Online Annex 1.1. Countercyclicality of Fiscal Policies[1]

This annex analyzes the responses of fiscal policies during adverse events across countries and identifies if counter-cyclical responses are greater during large crises. It elaborates the methodology of Figure 1.2 in Chapter 1.

Estimating Fiscal Counter-cyclicality Coefficients

Fiscal balances fluctuate with economic activity, with the direction and strength of this correlation being determined by two forces. First, government policies determine how the overall government balance (and each of its components) responds to changes in economic conditions. Fiscal policy is said to be counter-cyclical if the government deficit increases during economic downturns. Second, fiscal policy has a feedback effect—often referred to as the fiscal 'multiplier' effect—whereby exogenous changes in the government balance affect aggregate demand. The interaction of these two forces determines the impact of fiscal policy on macroeconomic stabilization, that is, the reduction in output volatility attributable to fiscal policy. Fiscal policy has two broad components: discretionary policy from explicit government actions, and automatic stabilizers, which refer to built-in elements in the tax-and-benefit system that tend to mitigate economic fluctuations without explicit government action.

The annex starts by estimating panel regressions for an unbalanced sample of 186 countries during 1980-2021 that takes the following form:

$$b_{ct} = \alpha_c + \tau_t + \beta x_{ct} + \epsilon_{ct} \quad (1)$$

where b_{ct} is a measure of government balance in country c at time t, x_{ct} is a measure of economic activity, α_c and τ_t are country and time fixed effects and ε_{ct} is a white noise disturbance term. The variable of interest is the estimated value of β, which captures the degree of counter-cyclicality of fiscal policy and thus of its stabilizing effects.[2] Different versions of (1) are considered:

- *Measures of economic activity* x_{ct}. Two alternative measures are considered: real GDP growth and the output gap. For the former, the coefficient β captures the budget response to a mix of demand and supply shocks. The coefficient on the output gap is expected to reflect mostly the budget response to demand-side disturbances. The baseline measure of the output gap is retrieved directly from World Economic Outlook (WEO) database. For robustness of the analysis and to maximize sample coverage, two additional versions of the output gaps are applied using the Hodrick and Prescott (HP) (1981, 1997) and Hamilton (2018) filtering methodologies. Online Annex Table 1.1.1 shows the panel estimations (with country and time fixed effects) of the overall β coefficients for the entire time span (1980-2021) using real GDP growth as a measure of activity across three income groups (advanced economies (AEs), emerging markets (EMs), and low-income countries (LICs)). Results based on the output gap in the WEO database or those via HP or Hamilton-filters are available upon request. The degree of fiscal counter-cyclicality is relatively higher for AEs, particularly when excluding commodity exporters, relative to other income groups.

  The analysis here estimates the extent to which fiscal deficits respond to changes in economic activity. Revenues decline when economic activity slows down, whereas government expenses are likely to rise with rising unemployment benefits and other expansionary fiscal measures. The estimation of β from (1), however, faces a challenge because fiscal measures in turn affect economic

[1] Prepared by Joao Jalles and Youssouf Kiendrebeogo.

[2] Empirical studies recognize the difficulties in providing accurate estimates of fiscal stabilizers, but they also acknowledge the need to have at least approximations of it (Cotis and others 1997; Auerbach and Feenberg 2000). Recent contributions on computing and employing estimates of fiscal stabilizers include: McKay and Reis (2016, 2021), Furceri and Jalles (2018, 2019), Jalles (2018, 2020) and Furceri, Choi and Jalles (2022).

activity and could lead to a downward bias in the estimate. To substantiate this point, Generalized Methods of Moments and Two-stage least square estimation methods are used to check the robustness. Possible instruments are lagged domestic real GDP growth and contemporaneous and lagged growth rate of main trading partners.

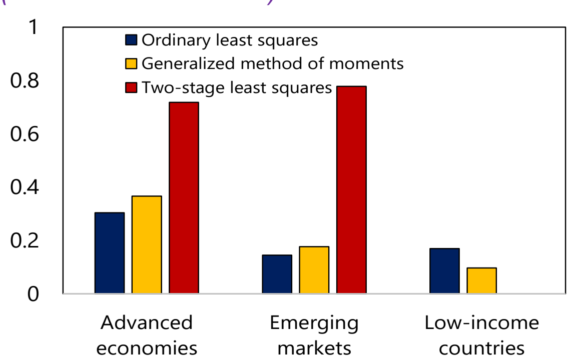
Online Annex Table 1.1.1 Overall Fiscal countercyclicality: panel regressions, unbalanced sample all countries and years, 1980-2021

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Not excluding commodity exporters			excluding commodity exporters			
sample	AE	EME	LIC	AE	EME	LIC	commodity exporters
Real GDP growth	0.2981***	0.2998***	0.1332**	0.3036***	0.1442***	0.1695***	0.2694***
	(0.050)	(0.055)	(0.051)	(0.050)	(0.039)	(0.059)	(0.076)
Observations	1,274	2,735	1,653	1,156	1,770	1,161	1,575
No. of countries	37	93	56				
R-squared	0.6099	0.2751	0.2494	0.5655	0.3739	0.1952	0.3066

Source: IMF staff estimates.
Note: Robust standard errors in parenthesis clustered at the country level. *, **, *** denote statistical significance at the 10, 5 and 1 percent levels, respectively. Country and time fixed effects included but omitted for parsimonious reasons. Constant term is included in the regression but not reported here.

Online Annex Figure 1.1.1. Addressing Endogeneity on Estimating Fiscal Countercyclicality

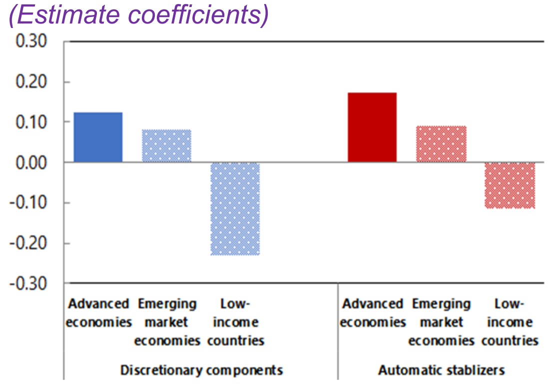
(Estimated coefficients)



Note: Estimations by income group using up to two lags of the growth rate of main trading partners as instrument for contemporaneous real GDP growth. Missing bars denote statistically insignificant coefficients.

Online Annex Figure 1.1.2. Estimated Countercyclicality by Budget Component

(Estimate coefficients)



Note: Discretionary components uses the cyclically adjusted budget balance (CAB) from the IMF WEO database. The automatic components are calculated as the difference between the overall and the cyclically adjusted budget balance. They are used separately as dependent variables in a panel regression with real GDP growth as regressor. Bars in lighter colors denote statistically insignificant coefficient estimates at the 10 percent level.

- *Automatic stabilizers versus discretionary budget measures.* Equation (1) is first estimated with b_t given by the overall budget balance in percent of GDP. As in Blanchard (1993), the estimated β gives the overall coefficient of fiscal counter-cyclicality. We then re-estimate two different but complementary budgetary components; that is, one decomposes the overall balance into a discretionary (cyclically-adjusted) part and automatic stabilizing part. The baseline measure of the cyclically adjusted balance (CAB) is based on WEO database.[3] The counter-cyclicality of fiscal policy appears stronger for AEs

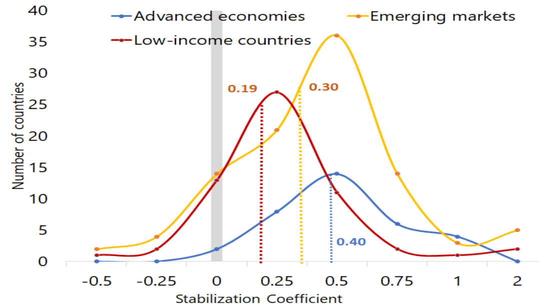
[3] Countries for which WEO output gaps are available are usually countries for which WEO cyclically adjusted balances are also available. Alternatively, cyclically adjusted balances are calculated from Hamilton- or HP-based output gaps as follows. First, potential GDP growth, i.e., actual real GDP net of the output gap, is calculated. Second, the elasticity of government revenues and government expenditures to potential GDP are taken to be, respectively, one and zero (Girouard and André (continued)

in both components while fiscal policy is weakly procyclical in low-income countries, though they are not statistically significant (Online Annex Figure 1.1.2).

- *Country heterogeneity*. The average degree of fiscal countercyclicality in advanced economies is greater than that in emerging markets and developing economies. This heterogeneity is based on estimating a time-varying version of equation (1) for individual countries over a rolling window of 10-years (for countries with at least 20 continuous observations of relevant variables) (Online Annex Figure 1.1.3).

