, we document that fiscal adjustment programs reduce output growth less for regions with higher share of industrial production (−4.56% vs. −6.39% for regions with lower share of industrial production).

Between-region inequality is found to increase between 2.22% and 7.94% for about three years after the implementation of an adjustment program when considering all the OECD economies in the dataset. When looking at the EU economies, the effect is found to be smaller (between 2.79% and 5.84%) but much shorter-lived: no significant effect is found for horizons beyond one year. Finally, looking at the Eurozone economies the effect vanishes completely.

The empirical findings presented here underline the importance of employing well-designed fiscal policies that on the one hand address fiscal imbalances, but on the other hand promote spatial justice by not generating differential growth effects, especially for regions in which agricultural production and construction are relatively larger. We also observe that increases in between-region inequality are rather contained over time. Therefore, whenever a fiscal consolidation is necessary, there is scope for improvement, as plans should be designed to incorporate information about the economic structure of regional income, so that no disparities emerge in the process.

# 1 Introduction

Following the Global Financial Crisis (GFC) of 2007-2009 there has been a renewed interest in the effects of fiscal policy. This crisis revived the debate about the potential of using fiscal policies to stimulate demand, and, in turn, about the impact of fiscal policy on output (Auerbach and Gorodnichenko 2012; Barro and Redlick 2011; Owyang *et al.* 2013; Ramey 2011). There are in fact diverse theoretical models which give rise to different predictions on the magnitude and the sign of the effect of fiscal expansions or consolidations on output and other macro variables (Baxter and King 1993; Christiano *et al.* 2011; DeLong and Summers 2012). In the aftermath of the GFC many OECD economies during 2009-13 adopted fiscal austerity policies designed to offset the expansionary increase in government spending that took place during the previous years. However, the literature on fiscal multipliers -defined as the ratio of a change in output to a change in tax revenue or government spending - is far from reaching a consensus about their size and how these might vary across different states of the world, as the empirical literature on the effects of fiscal policy has produced very different estimates (Ramey 2011). Using the cyclically adjusted primary balance[1] (CAPB), early work indicated that fiscal consolidations could be expansionary (Alesina and Ardagna 2010, 2013). In contrast, using a narrative approach to measuring austerity, Guajardo *et al.* (2014) find that austerity is contractionary, a result confirmed also in Jorda` and Taylor (2016).

Well before the GFC, however, even since the early 1980s, income and wealth inequality have risen in many advanced economies (see e.g. Atkinson 2015; Piketty 2014). Against this backdrop and leaving aside the output effects of fiscal austerity, there as also been an interest in the distributional effects of such policies that go beyond labor force participation and unemployment. There have been some studies indicating that fiscal adjustment episodes tend to be associated with increases in income inequality at the national level (see for instance Mulas-Granados 2005; Ball *et al.* 2013; Agnello and Sousa 2014; Agnello *et al.* 2016, among others).

The existing literature however has been silent as to how are these effects distributed within a country which implements a fiscal consolidation program. Whereas the effects of austerity have been found to be detrimental on national-level output, the regional effects of such programs have not been assessed. While it holds true that we can think of national output as the sum of regional income measures, it could well be the case that implemented fiscal policies are lopsided towards some regions: in this instance, a sharp drop in income in these regions could feed back to other regions, being magnified along the way. So the first question we seek to answer here is *to what extent sharp reductions of government deficits cause large output losses at the regional level?* Similarly, while some progress has been made on measuring the effects of fiscal consolidation on in-come distributions, a second question that begs answering is *how do these fiscal plans affect between-region income inequality?* To the best of our knowledge only the work by Agnello *et al.* (2016) provides some evidence on the

[1] The cyclically adjusted primary balance is an estimate of the fiscal balance that would apply under current policies if output were equal to its potential level. It is commonly used as a way to isolate the budget from its cyclical component.

effects on inequality at a sub-national level.[2]

This paper contributes to closing this gap in the existing empirical literature providing evidence on the effects of fiscal austerity on regional income and the between-region income distribution in a group of OECD countries. We aim to answer these questions by using country-level data on multi-year fiscal plans along the lines of Alesina *et al.* (2015a, 2019) and Alesina *et al.* (2017) rather than employing year-by-year shifts in fiscal variables, like those in Romer and Romer (2010) and Guajardo *et al.* (2014). We construct fiscal plans by sing data that document the shifts in taxes or spending that are announced ahead to be implemented in a 3-years horizon. We combine these with regional GDP data for 14 out of the 16 countries included in the dataset of Alesina *et al.* (2019) over a shorter time period, 2000-2018. Then, we construct measures of between-region inequality from regional income data, but as these measures are put together at the country level, our analysis here amounts to estimating the Average Treatement Effect (ATE) namely the difference in mean (average) outcomes between regions where austerity was applied (treated regions) and unaffected regions (control regions) at the national level (see also Agnello *et al.* 2016, for a similar approach in data construction).

There are three sets of results that come out of the analysis.[3] *First*, we find that austerity measures are indeed detrimental on regional output, and the effect is estimated to be larger relative to its national counterpart estimate. we also find that these effects vary considerably across the business cycle. Specifically, the accumulated output loss is estimated to be about -5.62% for all OECD countries, effect which is slightly smaller for the EU countries and completely insignificant for the Eurozone group. But once we allow for differential effects across booms and slumps, we get a more gloomy picture: the ATE in recessions varies between -5.94% for all OECD countries and -6.80% for the EU27 countries (the effect for Euro- zone countries is about -6.08%) which is much larger compared to that reported by Jorda` and Taylor (2016) for a similar sample of OECD economies (-3.54%). We do find however, in line with Jorda` and Taylor (2016) that in booms the ATE is essentially zero.[4]

The *second* set of results explores the regional production structure in explaining the size of the effect of a negative fiscal shock on regional income. To this end we examine how the effects of an austerity program differ depending on whether a particular region has a high

[2] There are four key differences between the current paper and that of Agnello *et al.* (2016). First, I employ more recent data covering the post GFC period and focus also non-European countries in my analysis. Second, the regional data I employ in constructing my inequality measures are measured at a much finer regional level (TL3 in OECD terms) while their data are at a coarser level (roughly TL2). Third, I employ the data of Alesina *et al.* (2019) which is based on the idea of (exogenous) fiscal plans, whereas their analysis makes use of the dataset by Devries *et al.* (2011). Fourth, they estimate dynamic panel data models, whereas I adopt an estimator that allows me to estimate the dynamic average treatment effect (ATE) of a consolidation episode

[3] Following Jordà and Taylor (2016) we employ an Augmented Inverse Probability Weighted (AIPW) methodology and estimate impulse response functions using local projections (Jordà 2005), which are essentially estimates of the dynamic ATE of a consolidation episode on cumulative regional income growth, treating regions as our units of analysis.

[4] A possible explanation of this difference is that this is due to the sample period used: my sample covers only the period from the 2000s on, whereas their sample period covers also the 1980s and 1990s, and these 20 years could make a difference in the estimated effect.

share of gross value added (GVA) in agriculture, construction or industry.[5] We find that when the GVA share of agriculture is large, the ATE of a fiscal program is −6.79%; whereas it is found to be about −4.62% when the GVA share of agriculture is relatively small. Similarly, we document that when the construction GVA is above the overall median, the ATE is estimated to be −6.85%, while being about −5.21% when the construction GVA share is small. In a symmetric fashion, when the share of industrial GVA is relatively large, we find that the ATE of a consolidation program is about −4.56% while we estimate it to be about −6.39% when the industrial GVA share is relatively small.

The *third* set of results pertains to the effects of fiscal austerity on between- region inequality. We find that there is an increase in inequality (between 2.22% and 7.94%) three years after the implementation of a consolidation program, when we consider all the OECD economies in our dataset. When looking at the EU economies the effect is found to be smaller (between 2.79% and 5.84%) but much shorter-lived: no significant ATE is found for horizons beyond one year. Finally, when looking at the Eurozone economies the effect vanishes completely. These findings seem to be in contrast with those in earlier studies who find persistent increases in inequality following a fiscal consolidation episode (Ball *et al.* 2013; Furceri *et al.* 2015; Agnello *et al.* 2016; Heimberger 2020).[6] As we explain, this finding could be driven by two facts: *first*, we employ a much shorter sample in terms of time coverage relative to these studies, and *second* our inequality measures may be measured with errors.

The last two sets of findings actually lead to important policy implications. In particular they highlight the need for designing austerity programs that on the one hand address fiscal imbalances, but on the other the do not lead to spatial injustice. Our findings indicate that the effects of (historical) fiscal adjustments have been more detrimental to regions in which agriculture and construction are relatively more important, whereas in regions in which industrial GVA is larger these effects on output growth are somewhat smaller. Although this does not generate increases in between-region inequality, it definitely deserves attention if the burden is to be equally shared. To this end, austerity programs should incorporate this information and be redesigned by establishing a mechanism of transfers from regions that at hurt less (with higher industrial production) towards regions that are hurt more from such programs (those with higher GVA shares of agriculture and construction).

The rest of the paper is structured as follows. Section 2 provides a review of the literature dealing with the macroeconomic effects of fiscal consolidations. Section 3 discusses the statistical approach used in this paper and the data employed in the analysis. Section 4 presents the empirical results for the effects of austerity on output and between-region inequality. The final section concludes.

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[5] In practice the high/low bins are defined by checking if the agricultural GVA in region $i$ during year $t$ is above/below the overall median of the agricultural GVA. The bins for construction and industry are constructed in a similar way.

[6] Agnello *et al.* (2016) find that a consolidation episode of 1% of national GDP leads to a persistent increase in between-region inequality, which is significant even at horizons of five years after the episode – this result is mostly driven by expenditure-based consolidations.

## 2 Related Literature

At the onset of the GFC there have been a series of papers providing useful insights into how the fiscal multipliers might vary with the business cycle, the degree of monetary policy accommodation, the composition of fiscal measures, the initial level of public debt, the exchange rate regime and openness of the economy as well as the spillover effects from/to other economies (Auerbach and Gorodnichenko 2012, 2013; Barrell *et al.* 2012; Christiano *et al.* 2011; DeLong and Summers 2012; Ilzetzki *et al.* 2013; Ramey 2011; Woodford 2011). But during the 2009-2013 period a reversal of these policies had taken place, especially in Europe (Alesina *et al.* 2015b; Lane 2012), which has shifted attention towards the effects of fiscal consolidations. A series of papers have assessed the effects of fiscal austerity on growth and employment (see e.g. Blanchard and Leigh 2014; Guajardo *et al.* 2014; Alesina *et al.* 2015a,b; Jorda` and Taylor 2016, among others).

The crucial question had been whether fiscal consolidations could be expansionary in the spirit of Alesina and Ardagna (2010). They find that spending-based adjustments have been associated with a relatively small negative direct effect on growth. This small effect can be fully compensated by the positive effect that accommodative monetary policies have on the demand side and by the positive effect of liberalization reforms on the supply side of the economy. Moreover, expectations about a change in the policy regime can generate a positive wealth effect and a reduction in risk premia on long-term interest rates with positive effects on private consumption and investment.

The paper by Blanchard and Leigh (2014) seriously doubted this thesis, as they estimated that for each additional percentage point of fiscal consolidation measures, institutions such as the IMF and the European Commission had underestimated their negative growth effects by about 1%. Hence the IMF had assumed that the multiplier would be about 0.5 whereas the implied estimate in Blanchard and Leigh (2014) was about 1.5. Moreover some influential empirical studies (Guajardo *et al.* 2014; Jorda` and Taylor 2016) found that that fiscal consolidations were always contractionary, and fiscal multipliers were higher during periods of economic slack.

Most of the emphasis had been placed on the output effects of austerity, with inequality receiving much less scrutiny. However, policy work at IMF had started paying attention to the effects of fiscal consolidations (IMF 2012; Bastagli et al. 2012; IMF 2014) and some papers also started establishing the negative effect of austerity on income inequality (Ball *et al.* 2013; Furceri *et al.* 2015; Woo *et al.* 2017). For instance, the IMF had argued that: "Preventing a significant worsening of the income distribution during the adjustment phase is critical to the sustain- ability of deficit reduction efforts, as a consolidation that is perceived as being fundamentally unfair will be difficult to maintain" (see IMF 2012, p. 50).

The more 'traditional' approach to the task was based on the use of a cyclically adjusted primary balance both when assessing output effects (Alesina and Ardagna 2010; Blanchard and Leigh 2013) and when looking at the effects on inequality (Mulas-Granados 2005; Agnello and Sousa 2012). However, changes in cyclically-adjusted fiscal balances might not only reflect the policymakers' desire to limit fiscal deficits. In response to this issue a *narrative* *approach* has been adopted (Romer and Romer 2010) which aims at producing "exogenous" measures of fiscal policy, as cyclically adjusted fiscal balances might lead to biased results (Guajardo *et al.* 2014). Subsequent work has employed or extended such data put together by Devries *et al.* (2011) which focus on discretionary changes in government spending and taxes.

Along similar lines using *narrative* fiscal consolidation data, there have been studies demonstrating that austerity measures typically lead to an increase in disposable income inequality (Ball *et al.* 2013; Agnello and Sousa 2014; Agnello *et al.* 2016; Furceri *et al.* 2015; Woo *et al.* 2017), while a similar finding is reported in Agnello *et al.* (2016) who employ between-region inequality Gini coefficients similar to the ones we use here. Instead, a reduction in inequality is reported by Ciminelli *et al.* (2019) who also employ *narrative* data from Devries *et al.* (2011) and Alesina *et al.* (2019), whereas Agnello and Sousa (2012) who employ changes in the CAPB also find a reduction in inequality. Moreover Agnello and Sousa (2014), Agnello *et al.* (2016), Ball *et al.* (2013) and Furceri *et al.* (2015) report that spending-based consolidations are more detrimental than tax-based consolidations in terms of their consequences on the income distribution.[7]

# 3 Data and Fiscal Consolidation Plans

Our goal is to estimate the average treatment effect (ATE) of fiscal austerity episodes (taking place at the national level) on regional incomes and between-region income inequality. The statistical approach we follow is described in detail in the section A1 in the Appendix.

We have collected data from various sources. To define the fiscal austerity plan variable ($D_{ct}$), we use the action-based dataset of Alesina *et al.* (2019), who rely on a narrative approach similar to Romer and Romer (2010) to identify fiscal consolidation plans in 16 OECD countries from 1978 to 2014.[8] This dataset covers fiscal measures adopted in the context of more than 250 austerity plans, with some of these measures being announced for future implementation, while others being implemented within the same announcement year. The fiscal consolidation plan measure is an indicator variable of whether country $c$ in year $t$ has implemented a *new* austerity plan as defined in Alesina *et al.* (2019).[9]

However, one of the empirical challenges already discussed in detail in Jorda` and Taylor (2016) is that of *endogeneity* or *selection bias*, as any austerity program is far from being a random

[7] Mulas-Granados (2005) also finds that expenditure-based consolidations increase inequality more than revenue-based consolidations.

