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2020

December 2020

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
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Editor: Clemens Fuest
https://www.cesifo.org/en/wp
An electronic version of the paper may be downloaded
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CESifo *Working Paper No. 8765*

Will Germany's Temporary VAT Tax Rates Cut as Part of the Covid-19 Fiscal Stimulus Package Boost Consumption and Growth?

Abstract

On 3 June 2020, the German government announced a EUR 130 billion fiscal stimulus package to stimulate market demand and jumpstart the economy in the wake of the COVID-19 pandemic lockdown in the spring of 2020. The most prominent measure of this package is an unconventional fiscal policy in the form of a temporary VAT rates cut for six months, from 1 July to 31 December 2020. Employing a dynamic stochastic general equilibrium (DSGE) framework, we study the efficiency of the VAT tax rates cut for ameliorating the consequences of the pandemic recession. The simulation of the calibrated DSGE model yields a tax policy-induced real GDP increase of about 0.3 percentage points for 2020.

JEL-Codes: E300, E600, H250, I150.

Keywords: fiscal policy, value-added tax, DSGE model, Covid-19, Germany.

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1. Introduction

The global economic landscape has changed dramatically since the turn of the year from 2019 to 2020. In December 2019, respiratory illness clusters due to a novel coronavirus emerged in Wuhan, the capital city of the mainland Chinese Hubei Province. The World Health Organization (WHO) named the disease SARS-CoV-2 (COVID-19). In addition to the global health crisis, the COVID-19 pandemic has led to an extraordinary disruption in economic activity and has transformed the fiscal outlook.[1] The incentives to act quickly in the wake of this crisis have been substantial. Fiscal policy has been highlighted as the best available policy response tool (Baldwin and Weder di Mauro, 2020). To ensure that firms can weather the storm without going into bankruptcy, governments rolled out easier borrowing terms and credit guarantees, collateral-free credit to small companies, supply-chain finance schemes, a suspension of tax payments, and/or provided direct financial assistance where needed. Furthermore, the job retention scheme ('Kurzarbeitergeld') has been a key component. Conceptually, 'Kurzarbeit' allows workers to remain formally with the firm even if not currently working.[2]

After these initial emergency aid programmes, the question of how to rebound economies and stimulate aggregate demand has taken centre stage. Overturning years of fiscal orthodoxy and the so-called 'black zero' policy, the German government announced on 3 June 2020 a stimulus package worth EUR 130 billion. This follows a EUR 123 billion supplementary budget passed in March. Fresh borrowing could reach 6% of GDP in 2020. The centrepiece of the policy is a temporary VAT tax rates cut for six months, from 1 July to 31 December 2020. The regular VAT rate will be reduced from 19 percent to 16 percent, and the reduced VAT rate from 7 percent to 5 percent.[3] The aim is to create a future path for increasing VAT taxes by stimulating aggregate demand today.[4] Furthermore, EUR 50 billion has been set aside for investment, much of it green-tinged.

Upon what does the effect of the adopted VAT tax measure depend? First of all, the economic impact will depend on the extent to which the VAT rates cut is passed on to consumers, thereby increasing their real income. The empirical literature shows that the tax incidence varies from sector to sector (Benedek et al., 2019; Benzarti and Carloni, 2019). Moreover, the effect of VAT tax rate variations appears to be asymmetric. In particular, reductions in VAT tax rates are passed on to consumers to a lesser extent than increases (Benzarti et al., 2020). On 1 January 2012 the VAT rate for restaurants and catering services in Sweden was reduced from 25 to 12 percent. The Swedish National Institute for Economic Research (2015) then determined an associated price pass-through of roughly 50 percent.

[1] For further information on the global economic fallout of the COVID-19 pandemic and GDP forecasts for 2020 and 2021, see https://www.imf.org/en/Publications/WEO/Issues/2020/09/30/world-economic-outlook-october-2020.

[2] According to the OECD, most countries have relied on such labour market toolkits intended to help firms adjust working time and preserve jobs. See the IMF Policy Response Tracker on COVID-19 at https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.

[3] In addition to the regular tax rate, there is a reduced tax rate for basic necessities (Section 12 and Annex 2 UStG).

[4] For the theoretical underpinnings of unconventional fiscal policies, see Correia et al. (2013).

Matching this, Falkenhall et al. (2020) employed register data from Swedish firms to show that the VAT tax rate reduction had a positive effect on restaurant turnover, employment, and profit margins.

The first empirical study on the pass-through of the VAT tax rate reduction in the German fuel market was conducted by Montag et al. (2020). They employed a dataset containing the universe of price changes at petrol stations in Germany and France for June and July 2020, and a difference-in-differences modelling strategy. The econometric results reveal that, depending on the type of fuel and the degree of competition, between 40 and 80 percent of the tax reduction was passed on to consumers. Fuest et al. (2020) observed an average price decline of about 2 percent in German supermarkets. These results indicate that the temporary reduction in VAT tax rates at supermarket checkouts was almost entirely passed on to consumers. Both aforementioned studies dealt with selected consumer goods. The first assessment of all goods and services in the CPI basket was presented by the Deutsche Bundesbank (2020, pp. 57-59). According to this, 60% of the temporary VAT tax rates cut has been passed on to consumers.

Furthermore, the efficiency of the temporary tax rate cut also depends on the strength of the substitution effect. Provided that the temporary measure is credible, and thus price increases are expected in the subsequent year 2021, consumers may bring forward their consumption (Feldstein, 2002; Christofzik et al., 2020).[5] In this case, a larger effect could be expected for consumer durables (D'Acunto et al., 2016, 2020; Büttner and Madzharova, 2019). The empirical evidence on the temporary VAT rate reduction in the UK between 2008 and 2009 has revealed a resulting short-term economic stimulus, followed by a decline after the measure ended (Blundell, 2009; Crossley et al., 2014). This is compatible with the postulated intertemporal shift in consumption.

Our work relates to recently published dynamic economic models analysing the effects of the fiscal response to the pandemic, including those of Faria-e-Castro (2020) using a two-agent DSGE model and Bayer et al. (2020) using a HANK model. According to the modelling results of the Ifo Institute in Munich, the temporary German VAT rate reduction will increase GDP by 0.2 percentage points in 2020.[6] The German Council of Economic Advisors (Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, 2020, pp. 114-117) has briefly summarised work examining the macroeconomic impact of the overall German stimulus package using an estimated DSGE, in the spirit of Drautzburg and Uhlig (2015). In this analysis, the growth-enhancing effect of the VAT tax rates cut amounts to 0.3 percentage points in 2020. None of these works, however, models the temporary German VAT rate cut in such a multifaceted way as our study.

[5] Feldstein (2002) and Hall (2011) introduced the notion of unconventional fiscal policy measures at times of liquidity traps. Among several possible interventions, Feldstein (2002) proposed a series of pre-announced increases in VAT to generate consumer price inflation, and thus increase private spending via intertemporal substitution.

[6] See https://www.bundestag.de/resource/blob/702942/2220ad3cf44aa03bafe4e9847e49ca21/Prof-Dr-Dr-h-c-Clemens-Fuest-data.pdf.

Against this background, the reminder of the paper is organised as follows. Section 2 describes the DSGE modelling framework. Section 3 puts forward the calibration, while Section 4 presents the numerical model evaluation. Section 5 concludes with final thoughts and suggestions for further research. The pressing relevance of the policy question is the primary motivation for this work.

2. The Modelling Framework

Isolating the effect of tax policies from complementary policies or other economic developments constitutes a significant challenge and requires cautious interpretations. To address this difficulty, a growing strand of the literature employs DSGE modelling frameworks. Given their micro foundation and forward-looking nature, while also preserving the transparency of any resulting policy analysis, DSGE models present a useful tool for policy analysis generally and unconventional fiscal policy analysis in particular. For this reason, this section models the temporary German VAT rate reduction using a DSGE framework. Doing so can facilitate the design and activation of countercyclical policies dampening the pandemic's negative consequences. Time is discrete, quarterly, and infinite.