Online Annex Figure 1.1.3. Distribution of Fiscal Countercyclicality Coefficients

(Number of countries)

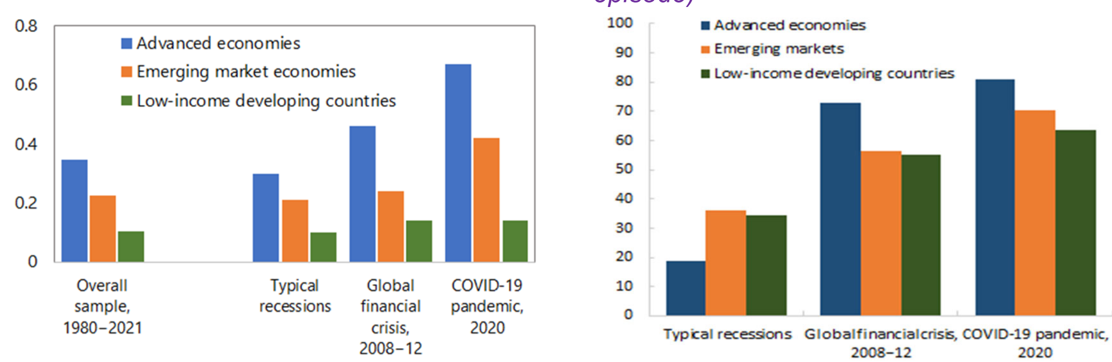


Note: The chart shows the distribution of static fiscal countercyclicality coefficients across income groups.

- *Countercyclicality during large crises*. Potential asymmetries in the degree of fiscal counter-cyclicality are compiled based on panel estimation (with country and time fixed effects) across country income groups for the overall β coefficients during 1980-2021, separated into sub-periods (with a focus on the global financial crisis and the COVID-19 pandemic). The countercyclicality of fiscal policy tends to be stronger during large crises relative to normal business cycles (Online Annex Figure 1.1.4). The share of countries that have larger countercyclical fiscal policies tend to be stronger during large crises than typical business cycles.

Online Annex Figure 1.1.4. Countercyclicality of Fiscal Policies in Large Crises

(Estimated coefficients) *(Share of countries with larger countercyclical fiscal policies in each episode)*



Note: The figure shows the average of time-varying coefficients by country income groups, estimated based on a panel regression on the sensitivity to GDP growth of the deficit to GDP ratio from 1980 to 2021. Typical recessions are defined as periods when individual country's growth rates are below their own average levels over the previous three 3 years.

Note: The share of countries is calculated for each income group. It refers to the percent of countries that have larger counter-cyclicality coefficients on their fiscal policies during each episode relative to their own national average level over the 1980-2021 period.

2005; Mourre and others 2014). This allows to calculate cyclically adjusted revenues and expenditures and, consequently, obtain as difference, the cyclically adjusted balance (as a share of GDP).

Online Annex 1.2. Income Stabilization Before and During COVID-19 Pandemic across EU countries: A Microsimulation Approach[4]

The main chapter reports the extent of income and consumption stabilization in European Union countries based on the tax-benefit microsimulations. This annex presents details of the methodology and data used to obtain such estimates.

Methodology and Data

The simulations employ the microsimulation model EUROMOD and microdata from the European Statistics on Income and Living Conditions (EU-SILC). The EUROMOD is a tax-benefit micro-simulation model developed by the European Commission-DG JRC in collaboration with EUROSTAT and a network of national experts. The model simulates direct taxes liabilities and cash benefit entitlements for samples of representative households in EU countries. It allows to analyze the static impact of tax-benefit policies and their changes on household income, allowing for budgetary and distributional considerations. To quantify how the disposable income and consumption are stabilized following a market income shock, two sets of stabilization coefficients are calculated.

- The *income stabilization coefficient* (ISC) measures the share of changes in market income (before direct taxes and benefits) that can be compensated by fiscal policies, thus mitigating the impact on household disposable incomes (after direct taxes and benefits), i.e.

$$ISC = \left(1 - \frac{\sum_{h=1}^{N} \Delta Y_h}{\sum_{h=1}^{N} \Delta M_h}\right) * 100 = \left(\frac{\sum_{h=1}^{N} \Delta T_h}{\sum_{h=1}^{N} \Delta M_h} - \frac{\sum_{h=1}^{N} \Delta B_h}{\sum_{h=1}^{N} \Delta M_h}\right)*100$$

  where ΔY_h measures the change in disposable income experienced by household *h* resulting from the market income shock ΔM_h. Intuitively, ISC is equal to one if no change in disposable income is observed following the shock (that is, fiscal policies absorbed fully the adverse impact of the shock), and equals to zero if it is fully transmitted to disposable income. The coefficient can be decomposed into different fiscal instruments, for example, tax and social contributions *(T)*, and benefits *(B)*.

- The *consumption stabilization coefficient* (CSC) measures the share of the market income shock that is not transmitted to household consumption (or demand) and is defined as follows

$$CSC = \left(1 - \frac{\sum_{h=1}^{N} \Delta Y_h * MPC_h}{\sum_{h=1}^{N} \Delta M_h}\right) * 100\ ,$$

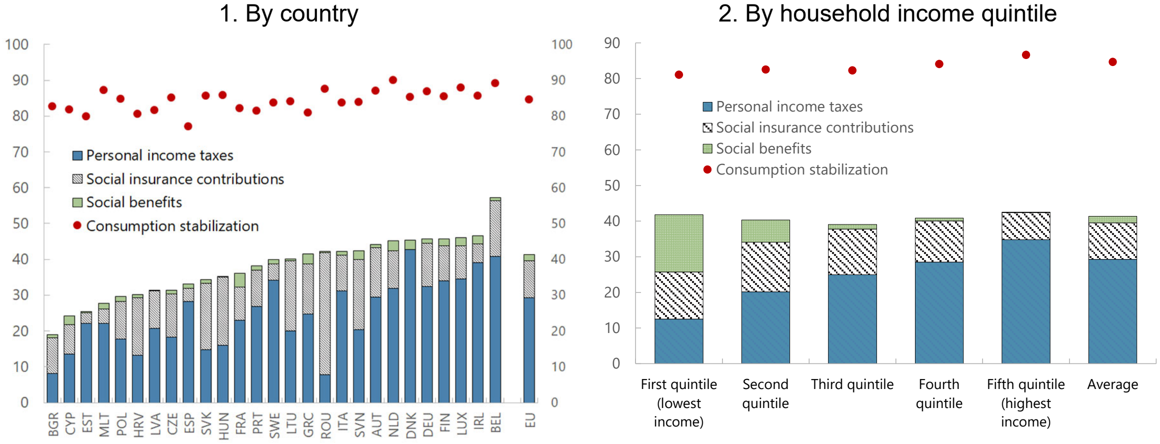
  where MPC_h denotes the marginal propensity to consume out of a transitory income shock.

Size of Automatic Stabilizers Before the COVID-19 Pandemic

Microsimulation estimates suggest that tax-benefit systems in EU countries could absorb 41 percent of a hypothetical uniform market income shock, which could be interpreted as the size of automatic stabilizers (Online Annex Figure 1.2.1, left panel) (Coady and others, forthcoming). At the aggregate levels, direct income taxes contributed significantly to the total stabilization in EU countries. Consumption is more stable, reflecting households save and borrow to smooth in face of income shocks. We use income-quintile specific MPCs based on Carroll and others (2014)—ranging from 0.23 for the richest quintile to 0.33 for the poorest quintile, to estimate consumption stabilization arising from an income shock. The EU-level consumption stabilization is large at 85 percent on average, with modest variation across countries.

[4] Prepared by Alexandra Solovyeva and Alberto Tumino. The pre-pandemic analysis is based on the joint work of D. Coady and S. De Poli, A. Hernández, A. Papini and A. Tumino, which extends on recent estimates by Astarita and others (2018). The authors are grateful to C. Carroll, J. Slacalek and K. Tokuoka for providing disaggregated indicators of marginal propensity to consume. The COVID-19 analysis is based on Christl and others (2022) and findings in Lam and Solovyeva (2022).

Online Annex Figure 1.2.1. Income and Consumption Stabilization across EU Countries
(Percent of income shock absorbed by the tax-benefit system, 2019)



Sources: Coady and others (forthcoming), Carroll and others (2014); and IMF staff calculations.
Note: Estimates are based on the EUROMOD I4.0+ and microdata from the 2019 EU-SILC under the assumption of a 5 percent negative shock to the market income for all households under the 2019 tax-benefit system.

The tax-benefit systems on average provided similar level of income stabilization across households. But the composition varies substantially, with social benefits being the most important for low-income households and taxes for high-income groups (Online Annex Figure 1.2.1, right panel). Social benefits absorb 16 percent of the market income shock for households in the lowest quintile (40 percent of total income stabilization) but only 0.1 percent for households at the top. The progressivity of income taxes means they stabilize more for high earners. As MPCs decline with income, consumption tends to be more stable for high-income groups, reflecting the better access to savings and borrowing.

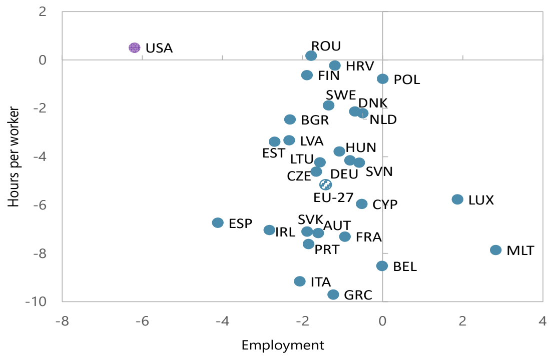
The tax-benefit systems could also stabilize against employment loss. As an illustration, the simulation for an increase of unemployment is modeled through a reweighting method. A 5 percent increase in the number of unemployed workers on top of the same uniform market income shock would lead to similar income stabilization at about 42 percent for the EU on average.