[8] The original compilation was done by Alesina *et al.* (2015b) who relied upon the dataset put together by Devries *et al.* (2011). Note that we employ data for all 16 countries when we estimate the propensity scores to increase precision, but we only employ data for 14 of them when estimating outcome effects, as there are no regional output data available for Australia and Canada.

[9] There three more ways to define the fiscal *treatment* indicator. The first alternative would be to follow Jordà and Taylor (2016) and define a consolidation plan when in year $t$ either new measures are implemented, or measures adopted earlier are enforced. The second alternative would be to work along the lines of Romer and Romer (2010) and define a consolidation plan either when new measures are implemented in year $t$ and/or new measures are announced for the future. And the third, to define a fiscal plan when in year $t$ either measures adopted in previous years or new measures in the current year are implemented, or plans are made for future periods. Although we employ the measure of *new* plans discussed in Alesina *et al.* (2019), the results we present below, do not depend on this choice.

choice or an exogenous policy shock, and its timing and level could be affected either by the outcome variables or by variables that are jointly determined with the outcomes. We deal with this issue by adjusting our estimation weights by the probability of implementing a fiscal consolidation, estimated by a series of probit models of the fiscal austerity treatment. We then use the predicted probability as the propensity score ($\hat{p}$). The method is described in detail in section A2 in the Appendix.

Data on regional output have been obtained from the OECD Regional Database, which contains data on real GDP and real GDP per capita for 14 countries listed in Table 1. Essentially these are reported in territorial grids (in particular the TL3 classification) which are officially established and relatively stable in all OECD member countries.[10] As regional inequality measures are not readily available, we have chosen to employ GDP per capita measures and put some measures together. Thus, we treat region $i$ in country $c$ during period $t$ as the unit of measurement and follow Cowell (2011) in constructing between-region inequality measures for country $c$ in year $t$. So we are essentially assuming that all individuals in region $i$ actually have the same (gross) income, which is quite strong as an assumption. Results based on these measures should be interpreted with a grain of salt, as they are based on relatively few observations especially for Ireland (8 obs) and Denmark (11 obs). However, such measures will allow us to investigate the effects of fiscal austerity programs on between-region inequality rather than on national level inequality.[11] To proceed we have put together an index in the Atkinson class (with $\epsilon = 1$), a Gini coefficient, the Palma ratio (the ratio the the 90th percentile to the 40th percentile) and Theil's $L$ or Mean Log Deviation (MLD) and Theil's $T$ (see e.g. the Technical Appendix in Cowell 2011, esp. Table A.1).[12]

[10] Details are available at OECD: https://www.oecd.org/cfe/regionaldevelopment/territorial-grid.pdf.
[11] This task has already been taken by Chroni and Konstantinou (2021) and Heimberger (2020) for instance.
[12] The two Theil measures are also described as generalized entropy measures with $\theta = 0$ and $\theta = 1$ respectively. Note that Theil's $L$ is more sensitive to differences at the lower part of the distribution, whereas Theil's $T$ is more sensitive to differences at the top of the distribution.

**Table 1 Countries and Number of Regions**

| Country | Number of Regions (1) | Number of Regions (2) |
|---|---|---|
| Austria | 35 | 36 |
| Belgium | 44 | 45 |
| Denmark | 11 | 12 |
| Finland | 19 | 20 |
| France | 101 | 102 |
| Germany | 401 | 401 |
| Ireland | 8 | 8 |
| Italy | 110 | 111 |
| Japan | 47 | 47 |
| Portugal | 25 | 26 |
| Spain | 59 | 60 |
| Sweden | 21 | 22 |
| United Kingdom | 179 | 180 |
| United States | 179 | 179 |

**Notes**: Table 1 reports the OECD countries and the number of regions per country used in the analysis. The data have been obtained from the OECD Regional Statistics. Column (1) reports the number of regions for which population data are available (to create per capita measures) whereas column (2) the number of regions by country for which real GDP is available. For European countries the TL3 regions used are quite close to the NUTS regional classification. Details on the specific regions are given in the OECD Territorial grids (https://www.oecd.org/cfe/regionaldevelopment/territorial-grid.pdf)

# 4 Empirical Results

## 4.2 The Impact of Fiscal Austerity Plans on Regional Income

After the identification of the treatment episodes and the probit estimation, we have fiscal consolidation episodes and propensity scores. As already explained above, from now on our analysis focuses only on the 14 OECD countries in Table 1, as regional GDP data are unavailable for Australia and Canada.[13] In what follows, our dependent variable is the cumulative change in regional GDP relative to the period before the treatment assignment, In the regressions to estimate the conditional mean of dependent variable for the treated and control groups, we include a vector of control variables to account for economic fundamentals that might influence regional output growth. Specifically, we control for the one-year and two-year lagged terms of regional GDP growth rate, lagged regional inflation rate (based on the GDP deflator), and the one-year lagged regional output gap and national output gap – summary statistics are provided in Table 2. This set of controls is obviously different from the one used in estimating the likelihood of fiscal consolidation episode, the latter taking place at the country level, sharing only lagged national output gap as a common covariate. In the analysis that follows we estimate two alternative specifications: In the first we assume that control variables

[13] In fact for both countries some regional income data are available but at a coarser regional classification (TL2) and are therefore excluded from the analysis.

affect in the same way all regions (*restricted model*) whereas in the second specification we allow the control variables to affect in a different way treated and control regions (*unrestricted model*).

**Table 2 Summary Statistics of Covariates for Regional Output Regressions**

| | Mean | Std. Dev. | Min | Max | Obs |
|---|---|---|---|---|---|
| Growth of regional GDP $(t-1)$ | 1.1117 | 4.2444 | -74.4447 | 115.8368 | 16011 |
| Growth of regional GDP $(t-2)$ | 1.1730 | 4.3252 | -74.4447 | 115.8368 | 14762 |
| Regional inflation $(t-1)$ | 1.6126 | 1.0129 | -4.7803 | 6.6532 | 16011 |
| Regional Output Gap $(t-1)$ | 0.0579 | 3.6958 | -50.5172 | 98.9451 | 17260 |
| National Output Gap $(t-1)$ | 0.2533 | 2.5992 | -15.0729 | 14.6651 | 18735 |

**Notes** for Table 2: The table reports summary statistics of the covariates used in estimating the conditional mean of the treated/control groups $\mu_j^h(\mathbf{w}_t, \boldsymbol{\psi}_j^h)$ when the outcome variable is the cumulative growth rate of regional GDP. The sample covers the period 2000-2014.

The benchmark results for the 14 OECD countries are reported in Table 3 and Table 4, which are organized into two blocks of rows. The first block of rows (first two) reports results based on the restricted models and the second block of rows (third and fourth row) reports results from unrestricted models.[14] The AIPW estimates of the ATE of fiscal austerity episodes on regional income peaks at a horizon of three years after the initiation of the program, and delivers an accumulated output loss over five years (last column) of -5.62%.[15] This implies an average annual real GDP loss of about 1.12% of GDP — which is quite larger than the corresponding 0.72% reported in Jorda` and Taylor (2016). Alternatively, a 1% fiscal consolidation program would lead to an average accumulated loss of regional real GDP between 0.600% and 1.295% depending on whether the average size of the austerity measures is measured by the overall *new* measures implemented or only by the *surprise* measures in year $t$.[16]

**Table 3 The Effect of Fiscal Adjustment Plan, AIPW Estimates, Full Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE | -0.407 | -0.995** | -0.870* | -2.175*** | -1.051 | -5.493** |
| (Restricted) | (0.415) | (0.340) | (0.453) | (0.399) | (0.807) | (1.843) |
| Fiscal Adjustment ATE | -0.551 | -1.042** | -0.925* | -2.031*** | -1.066 | -5.615** |
| (Unrestricted) | (0.411) | (0.387) | (0.495) | (0.465) | (0.898) | (2.086) |
| Observations | 14762 | 14760 | 14758 | 14756 | 14707 | 14707 |

**Notes** for Table 3: Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log real GDP using an HP filter with $\lambda$ = 100: $y_{gap}$ =

[14] We will retain this style of presentation below, distinguishing between cases in which the restriction is imposed and cases in which it is not.

[15] This should probably come as no surprise as most of the fiscal austerity programs identified in Alesina *et al.* (2019) tend to have a duration of about three years.

[16] The corresponding rescaling factors are 0.535 and 1.153 respectively using national averages.

$(\exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. ***/**/* indicate p-value < 0.01/0.05/0.10.

In Table 4 we explore the partition of the data into booms and slumps, depending on whether national output is above or below trend.[17] The AIPW estimates show that in a boom, an austerity has on average a smaller, negative effect which in the *unrestricted model* becomes larger, albeit it is not estimated very precisely. Both in booms and slumps, the accumulated loss over five years is between 5.94% and 6.62% of GDP – essentially only a minor difference between the two. This finding differs from the estimates in Jorda` and Taylor (2016), who, using national data (and a much different sample period indeed) find that in a slump the effect of a fiscal consolidation program during a slump is roughly three times as strong relative to that in a boom (and significant).

**Table 4 The Effect of Fiscal Adjustment Plan, AIPW Estimates, Booms *vs.* Slumps**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE in boom | -1.418*** | -1.248** | 0.288 | -1.588 | -1.773 | -5.738* |
| (Restricted) | (0.180) | (0.518) | (0.834) | (1.097) | (1.115) | (3.131) |
| Fiscal Adjustment ATE in slump | -0.106 | -1.200*** | -1.585*** | -2.569*** | -0.397 | -5.835*** |
| (Restricted) | (0.306) | (0.310) | (0.308) | (0.436) | (0.971) | (1.657) |
| Fiscal Adjustment ATE in boom | -1.964*** | -1.336** | 0.085 | -1.579 | -1.826 | -6.620* |
| (Unrestricted) | (0.254) | (0.534) | (1.159) | (1.246) | (1.227) | (3.936) |
| Fiscal Adjustment ATE in slump | -0.068 | -1.258*** | -1.731*** | -2.513*** | -0.357 | -5.936** |
| (Unrestricted ) | (0.293) | (0.345) | (0.397) | (0.480) | (1.059) | (2.086) |
| Observations | 14762 | 14760 | 14758 | 14756 | 14707 | 14707 |

**Notes** for Table 4: Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda$ = 100: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. The boom bin is for observations where the country-level output gap $y_{gap}$ is greater than zero, the slump bin is for observations where the country-level output gap is less than or equal to zero. ***/**/* indicate p-value < 0.01/0.05/0.10.

A valid question that arises is how different are these findings when one focuses only on European economies. To this end in Table 5 and Table 6 we report results from a similar

[17] Auerbach and Gorodnichenko (2012) and Ramey and Zubairy (2018) have forcefully argued that the effects of government spending differ markedly in recessions and in expansions, and Jordà and Taylor (2016) show that this is also the case for austerity.

exercise, employing data on EU28 countries only and in Table A3 and Table A4 in the Appendix we report results excluding also the UK from the analysis. Results in Table 5 are almost identical to those in Table 3 for the full sample. Instead, results in Table 6 show some important differences relative to those for the full sample. We now find that in a boom a fiscal consolidation has on average a small, negative and short-lived effect, which is imprecisely estimated – the accumulated loss over five years is about 4% of GDP. However, in a slump, the results are about one and a half times higher and strongly statistically significant: over five years, the accumulated output loss is -6.66%. The results using only the EU27 countries are similar, with two minor differences. First, the ATE in the *unrestricted model* is smaller in magnitude and short-lived (with the accumulated output loss being essentially indistinguishable from zero). Second, the estimated ATE in a slump is about double that in a boom (6.80% vs. 3.28% respectively), with the latter being insignificant.

**Table 5 The Effect of Fiscal Adjustment Plan, AIPW Estimates, EU28 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE | -0.399 | -1.142** | -0.741 | -2.036*** | -0.758 | -5.072** |
| (Restricted) | (0.475) | (0.428) | (0.532) | (0.496) | (0.921) | (2.135) |
| Fiscal Adjustment ATE | -0.576 | -1.337** | -0.851 | -1.890*** | -0.735 | -5.378* |
| (Unrestricted) | (0.499) | (0.554) | (0.611) | (0.557) | (0.987) | (2.541) |
| Observations | 12276 | 12274 | 12272 | 12270 | 12268 | 12268 |

**Notes**: Table 5 reports AIPW estimates of the fiscal consolidation ATE using data only for the EU countries/regions. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina et al. (2015, 2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda$ = 100: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. ***/**/* indicate p- value < 0.01/0.05/0.10.

**Table 6 The Effect of Fiscal Adjustment Plan, AIPW Estimates, Booms *vs.* Slumps, EU28 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE in boom | -1.549*** | -1.292* | 0.772 | -0.825 | -0.936 | -3.830 |
| (Restricted) | (0.221) | (0.590) | (0.994) | (1.276) | (1.194) | (3.383) |
| Fiscal Adjustment ATE in boom | -0.042 | -1.359*** | -1.754*** | -2.731*** | -0.079 | -5.943** |
| (Restricted) | (0.356) | (0.374) | (0.375) | (0.449) | (1.087) | (1.917) |
| Fiscal Adjustment ATE in boom | -2.072*** | -1.462** | 0.870 | -0.593 | -0.774 | -4.031 |
| (Unrestricted) | (0.272) | (0.547) | (1.226) | (1.304) | (1.185) | (3.879) |
| Fiscal Adjustment ATE in slump | -0.015 | -1.507*** | -2.049*** | -2.829*** | -0.284 | -6.663** |
| (Unrestricted) | (0.343) | (0.409) | (0.546) | (0.493) | (1.226) | (2.581) |
| Observations | 12276 | 12274 | 12272 | 12270 | 12268 | 12268 |

**Notes**: Table 6 reports AIPW estimates of the fiscal consolidation ATE using data only for the EU countries/regions in booms and slumps. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. The boom bin is for observations where the country-level output gap $y_{gap}$ is greater than zero, the slump bin is for observations where the country-level output gap is less than or equal to zero. ***/**/* indicate p-value < 0.01/0.05/0.10.