2.1 Households

The economy is populated by a representative household that chooses consumption c_t and hours worked n_t in order to maximise its discounted lifetime utility according to the constant relative risk aversion (CRRA) utility function:

$$E_t \sum_{t=0}^{\infty} \beta^t e^{\phi_t} \left\{ \frac{(c_t - hc_{t-1})^{1-\sigma}}{1-\sigma} - \chi \frac{n_t^{1+\psi}}{1+\psi} \right\}, \tag{1}$$

Where $\sigma > 0$ determines two attributes: it is the coefficient of relative risk aversion and also determines the intertemporal elasticity of substitution, given by $1/\sigma$. If σ is big, then the household is said to be risk averse. If σ is zero, then the household is said to be risk-neutral. The larger the value of σ, the more intense the household's interest in maintaining a smooth consumption profile. $\beta \in (0,1)$ is the discount factor, ψ is the inverse Frisch elasticity, χ is the labour disutility parameter, and $\phi_t$is an intertemporal preference shock.[7] The parameter $0 < h < 1$ measures the degree of habit formation. Habit persistence

[7] The modelling approach assumes that the pandemic will not lead to a long-run change in agent behaviour, although recent research suggests that COVID-19 may lead to lingering psychological effects that will persist long even after the pandemic has abated. See Attanasio et al. (2020) and Malmendier and Shen (2020), who have shown that consumption patterns in the aftermath of downturns tend to depress consumption for some time, even after controlling for income and other variables. COVID-19 might leave similar psychological scar, and this may complicate the task of restoring the German recession-stricken economy to growth.

captures intertemporal complementarity in consumption, which strengthens the smoothing motive relative to the time-separable CRRA case.[8]

The representative household maximises the utility function subject to the inter-temporal budget constraints:

$$p_t c_t + b_t + k_t = w_t n_t + \frac{b_{t-1}}{p_t} r_{t-1} + r_t^k k_{t-1} + \Psi_t - T_t \,, \tag{2}$$

where c_t denotes the consumption bundle of retail goods, p_t denotes the price index for retail goods, k_t is the capital stock, $w_t n_t$ is the labour income, r_t^k is the real gross return on capital, Ψ_t represents the profits of the production sector of the economy, and T_t are lump-sum taxes. Note that since households own firms, they receive firm profits. Finally, as in many simple New Keynesian models, we assume that there exists a single financial asset b_t each period, a one-period riskless nominal debt instrument, the interest rate r_t on which is also the central bank's policy instrument.

Furthermore, investment decisions are subject to convex capital adjustment costs and thus capital accumulates according to the law of motion:

$$k_t - (1-\delta)k_{t-1} = i_t \left(1 - \left(\frac{\gamma^i}{2}\right) x_t^2\right) \,, \tag{3}$$

Where $\delta \in (0,1)$ is the capital depreciation rate, γ^i is the investment adjustment cost parameter, and $x_t = (i_t / i_{t-1})$ denotes the growth rate of investment. The first-order conditions of the optimisation problem with respect to c_t, n_t, b_t , k_t and i_t are:

$$\lambda_t = e^{\phi_t} (c_t - h c_{t-1})^{-\sigma} + \; e^{\phi_{t+1}} \beta h E_t (c_{t+1} - h c_t)^{-\sigma} \tag{4}$$

$$\chi n_t^{\psi} = \lambda_t w_t \tag{5}$$

$$\lambda_t = \frac{E_t \beta \{\lambda_{t+1}\} r_t}{\pi_{t+1}} \tag{6}$$

$$q_t = \beta E_t \left\{ \frac{\lambda_{t+1}}{\lambda_t} \left(r_t^k + q_{t+1}(1-\delta) \right) \right\} \tag{7}$$

[8] Ravn et al. (2010) developed a model of deep habits which manages to produce positive consumption effects following expansionary policy shocks. 'Deep habits' refers to the idea that households form habits over sub-categories of consumption goods, such as cars and furniture, as opposed to aggregate consumption.

$$1 = q_t\left(1 - \left(\frac{\gamma^i}{2}\right)x_t^2 - \gamma^i x_t(1+x_t)\right) + E_t\beta\frac{\lambda_{t+1}}{\lambda_t}\left(q_{t+1}\,\gamma^i x_{t+1}\,(1+x_{t+1})^2\right)\,, \qquad (8)$$

Where λ_t denotes the Lagrange multiplier associated with the budget constraint, while q_t is the Lagrangian multiplier associated with the capital stock and represents the shadow price of capital (Tobin's q). Furthermore, $\pi_t = p_t/p_{t-1}$ denotes the inflation rate.

Following Voigts (2017), the household consumption bundle c_t is composed of differentiated retail good varieties $c_t^{ret}(r)$. Varieties are imperfect substitutes and are aggregated with the standard Dixit-Stiglitz (1977) aggregator:

$$c_t = \left[\int_0^1 (c_t^{ret}(r))^{\frac{\epsilon_r - 1}{\epsilon_r}} dr\right]^{\frac{\epsilon_r}{\epsilon_r - 1}}\,, \qquad (9)$$

Where ϵ_r is the elasticity of substitution between retail varieties. The associated demand function for retail goods is:

$$c_t^{ret}(r) = \left(\frac{p_t^{ret}(r)}{p_t}\right)^{-\epsilon_r} c_t\,, \qquad (10)$$

Where $p_t^{ret}(r)$ is the price of retail variety r and P_t is the aggregate retail price index

$$p_t = \left[\int_0^1 (p_t^{ret}(r))^{1-\epsilon_r} dr\right]^{\frac{1}{1-\epsilon_r}}\,. \qquad (11)$$

2.2 Supply Side

The assumed production process is composed of three distinct sub-processes. The first stage consists of monopolistically competitive intermediate good producers who sell the intermediates to representative final consumption good producers in the second stage. Following Voigts (2017) and in contrast to conventional DSGE models, a further third production stage exists beyond that. At this final production stage, retail firms repackage the homogeneous consumer goods and thus convert the homogeneous consumer goods into differentiated retail goods. The resulting imperfect competition on the retail goods market then allows for the modelling of different degrees of pass-through for the VAT tax rates cuts by the firms to the consumers.[9]

[9] In reality, these different production stages are often carried out by vertically integrated firms. In the DSGE modelling framework, the three stages are conceptually separated.

2.2.1 Intermediate Goods Firms

Intermediate goods firm $j \in [0,1]$ produces its differentiated intermediate good $y_t(j)$ using capital $k_t(j)$ and labour $n_t(j)$ through a Cobb-Douglas technology:

$$y_t(j) = \varphi_t k_t(j)^{\alpha} n_t(j)^{1-\alpha} \tag{12}$$

Where φ_t denotes the stochastic total factor productivity, and α $(1-\alpha)$ represents the share of capital (labour) in the production function. The first-order conditions for capital and labour imply

$$r_t^k = mc_t \alpha \frac{y_t(j)}{k_t(j)} \tag{13}$$

and

$$w_t = mc_t(1-\alpha)\frac{y_t(j)}{n_t(j)} \tag{14}$$

Where marginal cost is

$$mc_t = \left(\frac{1}{1-\alpha}\right)^{1-\alpha} \left(\frac{1}{\alpha}\right)^{\alpha} w_t^{1-\alpha} {r_t^k}^{\alpha} \quad . \tag{15}$$

Intermediate good firms are subject to a Calvo-pricing mechanism (1983), i.e., only a share $(1-\theta)$ of firms are allowed to re-adjust prices each period (the green-light-red-light approach). A firm that is randomly allowed to re-adjust prices maximises the expected sum of discounted profit:

$$\max_{p_t^{int}} E_t \sum_{k=0}^{\infty} \beta^k \Lambda_{t,t+k} \; \theta \left[y_{t+k|t}(j) p_t^{int}(j) \; - mc_{t+k}(j) y_{t+k|t}(j) \right] , \tag{16}$$

Where $\beta\Lambda_t$ is the stochastic discount factor. The optimal intermediate good price $(p_t^{int})^*$ is given by the first order condition of the following maximisation problem:

$$E_t \sum_{k=0}^{\infty} \beta^k \Lambda_{t,t+k} \theta y_{t+k|t}(j) \left[(P_t^{int})^* - \frac{\epsilon}{\epsilon - 1} mc_{t+k}(j) \right] = 0 \tag{17}$$

Equation (17) implies that the optimal intermediate good firm price $(P_t^{int})^*$ is a mark-up over the marginal cost.