Impact of the COVID-19 Pandemic on EU Labor Market

During the pandemic, labor markets in the EU adjusted mostly through reduction of working hours by workers rather than employment (Online Annex Figure 1.2.2, left panel). The income loss from a large decline in working hours was compensated by a large take-up of job retention schemes, including short-time work schemes and other wage subsidies (Giupponi, Landais, and Lapeyre 2022, Ando and others 2022). Almost all EU countries deployed such schemes early in the crisis, with some building on existing schemes. Countries expanded the schemes by simplifying access, relaxing eligibility criteria, and raising the benefit levels at a fiscal cost of about 2 percent of GDP (Online Annex Table 1.2.1). At the onset of the pandemic, the take-up of such schemes exceeded 12 percent of working-age population in half of the EU countries, while the take-up of unemployment income support increased only modestly by 1.2 percentage points (Online Annex Figure 1.2.2., right panel).

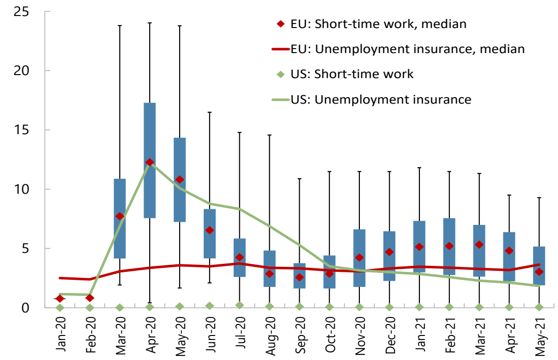
Online Annex Figure 1.2.2. EU Labor Market Dynamics during the Pandemic

1. Change in Employment and Working Hours
(Percentage change during 2019-20)



Sources: Bureau of Labor Statistics, Eurostat, and IMF staff calculations.

2. Take-up Rate of Income Support Programs
(Percent of working-age population)



Sources: Giupponi, Landais, and Lapeyre (2022); and IMF staff calculations.
Note: The box and whiskers show the dispersion of take-up on the job-retention schemes across EU countries, corresponding to the interquartile range and the minimum and maximum values.

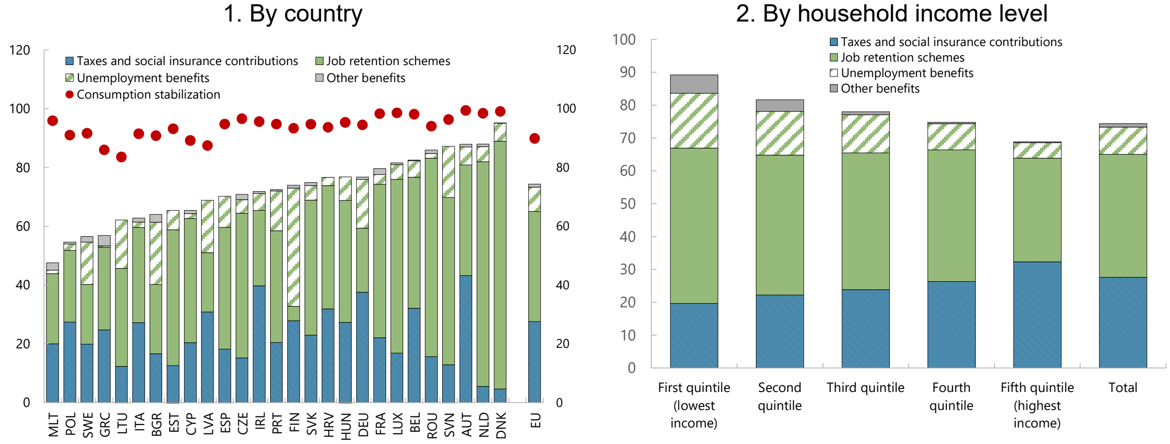
Income and Consumption Stabilization During the COVID-19 Pandemic

The annex includes a review of results in Christl and others (2022) and new simulations in Lam and Solovyeva (2022). Both use the Labor Market Adjustment (LMA) Add-on, a specific EUROMOD tool to adjust the underlying microdata based on EU-SILC 2019 data to reflect the actual changes in labor market conditions in 2020. The LMA Add-On modifies relevant socio-demographic variables of observations eligible for labor transitions, among earnings and labor market status, among others. Christl and others (2022) uses the EUROMOD model version I3.86+ to simulate the consequences of transitions from employment or self-employment into either unemployment or job retention schemes. The target values for transitions are based on EUROSTAT data, including the detailed information from the Labor Force Survey and other detailed administrative data. This provides a platform to conduct simulations and assess the stabilization role of tax-benefit systems incorporating pandemic-related measures in 2020.

The simulations suggest that fiscal responses played a crucial role in protecting household income. While market income fell on average by 6.1 percent in the EU owing to the pandemic, disposable income (after tax and benefits, including pandemic-related measures) decreased only by 1.5 percent. Three-quarters of the income loss posed by the pandemic were absorbed through new discretionary fiscal responses and automatic stabilizers in the tax-benefit systems. The extent of income stabilization varied across countries. Job retention schemes (including short-term work, wage subsidy, and other similar schemes for self-employed) aimed at compensating workers for reduced working hours stabilized nearly 40 percent of the income loss, with other tax-benefit instruments accounting for another 37 percent (Online Annex Figure 1.2.3, left panel). This has led to a drop of disposable income inequality (Online Annex Figure 1.2.4). Specifically, personal income taxes and social insurance contributions absorbed 28 percent, unemployment benefits 8 percent, and other benefits and pensions 1.1 percent. The consumption stabilization at the EU level—based on estimated marginal propensity to consume proxied by the likelihood of facing liquidity constraints for households—was large at almost 90 percent (Christl and others, 2022). The relatively low stabilization from unemployment income support was partly attributable to the modest rise of unemployment rates and the preference to preserve jobs under job-retention schemes.

Online Annex Figure 1.2.3. Income and Consumption Stabilization during the Pandemic, by Country and Household Income Groups

(Percent, share of the shock absorbed by the tax-benefit system)

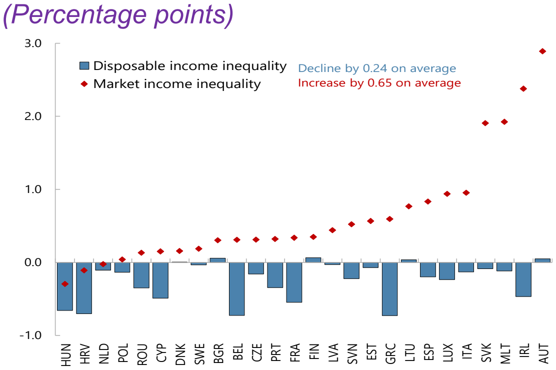


Sources: Christl and others (2022).
Note: Estimates are based on the EUROMOD and microdata from the 2019 EU-SILC. Labor market shock is simulated to replicate the 2020 labor market conditions using Labor Market Adjustment (LMA) Add-On.

In the absence of job-retention schemes where the reduction in working hours is not compensated, the EU-level ISC would have been only 47 percent, slightly larger than the pre-pandemic automatic stabilizers (41 percent), but smaller than the case when job-retention schemes are present (income stabilization at more than 75 percent). The reduction in overall ISCs in the absence of job-retention schemes is smaller than the contribution of such schemes on income stabilization because personal income taxes and means-tested benefits would partly offset the large decrease in disposable incomes (Online Annex Figure 1.2.5).

Online Annex Figure 1.2.4. Redistribution Effects of Fiscal Support Measures During the Pandemic

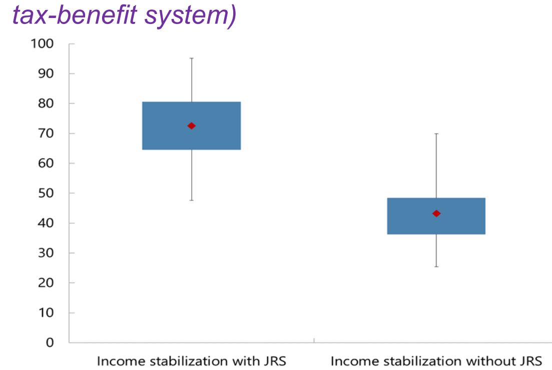
(Percentage points)



Sources: Lam and Solovyeva (forthcoming); and IMF staff calculations.
Note: Estimates are based on the EUROMOD and microdata from the 2019 EU-SILC (excluding Germany). Labor market shock is simulated to replicate the 2020 labor market conditions using EUROMOD Labor Market Adjustment Add-on.

Online Annex Figure 1.2.5. Comparison of Income Stabilization Effects

(Percent of the income shock absorbed by the tax-benefit system)

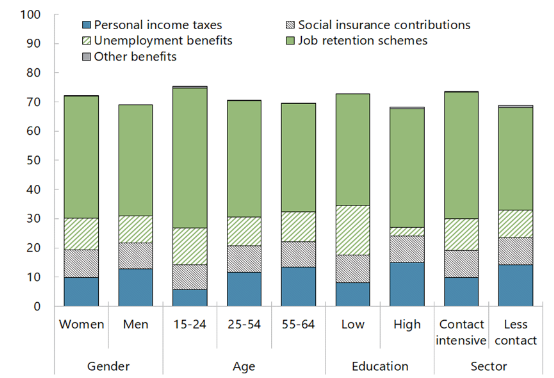


Sources: Christl and others (2022); and IMF staff estimates.
Note: Estimates are based on the EUROMOD and microdata from the 2019 EU-SILC. Labor market shock is simulated to replicate the 2020 labor market conditions using Labor Market Adjustment (LMA) Add-On. The box-whisker shows the variation across EU countries, with the median level (red dot), interquartile range (blue box), and the min-max levels (whiskers).