Finally, in Table 7 and Table 8 we repeat the same exercise using data only for countries that belong to the Eurozone. The added benefit of this analysis is that it allows us to control for monetary policy actions which could drive the results discussed thus far, while in this subgroup monetary policy fluctuates in the same way for all countries.[18] We find one notable difference relative to the results discussed so far: the estimated ATE regardless of whether the restriction is imposed or not in Table 7 is invariably insignificant for horizons beyond three years, with the accumulated output loss being essentially zero. However, when data are again grouped into booms and slumps, we find the ATE is slumps is strongly significant and about two times that in booms (which is imprecisely estimated).

**Table 7 The Effect of Fiscal Adjustment Plan, AIPW Estimates, Eurozone Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE | -0.024 | -0.918** | -0.623 | -2.260*** | -0.847 | -4.665 |
| (Restricted) | (0.363) | (0.299) | (0.595) | (0.553) | (1.179) | (2.574) |
| Fiscal Adjustment ATE | -0.208 | -1.084** | -0.734 | -2.019** | -0.744 | -4.777 |
| (Unrestricted) | (0.376) | (0.465) | (0.633) | (0.659) | (1.235) | (2.855) |
| Observations | 9708 | 9706 | 9704 | 9702 | 9700 | 9700 |

**Notes**: Table 7 reports AIPW estimates of the fiscal consolidation ATE using data only for the Eurozone countries/regions only. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income *y*, two lags of change in regional income *y*, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda$ = 100: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. ***/**/* indicate p- value < 0.01/0.05/0.10.

[18] In principle, while we have implicitly controlled for monetary policy actions by means of the short-term interest rate in the propensity score estimates, one could argue that part of the estimated effects could have been driven by different actions adopted by different central banks.

## Table 8 The Effect of Fiscal Adjustment Plan, AIPW Estimates, Booms *vs.* Slumps, Eurozone Sample

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE in boom | -1.578*** | -0.772 | 1.323 | -0.837 | -1.186 | -3.049 |
| (Restricted) | (0.282) | (0.599) | (1.177) | (1.724) | (1.578) | (4.248) |
| Fiscal Adjustment ATE in slump | 0.118 | -1.495*** | -1.996*** | -2.603*** | 0.647 | -5.291** |
| (Restricted) | (0.268) | (0.337) | (0.377) | (0.403) | (1.252) | (2.126) |
| Fiscal Adjustment ATE in boom | -2.000*** | -1.119 | 1.335 | -0.738 | -1.229 | -3.751 |
| (Unrestricted) | (0.395) | (0.649) | (1.530) | (1.870) | (1.659) | (5.119) |
| Fiscal Adjustment ATE in slump | 0.163 | -1.904*** | -2.601*** | -2.319*** | 0.557 | -6.081** |
| (Unrestricted) | (0.173) | (0.301) | (0.513) | (0.476) | (1.438) | (2.631) |
| Observations | 9708 | 9706 | 9704 | 9702 | 9700 | 9700 |

**Notes**: Table 8 reports AIPW estimates of the fiscal consolidation ATE using data only for the Eurozone countries/regions in booms and slumps. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda$ = 100: $y_{gap} = (exp(y_{c_{i,c,t}}) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. The boom bin is for observations where the country-level output gap $y_{gap}$ is greater than zero, the slump bin is for observations where the country-level output gap is less than or equal to zero. ***/**/* indicate p-value < 0.01/0.05/0.10.

Summing up our results thus far, we always find more adverse effects when fiscal consolidation plans are initiated in slumps rather than in booms, but there are small differences in some instances across, when samples including different countries are employed. Using the AIPW estimator, we find that there are large contractionary effects of fiscal consolidations even in booms (albeit not significant in many cases) whereas the cumulative effect over five years varies between -5.94% and -6.80% depending on the group of countries examined.

## 4.3 The ATE of Fiscal Adjustments and its Dependence on the Production Structure

While the sharp reduction in regional GDP following an austerity program is well documented above, especially if the program is initiated when the economy has entered a recession, there are certain aspects of it that remain unclear. Could it be that some observable features of the regional economies could explain these large variations in GDP growth, and if yes, which are these? The most likely candidate is the production structure of the regional economy studied, namely the sectoral composition of output. If this is indeed the case, then the information about different production structures should be incorporated in the design of consolidation programs, to avoid having the burden fall more on some regions relative to others, thereby leading to spatial disparities of the effects.

To explore this, we have used again data from OECD on the shares of gross value added (GVA) attributed to different economic activities: agriculture, construction and industry (including energy). In a way similar to defining booms and slumps above, we split our observations into bins of high and low shares of GVA. For instance, whenever the share agricultural GVA in region $i$ during year $t$ is above the overall median GVA share of agriculture for all regions in the sample, we classify this region to be a *high share* region, and a *low share* region otherwise. In a similar manner, we define *high share* regions for construction and industry.[19] We then explore the partition of the data into *high* and *low* share regions, and repeat the analysis for these groups.

The results from this experiment are summarized in Table 9 and Table 10 for the full sample of countries. We find that when the share of agricultural GVA is relatively large, then the ATE of a fiscal adjustment program on cumulative growth is about 1.5 times higher relative to when the share is small (−6.79% vs. −4.62%). Similarly, when the share of construction GVA is relatively large, the cumulative GDP loss is about −6.85%; whereas when the share is small, the output loss is about one and a half percentage points smaller. The exact mirror of this takes place in regions with high share of industrial GVA: the cumulative output loss five years after the program is −4.56%, compared to situations where the share of industrial GVA is small where we find an output loss of −6.39%.

[19] We have also experimented by splitting the sample around the 75th percentile of the GVA distribution for each type of economic activity and the results are pretty similar to those we discuss below.

**Table 9 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Agriculture/Construction, Full Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| **Panel A: Agriculture Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Agriculture | -0.259 | -0.837** | -1.008* | -2.467*** | -1.927* | -6.484*** |
| (Restricted) | (0.336) | (0.278) | (0.511) | (0.515) | (1.038) | (2.386) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.519 | -1.113** | -0.673 | -1.880*** | -0.190 | -4.366*** |
| (Restricted) | (0.539) | (0.506) | (0.484) | (0.496) | (0.611) | (1.598) |
| Observations | 14270 | 14268 | 14266 | 14264 | 14215 | 14215 |
| Fiscal Adjustment ATE with high share of Agriculture | -0.382 | -0.926** | -1.077* | -2.409*** | -2.010* | -6.791** |
| (Unrestricted) | (0.372) | (0.386) | (0.587) | (0.613) | (1.088) | (2.725) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.846 | -1.284* | -0.861 | -1.568** | -0.061 | -4.617** |
| (Unrestricted) | (0.606) | (0.597) | (0.545) | (0.597) | (0.764) | (1.935) |
| Observations | 14329 | 14327 | 14325 | 14323 | 14274 | 14274 |
| **Panel B: Construction Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Construction | -0.522 | -1.081*** | -1.069** | -2.115*** | -1.551* | -6.337*** |
| (Restricted) | (0.385) | (0.332) | (0.391) | (0.480) | (0.843) | (1.772) |
| Fiscal Adjustment ATE with low share of Construction | -0.417 | -1.047** | -0.834 | -2.275*** | -0.529 | -5.095** |
| (Restricted) | (0.444) | (0.404) | (0.617) | (0.399) | (0.924) | (2.324) |
| Observations | 14139 | 14137 | 14135 | 14133 | 14083 | 14083 |
| Fiscal Adjustment ATE with high share of Construction | -0.732 | -1.286*** | -1.193** | -2.039*** | -1.590* | -6.854*** |
| (Unrestricted) | (0.426) | (0.416) | (0.510) | (0.562) | (0.861) | (2.121) |
| Fiscal Adjustment ATE with low share of Construction | -0.603 | -1.116** | -0.993 | -2.021*** | -0.479 | -5.209** |
| (Unrestricted) | (0.421) | (0.437) | (0.635) | (0.507) | (1.069) | (2.571) |
| Observations | 14241 | 14239 | 14237 | 14235 | 14186 | 14186 |

**Notes**: Table 9 reports AIPW estimates of the fiscal consolidation ATE using full sample data for regions that have high/low shares of GVA in Agriculture (Panel A) and in Construction (Panel B). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Agricultural activity bin is for observations where the region-level gross value added is larger than the overall median agriculture GVA share (1.63%), and the low share bin is for observations where the region-level agriculture GVA is less the overall median. Similarly, the high share of Construction activity bin is for observations where the region-level gross value added is larger than the overall median construction GVA share (5.8%), and the low share bin is for observations where the region-level construction GVA is less the overall median.***/**/* indicate p-value < 0.01/0.05/0.10.

**Table 10 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Industry, Full Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE with high share of Industry | -0.183 | -0.688** | -0.663 | -2.580*** | -0.922 | -5.036** |
| (Restricted) | (0.344) | (0.265) | (0.529) | (0.376) | (1.063) | (2.132) |
| Fiscal Adjustment ATE with low share of Industry | -0.552 | -1.178*** | -1.001** | -1.641*** | -1.187 | -5.553*** |
| (Restricted) | (0.329) | (0.309) | (0.356) | (0.465) | (0.803) | (1.723) |
| Observations | 14630 | 14628 | 14626 | 14624 | 14575 | 14575 |
| Fiscal Adjustment ATE with high share of Industry | -0.341 | -0.677** | -0.710 | -2.126*** | -0.707 | -4.559* |
| (Unrestricted) | (0.319) | (0.313) | (0.559) | (0.578) | (1.245) | (2.498) |
| Fiscal Adjustment ATE with low share of Industry | -0.737* | -1.307*** | -1.181** | -1.781*** | -1.388 | -6.392*** |
| (Unrestricted) | (0.376) | (0.352) | (0.430) | (0.513) | (0.809) | (1.891) |
| Observations | 14694 | 14692 | 14690 | 14688 | 14639 | 14639 |

**Notes**: Table 10 reports AIPW estimates of the fiscal consolidation ATE using full sample data for regions that have high/low shares of GVA in Industry. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Industry activity bin is for observations where the region-level gross value added is larger than the overall median industry GVA share (20.7%), and the low share bin is for observations where the region-level industry GVA is less the overall median. ***/**/* indicate p-value < 0.01/0.05/0.10.

A similar picture is obtained when looking only at EU countries (see Table A7 and Table A8 in the Appendix). We find that for regions with high shares of agricultural GVA the cumulative GDP loss amounts to −7% compared to a −3.95% when the share is small. Likewise, the ATE of a fiscal adjustment program is −6.93% of output when the construction share is large, while the ATE is much smaller for regions with low share of construction GVA – in effect being indistinguishable from zero. In a similar vein, we find that in regions with high share of industrial GVA the cumulative output loss could well be zero (insignificant), whereas the output loss amounts to −6.93% for regions with low share of industrial GVA. An almost identical picture is obtained when excluding the UK from the analysis (see Table A9 and Table A10 in the Appendix): there is a significant cumulative GDP loss for regions with high shares of agricultural or construction (and low industrial) GVA, whereas there seems to be no output loss (the effect is insignificant) for regions with low shares of agricultural or construction (and high industrial) GVA.

Finally, Table A11 and Table A12 in the Appendix report results when focusing on the Eurozone countries only, which are pretty similar to those for the EU countries – the point estimates of cumulative output loss do differ slightly. Hence, even when looking at countries that face a common monetary policy framework, we find that for regions with high share of industrial production in their economic activity (and low shares in agriculture and construction) the ATE of an austerity program is essentially insignificant, whereas the opposite is true for regions with low shares of their output coming from industry (and relatively higher shares from agriculture and construction).

The findings just discussed point out that there are some important disparities caused by fiscal adjustments: they tend to hurt more regions with higher shares of agricultural and construction activities, and less regions with higher shares of industrial activities. To the extent that the government does not want to introduce such asymmetries of its policies, these findings should not be taken lightly. One policy implication is that when designing fiscal austerity measures they should strike a delicate balance by addressing fiscal imbalances on the one hand, but also promoting spatial justice on the other, by not generating differential growth effects for different regions. To be more concrete, consider a program that aims at collecting revenues from taxes of a particular amount. The above analysis shows that if the government also aims at avoiding disparities of the taxes levied, it should aim at collecting more tax revenue from industrial activities and less from agricultural and construction. In this manner, the same amount of fiscal measures will have effects which will be more equally distributed across types of economic activities and consequently regions in which these activities thrive.

## 4.4. The Effect of Fiscal Adjustment Plan on Income Inequality

We now turn to estimating the ATE of fiscal austerity on income inequality. Relative to the results discussed in the previous subsections, we only present estimates that do not distinguish between booms and slumps for two reasons. First, the (effective) sample period we are working with contains about 180 observations, which becomes considerably less when we perform the analysis for the EU and the Eurozone countries. Second, the literature discussed above does not consider the differential effects of various determinants of inequality in recession and expansions.

In this subsection, the dependent variable we use is the cumulative change in inequality relative to the period before the austerity program was initiated. We include some covariates to control for determinants of inequality that have not been accounted for in the propensity scores estimation. Specifically, we include the one-year lag of (the log of) real GDP and its square, the one-year lag of (the log of) a human capital index, and one year lags of the inflation rate, unemployment rate and trade openness, while we also include a crisis dummy as defined in Jorda\` *et al.* (2017).

In Table 11 we report benchmark results for all 14 OECD countries for which we have data available. We find that the AIPW estimates of the ATE peak at a horizon of three years after the implementation of the austerity program, and they are significant for all five inequality measures employed – especially when we estimate the unrestricted model. All five measures of inequality invariably increase between 2.22% (Palma ratio) and 7.94% (Theil's *T*) at their peak. These findings are in line with those reported in the existing literature (Agnello and Sousa 2014; Agnello *et al.* 2016; Ball *et al.* 2013; Chroni and Konstantinou 2021; Furceri *et al.* 2015; Heimberger 2020; Woo *et al.* 2017), which using different samples and estimation techniques finds that a fiscal consolidation leads to an increase in income inequality. Our results however are in sharp contrast to those reported in Ciminelli *et al.* (2019) and Agnello and Sousa (2012) who report a reduction in income inequality for a group of 17 OECD countries.