2.2.2 Final Goods Firm

A final goods firm bundles intermediate goods $y_t(j)$ into the final good y_t via the standard Dixit and Stiglitz (1977) aggregator:

$$y_t = \left(\int_0^1 y_t(j)^{\frac{\epsilon-1}{\epsilon}} di \right) \quad , \tag{18}$$

Where ϵ determines the elasticity of substitution between intermediate goods. The cost-efficient bundling of intermediates goods is:

$$y_t(j) = \left(\frac{p_t^{int}(j)}{p_t^{fin}} \right)^{-\epsilon} y_t \quad , \tag{19}$$

Where p_t^{fin} is the aggregate price index for the final good:

$$p_t^{fin} = \left(\int_0^1 p_t^{int}(j)^{1-\epsilon} \, di \right)^{\frac{1}{1-\epsilon}} \tag{20}$$

2.2.3 Retail Firms

The retail firms $r \in [0,1]$ buy the homogenous final goods and repackage them. Subsequently, they sell the created differentiated goods with a mark-up on the price:

$$P_t^{ret}(r) = \big(1 + \xi_t(r)\big) P_t^{fin} \tag{21}$$

In accordance with the German VAT legislation, we introduce a tax-inclusive value added tax τ_t^v levied upon retail firms.[10] A tax-inclusive system means that the tax liability is included in the tax base. The implication is that a retail firm $r \in [0,1]$ only receives after-tax revenues of the following per unit:

[10] The German VAT is a general consumption tax levied on firms, which in turn are supposed to pass it on to consumers. A VAT obligated firm is any firm that has taxable turnovers in Germany. However, each firm can deduct the VAT it paid on purchases required for production. The actual VAT amount to be paid is thus calculated as the difference between the VAT paid to the firm by its customers and the VAT on inputs. Consequently, only the businesses at the final stage of the supply chain are liable to pay VAT. This enables abstraction from VAT

$$P_t^{ret}(r) = (1 + \xi_t(r)) \frac{P_t^{fin}}{(1+\tau_t^v)} \tag{22}$$

Analogously to intermediate goods firms, retailers are also subject to a Calvo (1983) pricing mechanism in which only a share $1 - \theta^r$ of randomly chosen retailers can optimally re-adjust prices each period. When deciding on the mark-up ξ_t, re-adjusting retail firms solves the maximisation problem:

$$\max_{\xi_t} E_t \sum_{k=0}^{\infty} (\theta^r)^k \beta^k \Lambda_{t,t+k} y_t^{ret}(r) \left[\frac{P_{t+k|t}^{ret}(r)}{1 + \tau_t^v} - P_{t+k}^{fin} \right] \tag{23}$$

Plugging in $P_t^{ret}(r) = \big(1 + \xi_t(r)\big) P_t^{fin}$ yields the first-order condition of the optimisation problem for the optimal mark-up ξ_t^*:

$$E_t \sum_{k=0}^{\infty} (\theta^r)^k \beta^k \Lambda_{t,t+k}\, c_{t+k}\, p_{t+k}^{fin}\, (1 + \xi_{t+k})^{\epsilon r} \left[\frac{1 + \xi_t^*}{1 + \tau_t^v} - \frac{\epsilon_r}{\epsilon_r - 1} \right] = 0 \quad , \tag{24}$$

Where ϵ_r is the elasticity of substitution between retail varieties, implying that the market power of retail firms is $\left\{ \frac{\epsilon_r}{\epsilon_r - 1} (1 + \tau_t^v) \right\}$. The associated aggregate retail price index is given in equation (11) above.

2.2.4 Corporate Profits

Profits of the monopolistically competitive intermediate firms and retail firms are paid out to households. Aggregate profits are given by:

$$\Psi_t = P_t^{int} y_t - w_t n_t - r_t^k k_t + \left[\frac{(1 + \xi_t) P_t^{fin}}{1 + \tau_t^v} - P_t^{fin} \right] c_t \tag{25}$$

The balance of the first three terms provides the profits of the intermediate goods firms. The final term provides the profits of the retail firms.

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taxation at the upstream production stages. The tax incidence at the final production stage then depends on the degree of pass-through. When the temporary VAT rate reduction is fully passed on to consumers, they then benefit from the VAT rate reduction. When the VAT rate reduction is only partly passed on to consumers, then the temporary VAT rate cut will increase the companies' profits. See Voigts (1997, pp. 11-12) for a thorough discussion of this issue within the DSGE context.

2.3 Government

The government issues risk-free one period bonds b_t that return the interest rate r_t. In order to finance public spending g_t and debt service $r_t b_{t-1}$ expenditures, the government raises a value added tax τ_t^v and lump sum taxes T_t. Thus, the fiscal authority's period-by-period budget constraint has the following form:

$$b_t = r_t \frac{b_{t-1}}{p_t} + g_t - \frac{\tau_t^v}{1+\tau_t^v} c_t - T_t \tag{26}$$

Following Coenen et al. (2012) and Born et al. (2013), among others, the fiscal instruments are assumed to follow the prescriptions of simple feedback rules, with the feature that taxation responds to deviations of government debt from its steady-state level in an effort to stabilise public debt.[11] It is in this regard that the government is assumed to follow the requirements of the debt brake.[12] In particular, the following rule applies:

$$T_t = T + \gamma^b \left(\frac{b_{t-8}}{4y_{t-8}} - \frac{b}{4y} \right) \tag{27}$$

Where $b_{t-8}/4y_{t-8}$ denotes the lagged debt-to-GDP ratio, T denotes the steady-state level of lump sum taxes, and $\gamma^b > 0$ denotes the responsiveness of the tax rule to deviations in the debt-to-GDP ratio.[13] Note, however, that the method of financing government spending, at least in the short term, does not have significant effects. This is because taxation does not respond on impact and otherwise evolves slowly.

The VAT tax rate τ_t^v is calculated as the weighted average of the standard rate τ_t^c and the reduced rate τ_t^r on products deemed necessities of life. The overall VAT tax rate is thus given as:

[11] The DSGE framework assumes that, due to the German debt brake, the tax authority can credibly commit to any future tax change; thus, game-theoretic and time-inconsistency issues will not be considered (Barro and Gordon, 1983). The debt brake was introduced into the German constitution in 2009. The rule stipulated that, by 2020, the public budgets of the 16 German states (Länder) must be balanced in normal times. At the Federal level, structural deficits were restricted to a tight maximum of 0.35% of GDP. An exemption clause allows temporarily higher debt in special emergencies that are beyond the control of the government.

[12] Notice that we are assuming a lag of 8 quarters (2 years) in the feedback rules. After the great economic collapse in the wake of the COVID-19 pandemic, the German government has mobilised large-scale emergency measures designed to protect employees and firms from the economic consequences of the pandemic. The aim is to maintain their productive potential until after the crisis. The constitutional debt brake was temporarily suspended due to the extraordinary circumstances, strengthening Germany's ability to react decisively to the challenges posed by the pandemic.

[13] In the baseline specification of its DSGE modelling exercise, the German Council of Economic Experts has also adopted lump-sum taxation (see Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, 2020, p. 116).

$$\tau_t^v = \mu\tau_t^c + (1-\mu)\tau_t^r \,, \tag{28}$$

where μ $(1-\mu)$ represents the share of consumption goods taxed with the standard rate (reduced rate).

2.4 Monetary Policy

As is standard in the New Keynesian literature, we assume that the central bank adheres to an inflation targeting policy in the spirit of Taylor (1993). Thus, monetary policy reacts to deviations of inflation and output from their respective steady states according to:

$$r_t = \left\{(r_{t-1})^{\rho_i}\left(\left(\frac{\pi_t}{\pi}\right)^{\kappa_\pi}\left(\frac{y_t}{y}\right)^{\kappa_y}\right)^{1-\rho_i}\right\} \,, \tag{29}$$

Where r_t is the monetary policy rate, π_t is the inflation rate, y_t is output, ρ_i is the interest rate smoothing parameter, and κ_y and κ_π are the responsiveness parameters for inflation and the output gap, respectively.[14] The instantaneous interest rate reaction reflects the fact that monetary policy is enacted with ease and immediacy.

2.5 Stochastic Processes

Finally, the log of the technology shock and the demand shock are assumed to follow first-order autoregressive, or AR(1), processes.

$$\ln\varphi_t = \rho_\varphi \ln\varphi_{t-1} + \epsilon_t^\varphi \tag{30}$$

$$\ln\phi_t = \rho_\phi \ln\phi_{t-1} + \epsilon_t^\phi \,, \tag{31}$$

where $\epsilon_t^\varphi \sim N(0,\sigma^2)$ and $\epsilon_t^\phi \sim N(0,\sigma^2)$.

[14] In view of the fact that the zero lower bound has been reached in many countries, the interest rate in the monetary policy response function can also be interpreted as the shadow short rate, reflecting the joint influence of conventional and unconventional monetary policy measures. See https://sites.google.com/view/jingcynthiawu/shadow-rates.

2.6 Market Clearing

The final goods market is in equilibrium when the supply side of the economy is equal to the demand side of the economy, which implies that the final good production y_t is equal to aggregate consumption c_t, aggregate investment i_t, and aggregate public spending g_t.

$$y_t = c_t + i_t + g_t \tag{32}$$

The above toolbox provides the theoretical underpinnings for this study's quantitative evaluation of the temporary VAT reduction. The model can now be employed to investigate the immediate, transitional, and long-term effects of the German government's efforts to stimulate the economy after the COVID-19 shock.