The pandemic affected workers disproportionately, such as the low-skill workers in contact intensive industries (Ando and others, 2022). For example, the unemployment rate of low-skill workers tends to be more sensitive to economic fluctuations. Simulation results find that income stabilization is stronger for young workers and those with less educational attainment, which give some evidence that fiscal support stabilized income relatively more for vulnerable groups (Online Annex Figure 1.2.6) (Lam and Solovyeva, forthcoming). The simulation models the labor transitions with the EUROMOD with LMA Add-On to match the aggregate change in labor market conditions in the data. The overall income stabilization is calculated based on individual level ISC, defined as $(1 - \Delta Y_i/\Delta M_i)$ for an individual *i*. Job-retention schemes played the most important role for younger workers absorbing almost two-thirds of the income loss, while unemployment income support contributed the most for lower-skilled workers. Similarly, the income stabilization is stronger for workers working in contact-intensive sectors that were affected the most.

Online Annex Figure 1.2.6. Income Stabilization by Worker Groups

(Percent of the shock absorbed by the tax-benefit system)



Sources: Lam and Solovyeva (forthcoming); and IMF staff calculations.
Note: Estimates are based on the EUROMOD and microdata from the 2019 EU-SILC (excluding Germany). Labor market shock is simulated to replicate the 2020 labor market conditions using EUROMOD Labor Market Adjustment (LMA) Add-on. For each group, average individual stabilization coefficients across countries are reported. Job-retention schemes include compensation received by employees on short-time work schemes, wage subsidies as well as similar schemes for self-employed. Other benefits include social assistance and housing benefits, family and education benefits, health and disability benefits. Pensions are excluded. Contact intensive sectors include trade, transport, food and accommodation, and professional services. Low level of education corresponds to upper secondary or below. High level of education corresponds to post-secondary and tertiary education.

A regression consisting of individuals across 26 EU countries is used to determine whether the observed differences in income stabilization across worker groups are statistically significant, controlling for other factors. The specification is:

$$ISC_{i,c}^{COVID} = \alpha + X_{i,c}\beta + Y_c\gamma + D_c\delta + \varepsilon_{i,c},$$

where $ISC_{i,c}^{COVID}$ is the income stabilization coefficient for an individual *i* from country *c* during the pandemic using 2020 tax-benefit policies; $X_{i,c}$ is a vector of variables of individual's characteristics, such as age, gender, occupations, the level of education, and income quintile; Y_c is a vector of county-specific fiscal variables, including allowance of the job retention scheme (i.e. percent of lost income that a worker receives for hours not worked), change in cyclically adjusted primary deficit between 2019 and 2020 in percent of potential GDP, a net replacement rate in unemployment insurance, and change in the number of working hours per employee. The regression also includes a vector of country dummy variables (D_c).

Empirical results show that workers with lower levels of education (proxy for low skill levels) have higher ISCs on average and the respective coefficients are statistically significant (Online Annex Table 1.2.2). This means that the tax-benefit system (including pandemic-related measures) tends to stabilize their income relatively more compared to other workers. Countries with higher job retention scheme allowance and higher unemployment benefits exhibit stronger income stabilization, while it is lower in countries that experienced a larger decline in working hours. The income stabilization is higher in countries with greater counter-cyclical fiscal policies, suggesting other discretionary support plays a role.

Online Annex Table 1.2.1. Job-Retention Schemes in the EU during the COVID-19 Pandemic

	Pre-existing job-retention scheme	Increased access and coverage	Increased generosity	New job-retention scheme	Remarks
Austria	x	x	x		Longer duration, more flexible rules for extension of duration and administrative simplification. Up to 100 precent working time reduction in the hospitality sector.
Belgium	x	x	x		
Bulgaria				x	
Croatia				x	
Czech Republic	x	x	x		
Cyprus				x	
Denmark	x	x		x	Introduced temporararily with no membership in unemployment scheme required.
Estonia				x	
Finland	x	x	x		
France	x	x	x		No condition on type of contract, part or full time, seniority. The maximum duration is extended from 6 to 12 months. The subsidy is 70 percent of gross wage. Most employers do not bear any cost of hours no worked.
Germany	x	x	x		Firms can apply if 10 percent of their workforce is subject to reduction of hours (30 percent before). Replacement rate for lost earnings is raised to 70-80 percent.
Greece				x	Available for employers with at least a 20 percent revenue loss. Only full-time dependent employees are eligible. Replacement rate for lost earnings is 60 percent of net wages.
Hungary				x	Job-retention scheme with 30-50 percent working time reduction.
Ireland	x			x	The existing short-time work was replaced by a temporary wage subsidy.
Italy	x	x	x		Firms of any size and from all sectors can apply. Evidence of economic need is no longer required. Employers do not bear any cost for hours not worked.
Latvia				x	Short-time work with full- and part-time reduction.
Lithuania				x	Short-time work with full- and part-time reduction.
Luxembourg	x	x	x		Up to 100 percent working time reduction; temporary workers and apprentices eligible.
Malta				x	
Netherlands	x			x	The existing short-time work program was replaced by a temporary wage subsidy; employees received 100 percent of their wage.
Poland				x	
Portugal	x	x	x		
Romania				x	Short-time work program with up to 80 percent of reduced work time.
Slovakia	x	x	x		
Slovenia				x	
Spain	x	x	x		
Sweden	x	x	x		Larger working time reduction of 80 percent between May and July 2020.

Sources: Ando and others 2022, Giupponi, Landais, and Lapeyre 2022, Drahokoupil and Müller 2021, OECD 2020.

Online Annex Table 1.2.2. Regression Results on Differences of Individual Income Stabilization across the EU

	Dependent variable: Income Stabilization Coefficient				
	(1)	(2)	(3)	(4)	(5)
Age between 15-24	1.953	1.602	1.594	-1.653	-0.772
Age between 55-64	-2.307***	-2.164**	-2.164**	-1.651**	-1.769**
Female	4.447***	4.027***	4.087***	1.740***	1.918***
Education level, low	4.937***	4.441***	5.064***	0.906	1.308
Contact-intensive		3.876***	5.593***	2.896***	2.607***
Contact-intensive × Education level, low			-2.383**	-0.597	-1.462
Market income, the lowest quintile				3.713	3.939
Market income, 20th to 40th percentile				3.813**	3.867*
Market income, 60th to 80th percentile				-3.605**	-3.253*
Market income, the top quintile				-11.40***	-11.13***
Job retention scheme allowance, percent of lost income					0.495***
Change in cyclically adjusted primary deficit 2020					2.378***
Net replacement rate in unemployment, percent of previous income					0.407***
Hours per worker, percentage change in 2020					0.372***
Numer of country dummies	25	25	25	25	16
Constant	80.70***	80.17***	79.76***	85.26***	14.67***
Observations	48,945	48,945	48,945	48,945	41,365
Number of countries	26	26	26	26	21

Sources: Lam and Solovyeva (forthcoming); and IMF staff estimates.
This table reports results of the pooled ordinary least squares estimation. The dependent variable is the income stabilization coefficient based on micro-simulations described in the section (excluding Germany). Labor market shock is simulated to replicate the labor market conditions in 2020. Income quintiles used to construct dummy variables are calculated at the country level based on the individual's market income prior to the shock. Low level of education corresponds to upper secondary or below. Contact intensive sectors include trade, transport, food and accommodation, professional services, arts and entertainment. Standard errors are clustered at the country level. ***p<0.01, **p<0.05. *p<0.1

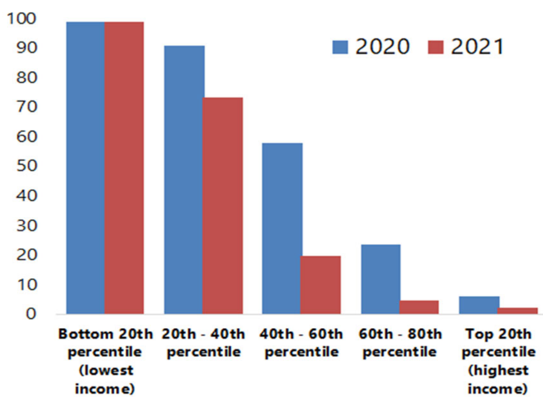
Online Annex 1.3. Brazil's Emergency Cash Transfer Program[5]

This annex describes the methodology and simulations for Figures 1.5 and 1.6 in Chapter 1. It uses household-level data to simulate the effects of the COVID-19 Emergency Aid cash transfer program in Brazil.

In response to the COVID-19 pandemic, Brazil introduced a temporary targeted cash transfer program (Emergency Aid or "*Auxílio Emergencial*") in April 2020. The program initially offered a monthly income of BRL600 ($116) to all adults without a formal job who did not receive social benefits (other than the Bolsa Familia, Brazil's conditional cash transfer scheme) and with family income below certain thresholds (Brollo and others, forthcoming). The program initially had 68.2 million direct beneficiaries (almost one-third of the population) and covered nearly all low-income households (Online Annex Figure 1.3.1). More than a third of benefits actually went to middle-class or high-income households in 2020. The cumulative fiscal cost of the program, in 2020−21, was approximately 4 percent of GDP. The Emergency Aid program covered the period from April 2020 to end-2021, with gradually tighter eligibility criteria and lower benefits over time (Brollo and others, forthcoming).