**Table 11 The Effect of Fiscal Adjustment Plan on Income Inequality, AIPW Estimates, Full Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ |
|---|---|---|---|---|---|
| **Panel A: Atkinson Index** | | | | | |
| Fiscal Adjustment ATE | 0.430 | 5.172*** | 0.221 | 1.075 | -0.670 |
| (Restricted) | (0.639) | (1.271) | (2.502) | (3.133) | (3.419) |
| Fiscal Adjustment ATE | 1.063 | 6.067*** | 4.762 | 7.645* | 7.044 |
| (Unrestricted) | (1.053) | (1.983) | (3.172) | (3.969) | (4.668) |
| **Panel B: Gini Coefficient** | | | | | |
| Fiscal Adjustment ATE | 0.153 | 2.542*** | 0.391 | 0.649 | -0.329 |
| (Restricted) | (0.367) | (0.688) | (1.301) | (1.533) | (1.730) |
| Fiscal Adjustment ATE | 0.403 | 2.965** | 2.413 | 3.558* | 3.214 |
| (Unrestricted) | (0.550) | (1.005) | (1.620) | (1.954) | (2.395) |
| **Panel C: Palma Ratio** | | | | | |
| Fiscal Adjustment ATE | 0.548* | 2.026** | 1.301 | 0.836 | 0.026 |
| (Restricted) | (0.288) | (0.676) | (0.736) | (0.889) | (0.859) |
| Fiscal Adjustment ATE | 0.861* | 2.311** | 2.274* | 2.221* | 1.841 |
| (Unrestricted) | (0.478) | (0.937) | (1.111) | (1.221) | (1.317) |
| **Panel D: Theil's L (GE0)** | | | | | |
| Fiscal Adjustment ATE | 0.439 | 5.236*** | 0.216 | 1.067 | -0.683 |
| (Restricted) | (0.648) | (1.297) | (2.544) | (3.188) | (3.482) |
| Fiscal Adjustment ATE | 1.074 | 6.146** | 4.841 | 7.763* | 7.174 |
| (Unrestricted) | (1.072) | (2.030) | (3.240) | (4.056) | (4.771) |
| **Panel E: Theil's *T* (GE1)** | | | | | |
| Fiscal Adjustment ATE | 0.688 | 5.715*** | 0.126 | 1.102 | -0.794 |
| (Restricted) | (0.649) | (1.296) | (2.666) | (3.407) | (3.718) |
| Fiscal Adjustment ATE | 1.241 | 6.229** | 4.796 | 7.942* | 7.055 |
| (Unrestricted) | (1.046) | (2.050) | (3.320) | (4.264) | (4.973) |
| Observations | 180 | 180 | 180 | 180 | 179 |

**Notes**: Table 11 reports AIPW estimates of the fiscal consolidation ATE on between- region income inequality. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: one lag of log real GDP and its square, one lag of log human capital, and one lag of unemployment rate, openness and the inflation rate, as well as a dummy for crises from the JST database. Specification includes country fixed effects in the propensity score model and in the AIPW model. The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. ***/**/* indicate p-value < 0.01/0.05/0.10.

We move on to assess how our results fair if the sample is restricted to EU and Eurozone countries. Table 12 that presents our findings for the EU countries shows a very different picture from the one we just described for all OECD countries. The only significant effects are found at the one year ahead horizon and only in the *restricted model* – the only exception to this is the Palma ratio.[0] This short-lived increase in inequality is between 1.53 (Gini) and 3.62% (Theil's *T*), much smaller than our findings above. When we exclude the UK from the analysis in Table A13, we get very similar picture, the only difference being that now the AIPW estimates of the ATE are significant both in the restricted and unrestricted model. In the latter case we find that the increase in the inequality measures varies significantly between 2.79% (Palma) and 5.84% (Theil's *L*). Taken at face value Theil's measures show that an austerity program leads to increases in inequality of about equal magnitude both at the lower part (*L*) and the top (*T*) of the income distribution.

In the last experiment, we estimate again the ATE using the AIPW methodology and data only for the Eurozone economies. Results reported in Table 13 indicate that the ATE on regional inequality turns out to be statistical indistinguishable from zero. This holds true for all five inequality measures and all horizons – the only exceptions being the Gini coefficient at the one year horizon showing a 4% increase in inequality and the Palma ratio that shows a 2% reduction in inequality at the four year horizon, with both effects being significant only at the 10% level. A natural question that arises is whether the Eurozone is fundamentally different from the rest of the EU. The answer is probably not. Looking back at Table 12 and Table A13 in the Appendix the ATE is significant only at the one year horizon – results which are inline with that reported in Chroni and Konstantinou (2021) who find the effect of austerity is short-lived, but in contrast to those reported in Agnello *et al.* (2016), Ball *et al.* (2013), Furceri *et al.* (2015) and Heimberger (2020) who find that the effect is much longer-lived. One possible explanation for this difference could be the fact that the sample used here is much shorter in terms of time period covered relative to earlier studies.

**Table 12 The Effect of Fiscal Adjustment Plan on Income Inequality, AIPW Estimates, EU28 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ |
|---|---|---|---|---|---|
| **Panel A: Atkinson Index** | | | | | |
| Fiscal Adjustment ATE | -0.142 | 3.316** | -0.922 | 0.422 | -0.949 |
| (Restricted) | (0.722) | (1.403) | (1.939) | (1.968) | (2.580) |
| Fiscal Adjustment ATE | 1.531 | 4.885 | 3.490 | 4.826 | 6.531 |
| (Unrestricted) | (1.620) | (2.890) | (3.909) | (4.413) | (5.208) |
| **Panel B: Gini Coefficient** | | | | | |
| Fiscal Adjustment ATE | -0.215 | 1.528* | -0.537 | -0.066 | -0.922 |
| (Restricted) | (0.417) | (0.727) | (1.076) | (1.065) | (1.458) |
| Fiscal Adjustment ATE | 0.754 | 2.458 | 1.854 | 2.348 | 3.047 |
| (Unrestricted) | (0.805) | (1.439) | (2.023) | (2.302) | (2.837) |
| **Panel C: Palma Ratio** | | | | | |
| Fiscal Adjustment ATE | 0.717* | 2.291** | 1.491* | 1.047 | -0.209 |
| (Restricted) | (0.331) | (0.766) | (0.812) | (0.928) | (0.907) |
| Fiscal Adjustment ATE | 1.031 | 2.679** | 2.201 | 1.847 | 2.031 |
| (Unrestricted) | (0.596) | (1.196) | (1.397) | (1.523) | (1.725) |
| **Panel D: Theil's *L* (GE0)** | | | | | |
| Fiscal Adjustment ATE | -0.136 | 3.365** | -0.927 | 0.418 | -0.948 |
| (Restricted) | (0.733) | (1.434) | (1.978) | (2.020) | (2.637) |
| Fiscal Adjustment ATE | 1.538 | 4.937 | 3.538 | 4.890 | 6.623 |
| (Unrestricted) | (1.647) | (2.952) | (3.997) | (4.526) | (5.338) |
| **Panel E: Theil's *T* (GE1)** | | | | | |
| Fiscal Adjustment ATE | 0.153 | 3.623** | -0.907 | 0.591 | -0.797 |
| (Restricted) | (0.737) | (1.457) | (1.968) | (1.995) | (2.652) |
| Fiscal Adjustment ATE | 1.491 | 4.522 | 2.919 | 4.200 | 5.796 |
| (Unrestricted) | (1.617) | (2.922) | (3.908) | (4.482) | (5.334) |
| Observations | 154 | 154 | 154 | 154 | 154 |

**Notes**: Table 12 reports AIPW estimates of the fiscal consolidation ATE on between- region income inequality using data only for the EU countries. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: one lag of log real GDP and its square, one lag of log human capital, and one lag of unemployment rate, openness and the inflation rate, as well as a dummy for crises from the JST database. Specification includes country fixed effects in the propensity score model and in the AIPW model. The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. ***/**/* indicate p-value < 0.01/0.05/0.10

**Table 13 The Effect of Fiscal Adjustment Plan on Income Inequality, AIPW Estimates, Eurozone Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ |
|---|---|---|---|---|---|
| **Panel A: Atkinson Index** | | | | | |
| Fiscal Adjustment ATE | 0.749 | 1.709 | -3.033 | -1.077 | -4.087 |
| (Restricted) | (0.855) | (1.512) | (2.300) | (1.897) | (3.009) |
| Fiscal Adjustment ATE | 3.811 | 7.237 | 5.149 | 8.005 | 10.129 |
| (Unrestricted) | (2.332) | (3.948) | (4.483) | (4.922) | (5.764) |
| **Panel B: Gini Coefficient** | | | | | |
| Fiscal Adjustment ATE | 0.308 | 0.910 | -1.706 | -0.725 | -2.772 |
| (Restricted) | (0.498) | (0.818) | (1.320) | (1.102) | (1.794) |
| Fiscal Adjustment ATE | 2.122 | 4.014* | 2.976 | 4.289 | 5.238 |
| (Unrestricted) | (1.174) | (1.963) | (2.330) | (2.581) | (3.148) |
| **Panel C: Palma Ratio** | | | | | |
| Fiscal Adjustment ATE | 0.286 | 0.372 | -0.723 | -0.435 | -2.240* |
| (Restricted) | (0.361) | (0.689) | (0.726) | (0.945) | (1.008) |
| Fiscal Adjustment ATE | 1.415 | 2.185 | 1.301 | 0.903 | 0.980 |
| (Unrestricted) | (0.832) | (1.498) | (1.603) | (1.887) | (1.890) |
| **Panel D: Theil's *L* (GE0)** | | | | | |
| Fiscal Adjustment ATE | 0.768 | 1.729 | -3.069 | -1.113 | -4.132 |
| (Restricted) | (0.866) | (1.541) | (2.336) | (1.937) | (3.056) |
| Fiscal Adjustment ATE | 3.845 | 7.313 | 5.211 | 8.085 | 10.231 |
| (Unrestricted) | (2.369) | (4.021) | (4.579) | (5.037) | (5.894) |
| **Panel E: Theil's *T* (GE1)** | | | | | |
| Fiscal Adjustment ATE | 1.084 | 1.860 | -2.958 | -0.921 | -3.744 |
| (Restricted) | (0.899) | (1.452) | (2.246) | (1.777) | (2.957) |
| Fiscal Adjustment ATE | 3.699 | 6.533 | 4.343 | 7.117 | 9.087 |
| (Unrestricted) | (2.300) | (3.813) | (4.293) | (4.807) | (5.701) |
| Observations | 112 | 112 | 112 | 112 | 112 |

**Notes**: Table 13 reports AIPW estimates of the fiscal consolidation ATE on between- region income inequality using data only for the Eurozone countries. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: one lag of log real GDP and its square, one lag of log human capital, and one lag of unemployment rate, open- ness and the inflation rate, as well as a dummy for crises from the JST database. Specification includes country fixed effects in the propensity score model and in the AIPW model. The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. ***/**/* indicate p-value < 0.01/0.05/0.10.

To recapitulate, we find that the ATE is significant and slightly more persistent for the 14 OECD countries together, whereas it is much shorter-lived for the EU countries, being insignificant when the group is narrowed down to the Euro-zone. One potential explanation of this finding is that the inequality measures we have used are just "proxies" for between-region inequality, whereas typical analyses employ country-wide measures (Gini coefficients) obtained from micro-level data. A second potential explanation is that the proxies employed here are based on strong assumptions (equal distribution within region) and therefore are subject to measurement error. However, in our view they do provide a fresh look at what happens in regional inequality within countries following the adoption of austerity programs.

# 5 Concluding Remarks and Outlook

Following the fiscal consolidations programs adopted to reverse the expansions that took place during the GFC, a series of papers has sought to assess whether and to what extent these consolidations have been detrimental to growth. There seems to be a consensus that austerity tends to generate recessions, with the estimates varying depending on the exact dataset used as well as the technique employed. Moreover, some papers have demonstrated that the adoption of austerity also tends to increase income inequality, and it does so in a persistent fashion. However, this literature has mostly shunned away from studying the effects of such changes in fiscal policy on regional outcomes, be they income growth or income inequality.

This paper has tried filling this gap, setting out to estimate the regional effects of fiscal austerity programs. In doing so, we moved away from typical analyses that study these effects by simply estimating the dynamic responses to exogenous shifts in policy using panel VAR models and/or local projections methods. Instead, we adopt an Augmented Inverse Probability Weighted estimator that allows us to estimate the average treatment effect of consolidation programs, following the early lead of Jorda` and Taylor (2016). Our analysis employs regional data from 14 OECD economies that cover the period 2000-2018.

Findings reported show clearly that austerity measures lead to a persistent reduction in regional income growth, with the ATE estimated to be larger than its national counterpart: our estimate of the ATE for the accumulated income loss is as low as −5.6% whereas the country-level estimate is about −3.6% (Jorda` and Taylor 2016). The estimated ATE is also found to be much larger in recessions (between −5.94% and −6.80%) than in expansions (between −3.28% and −6.62%), but the latter is invariably statistically insignificant, in line with country-level estimates. We also find that cumulative output losses tend to be larger in regions where agricultural production and construction tend to be more important economic activities, whereas these losses are smaller in regions where industrial production is larger. Regarding the relation of our work to WP8 our results indicate that spatial justice in a fiscal austerity period would imply designing fiscal adjustment programs that shift the burden more towards industrial activities and less towards agricultural and construction ones. Finally, the estimated ATE on between-region income inequality is found to be large in economic terms (between 2.2% and 7.9%), but the all the effect takes place within a couple of years, leaving no significant drag.

The present study presents a step into assessing the regional effects of fiscal austerity measures. It complements the analysis of WP6 on the effects of fiscal policy (welfare regimes) on regional inequalities using micro data from the tax-benefit microsimulation model EUROMOD. However future research could and should assess the effects of our paper on a larger cross-section of countries, thereby providing more general results. Admittedly, the inequality measures employed here are far from perfect and do not vary at the regional level. In that respect our study stresses the importance of WP2 work to construct a dataset of local indicators from disaggregated data estimations produced through estimation techniques. Unfortunately to use these disaggregated data in our analysis would require future research repeating this exercise for more years to assign a time dimension to the dataset. This would be an important step forward that would allow investigating the effects of policy interventions on income inequality using spatial income distribution data at the micro level.

# References

Agnello L. and Sousa R. M. (2012) Fiscal Adjustment and Income Inequality: a First Assessment, Applied Economics Letters 19(16): 1627–1632

Agnello, L., and Sousa, R. M. (2014) How Does Fiscal Consolidation Impact on Income Inequality?, *Review of Income and Wealth*, 60(4): 702–726.

Agnello, L., Fazio, G. and Sousa R. M. (2016), National Fiscal Consolidations and Regional Inequality in Europe, *Cambridge Journal of Regions, Economy and Society*, 9(1): 59–80.

Agnello, L., Castro, V., Jalles, J.T and Sousa, R. M. (2016) Income inequality, fiscal stimuli and political (in)stability, International Tax and Public Finance 24: 484– 511

Alesina, A. and Ardagna, S. (2010) Large Changes in Fiscal Policy: Taxes versus Spending, in **J. R. Brown** (ed.), *Tax policy and the economy*, Vol. 24, pp. 35–68, University of Chicago Press, Chicago.