3. Model Calibration

The baseline model parameter values in Table 1 were chosen to match their empirical counterparts and to be consistent with the quarterly frequency. Where possible, an attempt has been made to define parameters specific to the German economy. For the most part, we employ standard parameters as found in the literature, and thus our discussion can be brief.

Following Drygalla et al. (2020), the intertemporal elasticity of substitution is set to 1. The habit persistence parameter h is set to 0.68 following the estimates of Pytlarczyk (2005). The inverse Frisch elasticity ψ is set to 1.2133 following the estimates of Kollman et al. (2015). The steady-state number of hours worked n is set to 0.22 following OECD data on the average number of hours worked in Germany in 2019. The labour disutility parameter χ is 7.5 in order to pin down the steady-state number of hours worked.

The depreciation rate of capital δ and the share of capital in the production function α and are set to 0.025 and 0.33, respectively. The investment adjustment cost parameter γ^i is set following the estimates of Drygalla et al. (2017). The steady-state intermediate goods firms mark-up is set to 1.3, implying an elasticity of substitution ϵ = 4.33. For the Calvo parameter of intermediate goods, we follow Altissimo et al. (2006) and set $\theta = 0.75$. Conversely, the Calvo parameter of retail firms θ^r is set to 0.4 in order to match the pass-through estimates of the Deutsche Bundesbank (2020).[15] The elasticity of substitution between retail varieties $\epsilon_r = 11$ is adjusted based on the estimates of Thum-Thysen and Canton (2015) in order to match a steady-state mark-up for retail firms of 1.1.

[15] In general, prices in sectors covered by the CPI tend to be changed every four to five quarters. However, changes in indirect taxes have led to temporary increases in the frequency of price changes (Deutsche Bundesbank, 2008; European Central Bank 2003, 2004).

Both shock persistence parameters are set at 0.33, implying a pandemic shock persistence of about six quarters. The model calibration is thus guided by the assumption that the pandemic will lead to a v-type recession. Alternatively, it could be said that the calibration is motivated by the anticipation of progressively effective pharmaceutical interventions for the pandemic from mid-2021 onwards.

Table 1: Parameter Values in the Baseline Model

Parameter	Description	Value
Households		
β	Discount factor	0.99
h	Habits	0.68
χ	Labour disutility parameter	7.5
ψ	Inverse Frisch elasticity	1.2133
n	Steady-state hours worked	0.22
$1/\sigma$	Intertemporal elasticity of substitution	1
Firms		
δ	Depreciation rate of capital	0.025
α	Share of capital	0.33
$\epsilon/(\epsilon-1)$	Intermediate goods firms' mark-up	1.3
θ	Calvo parameter for intermediate goods producers	0.75
γ^i	Investment adjustment cost parameter	4
$\epsilon_r/(\epsilon_r-1)$	Retail firms' mark-up	1.1
θ^r	Calvo parameter for retailers	0.4
Government		
$b/4y$	Steady-state debt to GDP ratio	0.62
g/y	Steady-state public spending	0.203
γ^b	Tax responsiveness to public debt	0.0125
τ^v	Aggregate VAT rate	0.1745
τ^c	Regular VAT rate	0.19
τ^r	Reduced VAT rate	0.07
μ	Share of goods subject to the regular VAT tax rate	0.865
Shocks		
ρ_φ	Persistence of the TFP shock	0.33
ρ_ϕ	Persistence of the preference shock	0.33
Monetary policy		
ρ_i	Interest rate smoothing parameter	0.8
κ_π	Monetary policy response to inflation	1.5
κ_y	Monetary response to output	0.125

Turning to the fiscal side, the German sovereign debt-to-GDP ratio $b/4y$ is set to 0.62, and the steady state government consumption-to-GDP ratio g/y is set to 0.203. In the case of the tax responsiveness parameter γ^b, we follow the European Commission's target under the excessive deficit procedure. This requires that a debt-to-GDP ratio above 60% be reduced by one twentieth each year. According to this

narrative, we assume $\gamma^d = 1/80 = 0.0125$. The regular VAT rate τ^c is set to 0.19 and the reduced VAT rate τ^r is set to 0.07, matching the prevailing tax rates prior to the 2020 temporary tax cut. The share of goods subject to the regular VAT tax rate is set to $\mu = 0.865$ following Bach and Isaak (2017). Finally, the chosen monetary policy parameters are $\kappa_\pi = 1.5$, $\kappa_y = 0.125$, and $\rho_i = 0.8$, respectively. This ensures adherence to the Taylor principle. This means that while inflation targeting is the main objective, output fluctuations (and the level of the output gap) also feature in monetary policy decisions.

4. Numerical Model Evaluation

Armed with our modelling framework in the New Keynesian tradition, we now turn to the policy evaluation. The temporary VAT rate reduction is modelled as a non-anticipated measure.[16] On the contrary, the end of the measure is assumed to be known and credible. Since the New Keynesian model is inherently forward-looking, we employ the perfect foresight rational expectations solution method. The basic idea is that agents have perfect foresight of the path of the VAT rate and of all shocks until an arbitrary point in time. This feature makes it suitable for the announced duration of the tax reduction, limited to six months. After reverting to the initial tax rates, all the shocks are zero and the solution method is standard.[17] Therefore, the system can be solved backwards from this point. The algorithm takes into consideration the special structure of the Jacobian matrix in dynamic models with forward-looking agents. The details of the algorithm can be found in Juillard (1996).

4.1 Model Dynamics

Figure 1 plots the impulse responses of key model variables in response to the temporary VAT rate cut.[18] Specifically, a simultaneous decrease of 15.7% of the regular VAT rate and 28% of the reduced VAT rate for six months is assumed. Due to perfect foresight, agents presume that the VAT rate cut is temporary and that the VAT rate will return to initial levels after six months.

Figure 1 illustrates the isolated effect of the VAT rate cut in the German stimulus package. The responses are broadly intuitive, with a lower VAT rate inducing positive consumption, investment, and labour supply responses, which, in turn, increase output by 0.3 percentage points in 2020. The CPI inflation rate initially falls and then rises again. Furthermore, it is evident that firms also benefit from the temporary VAT rate tax cut and thus stimulate demand. Finally, the increase in public debt is rather

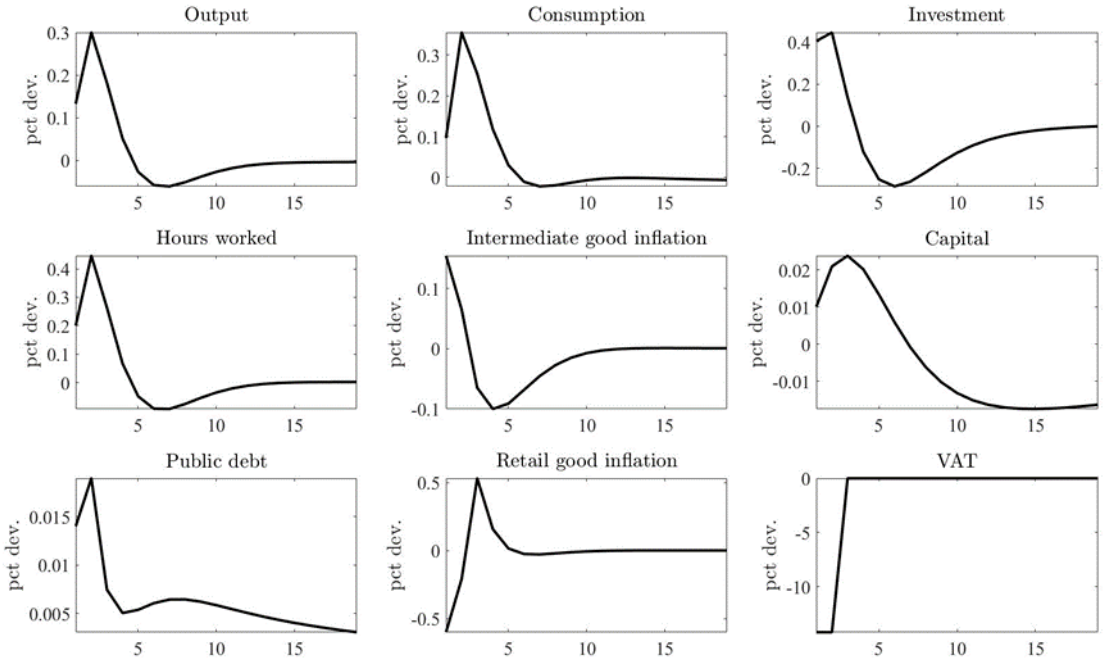
[16] The temporary VAT rates cut has not been anticipated. In the run-up to the decision, only a possible renewed cash for clunkers programme was discussed in public. However, the government has ignored the lobbying of Germany's powerful car industry for such a programme, with the exception of electric cars.