Online Annex Figure 1.3.1. Share of Population Receiving Emergency Aid Program, by Income Group

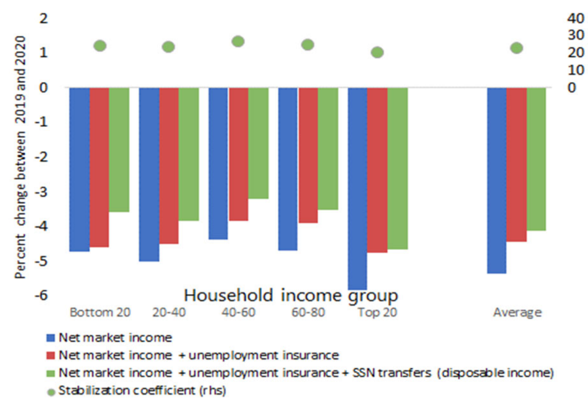
(Percent)



Source: BraSim tax and benefit tool and IMF staff estimates.
Note. Estimates are based on microsimulations and all members of households that receive benefits.

Online Annex Figure 1.3.2. Change in Per-Capita Income across Households Income Distribution

(Percentage change 2019-20, left scale; percent, right scale)



Source: BraSim tax and benefit tool and IMF staff estimates.
Note. Estimates are based on microsimulations. Net market income includes contributory pension benefits received. Stabilization coefficient defined as (1-percent change in disposable income/percent change in market income)*100.

To rapidly scale up coverage, the Emergency Aid program leveraged existing social registry information, administrative records, and digital applications to identify new beneficiaries and verify eligibility. Beneficiaries of the Bolsa Familia program and individuals listed in the social registry but not in the Bolsa Familia program are automatically enrolled in the Emergency Aid program. The government made use of digital technologies (mobile app and website) to allow people to apply. All applicants were subject to eligibility verification based on cross-checking administrative records. (Lara de Arruda and others, 2022). Program benefits were disbursed through various channels, including a mobile app developed by a state-owned bank.

To quantify the income stabilization effects of the Emergency Aid program relative to those of the pre-pandemic social protection system, the analysis uses micro-simulations. We first simulate labor market

[5] Prepared by Fernanda Brollo. The micro-simulations are based on joint work with G. Lara Ibarra and R. Campante Vale.

conditions and incomes during the pandemic.[6] Then the tax-benefit simulation tool—*BraSim,* developed by the World Bank—is used to simulate how taxes and social benefits would have responded to labor market conditions observed in three different scenarios:[7] (i) pre-pandemic social protection system, which provides a counter-factual scenario to understand what would have happened in the absence of the Emergency Aid program; (ii) considering the pre-pandemic social benefits and the Emergency Aid program, which reflects the policies actually in place during the pandemic; and (iii) a counterfactual Emergency Aid program with lower benefits (BRL 200, or one-third of the initial benefit) and same coverage. The simulation results suggest that:

1. The pre-pandemic social protection system would have provided a more limited degree of income stabilization.[8] The pandemic shock led to a fall of 5.3 percent in average per-capita net market income in 2020. Under the pre-pandemic social protection programs, average per-capita disposable income would have fallen by 4.1 percent (Online Annex Figure 1.3.2). The pre-pandemic tax-benefit systems would have cushioned only about a quarter of the income losses.
2. The Emergency Aid program boosted income for many households. Average per-capita disposable income rose by 2.1 percent in 2020 despite the large decline in market income. The income boost was larger for lower-income households (Annex Figure 1.3.3.). The income stabilization effects of the Emergency Aid program far exceeded that of the pre-pandemic safety net. The program helped reduce temporarily the poverty and inequality during the health crisis. The poverty rate dropped from 28.4 to 21.6 percent from 2019 to 2020 (Annex Figure 1.3.4). The temporary decline in extreme poverty was even more, from 7.5 to only 2.3 percent during 2019-20.[9] As the program phased out by end-2021, poverty and inequality picked up again in the simulations, though remained below their 2019 levels. In contrast, if only the pre-pandemic tax-benefits system had been in place, poverty would have risen significantly.
3. An alternative counter-factual program—set at one-third of actual initial benefits—with same eligibility criteria would have remained effective in stabilizing household income for vulnerable households at a fiscal cost of 2.3 percent of GDP. Under this alternative scenario, households in the bottom 60 percent of the income distribution would have experienced a rise in disposable income on average, albeit smaller than those observed (Online Annex Table 1.3.1). Poverty and inequality would have decreased temporarily in 2020, though by less than the baseline simulations.

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[6] A two-step process was used to estimate labor incomes in 2020 and 2021, following Olivieri (2020). First, all working-age individuals observed in the 2019 household survey are assigned a labor market status to replicate actual labor market statistics in 2020-21. Working-age individuals can be inactive, unemployed, or work in one of six sectors: agriculture, industry, and services, either formal or informal. The probability that an individual is in each of the above categories is estimated using the predicted values from a multinomial logit regression. A sequential allocation process is then carried out until the working age population is distributed in a way that matches actual data in 2020-21. Second, the income of those individuals that move into a new category is predicted through a set of Mincerian regressions.

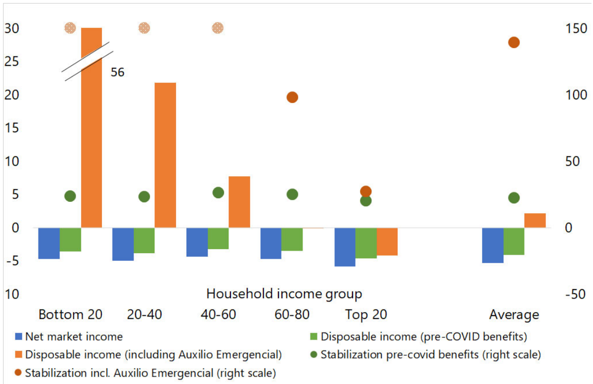
[7] *BraSim* is an incidence analysis tool designed to model reforms to the tax and social protection system. The tool can be used to assess the partial equilibrium distributional implications of different policies. See Cereda, Rubiao, and Sousa2020.

[8] In this simulation, while the negative income shock makes more households qualified for the Bolsa Familia program, the number of beneficiaries is assumed to remain unchanged. In late 2019 and early 2020, about 1½ million families who met the eligibility criteria were not included in the Bolsa Familia program owing to budget constraints.

[9] The poverty estimates calculated by the BraSim microsimulation model are lower than those calculated based on the household survey (PNADC) for 2020−21. This is because the microsimulation model takes into account simulated income from direct government transfers which are underreported in PNADC.

Online Annex Figure 1.3.3. Change in Per-Capita Income across Household Income Quintiles in Brazil, 2020

(Percent change, left scale; percent, right scale)



Sources: BraSim tax and benefit tool and IMF staff estimate.
Note. Estimates are based on microsimulations. Net market income includes contributory pension benefits received. Stabilization coefficient is defined as (1-percent change in disposable income/percent change in market income)*100. Stabilization coefficients including Brazil's emergency aid program (Auxilio Emergencial) for the bottom 60th percentile of households are not drawn to scale.

Online Annex Figure 1.3.4. Evolution of Poverty and Income Inequality during the Pandemic in Brazil, 2019−21

(Percent, left scale; Gini coefficient, right scale)

Source: BraSim tax and benefit tool (Cereda, Rubiao, and Sousa 2020) and IMF staff estimates.
Note. Estimates are based on microsimulations. Poverty is defined as per-capita household income less than half of minimum wage (US$6.30 per day in 2011 purchasing power parity (PPP) terms. Extreme poverty is US$2.25 per day at 2011 PPP, defined using the Bolsa Familia eligibility thresholds. Income inequality is based on disposable income after taxes and transfers.

Online Annex Table 1.3.1. Scenarios of Emergency Aid Program—A Comparison

Changes between 2019 and 2020	Pre-COVID19 benefits	Including discretionary cash transfer (the Emergency Aid program): Simulated results based on actual program	Including discretionary cash transfer (the Emergency Aid program): Simulated results based on less generous benefits (One-third of initial benefits)
Percentage change in disposable income	-4.1	2.1	-0.7
Bottom 20th percentile	-3.6	55.9	25.2
20th - 40th percentile	-3.8	21.8	10.6
40th - 60th percentile	-3.2	7.7	3.1
60th - 80th percentile	-3.5	-0.1	-1.5
Top 20th percentile	-4.7	-4.2	-4.4
Average income stabilization coefficient	23	139	86
Change in poverty rate (2020)	1.9	-6.8	-2.5
Change in income inequality (Gini coefficients)	0.3	-4.4	-2.2
Fiscal cost (percent of GDP)	-	4.2	2.3

Source: BraSim tax and benefit tool and IMF staff estimates.
Note. Estimates are based on microsimulations. Stabilization coefficient defined as (1-percentage change in disposable income/percent change in market income). Extreme poverty line corresponds to ($2.25 per day at 2011 Purchasing Power Parity terms), whereas poverty line defined as half a minimum salary ($6.30 per day at 2011 Purchasing Power Parity terms).

Online Annex 1.4. Designing Fiscal Tools to Build Resilience: A DSGE-based analysis[10]

The annex presents a dynamic stochastic general equilibrium (DSGE) model with heterogeneous agents to illustrate how design of fiscal tools in stabilizing consumption depend on the nature of shocks and the timeliness and targeting of measures.