Alesina, A. and Ardagna, S. (2013) ‘The Design of Fiscal Adjustments, in **J. R. Brown** (ed.), *Tax policy and the economy*, Vol. 27, pp. 19–67

Alesina, A., Barbiero, O., Favero, C., Giavazzi, F. and Paradisi, M. (2015) Austerity in 2009–2013, *Economic Policy* 30(83): 385–437

Alesina, A., Barbiero, O., Favero, C., Giavazzi, F. and Paradisi, M. (2017) The Effects of Fiscal

Consolidations: Theory and Evidence, *NBER WP* No. 23385

Alesina, A., Favero, C. and Giavazzi, F. (2015) The Output Effect of Fiscal Consolidation Plans, *Journal of International Economics*, 96: S19–S42

Alesina, A., Favero, C. and Giavazzi, F. (2019) *Austerity: When it Works and when it Doesn't*, Princeton University Press.

Angrist, J. D., Jorda`, O` . and Kuersteiner, G. M. (2018) Semiparametric Estimates of Monetary Policy Effects: String Theory Revisited, *Journal of Business and Economic Statistics*, 36(3): 371–387

Atkinson, A. (2015) *Inequality: What Can Be Done?* Harvard University Press

Auerbach, A. J. and Gorodnichenko, Y. (2012) Measuring the Output Responses to Fiscal Policy, *American Economic Journal: Economic Policy*, 4(2): 1–27.

Auerbach, A. J. and Gorodnichenko, Y. (2013) Fiscal multipliers in recession and expansion, in **A**. **Alesina** and **F**. **Giavazzi**, (eds.) *Fiscal Policy after the Financial Crisis*, pp. 98–102, University of Chicago Press.

Ball, L. M., Furceri, D., Leigh, M. D., and Loungani, M. P. (2013) The distributional effects of fiscal consolidation, *IMF WP No.* 13/151

Barrell R., Holland D. and Hurst I. (2012) Fiscal Multipliers and Prospects for Consolidation, *OECD Journal: Economic Studies* 2012(1): 71–102

Baret, K. (2018) Effectiveness of fiscal performance in the EU: Contributions of Propensity Score Matching, *Bureaud Economie the Oriqueet Appliquee*, 2018: 1–31.

Barro, R. J. and Redlick, C. J. (2011) Macroeconomic Effects from Government Purchases and Taxes, *Quarterly Journal of Economics*, 126(1): 51–102.

Bastagli, F. Coady, D. and Gupta (2012) Income Inequality and Fiscal Policy, *IMF Staff Discussion Note* SDN/12/08

Baxter, M. and King, R. G. (1993) Fiscal Policy in General Equilibrium, *American Economic Review*, 83(3): 315–34.

Blanchard, O. and Leigh, D. (2013) Growth Forecast Errors and Fiscal Multipliers, IMF WP No 13/1.

Blanchard O. and Leigh D. (2014) Learning about Fiscal Multipliers from Growth Forecast Errors, *IMF Economic Review* 62(2): 179–212

Born, B., Mu¨ ller, G., Pfeifer, J. and Wellmann, S. (2020) Different no more: Country spreads in advanced and emerging economies, *CEPR Discussion Paper* 14392

Christiano, L.J., Eichenbaum, M. and Rebelo, S. (2011). When is the Government Spending Multiplier Large? *Journal of Political Economy*, 119(1): 78–121

Chroni, E. and Konstantinou, P. T. (2021) Fiscal Adjustments and Income Inequality: Evidence from OECD Countries, *AUEB mimeo*

Ciminelli, G., Ernst, E., Merola, R., and Giuliodori, M. (2019) The composition effects of tax-based consolidation on income inequality, *European Journal of Political Economy*, 57: 107–124

Cowell, F. A. (2011) *Measuring Income Inequality*, 3rd ed, Oxford University Press DeLong, J. B. and Summers, L. H. (2012) Fiscal Policy in a Depressed Economy, *Brookings Papers on Economic Activity*, 43(1): 233–297

Devries, M.P., Guajardo, J., Leigh, M.D., and Pescatori, A. (2011) A New Action-Based Dataset of Fiscal Consolidation, *IMF WP No* 11/128

Feenstra, R. C., Inklaar, R. and Timmer, M. P. (2015) The Next Generation of the Penn World Table, *American Economic Review* 105(10): 3150–3182

Furceri D., Jalles J. T., Loungani P. (2015) Fiscal Consolidation and Inequality in Advanced Economies: How Robust is the Link?, Chapter 8 in **Clements, B., de Mooij, R., Gupta, S.** and **Keen, M.** (eds) *Inequality and fiscal policy*, International Monetary Fund, pp. 141–158

Furceri, D., Ge, J., Loungani, P. and Melina, G. (2018) The Distributional Effects of Government Spending Shocks in Developing Economies, *IMF WP No.* 18/57

Furceri, D., Loungani, P. and Ostry, J. D. (2019) The Aggregate and Distributional Effects of Financial Globalization: Evidence from Macro and Sectoral Data. *Journal of Money, Credit and Banking* 51: 163–198.

Glynn, A.N., and Quinn, K.M. (2010) An introduction to the augmented inverse propensity weighted estimator, *Political Analysis* 18(1): 36–56.

Guajardo, J., Leigh, D. and Pescatori, A. (2014). Expansionary austerity: new international evidence, *Journal of the European Economic Association*, vol. 12(4): 949–68.

Heimberger, P. (2020) The dynamic effects of fiscal consolidation episodes on income inequality: evidence for 17 OECD countries over 1978–2013, *Empirica* 47:53–81

Ilzetzki E., Mendoza E. G. and Ve´gh C. A. (2013) How Big (Small?) Are Fiscal Multipliers? *Journal of Monetary Economics* 60(2): 239–254

Imbens, G. W. (2004) Nonparametric Estimation of Average Treatment Effects Un- der Exogeneity: A Review, *Review of Economics and Statistics* 86(1): 4–29.

International Monetary Fund (2012) Taking stock. A Progress Report on Fiscal Adjustment, *Fiscal Monitor* October 2012, International Monetary Fund

International Monetary Fund (2014) Fiscal Policy and Income Inequality, *IMF Policy Paper* January 23rd 2014, International Monetary Fund

Jorda`, O` . (2005). Estimation and Inference of Impulse Responses by Local Projections, *American Economic Review*, 95(1):161–182.

Jorda`, O` ., Schularick, M., and Taylor, A. M. (2017) Macrofinancial History and the New Business Cycle Facts, *NBER Macroeconomics Annual*, 31(1): 213–263

Jorda`, O` . and Taylor, A. M. (2016) The Time for Austerity: Estimating the Average Treatment Effect of Fiscal Policy, *Economic Journal*, 126(590): 219–255

Lane P. R. (2012) The European Sovereign Debt Crisis, *Journal of Economic Perspectives* 26(3): 49–68

Lunceford, J. K. and Davidian, M. (2004) Stratification and Weighting via the Propensity Score in Estimation of Causal Treatment Effects: a Comparative Study, *Statistics in Medicine*, 23(19): 2937–2960.

Mountford, A. and Uhlig, H. (2009) What Are the Effects of Fiscal Policy Shocks?, *Journal of Applied Econometrics*, 24(6): 960–92

Musho¨ vel, F. (2020) Fiscal Consolidation and Inequality: the Distributive Effects of Fiscal Reforms in Greece and Portugal in **N. F. Campos**, **P. De Grauwe** and **Y. Ji** (eds.) *Economic Growth and Structural Reforms in Europe* Cambridge University Press

Mulas-Granados, C. (2005) Fiscal Adjustments and the Short-Term Trade-Off Between Economic Growth and Equality, Hacienda Pu´blica Espan˜ola/Revista de Econom´ıa Pu´blica, 172(1): 61–92.

Nakamura, E. and Steinsson, J. (2014) Fiscal Stimulus in a Monetary Union: Evidence from US Regions, *American Economic Review*, 104(3): 753–92.

Owyang, M.T., Ramey, V.A. and Zubairy, S. (2013) Are Government Spending Mul- tipliers Greater During Periods of Slack? Evidence from Twentieth-Century Historical Data, *American Economic Review*, 103(3): 129–34.

Piketty, T. (2014) *Capital in the Twenty-First Century*, Harvard University Press Ramey, V. A. (2011) Can Government Purchases Stimulate the Economy? *Journal of Economic Literature*, 49(3): 673–85.

Ramey, V. A. (2016) Macroeconomic Shocks and Their Propagation. In **J. Taylor** and **H. Uhlig**, eds., *Handbook of Macroeconomics*, Vol. 2., Elsevier, pp. 71–162. Ramey,

V. A. and Zubairy, S. (2018) Government Spending Multipliers in Good Times and in Bad: Evidence from US Historical Data, *Journal of Political Economy*, 126(2): 850–901.

Romer, C. D. and Romer, D. H. (2010) The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks, *American Economic Review* 100(3): 763–801.

Rosenbaum, P. R. and Rubin, D. B. (1983). The Central Role of the Propensity Score in Observational Studies for Causal Effects, *Biometrika*, 70(1): 41–55

Tapsoba, R. (2012) Do National Numerical Fiscal Rules really shape fiscal behaviours in developing countries? A treatment effect evaluation, *Economic Modelling* 29: 1356–1369

Woo, J, Bova, E., Kinda, T. and Zhang, Y. S. (2017) Distributional Consequences of Fiscal Adjustments: What Do the Data Say?, *IMF Economic Review* 65: 273–307

Woodford M. (2011) Simple Analytics of the Government Expenditure Multiplier, *American Economic Journal: Macroeconomics* 3(1): 1–35

Wooldridge, J.M. (2007) Inverse Probability Weighted M-Estimation for General Missing Data Problems, *Journal of Econometrics* 141(2): 1281–301.

# Appendix

## A1. Statistical Approach

Let $y_t$ be the outcome variable of interest during year $t$ and $D_{ct} \in \{0,1\}$ denote the fiscal consolidation indicator, which takes place at the country level.[20] In what follows, we try to estimate the effect of the *treatment* on the cumulative change of the outcome variable $h$ periods ahead, relative to the period before the program, $y_{t+h} - y_{t-1}$. A simple way to estimate this causal effect of interest would be by estimating series of a local projections (LP) regressions of the form (see for instance Jorda` (2005))

$$y_{t+h} - y_{t-1} = D_{ct}\gamma_1^h + (1 - D_{ct})\gamma_0^h + D_{ct}\mathbf{w}_t'\boldsymbol{\beta}_1^h + (1 - D_{ct})\mathbf{w}_t'\boldsymbol{\beta}_0^h + v_{t+h} \quad (1)$$

where $\mathbf{w}_t$ is a set of controls, and the policy effect is $(\gamma_1^h - \gamma_0^h)$.[21] Here one could assume that the effect of controls across treated and control subpopulations is stable (that is $\boldsymbol{\beta}_1^h = \boldsymbol{\beta}_0^h = \boldsymbol{\beta}^h$ ) but this is not required. If we do not wish to impose the quite restrictive condition that the expected value of $\mathbf{w}_t$ in each subpopulation (treated vs. nontreated) is the same, and that the slopes of the controls are common, we may estimate the causal effect of interest by

$$y_{t+h} - y_{t-1} = \frac{1}{n_1}\sum_{t=1}^{T} D_{ct}\mu_1^h(\mathbf{w}_t, \boldsymbol{\psi}_1^h) - \frac{1}{n_0}\sum_{t=1}^{T}(1 - D_{ct})\mu_0^h(\mathbf{w}_t, \boldsymbol{\psi}_0^h) \text{ for all } h > 0 \quad (2)$$

where $\mu_j^h(\mathbf{w}_t, \boldsymbol{\psi}_j^h)$ denotes the conditional mean of $y_{t+h} - y_{t-1}$ and $\boldsymbol{\psi}_j^h = (\gamma_j^h, \boldsymbol{\beta}_{1j}^h)$ for each subgroup.

Following Jorda` and Taylor (2016), we assume that policy (treatment) is deter- mined by $D_{ct} = D(\mathbf{x}_{ct}, \boldsymbol{\phi}, \varepsilon_{ct})$, where $\boldsymbol{\phi}$ are parameters of the implied policy function and $\varepsilon_{ct}$ is a source of random variation. We also assume that the conditional independence assumption (CIA) holds (see also Angrist *et al.* (2018) and Rosenbaum and Rubin (1983)):

$$y_{t+h}(d) - y_{t-1} \perp D_{ct} | \mathbf{x}_{ct} \text{ for all } h > 0 \text{ and for } d \in \{0,1\} \quad (3)$$

where $y_{t+h}(d)$ is the potential outcome when the unit receives the treatment $(d = 1)$ and when it does not $(d = 0)$, and $\mathbf{x}_{ct}$ is a vector of controls that determine the treatment policy. The idea

[20] Note that in some cases the outcome will be income in region $i$, in country $c$, during year $t$, whereas in others it will be between-region inequality at the country level. We have therefore chosen not to include region/country subscripts here.
[21] Note that these controls might be at a different level than those that determine the treatment assignment below, e.g. these could be region-level controls, whereas treatment assignment is at the national level.

is that the treatment-control allocation is independent of potential outcomes, conditional on the covariates.

If the CIA holds, then by means of the propensity score theorem (Rosenbaum and Rubin 1983) equation (3) may be expressed as

$$y_{t+h}(d) - y_{t-1} \perp D_{ct} | p(D_{ct} = 1|\mathbf{x}_{ct}, \boldsymbol{\phi}) \text{ for all } h > 0 \text{ and for } d \in \{0,1\} \qquad (4)$$

where $p(D_{ct} = 1|\mathbf{x}_{ct}, \boldsymbol{\phi})$ is the propensity score indicating the probability of receiving a treatment conditional on $\mathbf{x}_{ct}$.[22] Note that (4) indicates that it is sufficient to *match* the treatment and control groups based on their propensity scores, instead of matching covariates directly.