[17] Thus, this paper relates to the literature on foresight and anticipation in fiscal policy. Amongst others, important contributions include Leeper et al. (2012) and Mertens and Ravn (2012). To ensure that a perfect foresight solution exists, the DSGE model has to be stable under perfect foresight. See, e.g., Boucekkine (1995).

[18] Given the unprecedented uncertainty caused by the pandemic, caution should be exercised when reading the impulse response functions, as these do not allow for confidence intervals. See Baker et al. (2020).

long-lasting, as the resulting increase in lump-sum taxation occurs with a lag of eight quarters. In terms of magnitude, the reactions are comparable with existing estimates. The Ifo Institute in Munich has predicted that the temporary German VAT tax rates reduction will increase GDP by 0.2 percentage points in 2020, while the German Council of Economic Advisers has estimated that the tax stimulus will increase German GDP by 0.3 percentage points in 2020.[19]

Figure 1: Impulse Responses to the Temporary VAT Rate Cut



Note: Impulse responses are reported as percentage deviations from the non-stochastic steady state with the exception of the inflation rates, which are reported as annualised percentage-point deviation.

An critical question is whether and to what extent the model predicts an intertemporal pull-forward effect in consumption. In other words, will the temporary VAT tax rates cut incentivise households to bring consumption forward, jump-starting and helping the economy to exit the COVID-19 recession? Does the baseline model support this conjecture? Figure 1 reveals that in the baseline model calibration, such a response is hardly visible. In other words, an intertemporal shift in consumption is quantitatively of minor importance.[20] Section 4.2 below offers a detailed sensitivity analysis of this transmission channel.

[19] There are well-founded reasons to believe that these steady-state deviations represent a lower limit. Numerous studies indicate that expansionary fiscal policy shocks unfold greater effects during recessions (see, e.g., Berg, 2019 and Gechert and Rannenberg, 2018).

[20] This finding is certainly no surprise. Non-expert household surveys from the GfK consumer research association (https://www.gfk.com/en-gb/home) in summer 2020 have revealed that only a limited number of consumers planned to bring forward purchases. See https://www.gfk.com/de/presse/29-prozent-der-deutschen-

The evidence presented in Figure 1 brings more clarity to the debate on the effectiveness of the temporary VAT tax rates cut. Despite existing reservations, the impulse response functions demonstrate that the temporary tax policy measure has mitigated the consequences of the pandemic.

A natural follow-up question is to ask how a longer-term VAT rate reduction would work as compared to the six-month measure. While the impressive German real GDP turnaround in 2020: Q3 is a welcome rebound, it is akin to the snapback of a stretched rubber band. Vulnerability is hardly debatable. The second wave of the pandemic and the finally-decreed second light lockdown in November and December 2020 left Germany's economy vulnerable to a setback. Thus, the true test will come after the snapback. The resurgence of COVID-19 in Europe in autumn, and varying degrees of lockdowns to contain the virus, may once again slow economic recovery. Pessimistic voices would say that this fits the script of the dreaded double-dip *w*-type recession. Longer-run changes in consumer preferences (for example, declining demand for air travel or cruises) might also limit the demand rebound.[21]

Against this background, Figure 2 plots the impulse responses following a temporary VAT tax rates cut with a length of 2, 4 and 6 quarters, respectively. All other parameters are unaltered. In particular, three lessons can be learnt from this policy experiment. First, if the tax cuts had been implemented over a longer period of time, then the growth in consumption would be longer lasting and thus more expansionary overall. Second, in the case of more permanent tax cuts, the consumption impact would occur with a time lag. As is intuitively reasonable, in the case of a short-lasting VAT tax rate reduction, agents squeeze in their expenditures while the VAT tax rate cut exists. Third, due to the convex adjustment costs, a longer time span for the tax measure would lead to a more pronounced increase in investment. In the interest of a swift recovery after the pandemic lockdown in spring, a prolongation of the tax measure would thus have been associated with drawbacks. In a nutshell, the guiding principle can be summarised with the phrase 'make hay while the sun shines'.

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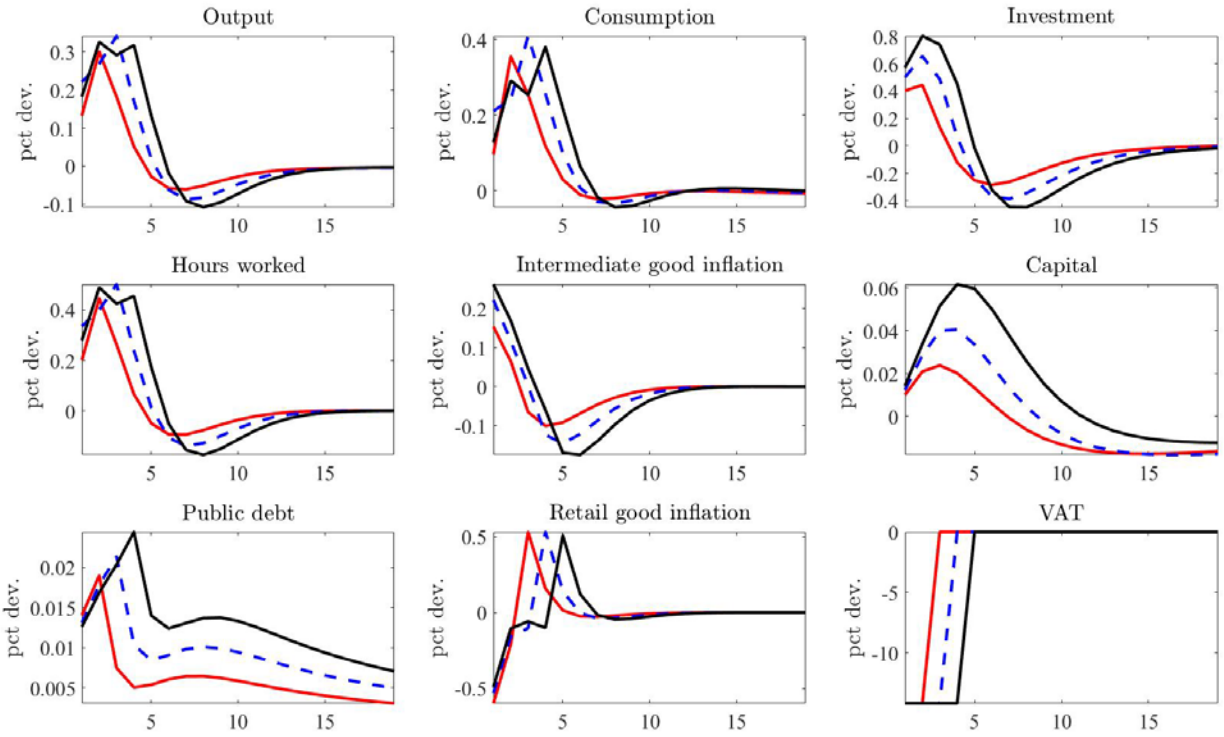
planen-groessere-anschaffungen-vorzuziehen. An analogous conclusion results from the SAFE Leibniz Institute for Financial Research 'Household Crisis Barometer', providing representative in-depth insights into the purchasing behaviours and expectations of German consumers. The overall conclusion is that it is highly unlikely that the temporary VAT rate reduction will induce households to consume much more in the current situation. See https://safe-frankfurt.de/fileadmin/user_upload/editor_common/Policy_Center/SAFE_Policy_Letter_87_final.pdf.

[21] The extent of pent-up demand is also uncertain. Private sector leverage and loss of income may depress the rebound in demand. The reason for this is that households and firms can end up accumulating more debt during the containment phase. The debt payments amount to a transfer from borrowers to lenders during the recovery phase, which can potentially dampen aggregate demand due to differences in marginal propensity to consume between borrowers and lenders (Mian et al., 2020).

Figure 2: Impulse Responses to Temporary VAT Rate Cuts of Different Lengths



Note: The figures plot the impulse responses following a temporary VAT rate cut with a length of two quarters (solid red lines), four quarters (dashed blue lines), and six quarters (solid black lines), respectively. Impulse responses are reported as percentage deviations from the non-stochastic steady state with the exception of the inflation rates, which are reported as annualised percentage-point deviation.