A DSGE Model in a nutshell

The DSGE includes several elements of frontier research in modeling, including incomplete insurance and heterogenous agents.

Households. There are two types of households: Type-I (higher-income households) and type-J (lower-income households). Both participate in a market for one-period nominal bonds, supply labor and hours of working (capturing both extensive and intensive margin) and face the risks of unemployment. The model features endogenous labor market search and matching frictions, with disutility of work search. Type-I households own firms and receive profits, and earn either wages when employed or unemployment benefits when unemployed. They are perfectly insured against idiosyncratic unemployment risk. On the other hand, type-J households earn the real wage if employed and unemployment insurance if unemployed. They face a borrowing constraint and cannot insure perfectly against idiosyncratic unemployment risk.[11] As a result, low-income workers raise precautionary savings in response to such a risk. Greater risk of job loss intensifies the precautionary saving motive, and therefore reduce aggregate demand, output, and employment, which in turn adds to greater unemployment risk.

Online Annex Table 1.4.1. Calibration Parameters

Parameters	Value	Note
ϑ	2	Inverse of the Frisch elasticity
ϵ	6	Elasticity of substitution of goods
ξ	0.7	Calvo-price stickiness
θ_p	1.5	Monetary policy rule: response to inflation
θ_y	0.5/4	Monetary policy rule: response to output gap
β^I	0.9985	Discount factor of higher income household
β^J	0.9892	Discount factor of lower income household
μ	0.5	Matching elasticity
η	0.5	Bargaining power
κ	15	Search elasticity
e	0.075	Steady state destruction rate
ρ_w	0.9	Wage dynamic: AR(1) parameter
ζ_w	1.7	Elasticity of labor on wage
M	0.63	Matching efficiency
ω	0.8	Share of constrained households
ψ	3.2	Premium factor on wage
κ_v	0.0375	Vacancy cost
b	0.5	Replacement rate
σ_p	0.005	Standard deviation of premium shock
σ_g	0.0053	Standard deviation of gov. exp. shock
σ_a	0.0048	Standard deviation of Total Factor Productivity shock
σ_m	0.01	Standard deviation of price markup shock
σ_e	0.0695	Standard deviation of job destruction shock
σ_r	0.0045	Standard deviation of monetary policy shock
σ_w	0.0052	Standard deviation of wage markup shock
ρ_*	0.8	Autoregressive of one lag for the parameter of shocks

Firms. Intermediate good firms make optimal decisions on how many workers to hire via posting vacancies subject to a vacancy cost and set the prices to optimize the expected profits. However, the price setting faces Calvo-typed price rigidity, so each intermediate producer can reoptimize her price in a given period with a constant probability. The intermediate goods are then sold to the competitive final good producer who turns into a final good for consumption.

Authorities. For monetary policy, a central bank determines the nominal interest rate via a Taylor rule. For fiscal policy, the model has a rich set of fiscal tools that allow us to explore different tradeoffs, particularly the unemployment income support, targeted transfer, and a wage subsidy. The inclusion of a variety of fiscal tools into a tractable DSGE model with heterogenous agents, incomplete insurance, and precautionary savings is one of the key extensions to the literature.

The model captures several key channels of stabilization in McKay and Reis (2016): the intertemporal substitution, nominal rigidities, liquidity constraints and unemployment, and incomplete insurance markets and precautionary savings. The model is calibrated to a typical advanced economy on standard

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[10] Prepared by Anh Dinh Minh Nguyen and W. Raphael Lam.

[11] This type of model has been increasingly used in the literature, for instance Challe and others (2017), Ravn and Sterk (2017, 2020), Challe (2020). In these models, the lower-income households hold zero or little liquid wealth, in line with the U.S. data (Challe and others, 2017).

structural parameters in the literature, such as nominal rigidities and Taylor rule, particularly for the United States, United Kingdom, and the euro area. Other parameters are calibrated to match labor market features, including the long-term unemployment rate at 7 percent, the steady-state probability of finding a job is 50 percent, and the steady-state probability of filling a vacancy is 80 percent (Blanchard and Gali, 2010; Moyen and Stahler, 2014; Christoffel, Kuester, and Linzert, 2009). The share of liquidity constrained household is 80 percent, in line with Auray and Eyquem (2020), Challe et al. (2017), and Challe, (2021).[12] A wage premium exists for the labor by higher-income households, calibrated to match the share of their consumption at 40 percent of the aggregate level. The benchmark value of replacement ratio is 0.5, i.e. half at labor income, which is the policy instrument to analyze the effects on stabilization and redistribution. Finally, the model features a variety of typical aggregate supply and demand shocks affecting the business cycles.

Results

1. *Tradeoffs of enhancing automatic stabilizers*. The *ex-ante* design of automatic stabilizers, such as unemployment income support (UIS), affects how the tax-benefit systems stabilizers consumption during typical business cycles. The stabilization property can be captured with a coefficient that shows the variation of consumption to changes in the replacement ratio of unemployment income support, as in McKay and Reis (2016) and Smyth (1966).[13] Results show that enhancing the automatic stabilizers would stabilize consumption more to lower income households who are imperfectly insured against shocks (red circles), which in turn contributes to stabilizing aggregate consumption (Online Annex Figure 1.4.1). A higher unemployment income support dampens the feedback loop between unemployment fears, precautionary savings, and aggregate demand, which is high in a recession, as highlighted in McKay and Reis (2021). Enhancing unemployment income support also distributes resources toward lower-income households, raising their consumption share and reducing inequality, similar to findings in Aguiar and Bils (2015) and Auray and Eyquem (2020).[14] Nevertheless, it involves a tradeoff by reducing work incentives (Online Annex Figure 1.4.2). An increase in the replacement rate from 0.5 (benchmark threshold) to 0.6 would lead to a small rise in long-term unemployment rate by 0.2 ppt, within the range of estimates in the literature (Boeri, 2011).

2. *Comparison of stabilization and redistribution properties of different fiscal tools*. The stabilization and redistribution properties vary across different fiscal instruments. Here we compare two *ex-ante* instruments, i.e., unemployment income support versus targeted transfers to cash-constrained households, assuming an additional spending of 1 percent of GDP in each case in the steady state. Both fiscal tools provide resilience against income losses during adverse events, but the effects could vary: targeted transfers support the lower-income group regardless of their employment status and are highly progressive by design, while the unemployment income support benefits mostly unemployed workers and stabilize income more (6 percent) by insuring against job risks (Online Annex Figure 1.4.3). However, this result depends on the flexibility of labor market structure. For instance, in a counterfactual analysis where most adjustments are via income or wages and monetary policy (Panel B), targeted transfers, could have a large stabilization impact than unemployment income support for the same fiscal cost. Targeted transfers also lead to a larger increase in the consumption share of lower-income

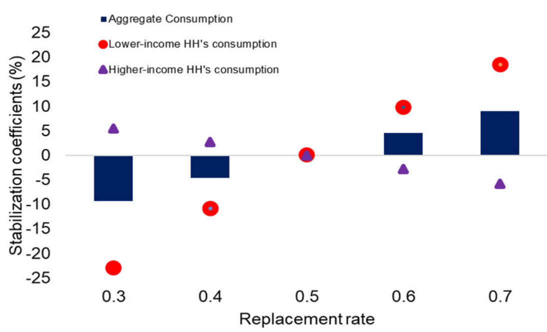
[12] This reflects that a large share of population has only low liquid wealth. According to Challe (2020), liquid wealth, rather than the entire net worth, is more relevant wealth concept to think about households' ability to smooth nondurables consumption from income fluctuations occurring at the business-cycle frequency, see Kaplan and Violante (2014) and Challe et al. (2017).

[13] The stabilization coefficient S is defined as: $S = 1 - \frac{V'}{V}$ where V is the variance at the selected benchmark calibrated parameters and V' is the variance at the alternative value.

[14] Results remain robust when considering only aggregate demand shocks or only aggregate supply shocks. First, greater unemployment income support would increase the resources toward those with high marginal propensity to consume, reducing demand deficiency in the case of a contractionary aggregate demand shock. It also stabilizes income and consumption a negative aggregate supply shock.

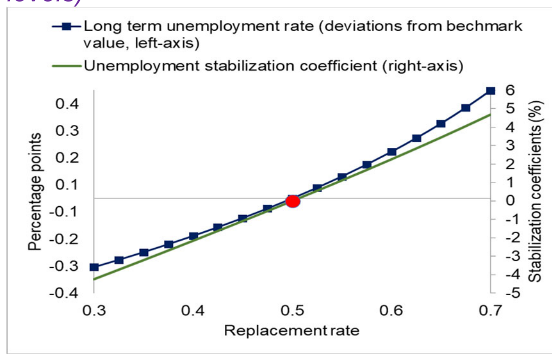
households (Panel C). Hence, fiscal responses to adversity would need to consider the nature of shocks and the distribution effects on households. At the extreme, if the adverse events hit households' income without causing job losses, targeted transfers are likely more effective.