Let the policy propensity score be defined as $p(D_{ct} = 1|\mathbf{x}_{ct}, \boldsymbol{\phi}) = p_1(\mathbf{x}_{ct}, \boldsymbol{\phi})$ and $p(D_{ct} = 0|\mathbf{x}_{ct}, \boldsymbol{\phi}) = p_0(\mathbf{x}_{ct}, \boldsymbol{\phi}) = 1 - p_1(\mathbf{x}_{ct}, \boldsymbol{\phi})$. Given these, the ATE can then be expressed as

$$\begin{aligned} & E\{[y_{t+h}(1) - y_{t-1}] - [y_{t+h}(0) - y_{t-1}]\} \\ &= E(E\{[y_{t+h}(1) - y_{t-1}] - [y_{t+h}(0) - y_{t-1}]\}|\mathbf{x}_{ct}) \\ &= E\left\{(y_{t+h} - y_{t-1})\left[\frac{\mathbf{1}\{D_{ct} = 1\}}{p_1(\mathbf{x}_{ct}, \boldsymbol{\phi})} - \frac{\mathbf{1}\{D_{ct} = 0\}}{1 - p_1(\mathbf{x}_{ct}, \boldsymbol{\phi})}\right]\right\} \text{ for all } h > 0. \end{aligned} \qquad (5)$$

where $\mathbf{1}\{\cdot\}$ is an indicator function. Substituting with estimated values, we obtain an estimate of the fiscal program ATE by the inverse propensity weighted (IPW) estimator:

$$\widehat{ATE}^h_{IPW} = \frac{1}{n_1^*}\sum\nolimits_{t=1}^{T} \frac{D_{ct}(y_{t+h} - y_{t-1})}{\widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})} - \frac{1}{n_0^*}\sum\nolimits_{t=1}^{T} \frac{(1 - D_{ct})(y_{t+h} - y_{t-1})}{1 - \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})}, \qquad (6)$$

with $n_1^* = \sum_{t=1}^{T} D_{ct}/\widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})$ and $n_0^* = \sum_{t=1}^{T}(1 - D_{ct})/(1 - \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi}))$. The recent literature has shown that it is possible to use refinements to the IPW estimator, which increase robustness and efficiency by weights renormalization and regression adjustment leading to a class of doubly robust estimators (Imbens 2004; Lunceford and Davidian 2004; Wooldridge 2007). In particular Lunceford and Davidian (2004) show that the most efficient doubly robust estimator is the augmented IPW (AIPW) estimator which takes the form:

$$\begin{aligned} \widehat{ATE}^h_{AIPW} = \frac{1}{n}\sum\nolimits_{t=1}^{T} \Bigg\{ & \left[\frac{D_{ct}(y_{t+h} - y_{t-1})}{\widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})} - \frac{(1 - D_{ct})(y_{t+h} - y_{t-1})}{1 - \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})}\right] \\ & \frac{D_{ct} - \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})}{\widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})(1 - \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi}))}\left[(1 - \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi}))\mu_1^h(\mathbf{w}_t, \widehat{\boldsymbol{\psi}}_1^h) + \widehat{p_1}(\mathbf{x}_{ct}, \boldsymbol{\phi})\mu_0^h(\mathbf{w}_t, \widehat{\boldsymbol{\psi}}_0^h)\right] \Bigg\} \end{aligned} \qquad (7)$$

[22] One may employ a probit or a logit model to estimate the propensity score and we opt for the first alternative.

Essentially (7) is the basic IPW estimator in (6) plus a regression adjustment term (a weighted average two regression).

The AIPW estimator is ‘doubly robust’ as long as either the regression for the outcome is correctly specified or the propensity score is properly specified (Imbens 2004), and has been recently used in studying the effects fiscal austerity programs (Jorda` and Taylor 2016) or the effects of a risk-spread shock (Born *et al.* 2020).

### A2. Estimating Propensity Scores

Similar to the propensity score matching method used Baret (2018) and Tapsoba (2012), the re-randomization of the AIPW method is a neat way to deal with this issue by re-assigning the weights based on the probability of implementing a fiscal consolidation. To this end, we estimate a series of probit models of the fiscal austerity treatment, and use the predicted probability as the propensity score ($\hat{p}$). In order to estimate the propensity score at the country level, following Jorda` and Taylor (2016) we use a wide set of covariates. These include the public debt to GDP ratio, the output gap, the growth rate of GDP, real private loan growth, CPI inflation, the change in the investment to GDP ratio, the short-term and long- term interest rates on government securities, the current account to GDP ratio. Real GDP comes from the Penn World Tables (Feenstra *et al.* 2015) and the output gap is constructed from the cyclical component of log GDP using the HP filter with smoothing parameter set to 100. The other variables have been obtained from the Jorda`-Schularick-Taylor Macrohistory Database (see Jorda` *et al.* 2017).[23] That is, I estimate:

$$p_{ct} = \Pr\left(FProgram_{ct} = 1 | \mathbf{x}_{c,t}\right) \qquad (8)$$

where $FProgram_{ct}$ equals 1 when a new fiscal program takes place in country $c$ in year $t$. We employ two lags of the growth rate of GDP, one lag of the Debt to GDP ratio, the output gap, real private loan growth, CPI inflation, the change in investment to GDP ratio, the short and the long-term interest rates and the current account to GDP, as well as the treatment variable lagged once. The specifications include country fixed effects as well.

We have chosen to estimate four models. The first uses the sample period 1978-2014 and employs all 16 OECD countries, whereas the second excludes Australia and Canada from the analysis – these countries do not have TL3 regional output data, hence the outcome variables are not available for them. The third uses the sample period 2000-2018 and employs all 16 OECD countries, whereas the fourth uses the same period but excludes Australia and Canada from the analysis. The marginal effects of all four models are reported in Table A1. The predicted

[23] The Jordà *et al.* (2017) database does not include data for Austria. These have been obtained from IMF’s International Financial Statistics and Historical Public Debt Database, the OECD Main Economic Indicators and Economic Outlook and BIS (total credit to the private- non-financial sector).

probabilities from these probit models can be used as the propensity scores in what follows. Note that the debt to GDP ratio is not found to be significant in any specification, unlike the findings of Jordà and Taylor (2016). Moreover, the output gap is a significant driver of fiscal consolidations for the full sample, whereas the inflation rate, the change in investment to GDP ratio and the interest rates are significant determinants in all specifications, and the same applies to the lagged treatment variable.

**Table A1 Fiscal Treatment Regression, Probit Estimators (Average Marginal Effects)**

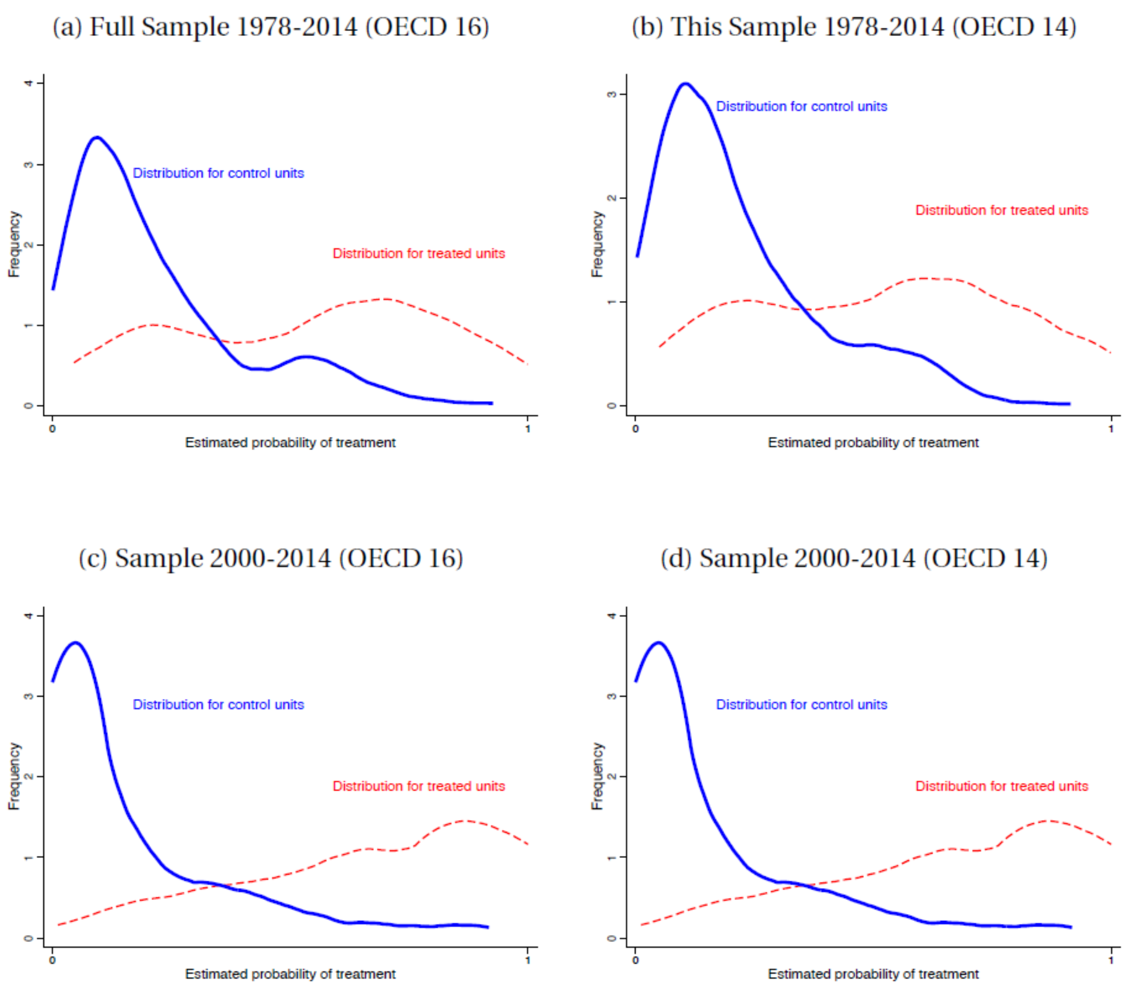
Probit Model of Treatment at Year *t* (Fiscal Adjustment Event)

| Model | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Public Debt/GDP ($t-1$) | 0.133 | 0.106 | 0.124 | 0.140 |
| | (0.154) | (0.161) | (0.090) | (0.092) |
| Output Gap ($t-1$) | 0.015** | 0.017*** | 0.009 | 0.011 |
| | (0.007) | (0.007) | (0.008) | (0.009) |
| Growth Rate of Output ($t-1$) | -0.008 | -0.007 | 0.012 | 0.015 |
| | (0.008) | (0.008) | (0.009) | (0.010) |
| Growth Rate of Output ($t-2$) | -0.009 | -0.015 | 0.001 | -0.001 |
| | (0.009) | (0.009) | (0.010) | (0.012) |
| Real Private Loan Growth ($t-1$) | -0.670 | -0.916 | -0.346 | -0.636 |
| | (0.571) | (0.635) | (0.564) | (0.640) |
| CPI Inflation ($t-1$) | -0.027** | -0.025** | 0.054** | 0.059** |
| | | (0.010) | | |
| Change in Investment to GDP Ratio ($t-1$) | -0.006** | -0.005* | -0.014*** | -0.014*** |
| | (0.003) | (0.003) | (0.004) | (0.004) |
| Short-Term Interest Rate ($t-1$) | -0.035*** | -0.035*** | -0.125*** | -0.129*** |
| | (0.013) | (0.014) | (0.025) | (0.030) |
| Long-Term Interest Rate ($t-1$) | 0.061*** | 0.056*** | 0.091*** | 0.109*** |
| | | | (0.023) | |
| Current Account to GDP ratio ($t-1$) | -0.00015 | -0.00022* | -0.00025 | -0.00024 |
| | (0.00013) | (0.00013) | (0.00017) | (0.00017) |
| Treatment ($t-1$) | 0.254*** | 0.225*** | 0.194*** | 0.177*** |
| | (0.039) | (0.042) | (0.045) | (0.050) |
| Observations | 573 | 501 | 240 | 195 |
| Classification test: AUROC | 0.827 | 0.815 | 0.903 | 0.917 |
| | (0.019) | (0.021) | (0.021) | (0.020) |

**Notes** for Table A1 Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). The output gap $y_{gap}$ is obtained from log real GDP using an HP filter with $\lambda = 100$: $y_{gap} = (\exp(y_c) - 1) \times 100$, where $y_c$ is the cyclical component of the filter. Column (1) reports results from a probit model with data for all 16 countries in the dataset of Alesina *et al.* (2019) over 1978-2014 and column (2) the same probit estimated without Australia and Canada in the sample. Both probit specifications include country dummies. Columns (3) and (4) report similar estimates using data for the period 2000-2014. AUROC is the area under the receiver operating characteristic (ROC) curve. *** p<0.01, ** p<0.05, * p<0.1

To get a better feeling of the estimated propensity scores Figure 1 displays smooth kernel density estimates of the distribution of the propensity scores for the treated and control units to check for overlap. All four figures show that the distribution of treated country-years spike at a value close to one and that of the control spike at a value close to zero, and more importantly that there is considerable overlap between the distributions. This in turn implies that I have at hand some satisfactory propensity score models, with which I may estimate the ATE properly, using the AIPW estimator. However, the figure also indicates that there are some observations likely to get very high weights. Specifically, there are control (treated) units whose propensity score is near zero (one) and hence get weights in the AIPW that are quite large.

**Figure 1 Overlap Checks: Empirical Distributions of the Treatment Propensity Scores**




**Notes**: The propensity score is estimated using the saturated probit specification discussed in the text, which includes country fixed effects. Figure 1 displays the predicted probabilities of treatment with a dashed line for the treatment observations and with a solid line for the control observations. Panel (a) shows the distributions for the treated and control groups using estimates for all 16 OECD countries available in Alesina *et al.* (2019) for the period 1978-2014. Panel (b) displays the same distributions when excluding Australia and Canada from the sample. Panel (c) reports the same distributions when probit models are estimated for all 16 OECD countries but for the period 2000-2014 and Panel (d) when Australia and Canada are again excluded from the smaller sample period.

To see this more clearly, in Table A2 we report summary statistics for the predicted probabilities from the four estimated models as well as using the full sample to estimate the model and then truncating the *effective* sample period, and also dropping the two countries from the sample for which the outcome variables are not available. The crucial finding is that when using data only for the post 2000 period the minimum and maximum predicted probabilities are very close to zero and one respectively, implying extremely large and minuscule weights on some observations. Based on these findings the Common Support hypothesis ($0 < p(\mathbf{x}_{ct}) < 1$), which translates into the existence of some comparable control units for each treated unit, is clearly violated when we restrict the estimation period to 2000-2014. We have therefore decided to proceed with our analysis using the full sample estimates, but truncating the *effective sample* to the post 2000 period. The kernel density estimates of propensity scores for the full sample and the ones finally adopted are graphically displayed in Figure 2.