As a third exercise within the model, we consider the joint impact of the COVID-19 shock and the temporary VAT tax rates cut. This requires the introduction of the pandemic shock into the DSGE model. The COVID-19 shock has specific characteristics. Whether the COVID-19 pandemic is primarily a demand or supply shock is one of macroeconomics' ongoing questions. In response to the COVID-19 pandemic, governments around the world used non-pharmaceutical interventions and lockdowns which led to disruptions in international supply chains and the shutdown of entire sectors of the global economy. At the same time, consumers voluntarily reduced their consumption of goods and services involving high levels of physical contact with other people. This, combined with uncertainty about the evolution of the pandemic, has led to a reduction in demand for goods and services across the board. For this reason, most economists agree that the economic effects of the pandemic combine aspects of aggregate supply and aggregate demand shocks (Baldwin and Weder di Mauro, 2020).

Using survey-based forecast revisions to resolve the identification problem for the structural shocks, Bekaert et al. (2020) have attributed two thirds of the decline in US GDP in 2020Q1 to a negative shock to aggregate demand. In contrast, regarding the staggering decline in US GDP in 2020Q2, they have estimated two thirds of that decline were due to a reduction in aggregate supply. Balleer et al. (2020)

have investigated planned price changes among German firms to infer the relative importance of supply and demand shocks during the COVID-19 pandemic. The micro data used are from the Ifo Business Climate Survey database through August 2020. All in all, the results suggest that demand and supply shocks account for a significant share of the fall in GDP. However, the demand shocks exhibit a somewhat greater significance.[22]

A contributing factor to this difference has been the declining demand for contact-intensive goods and services due to individuals' responses to the COVID-19 risk. Headline CPI inflation and core inflation (excluding energy and food) in Germany took a nosedive.[23] When the lockdown measures in spring were eased, inflation recovered somewhat but remained below the pre-pandemic level. This points to the relevance of demand shocks. Thus, we assume that the downturn has been triggered by demand and supply shocks at a ratio of 70:30.[24]

Figure 3 shows the exercise of simulating the pandemic-induced recession. The weighted sum of both structural shocks leads to a 5.1% percentage point decline of German GDP, as predicted by the Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2020) for the year 2020. The exercise also sheds light on the amplification and transmission processes during the economic downturn as well as the subsequent recovery.[25] In the following, we will use this simulated benchmark COVID-19 recession as the reference allocation in the welfare analysis.

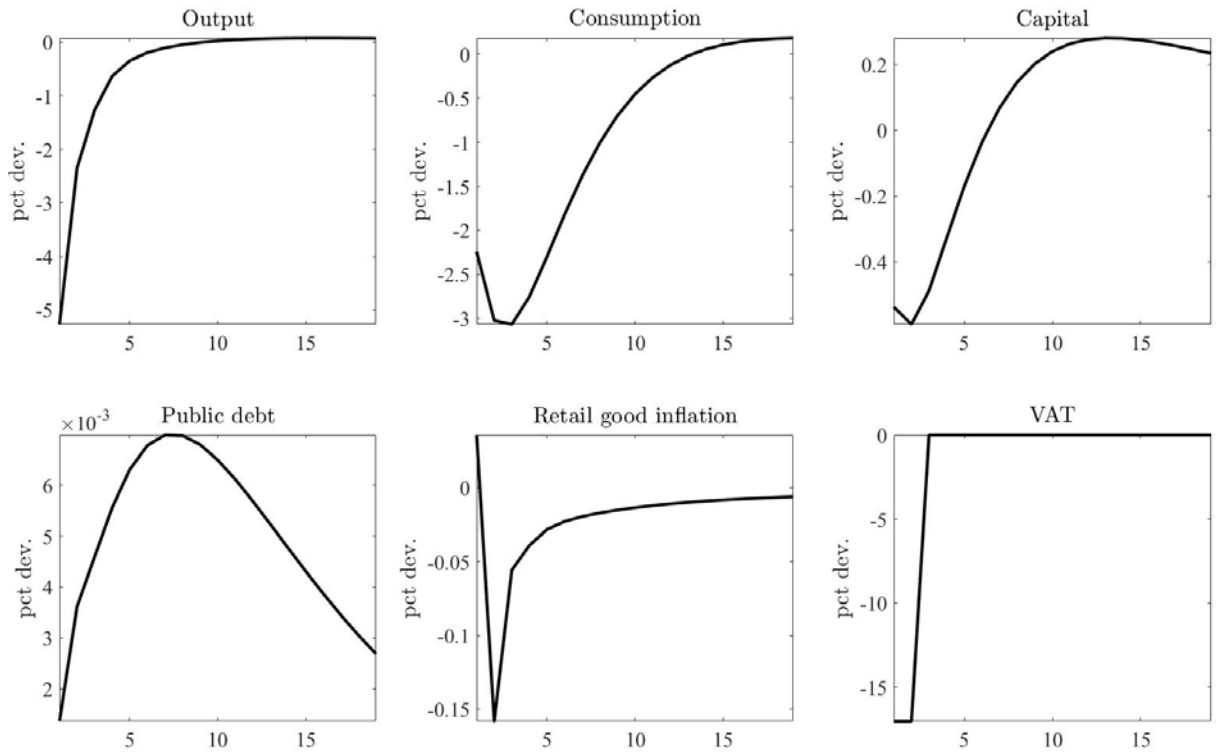
[22] In line with this, Guerrieri et al. (2020) have termed the pandemic shock a 'Keynesian supply shock'.

[23] In January 2020, the annual increase in the German headline CPI was 1.7%. In May 2020, it fell to 0.6%. Over the same period, the core inflation rate fell from 1.5% to 1.2%.

[24] Past epidemics may also shed some light on the inflation dynamics to be expected during and after the current COVID-19 pandemic. As Barro et al. (2020) have shown, the effect of the Spanish flu on inflation (during and after) was negligible.

[25] The reduction in public debt commencing after eight quarters is the result of the delayed debt reductions, as postulated in equation (27).

Figure 3: Effects of the Pandemic-Induced Recession



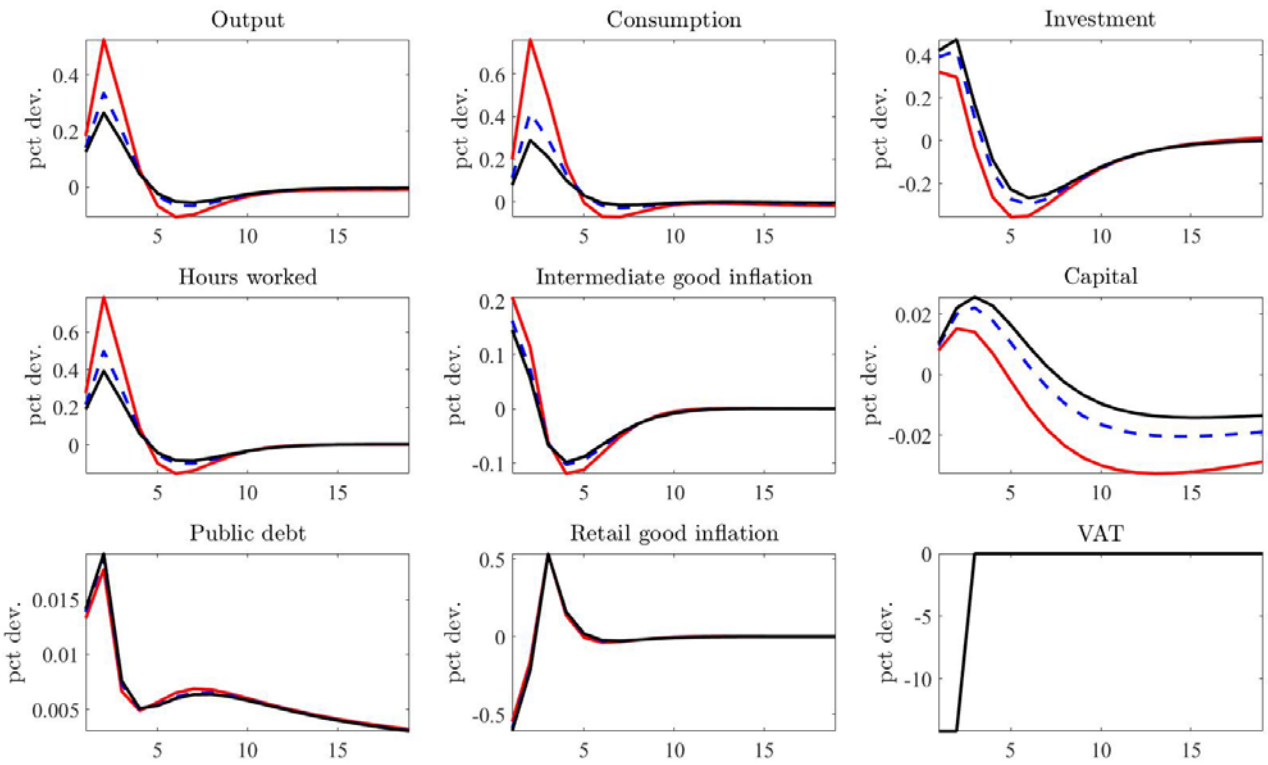
Note: The impulse responses are reported as percentage deviations from the non-stochastic steady state with the exception of the inflation rates, which are reported as annualised percentage-point deviation.