Online Annex Figure 1.4.1. Stabilization Effects of Unemployment Benefits
(Percent)



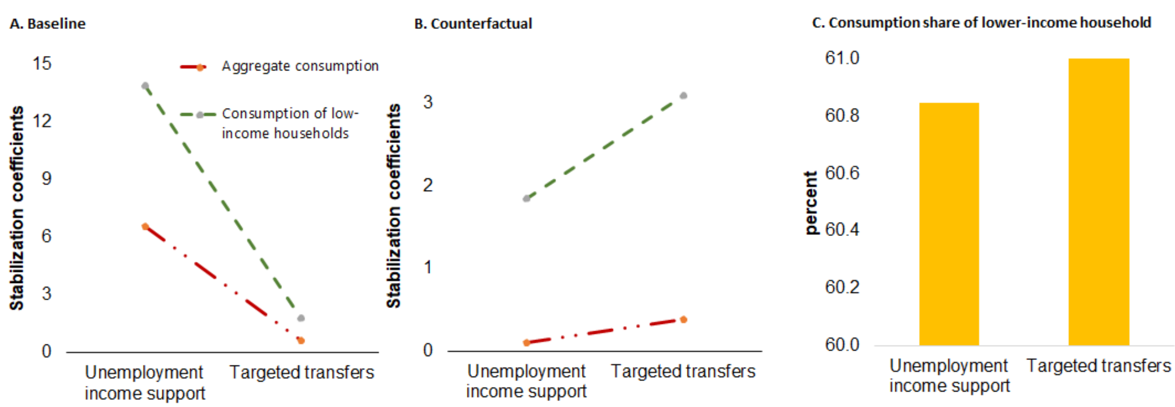
Source: IMF staff estimate
Note: A higher stabilization coefficient means more consumption stabilization and therefore stronger protection of individual income losses. The horizontal axis shows the replacement rate, which is set at 0.5 in the baseline.

Online Annex Figure 1.4.2. Tradeoffs Between Stabilization and Work Disincentives
(Percentage points deviation from the baseline levels)



Source: IMF staff estimate
Note: The baseline replacement rate is set at 0.5 with long-term unemployment rate at 7 percent. The horizontal axis shows the replacement rates while the vertical left-axis shows the deviations from the baseline unemployment rate at percentage points. The vertical right-axis shows the stabilization coefficients of unemployment rate.

Online Annex Figure 1.4.3. Unemployment Income Support and Targeted Transfer

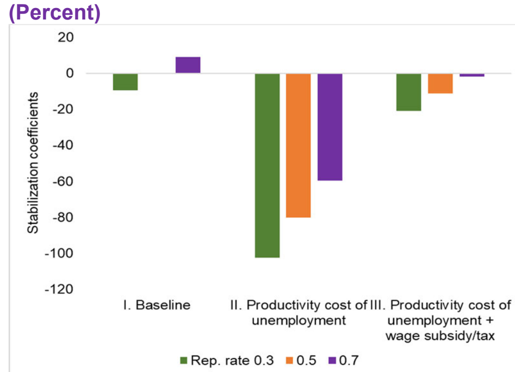


Source: IMF staff estimate.
Notes: The figures compare the effects of raising unemployment income support and targeted transfers in terms of consumption stabilization for the baseline (panels A and B). For the counterfactual model, most adjustments are via more sensitive to unemployment income support from search efforts and redistribution toward low-income households.

3. *Linkages of job retention schemes and unemployment income support.* During the pandemic, many countries introduced new or expanded existing job retention schemes to avoid layoffs. In a model scenario with a productivity cost when losing a job (calibrated to Chang and others (2002) and Engler and Tervala (2018), the results (the middle set of bars in Online Annex Figure 1.4.4) indicate that unemployment income support alone provides limited income stabilization, whereas other tools such as job retention schemes can be effective to limit the adverse impact on workers (the third scenario in Online Annex Figure 1.4.4). Nevertheless, potential misallocation of workers could occur if adverse events become protracted.

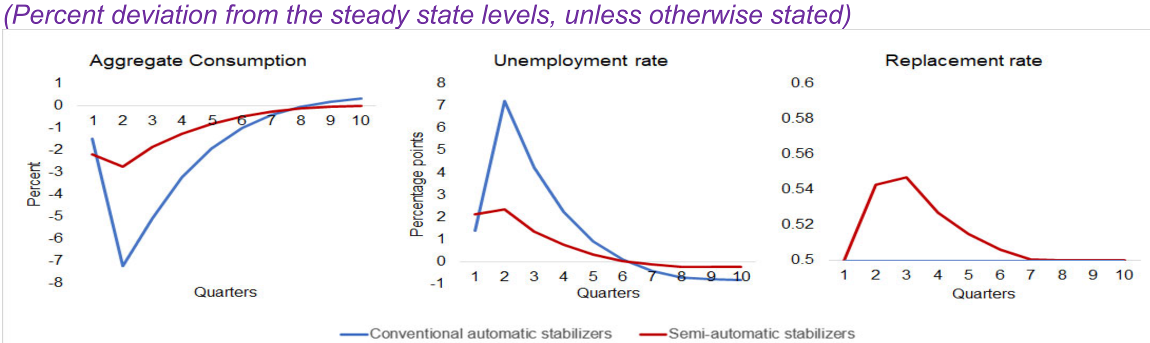
4. *Semi-automatic stabilizers and temporary discretionary support.* The discussion has focused so far on the *ex-ante* policy design. The subsequent discussion explores the effects of varying unemployment income support during adverse shocks. First, automatic stabilizers can be made more impactful at a modest cost. As a scenario illustration, an adverse event that combines *unanticipated* protracted aggregate demand and supply shocks for two quarters and then gradually fades away. The conventional automatic stabilizer of UIS (with a baseline replacement rate of 0.5) would help mitigate the drop in aggregate consumption. However, if it is a large crisis by scenario design, the negative impact would still remain large such as raising unemployment rate by 7 percentage points (Online Annex Figure 1.4.5, blue line). If semi-automatic stabilizer can be made more attuned to economic conditions, such as through a higher replacement rate if unemployment rates exceed certain thresholds or health protocols and lockdown restrictions are introduced, it can stabilize consumption better.[15] An explanation for the large difference is because the semi-automatic stabilizers provide not only a greater support, but also happen in difficult times when people most need it. The policy is also conditional on the severity of the adversity, therefore helps anchor households' expectations and reduce the needs of precautionary savings in the intertemporal setting. By stabilizing output and consumption more, the fiscal cost of the semi-automatic stabilizers is at 3.5 percent of GDP (cumulated over 2½ years), smaller than that of conventional stabilizers at 5 percent of GDP.

Online Annex Figure 1.4.4. Stabilization Effects of Job Retention Schemes When There Is Productivity Cost of Unemployment
(Percent)



Source: IMF staff estimate
Notes: Stabilization coefficients are calculated against a replacement rate of 0.5 and without the productivity cost of unemployment. The baseline calibration as in Figure 1.4.1. Scenario II assumes that if unemployment rate rises above the natural level by 1 percentage point, there would be a negative productivity impact of 0.12 percent in next quarter and fading away gradually, as in Engler and Tervala (2018) and Chang (2002) (three bars in the middle). Scenario III includes a job retention scheme to workers and firms when the unemployment rate exceeds the natural rates.

Online Annex Figure 1.4.5. Designing Semi-automatic Stabilizers
(Percent deviation from the steady state levels, unless otherwise stated)



Source: IMF staff estimate
Notes: The scenario considers an adverse event combining unanticipated demand and supply shocks in the first and second quarters and then gradually fades away. The conventional automatic stabilizer has a fixed replacement rate of 0.5 (as in the baseline). When the adverse event occurs, unemployment income support would help dampen the rise of unemployment rate and drop in aggregate consumption. The adverse impact remains large given it is a large crisis by design. The semi-automatic stabilizer features a time-varying replacement rate, which increases by 2 percentage points for every percentage point deviation of unemployment rate from its natural rate.

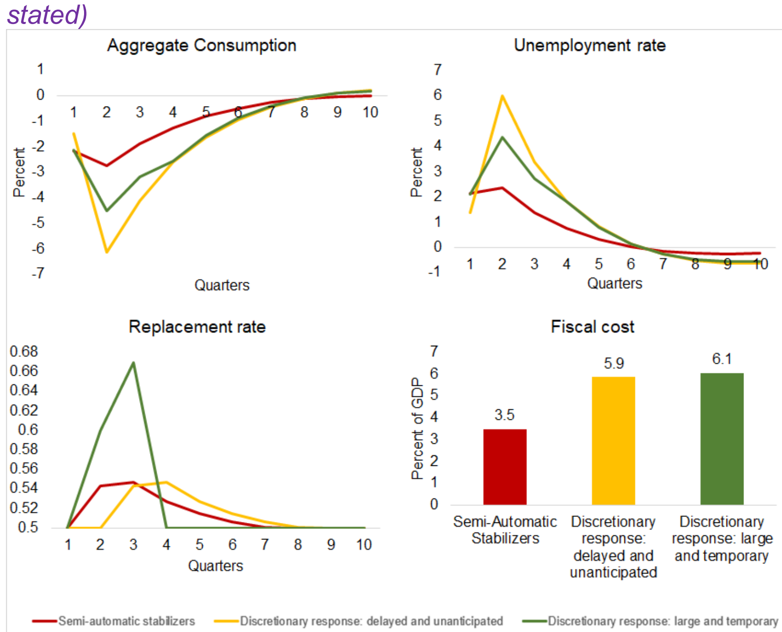
[15] Here considers an asymmetric rule in which the replacement rate increases when unemployment rate rises above the natural rate, while remains fixed during normal times. Solving the non-linearity of this mechanism uses the Occbin toolkit developed by Guerrieria and Iacoviello (2015). The semi-automatic stabilizers are calibrated so that the replacement rate increases by 2 percentage point given 1 percentage point increase in the unemployment rate from the natural rate, as in McKay and Reis (2021) and Mitman and Rabinovich (2021). Alternatively, tax policy can also be used in semi-automatic stabilizers to help stabilize income and consumption (Coleman 1991; Scheuer 2013).