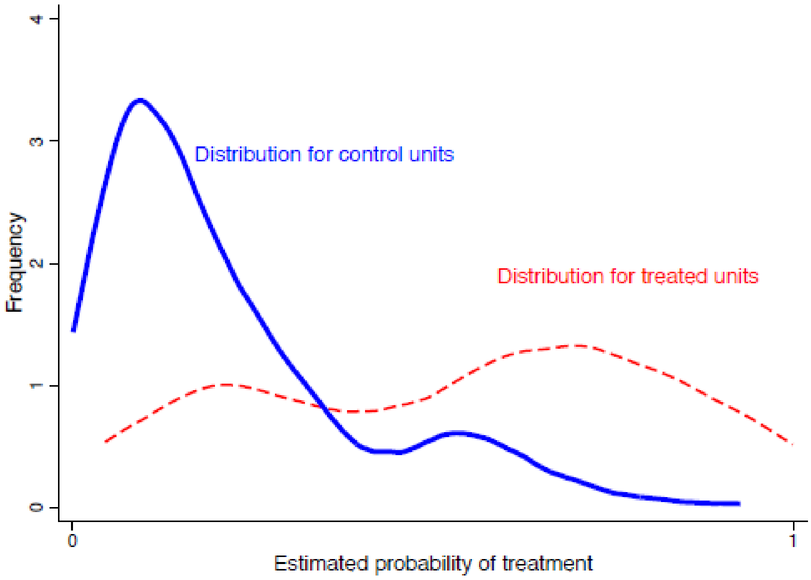
**Table A2 Propensity Scores: Summary Statistics**

| | mean | st. dev. | min | max | obs. |
|---|---|---|---|---|---|
| Full Sample, 16 Countries ($\hat{p}_1$) | 0.3191 | 0.2640 | 0.0010 | 0.9992 | 573 |
| Full Sample, 14 Countries ($\hat{p}_2$) | 0.3133 | 0.2544 | 0.0032 | 0.9989 | 501 |
| 2000-2014, 16 Countries ($\hat{p}_3$) | 0.3459 | 0.3432 | 0.0000 | 1 | 240 |
| 2000-2014, 14 Countries ($\hat{p}_4$) | 0.3470 | 0.3413 | 0.0000 | 1 | 210 |
| 2000-2014, 16 Countries ($\hat{p}_1^*$) | 0.3193 | 0.2706 | 0.0124 | 0.9992 | 240 |
| 2000-2014, 14 Countries ($\hat{p}_1^{**}$) | 0.3287 | 0.2773 | 0.0124 | 0.9992 | 210 |

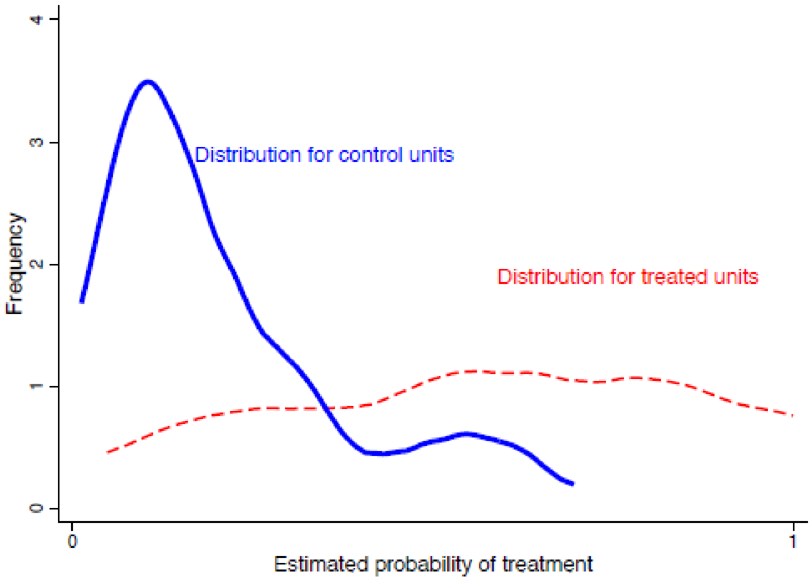
**Notes** for Table A2: The table reports summary statistics of the predicted probabilities in rows 1 to 4 from models estimated in Table 2. The fifth row shows summary statistics from the model estimated in column (1) of Table 2, but with the sample truncated to the period 2000-2014. The sixth row shows the same summary statistics excluding observations for Australia and Canada.

**Figure 2 Overlap Checks: Empirical Distributions of the Treatment Propensity Score**

(a) Full Sample Estimates for all 16 OECD Countries




(b) Full Sample Estimates for all 16 OECD Countries, Truncated: 2000-2014, excl. AUS & CAN




**Notes**: The propensity score is estimated using the saturated probit specification discussed in the text, which includes country fixed effects. Figure 2 displays the predicted probabilities of treatment with a dashed line for the treatment observations and with a solid line for the control observations. Panel (a) of the figure shows the distributions for the treated and control groups using estimates for all 16 OECD countries available in Alesina *et al.* (2019) for the sample period 1978-2014. Panel (b) displays the same distributions, but truncated for the period used in the analysis 2000-2014 and excluding observations for Australia and Canada. Both are based on estimates reported in column (1) in Table 2.

# TABLES

**Table A3 The Effect of Fiscal Adjustment Plan, AIPW Estimates, EU27 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE | -0.144 | -0.858** | -0.594 | -2.318*** | -0.964 | -4.868* |
| (Restricted) | (0.382) | (0.279) | (0.595) | (0.547) | (1.172) | (2.613) |
| Fiscal Adjustment ATE | -0.277 | -1.018** | -0.657 | -2.190*** | -0.917 | -5.047 |
| (Unrestricted) | (0.394) | (0.445) | (0.655) | (0.636) | (1.242) | (2.977) |
| Observations | 10116 | 10114 | 10112 | 10110 | 10108 | 10108 |

**Notes**: Table A3 reports AIPW estimates of the fiscal consolidation ATE using data only for the EU27 countries/regions (excluding the UK regions). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. ***/**/* indicate p-value< 0.01/0.05/0.10.

**Table A4 The Effect of Fiscal Adjustment Plan, AIPW Estimates, Booms *vs.* Slumps, EU27 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE in boom | -1.530*** | -0.731 | 1.302 | -0.754 | -1.116 | -2.829 |
| (Restricted) | (0.266) | (0.558) | (1.128) | (1.646) | (1.501) | (4.076) |
| Fiscal Adjustment ATE in slump | 0.181 | -1.205*** | -1.658*** | -3.019*** | -0.171 | -5.839** |
| (Restricted) | (0.233) | (0.342) | (0.405) | (0.384) | (1.380) | (2.403) |
| Fiscal Adjustment ATE in boom | -1.936*** | -0.990 | 1.346 | -0.693 | -1.009 | -3.281 |
| (Unrestricted) | (0.345) | (0.583) | (1.416) | (1.780) | (1.482) | (4.763) |
| Fiscal Adjustment ATE in slump | 0.331 | -1.362*** | -2.029*** | -3.308*** | -0.463 | -6.803** |
| (Unrestricted) | (0.200) | (0.352) | (0.551) | (0.535) | (1.519) | (2.914) |
| Observations | 10116 | 10114 | 10112 | 10110 | 10108 | 10108 |

**Notes**: Table A4 reports AIPW estimates of the fiscal consolidation ATE using data only for the EU27 countries/regions (excluding the UK regions) in booms and slumps. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. The boom bin is for observations where the country-level output gap $y_{gap}$ is greater than zero, the slump bin is for observations where the country- level output gap is less than or equal to zero. ***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A5 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Agriculture/Construction, Full Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| **Panel A: Agriculture Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Agriculture | -0.259 | -0.837** | -1.008* | -2.467*** | -1.927* | -6.484*** |
| (Restricted) | (0.336) | (0.278) | (0.511) | (0.515) | (1.038) | (2.386) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.519 | -1.113** | -0.673 | -1.880*** | -0.190 | -4.366*** |
| (Restricted) | (0.539) | (0.506) | (0.484) | (0.496) | (0.611) | (1.598) |
| Observations | 14270 | 14268 | 14266 | 14264 | 14215 | 14215 |
| Fiscal Adjustment ATE with high share of Agriculture | -0.382 | -0.926** | -1.077* | -2.409*** | -2.010* | -6.791** |
| (Unrestricted) | (0.372) | (0.386) | (0.587) | (0.613) | (1.088) | (2.725) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.846 | -1.284* | -0.861 | -1.568** | -0.061 | -4.617** |
| (Unrestricted) | (0.606) | (0.597) | (0.545) | (0.597) | (0.764) | (1.935) |
| Observations | 14329 | 14327 | 14325 | 14323 | 14274 | 14274 |
| **Panel B: Construction Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Construction | -0.522 | -1.081*** | -1.069** | -2.115*** | -1.551* | -6.337*** |
| (Restricted) | (0.385) | (0.332) | (0.391) | (0.480) | (0.843) | (1.772) |
| Fiscal Adjustment ATE with low share of Construction | -0.417 | -1.047** | -0.834 | -2.275*** | -0.529 | -5.095** |
| (Restricted) | (0.444) | (0.404) | (0.617) | (0.399) | (0.924) | (2.324) |
| Observations | 14139 | 14137 | 14135 | 14133 | 14083 | 14083 |
| Fiscal Adjustment ATE with high share of Construction | -0.732 | -1.286*** | -1.193** | -2.039*** | -1.590* | -6.854*** |
| (Unrestricted) | (0.426) | (0.416) | (0.510) | (0.562) | (0.861) | (2.121) |
| Fiscal Adjustment ATE with low share of Construction | -0.603 | -1.116** | -0.993 | -2.021*** | -0.479 | -5.209** |
| (Unrestricted) | (0.421) | (0.437) | (0.635) | (0.507) | (1.069) | (2.571) |
| Observations | 14241 | 14239 | 14237 | 14235 | 14186 | 14186 |

**Notes**: Table A5 reports AIPW estimates of the fiscal consolidation ATE using full sample data for regions that have high/low shares of GVA in Agriculture (Panel A) and in Construction (Panel B). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Agricultural activity bin is for observations where the region-level gross value added is larger than the overall median agriculture GVA share (1.63%), and the low share bin is for observations where the region-level agriculture GVA is less the overall median. Similarly, the high share of Construction activity bin is for observations where the region-level gross value added is larger than the overall median construction GVA share (5.8%), and the low share bin is for observations where the region-level construction GVA is less the overall median.***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A6 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Industry, Full Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE with high share of Industry | -0.183 | -0.688** | -0.663 | -2.580*** | -0.922 | -5.036** |
| (Restricted) | (0.344) | (0.265) | (0.529) | (0.376) | (1.063) | (2.132) |
| Fiscal Adjustment ATE with low share of Industry | -0.552 | -1.178*** | -1.001** | -1.641*** | -1.187 | -5.553*** |
| (Restricted) | (0.329) | (0.309) | (0.356) | (0.465) | (0.803) | (1.723) |
| Observations | 14630 | 14628 | 14626 | 14624 | 14575 | 14575 |
| Fiscal Adjustment ATE with high share of Industry | -0.341 | -0.677** | -0.710 | -2.126*** | -0.707 | -4.559* |
| (Unrestricted) | (0.319) | (0.313) | (0.559) | (0.578) | (1.245) | (2.498) |
| Fiscal Adjustment ATE with low share of Industry | -0.737* | -1.307*** | -1.181** | -1.781*** | -1.388 | -6.392*** |
| (Unrestricted) | (0.376) | (0.352) | (0.430) | (0.513) | (0.809) | (1.891) |
| Observations | 14694 | 14692 | 14690 | 14688 | 14639 | 14639 |

**Notes**: Table A6 reports AIPW estimates of the fiscal consolidation ATE using full sample data for regions that have high/low shares of GVA in Industry. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Industry activity bin is for observations where the region-level gross value added is larger than the overall median industry GVA share (20.7%), and the low share bin is for observations where the region-level industry GVA is less the overall median. ***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A7 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Agriculture/Construction, EU Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| **Panel A: Agriculture Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Agriculture | -0.369 | -1.051** | -0.986 | -2.351*** | -1.670 | -6.416** |
| (Restricted) | (0.410) | (0.360) | (0.623) | (0.622) | (1.180) | (2.780) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.527 | -1.257* | -0.479 | -1.648** | 0.177 | -3.731** |
| (Restricted) | (0.619) | (0.618) | (0.497) | (0.610) | (0.632) | (1.572) |
| Observations | 12204 | 12202 | 12200 | 12198 | 12196 | 12196 |
| Fiscal Adjustment ATE with high share of Agriculture | -0.578 | -1.312** | -1.159 | -2.305*** | -1.672 | -7.004** |
| (Unrestricted) | (0.479) | (0.532) | (0.742) | (0.725) | (1.199) | (3.258) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.814 | -1.464* | -0.658 | -1.336* | 0.315 | -3.952* |
| (Unrestricted) | (0.698) | (0.760) | (0.576) | (0.687) | (0.755) | (2.030) |
| Observations | 12239 | 12237 | 12235 | 12233 | 12231 | 12231 |
| **Panel B: Construction Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Construction | -0.597 | -1.234*** | -1.080** | -2.036*** | -1.449 | -6.396*** |
| (Restricted) | (0.427) | (0.380) | (0.421) | (0.513) | (0.875) | (1.844) |
| Fiscal Adjustment ATE with low share of Construction | -0.413 | -1.287** | -0.589 | -2.050*** | -0.044 | -4.362 |
| (Restricted) | (0.474) | (0.515) | (0.713) | (0.558) | (1.091) | (2.807) |
| Observations | 12157 | 12155 | 12153 | 12151 | 12149 | 12149 |
| Fiscal Adjustment ATE with high share of Construction | -0.834 | -1.485** | -1.240** | -1.945*** | -1.426 | -6.930*** |
| (Unrestricted) | (0.479) | (0.479) | (0.560) | (0.596) | (0.880) | (2.250) |
| Fiscal Adjustment ATE with low share of Construction | -0.529 | -1.370* | -0.715 | -1.866** | 0.017 | -4.445 |
| (Unrestricted) | (0.474) | (0.626) | (0.738) | (0.668) | (1.183) | (3.147) |
| Observations | 12239 | 12237 | 12235 | 12233 | 12231 | 12231 |

**Notes**: Table A7 reports AIPW estimates of the fiscal consolidation ATE using data for EU countries only and for regions that have high/low shares of GVA in Agriculture (Panel A) and in Construction (Panel B). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Agricultural activity bin is for observations where the region-level gross value added is larger than the overall median agriculture GVA share (1.63%), and the low share bin is for observations where the region-level agriculture GVA is less the overall median. Similarly, the high share of Construction activity bin is for observations where the region-level gross value added is larger than the overall median construction GVA share (5.8%), and the low share bin is for observations where the region-level construction GVA is less the overall median.***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A8 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Industry, EU Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE with high share of Industry | -0.305 | -1.061** | -0.440 | -2.233*** | -0.444 | -4.476* |
| (Restricted) | (0.421) | (0.352) | (0.570) | (0.478) | (1.045) | (2.358) |
| Fiscal Adjustment ATE with low share of Industry | -0.437 | -1.074*** | -1.008** | -1.693*** | -1.111 | -5.322** |
| (Restricted) | (0.365) | (0.329) | (0.437) | (0.533) | (0.924) | (2.028) |
| Observations | 12192 | 12190 | 12188 | 12186 | 12184 | 12184 |
| Fiscal Adjustment ATE with high share of Industry | -0.484 | -1.090** | -0.461 | -1.638** | -0.134 | -3.789 |
| (Unrestricted) | (0.414) | (0.436) | (0.592) | (0.657) | (1.201) | (2.785) |
| Fiscal Adjustment ATE with low share of Industry | -0.720 | -1.558*** | -1.494** | -1.957*** | -1.202 | -6.930*** |
| (Unrestricted) | (0.462) | (0.491) | (0.590) | (0.562) | (0.873) | (2.373) |
| Observations | 12239 | 12237 | 12235 | 12233 | 12231 | 12231 |