4.2 Sensitivity

In this section, we look at how the response of the economy to the temporary VAT tax rates cut varies when considering different values of certain parameters. The different parameters we take a closer look at are the household's intertemporal elasticity of substitution $1/\sigma$, the Calvo parameter of retail firms θ^r, and the habit formation parameter h. All other parameters conform to their respective baseline calibrations.

The intertemporal decision theory outlined above implies consumption smoothing over the consumer's life cycle. To illustrate the dependence on key model parameters, Figure 4 provides the impulse responses for different intertemporal elasticities of substitution $1/\sigma$.

Figure 4: Impulse Responses for Alternative Intertemporal Elasticities of Substitution

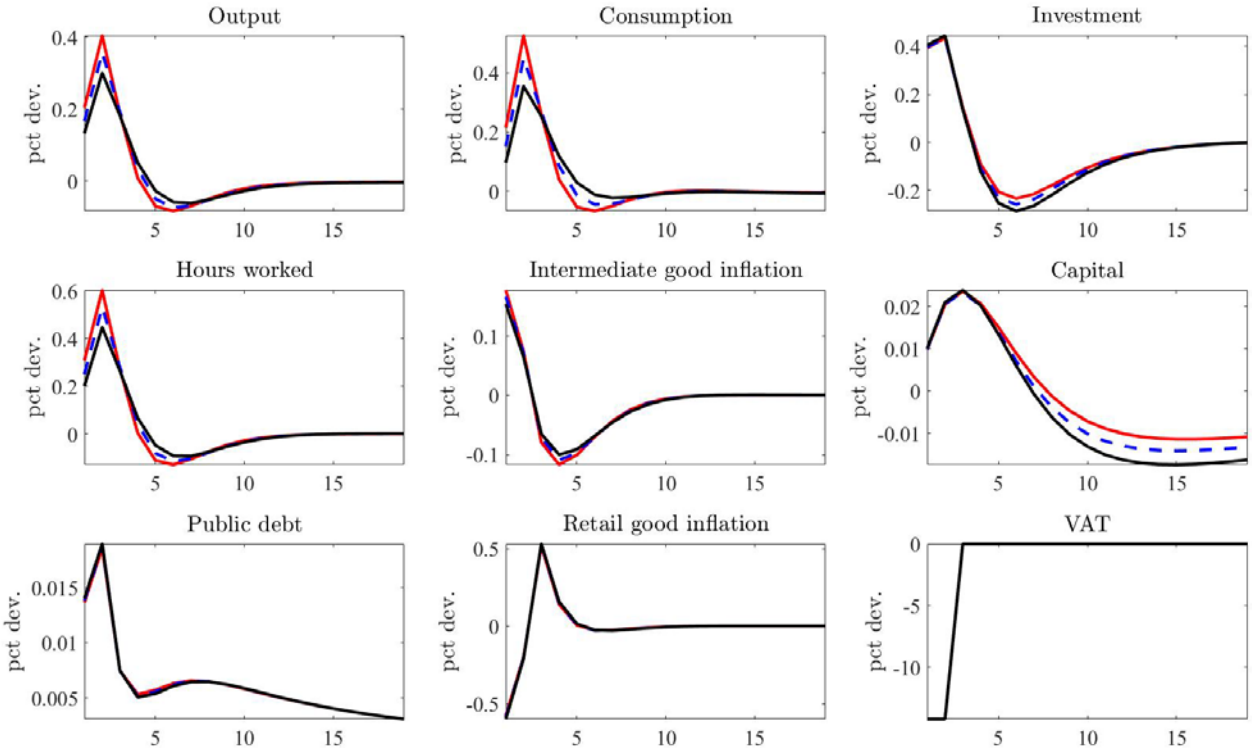


Note: The figures depict the impulse responses for an intertemporal elasticity of substitution $1/\sigma = 1/1.5 = 0.67$ (solid black lines), the baseline calibration $1/\sigma = 1/1 = 1$ (dashed blue lines), and $1/\sigma = 1/0.5 = 2$ (solid red lines). The impulse responses are reported as percentage deviations from the non-stochastic steady state with the exception of the inflation rates, which are reported as annualised percentage-point deviation.

A comparison of the different model calibrations in Figure 4 clearly illustrates that the intertemporal elasticity of substitution characterises the consumer's willingness to pre- or postpone consumption. Consumers with a high elasticity of intertemporal substitution are more willing to substitute consumption over time in view of the temporary VAT tax rate cut. One objective of the temporary tax policy measure was to create a future path of higher VAT tax rates, and thus stimulate more immediate aggregate demand. The sensitivity of the consumption dynamics on preferences apparent in Figure 4 poses the question of what a reasonable model calibration actually is. Unfortunately, the elasticity of intertemporal substitution is a parameter which is notoriously difficult to estimate. A thorough meta-analysis of the elasticity of intertemporal substitution estimates across 104 countries has been carried out by Havranek et al. (2015). One of their main conclusions was that, in representative agent models, it is difficult to argue against values for $1/\sigma$ that are below one. For Germany, too, values $1/\sigma < 1$ are ascertained. This suggests that the parameter $1/\sigma = 1$ in the baseline specification actually constitutes an upper bound. Conversely, this means that unconventional fiscal policy is ineffective for bringing consumption forward.

A closely-related question is that of habit formation significance, which is governed by the habit formation parameter $h \in [0,1]$. A consumer with more pronounced habit formation is less willing to substitute consumption over time. We calibrated the model for $h = 0.5$, $h = 0.6$, and $h = 0.68$, respectively.[26] The associated impulse response functions are presented in Figure 5. As expected, consumers with a less pronounced habit persistence attitude are more willing to substitute consumption over time in view of the temporary tax cut.

Figure 5: Impulse Responses for Alternative Habit Parameters



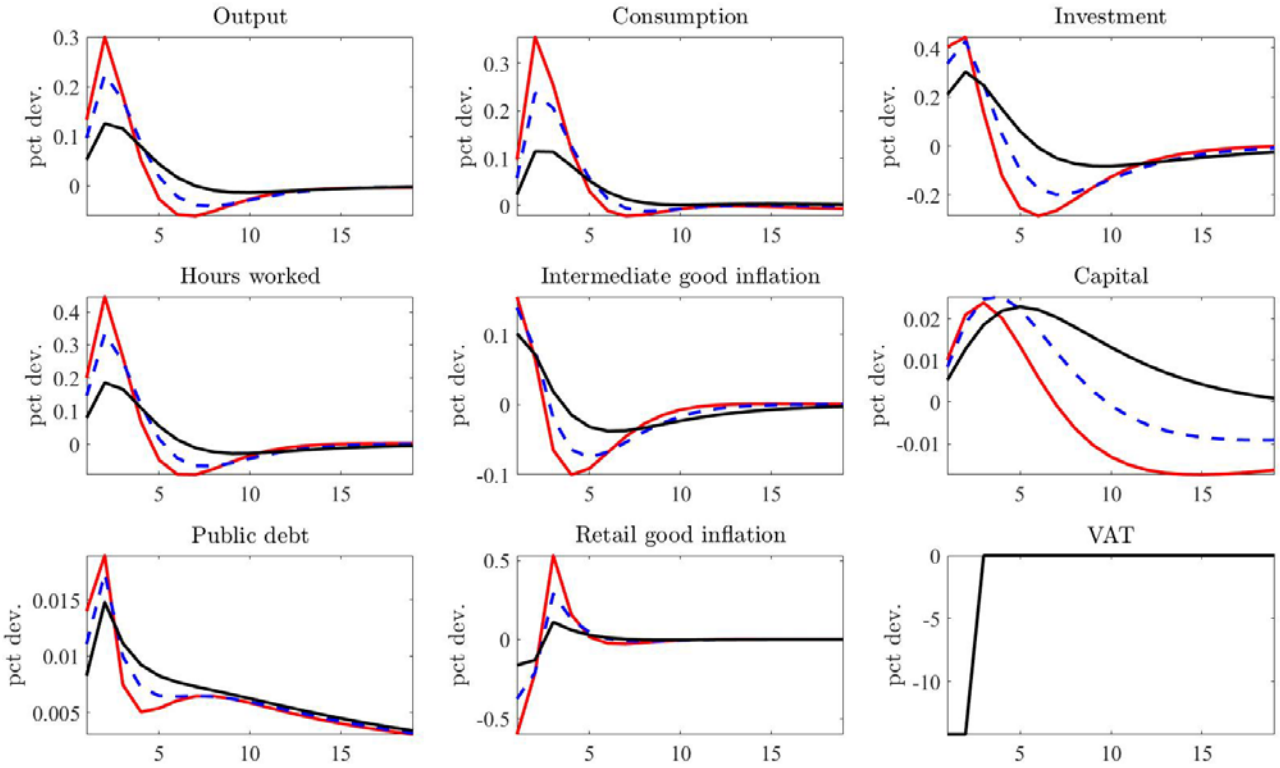
Note: The figure depicts the impulse responses for $h = 0.5$ (solid red lines), $h = 0.6$ (dashed blue lines), and the baseline specification $h = 0.68$ (solid black lines). The impulse responses are reported as percentage deviations from the non-stochastic steady state with the exception of the inflation rates, which are reported as annualised percentage-point deviation.