Discretionary fiscal support can tailor to specificity of the adverse shocks but their effects depend on the size, timing, duration. We explore the issue by considering two sets of discretionary support (Online Annex Figure 1.4.6: i) a delayed expansion of unemployment benefits (yellow line); and ii) a timely and short-lived expansion of unemployment benefits (green line). The shocks are calibrated as before, which reduce consumption by 7 percent at the maximum and increase unemployment rate by 7 percentage points at trough.

The model results show that both types of discretionary support mitigate income and job losses. While they have similar fiscal cost (about 6 percent of GDP over 2½ years), a timely and short-lived support is more effective in stabilizing consumption. In practice, it is also challenging to determine the size and duration in real time and to unwind timely. Results also suggest that semi-automatic stabilizers as discussed before, provide a stronger stabilization and lower cost—because the latter provides guidance on state-contingent policy responses and dampens the adversity.

Online Annex Figure 1.4.6. Simulated Effects of Discretionary Support and Time-Varying Automatic Stabilizers

(Percent deviation from the baseline scenario, unless otherwise stated)



Source: IMF staff estimate.

Note: The unanticipated adverse events occur in the first and second quarters and then gradually fade away. The "semi-automatic" unemployment income support features a time-varying replacement rate that increases by 2 percentage points for each 1 percentage point deviation of unemployment rate from its natural rate. The two discretionary responses vary in terms of size and timing. Fiscal costs across scenarios are cumulative over 2½ years and are expressed in percent of GDP.

5. *Fiscal tools at times of rising cost of living.* Discretionary targeted transfers could be more effective than unemployment income support if the negative shocks pose risks on real income rather than unemployment or aggregate output. As an illustration, a model scenario considers the adverse shocks are a combination of a positive demand shock (raising aggregate demand and prices) and a negative supply shock (lowering output but raising prices), so that unemployment rate stay close to the natural rate, while the cost of living surges above its steady state.[16] It is also assumed that the increase of relative prices affect disproportionately lower-income households owing to the components of their consumption basket, therefore affecting their consumption more significantly.[17]

In this situation without any fiscal support, the consumption of the lower-income household decreases by 1 percent on impact and by as much as 2 percent (Online Annex Figure 1.4.7). Three set of policy measures are compared with the same fiscal cost of 1 percent of GDP: (i) an increase in unemployment income support, (ii) a targeted transfer to lower-income households, and (iii) a universal transfer (to all households). Among these measures, targeted transfers stand out to be a more effective measure to support constrained vulnerable households and limit the deterioration in consumption inequality because

[16] Price level increases by 4 percentage point (annualized) from its steady state on impact. Monetary policy follows a Taylor reacting to both inflation gap and output gap. The conventional automatic stabilizer has a fixed replacement rate of 0.5 for unemployment income support.

[17] The size of constrained households is calibrated to 20 percent of population compared to 80 percent in the baseline, reflecting the current large accumulation of household savings. The consumption share of this group is calibrated at 10 percent of aggregate consumption based on OECD data for a typical advanced economy.

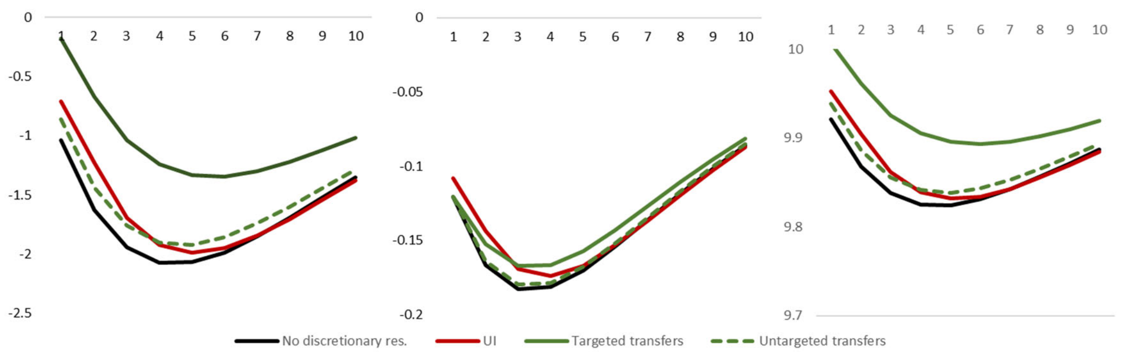
the per-beneficiary support is the highest among three instruments. These results echo the findings of Hanna and Olken (2018) and build a case for targeted transfer in response to current high food and energy prices.

Online Annex Figure 1.4.7. Discretionary Targeted Transfer to Vulnerable Households in Response to Increasing Living Cost

A. Lower-Income Households' Consumption (Percent deviation from the steady state levels)

B. Aggregate Consumption (Percent deviation from the steady state levels)

C. Consumption Share of Lower-Income Households (level)



Source: IMF staff estimate
Notes: The scenario considers a combination of positive demand shock and negative supply shock occuring in the first quarter and gradually fades away. These shocks (black lines) cause an increase in both aggregate inflation as well as the relative price of consumption basket for the lower-income household, while having negligible effect on unemployment.

Online Annex 1.5. Externalities from Energy Pricing Subsidies[18]

The annex illustrates a model to analyze the effects when most countries introduce universal pricing subsidies in response to temporary rise in energy prices. It shows that pricing subsidies incur high fiscal cost but limited protection to the vulnerable.

Model setup

The model assumes multiple countries with two types of households in each economy. The rich households can borrow or lend to smooth consumption and income shocks while the poor individuals cannot. The latter is also assumed to consume relatively more toward commodities (and less toward consuming the second good that is globally traded). Countries differ on their endowment of commodities, with some become importers and others exporting commodities. Exogenous global fluctuations on the endowments cause volatility in commodity prices. It is assumed that only rich households own the domestic commodity endowment in each country, so that the income of poor households is completely insulated from commodity price changes. Fluctuations in international prices have welfare implications for all individuals, both domestically (poor households is hit relatively harder with their consumption basket affected more by rising commodity prices) and internationally (commodity importers suffer relatively more). Governments put a progressive tax on households to finance measures meant to reduce the negative welfare effect on poor households. They can do it through a targeted income transfer or a universal subsidy to the domestic price of commodities.

Scenarios

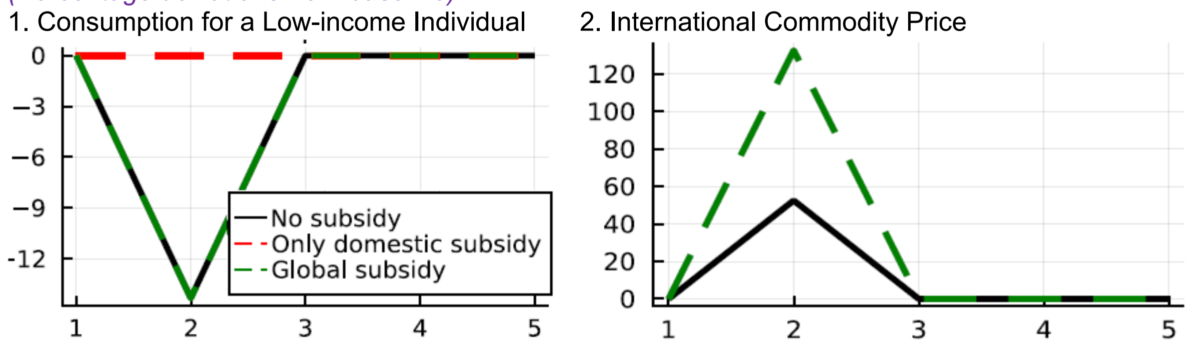
When governments employ universal subsidy on energy consumption to counter a temporary rise in commodity prices (Online Annex Figure 1.5.1). Three cases are considered: (i) no subsidies for domestic consumption of commodities across countries; (ii) only the domestic country subsidizes commodities, at a rate to fully insulate the adverse impact on the domestic poor from the international price shocks; and (iii) all countries contemporaneously subsidize (at the same rate as in previous case) domestic consumption of commodities with an intention to protect the poor.

Simulation results

In the case without subsidies, the domestic price of commodities rises, and consumption by the domestic poor falls. When only the domestic economy subsidizes (second case), then consumption of the poor remains constant, while the rich domestic households reduce consumption. However, when all governments follow similar strategy to subsidize prices (third case), it would lead to unintended consequences of high fiscal cost but limited protection for the poor households. Since the near-term energy supply is fixed globally, a universal subsidy by all countries simply translates into a one-to-one increase in global commodity prices. Therefore, domestic prices, while being lower than international prices, are still identical to what they would have been with no subsidy at all. This leads to a transfer of national wealth from the public budget of commodity importing countries toward commodity exporters, and an improvement in the net foreign asset position of commodity exporters. The results suggest that a blanket pricing subsidy may entail large cost but have limited protection for poor households.

[18] Prepared by Roberto Piazza.

Online Annex Figure 1.5.1. Effects of Global Energy Pricing Subsidies
(Percentage deviations from baseline)



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