**Notes**: Table A8 reports AIPW estimates of the fiscal consolidation ATE using data for EU countries only and for regions that have high/low shares of GVA in Industry. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Industry activity bin is for observations where the region-level gross value added is larger than the overall median industry GVA share (20.7%), and the low share bin is for observations where the region-level industry GVA is less the overall median. ***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A9 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Agriculture/Construction, EU27 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| **Panel A: Agriculture Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Agriculture | -0.269 | -0.938** | -0.903 | -2.402*** | -1.710 | -6.210** |
| (Restricted) | (0.404) | (0.340) | (0.665) | (0.699) | (1.297) | (3.030) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.041 | -0.695*** | -0.201 | -2.223*** | -0.217 | -3.370 |
| (Restricted) | (0.281) | (0.162) | (0.494) | (0.466) | (1.007) | (2.174) |
| Observations | 10048 | 10046 | 10044 | 10042 | 10040 | 10040 |
| Fiscal Adjustment ATE with high share of Agriculture | -0.478 | -1.202** | -1.074 | -2.351** | -1.684 | -6.765* |
| (Unrestricted) | (0.483) | (0.537) | (0.789) | (0.805) | (1.314) | (3.517) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.174 | -0.779** | -0.281 | -2.075*** | -0.160 | -3.462 |
| (Unrestricted) | (0.268) | (0.266) | (0.500) | (0.620) | (1.127) | (2.514) |
| Observations | 10079 | 10077 | 10075 | 10073 | 10071 | 10071 |
| **Panel B: Construction Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Construction | -0.325 | -0.936*** | -0.928* | -2.256*** | -1.705 | -6.150** |
| (Restricted) | (0.392) | (0.295) | (0.511) | (0.650) | (1.088) | (2.397) |
| Fiscal Adjustment ATE with low share of Construction | -0.180 | -0.988*** | -0.427 | -2.350** | -0.221 | -4.140 |
| (Restricted) | (0.273) | (0.233) | (0.727) | (0.758) | (1.441) | (3.285) |
| Observations | 10008 | 10006 | 10004 | 10002 | 10000 | 10000 |
| Fiscal Adjustment ATE with high share of Construction | -0.546 | -1.220** | -1.090 | -2.177** | -1.642 | -6.675** |
| (Unrestricted) | (0.452) | (0.473) | (0.672) | (0.738) | (1.100) | (2.822) |
| Fiscal Adjustment ATE with low share of Construction | -0.192 | -0.978** | -0.432 | -2.214** | -0.164 | -3.960 |
| (Unrestricted) | (0.210) | (0.319) | (0.693) | (0.873) | (1.487) | (3.440) |
| Observations | 10079 | 10077 | 10075 | 10073 | 10071 | 10071 |

**Notes**: Table A9 reports AIPW estimates of the fiscal consolidation ATE using data for EU27 countries only (excluding the UK) and for regions that have high/low shares of GVA in Agriculture (Panel A) and in Construction (Panel B). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Agricultural activity bin is for observations where the region-level gross value added is larger than the overall median agriculture GVA share (1.63%), and the low share bin is for observations where the region-level agriculture GVA is less the overall median. Similarly, the high share of Construction activity bin is for observations where the region-level gross value added is larger than the overall median construction GVA share (5.8%), and the low share bin is for observations where the region-level construction GVA is less the overall median.***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A10 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Industry, EU27 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE with high share of Industry | -0.166 | -0.887*** | -0.335 | -2.400*** | -0.539 | -4.316* |
| (Restricted) | (0.325) | (0.221) | (0.585) | (0.547) | (1.220) | (2.580) |
| Fiscal Adjustment ATE with low share of Industry | -0.142 | -0.765** | -0.876 | -1.959** | -1.385 | -5.127* |
| (Restricted) | (0.351) | (0.253) | (0.586) | (0.693) | (1.189) | (2.797) |
| Observations | 10040 | 10038 | 10036 | 10034 | 10032 | 10032 |
| Fiscal Adjustment ATE with high share of Industry | -0.303 | -0.895** | -0.333 | -1.884** | -0.255 | -3.652 |
| (Unrestricted) | (0.307) | (0.315) | (0.591) | (0.749) | (1.365) | (2.990) |
| Fiscal Adjustment ATE with low share of Industry | -0.356 | -1.204** | -1.253 | -2.125** | -1.372 | -6.309** |
| (Unrestricted) | (0.448) | (0.487) | (0.725) | (0.714) | (1.151) | (3.077) |
| Observations | 10079 | 10077 | 10075 | 10073 | 10071 | 10071 |

**Notes**: Table A10 reports AIPW estimates of the fiscal consolidation ATE using data for EU27 countries only and for regions that have high/low shares of GVA in Industry. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Industry activity bin is for observations where the region-level gross value added is larger than the overall median industry GVA share (20.7%), and the low share bin is for observations where the region-level industry GVA is less the overall median. ***/**/* indicate p-value ¡ 0.01/0.05/0.10.

**Table A11 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Agriculture/Construction, Eurozone Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| **Panel A: Agriculture Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Agriculture | -0.193 | -0.913** | -0.883 | -2.374** | -1.684 | -6.038* |
| (Restricted) | (0.405) | (0.348) | (0.704) | (0.763) | (1.384) | (3.219) |
| Fiscal Adjustment ATE with low share of Agriculture | 0.116 | -0.874*** | -0.260 | -2.060*** | 0.059 | -3.014* |
| (Restricted) | (0.256) | (0.197) | (0.456) | (0.380) | (0.817) | (1.788) |
| Observations | 9653 | 9651 | 9649 | 9647 | 9645 | 9645 |
| Fiscal Adjustment ATE with high share of Agriculture | -0.415 | -1.175* | -1.043 | -2.255** | -1.597 | -6.460* |
| (Unrestricted) | (0.482) | (0.565) | (0.840) | (0.904) | (1.408) | (3.761) |
| Fiscal Adjustment ATE with low share of Agriculture | -0.111 | -0.989*** | -0.525 | -1.746*** | 0.116 | -3.249* |
| (Unrestricted) | (0.259) | (0.294) | (0.419) | (0.455) | (0.840) | (1.810) |
| Observations | 9683 | 9681 | 9679 | 9677 | 9675 | 9675 |
| **Panel B: Construction Share** | | | | | | |
| Fiscal Adjustment ATE with high share of Construction | -0.230 | -0.890** | -0.893 | -2.206** | -1.665 | -5.883** |
| (Restricted) | (0.387) | (0.298) | (0.525) | (0.696) | (1.155) | (2.498) |
| Fiscal Adjustment ATE with low share of Construction | -0.086 | -1.264*** | -0.542 | -2.154** | 0.109 | -3.913 |
| (Restricted) | (0.258) | (0.252) | (0.716) | (0.699) | (1.313) | (3.068) |
| Observations | 9617 | 9615 | 9613 | 9611 | 9609 | 9609 |
| Fiscal Adjustment ATE with high share of Construction | -0.489 | -1.134** | -0.995 | -1.985** | -1.500 | -6.103** |
| (Unrestricted) | (0.451) | (0.475) | (0.696) | (0.835) | (1.196) | (2.976) |
| Fiscal Adjustment ATE with low share of Construction | -0.136 | -1.237*** | -0.751 | -2.025** | 0.019 | -4.118 |
| (Unrestricted) | (0.192) | (0.326) | (0.655) | (0.789) | (1.343) | (3.123) |
| Observations | 9683 | 9681 | 9679 | 9677 | 9675 | 9675 |

**Notes**: Table A11 reports AIPW estimates of the fiscal consolidation ATE using data for EU27 countries only (excluding the UK) and for regions that have high/low shares of GVA in Agriculture (Panel A) and in Construction (Panel B). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (\exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Agricultural activity bin is for observations where the region-level gross value added is larger than the overall median agriculture GVA share (1.63%), and the low share bin is for observations where the region-level agriculture GVA is less the overall median. Similarly, the high share of Construction activity bin is for observations where the region-level gross value added is larger than the overall median construction GVA share (5.8%), and the low share bin is for observations where the region-level construction GVA is less the overall median.***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A12 The Effect of Fiscal Adjustment Plan, AIPW Estimates, High *vs.* Low Economic Activity in Industry, Eurozone Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | Sum |
|---|---|---|---|---|---|---|
| Fiscal Adjustment ATE with high share of Industry | 0.003 | -0.946*** | -0.484 | -2.467*** | -0.511 | -4.397* |
| (Restricted) | (0.305) | (0.245) | (0.578) | (0.494) | (1.126) | (2.390) |
| Fiscal Adjustment ATE with low share of Industry | -0.036 | -0.732** | -0.746 | -1.828** | -1.255 | -4.596 |
| (Restricted) | (0.333) | (0.246) | (0.609) | (0.773) | (1.284) | (2.977) |
| Observations | 9646 | 9644 | 9642 | 9640 | 9638 | 9638 |
| Fiscal Adjustment ATE with high share of Industry | -0.117 | -0.945** | -0.594 | -1.993** | -0.332 | -3.967 |
| (Unrestricted) | (0.275) | (0.329) | (0.546) | (0.650) | (1.192) | (2.593) |
| Fiscal Adjustment ATE with low share of Industry | -0.299 | -1.146** | -1.075 | -1.880* | -1.219 | -5.619* |
| (Unrestricted) | (0.435) | (0.484) | (0.742) | (0.842) | (1.273) | (3.279) |
| Observations | 9683 | 9681 | 9679 | 9677 | 9675 | 9675 |

**Notes**: Table A12 reports AIPW estimates of the fiscal consolidation ATE using data for Eurozone countries only and for regions that have high/low shares of GVA in Industry. Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: the output gap of regional income $y$, two lags of change in regional income $y$, one lag of regional inflation rate, the country-level output gap, and regional fixed effects. $y_{gap}$ is the output gap measured from log $y$ (log real GDP) using an HP filter with $\lambda = 100$: $y_{gap} = (exp(y_c) - 1) \times 100$. The specification includes country fixed effects in the propensity score model but not in the AIPW model (these are collinear with regional fixed effects). The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. The high share of Industry activity bin is for observations where the region-level gross value added is larger than the overall median industry GVA share (20.7%), and the low share bin is for observations where the region-level industry GVA is less the overall median. ***/**/* indicate p-value < 0.01/0.05/0.10.

**Table A13 The Effect of Fiscal Adjustment Plan on Income Inequality, AIPW Estimates, EU27 Sample**

| Horizon | $h = 0$ | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ |
|---|---|---|---|---|---|
| **Panel A: Atkinson Index** | | | | | |
| Fiscal Adjustment ATE | 0.068 | 4.024** | -0.304 | 1.217 | -0.245 |
| (Restricted) | (0.788) | (1.401) | (2.074) | (1.988) | (2.742) |
| Fiscal Adjustment ATE | 1.738 | 5.757* | 4.158 | 5.704 | 7.476 |
| (Unrestricted) | (1.721) | (2.996) | (4.138) | (4.612) | (5.431) |
| **Panel B: Gini Coefficient** | | | | | |
| Fiscal Adjustment ATE | -0.121 | 1.873** | -0.248 | 0.308 | -0.602 |
| (Restricted) | (0.457) | (0.740) | (1.164) | (1.102) | (1.572) |
| Fiscal Adjustment ATE | 0.855 | 2.873* | 2.149 | 2.719 | 3.448 |
| (Unrestricted) | (0.859) | (1.492) | (2.145) | (2.422) | (2.992) |
| **Panel C: Palma Ratio** | | | | | |
| Fiscal Adjustment ATE | 0.840** | 2.367** | 1.580 | 1.228 | -0.179 |
| (Restricted) | (0.357) | (0.838) | (0.886) | (0.994) | (0.994) |
| Fiscal Adjustment ATE | 1.236* | 2.792* | 2.267 | 1.916 | 1.995 |
| (Unrestricted) | (0.628) | (1.304) | (1.502) | (1.597) | (1.830) |
| **Panel D: Theil's *L* (GE0)** | | | | | |
| Fiscal Adjustment ATE | 0.083 | 4.100** | -0.279 | 1.247 | -0.205 |
| (Restricted) | (0.799) | (1.429) | (2.111) | (2.036) | (2.795) |
| Fiscal Adjustment ATE | 1.758 | 5.841* | 4.238 | 5.802 | 7.609 |
| (Unrestricted) | (1.749) | (3.054) | (4.225) | (4.720) | (5.552) |
| **Panel E: Theil's *T* (GE1)** | | | | | |
| Fiscal Adjustment ATE | 0.427 | 4.500** | -0.083 | 1.612 | 0.146 |
| (Restricted) | (0.793) | (1.388) | (2.049) | (1.900) | (2.732) |
| Fiscal Adjustment ATE | 1.770 | 5.600* | 3.825 | 5.339 | 7.032 |
| (Unrestricted) | (1.687) | (2.927) | (4.015) | (4.516) | (5.376) |
| Observations | 140 | 140 | 140 | 140 | 140 |

**Notes**: Table A13 reports AIPW estimates of the fiscal consolidation ATE on between- region income inequality using data only for the EU27 countries (excluding the UK). Robust standard errors (clustered by country) in parentheses. The policy treatment is defined as a new program in Alesina *et al.* (2019). Conditional mean controls: one lag of log real GDP and its square, one lag of log human capital, and one lag of un- employment rate, openness and the inflation rate, as well as a dummy for crises from the JST database. Specification includes country fixed effects in the propensity score model and in the AIPW model. The propensity score based on the saturated probit model as described in the text is estimated over the period 1978-2014. The AIPW estimates are based on the sample period 2000-2018 (effective sample 2003-2014 due to leads/lags). Moreover, the AIPW estimates do not impose restrictions on the weights of the propensity score. Truncated results are not reported here but are available in the appendix. ***/**/* indicate p-value < 0.01/0.05/0.10.