As another example of how the model works, we consider the VAT pass-through in more detail. In the model, retail firms set prices in a staggered fashion. Complementing the solution of the baseline model, Figure 6 provides a sensitivity analysis regarding the retail sector Calvo parameter. Given the short-term nature of the VAT tax rates cut, this is especially relevant for the fiscal policy transmission process. As a result of Calvo pricing in the New Keynesian model, only $1 - \theta^r$ percent of firms can optimally adjust prices in each period. The imminent consequence is that the pass-through degree and

[26] Most empirical estimates find habit persistence parameters around 0.6. See, e.g., Thimme (2017) for a thorough literature review.

the retail sector Calvo parameter θ^r are inversely related. In other words, larger θ^r parameters initially diminish the expansionary consumption impact of VAT policy; after the change-back to the higher VAT tax rates from January 2021 onwards, the expansionary effects will be more persistent for smaller Calvo parameters θ^r. These two opposing effects are clearly visible in Figure 6. As in the other graphs, there are also numerous general equilibrium feedback effects.

Figure 6: Impulse Responses for Alternative Retail Sector Calvo Parameters



Note: The figures depict the impulse responses for the baseline parameter $\theta^r = 0.4$ (solid red lines), $\theta^r = 0.6$ (dashed blue lines), and $\theta^r = 0.6$ (solid black lines). The impulse responses are reported as percentage deviations from the non-stochastic steady state with the exception of the inflation rates, which are reported as annualised percentage-point deviation.

In closing, one can say that, like any other model simulation, these sensitivity analyses are challengeable. However, they do illustrate the locations of the most neuralgic points.

4.3 Welfare

In order to compare welfare under different scenarios, both a welfare criterion and a reference scenario are required. We chose the pandemic recession scenario in Figure 3 as our reference allocation. The metric that we use is the consumption equivalent change in welfare of the representative household. Formally, Table 2 reports the value of x that solves the following:

$$\sum_{t=0}^{T} \beta^t u(c_t(1+x), n_t) = u(c,n) \sum_{t=0}^{T} \beta^t \tag{33}$$

Equivalent variation is the amount of consumption the agent would require (in percentages) to be indifferent between staying in the steady-state allocation and the pandemic-induced recession with or without implementation of the expansionary VAT tax policy cut. Equivalent variation is negative if the consumer is worse off, and positive if the consumer is better off.

Table 2: The Computed Welfare Gains/Losses in Percentages

Horizon	Pandemic-Induced Welfare Losses	VAT Cut Welfare Gains	Net Welfare Losses
$t = 4$	-5.028	0.349	-4.679
$t = 8$	-2.554	0.116	-2.438
$t = 12$	-1.626	0.072	-1.554
$t = 16$	-1.168	0.051	-1.117
$t = 20$	-0.907	0.039	-0.868

The resulting welfare gains/losses over different horizons are given in Table 2. Time, measured in quarters, is given in the first column. In each case, we report the welfare losses/gains in percentages conditional upon the pandemic-induced crisis scenario in Figure 3. This allows us to get a sense of the welfare gains of the unconventional VAT tax cut policy compared to the total losses of the crisis. The net welfare losses in the third column are the difference between the first and second columns.

Table 2 provides three findings in particular. First, we see that the welfare losses of the pandemic–induced recession are substantial.[27] Second, even though the COVID-19 shock has led to a very severe recession, this recession is not especially long-lived. Finally, the calculations show the positive welfare effect of the unconventional temporary VAT tax measure. For the sake of comprehensiveness, however, it must be noted that the temporary VAT tax rates cut is merely an element of the overall fiscal stimulus package.

5. Conclusion

The COVID-19 pandemic continues to impact the economy via two main transmission channels: (i) The lockdown restrictions guarding against the virus prevent businesses from operating; and (ii) the rise in the number of infections leads consumers to postpone consumption to avoid the risk of infection, and leads firms to limit their investment expenditures because of general uncertainty. Against this backdrop

[27] The magnitude of the pandemic welfare loss is slightly smaller than the calculated welfare loss of the global financial crisis 2007/2009 in Auray (2018, p. 162).

and the controversial debate as to whether the temporary VAR rate cut will help to overcome the crisis, this paper provides some insight into how the temporary VAT tax policy measure affects the German economy. The Representative Agent New Keynesian (RANK) modelling results presented above indicate that the economic GDP increase provided by the temporary VAT rate reduction is likely to be significant in 2020. We also uncovered differing economic adjustment processes as a result of different model calibrations.

The current paper offers theoretical underpinnings for the temporary VAT rate cut measure. How realistic is this VAT tax policy evaluation? From an empirical as well as from a modelling perspective, a few caveats are necessary. A first conceivable objection is that the nature of the COVID-19 downturn has changed over the course of a pandemic. Steps taken towards reopening over the summer months have helped the German economy to make up for some of the enormous output losses sustained between March and May. However, since September a second wave of COVID-19 has been washing over Europe. In many countries the daily numbers of confirmed cases have even exceeded their spring peaks, though this may be partly because of increased testing. Nevertheless, it is apparent that the rebound in the summer masked a fragile recovery. The wave-like course of the pandemic renders it likely that further backlashes upon consumption may occur. People are still wary of venturing into crowded places. The consequence is a voluntary social distancing leading to a decline in consumption (see, e.g., Chudik et al., 2020). All the more important will be communication managing collective confidence. In other words, the preference shock reinforces the insight that fiscal policy is not a sort of macroeconomic engineering for tweaking taxes. It is rather the case that psychology plays an important role. Another conclusion would be to focus more on sequential state-contingent fiscal policy measures. Depending on the further course of the pandemic, policy-makers would then need to make a sequence of fiscal policy decisions.

Two further aspects can be highlighted. First, the modelling framework assumes rational expectations on the part of all decision makers, which enhances the effectiveness of state-dependent fiscal policies. Yet the grounds for assuming rational expectations are questionable. Since the triggering pandemic and the temporary VAT rate cut mark uncharted territory, one can doubt whether agents have rational expectations or can deduce the consequences of the policy as a result of learning from experience. Furthermore, the stimulus package marks a change of regime in German fiscal policy. Prior to the COVID-19 pandemic, the German government had continually resisted pressure to abandon its balanced budget rule and boost economic growth by increasing public investment and/or cutting taxes.[28] Second, the VAT tax is highly regressive. Therefore, a VAT rate reduction favours lower- and middle-income households and thus has income distribution effects. A model theoretical analysis of such distributional effects would require a Two-Agent New Keynesian (TANK) model or a Heterogeneous Agent New Keynesian (HANK) framework (see, e.g., Cantore and Freund, 2020). In these expanded

[28] See, for example, Coibion and Gorodnichenko (2012, 2015). Their research agenda pursues the broader questions of how individuals form expectations and how expectations affect actions.

models, the response of consumption to the pandemic and the temporary fiscal shock would depend on three key dimensions of households' heterogeneity: their portfolios, their exposure to aggregate fluctuations, and their marginal propensities to consume.[29] We leave such model extensions adding further heterogeneity on the household side to future research.

[29] For a summary of the progress in this direction, see Kaplan and Violante (2018).

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