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Bracket creeps: Bane or boon for the stability of numerical budget rules?

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**Bracket Creeps:
Bane or Boon for the Stability of Numerical Budget Rules?**
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Bracket Creeps: Bane or Boon for the Stability of Numerical Budget Rules?

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Abstract

As taxpayers typically pay low attention to a small inflation-induced bracket creep of the income tax, policy-makers tend to postpone its correction into the future. However, the fiscal illusion fades away and political pressure for a tax relief arises since after some years the cumulative increase of the average tax rate exceeds a critical threshold. Using Germany as an example, this paper shows that bracket creeps can provoke revenue cycles in public budgets hindering governments' compliance with the numerical budget rules. An indexation of the tax tariff could prevent such fluctuations and thus provides a favourable framework for the debt rule.

Keywords: progressive income taxes, bracket creep, political budget cycles, debt brake

JEL Classification: H24, H31, H63

Bracket Creeps: Bane or Boon for the Stability of Numerical Budget Rules?

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July 27, 2017

Abstract

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1 Introduction

In recent years, permanent numerical debt rules were introduced in several countries, especially in the member states of the European Monetary Union (EMU). The numerical targets for budgetary aggregates are justified by the governments' bias towards deficit spending. The deficit bias usually stems from distortions in the fiscal policy process as well as decision-makers' rent-seeking behavior and short-termism.¹ In Germany the numerical debt rule stipulates a maximum borrowing of 0.35 percent in relation to the nominal gross domestic product (GDP) in a normal cyclical position for the federal government while the state governments (Länder) must display structurally balanced budgets from 2020. The establishment of the newly created maximum debt ceiling in the budget process represents an important challenge for the fiscal authorities. If the budget rule is frequently violated either *de jure* by excessive deficits or *de facto* by a rule bypass via accounting tricks, the long-term stability of the debt rule would be in danger.

The great challenge is to design a debt rule that is tight enough to solve the deficit bias and that is loose enough to give the government some leeway to react on revenue and expenditure fluctuations. Hence, on the one hand, the rule should allow for tax smoothing by taking into account business cycles and singular events such as natural disasters.² On the other, it should grant as little exceptions as possible in order to

¹see Alesina and Perotti (1996).

²Barro (1979) shows that deficit financing is justified if the the net present value of the excess burden, that arises from the variation of tax rates to level out revenue and expenditure up- and downturns, is larger than the net present value of distortions caused by a tax smoothing policy. Since the excess burdens of taxation in general increases more than proportionally with tax rates, governments can minimize tax distortions in a dynamic context by keeping tax rates relatively even and at the same time offset temporal revenue and spending variations.

prevent excessive complexity and additional loopholes for creative accounting. Besides, a numerical budget limit alone may not solve the typical misalignment in the fiscal policy process that has led to ever-increasing public debt levels in recent decades. It also requires a sound institutional environment, including clearly defined fiscal responsibilities, flexible fiscal instruments for authorities on the revenue side and high transparency for voters and taxpayers in the fiscal process.

This paper examines whether bracket creep (cold progression) in the German income tax system can have an impact on budgetary discipline of German jurisdictions. Bracket creep occurs when inflation drives taxpayers into higher tax brackets of the income tax scale. This phenomenon takes place if the basis of assessment of a progressive income tax is the nominal (not inflation-adjusted) income. The average tax rate does not only increase with households' higher economic performance, but also with wage adjustments to inflation. This is why households' tax burden augments, although their real gross income remains constant after the inflation adjustment. The intensity of the cold progression crucially hinges on the inflation rate. Moreover, it depends on the rate of progression of the underlying tax scale in the considered income class. This is why taxpayers from different income classes are affected heterogeneously.

Empirical studies show that in complex and non-transparent tax systems taxpayers typically do not fully notice a variation of the tax burden. This is particularly true for bracket creep.³ A small increase of the average tax burden induced by inflation is hardly noticed by taxpayers.⁴ Apart from constitutionally required adjustments of

³De Bartolome (1995) and Feldman and Katuscak (2006) show that taxpayers tend to mix up the average tax rate with the marginal tax rate.

⁴see Fochmann and Weimann (2013).

the personal and child allowance to the income necessary to cover the subsistence level, lawmakers in Germany can correct the income tax rate for the cold progression in their sole discretion. Fiscal illusion involved with the cold progression gives policy makers the opportunity to increase the income tax burden, without incurring substantial political resistance or market distortions. The non-correction of the bracket creep is an option for government decision-makers to increase the tax burden mostly unnoticed. In this connection, government's effective fiscal power, i.e. its ability to raise fiscal resources, augments.⁵

Viewed in isolation, increasing fiscal power makes the compliance of the debt rule more likely.⁶ However, the fiscal illusion with respect to the bracket creep is limited in time. Behavioral economic studies show that the taxpayers' attention towards changes in the average tax rate is only low if the underlying changes are sufficiently small. After a few years, the cumulated additional tax burden causes a noticeable loss of taxpayers' purchasing power. If the uncorrected bracket creep produces a sufficiently high increase of the tax burden the taxpayers' attention typically rises again. The associated political pressure induce the government to enact a tax relief.⁷ Hence, besides business cycles, the bracket creep produces additional revenue fluctuations in the public budgets. The

⁵In the presence of political competition, governments may tend to a less salient tax policy, see Bracco et al. (2013). A tax burden caused by a bracket creep is, at least in the short term, less salient to tax payers than an explicit rise in tax rates. Hence, to governments, a bracket creep is a convenient instrument for increasing tax revenues.

⁶In fact, in Germany there are concerns about the automatic adjustment of the tax tariff to cold progression by using an indexation formula as this may reduce the legislators' budget authority, see Federal Ministry of Finance (2015), Monthly Report, August 2015.

⁷The timing of a tax relief does not only depend on the growing visibility of the bracket creep but also on the promises of that political actors in the context of political budget cycles, see Shi and Svensson (2006), as well as Alt and Lassen (2006).

latter involve a period of increasing tax revenue, due to the increase in average tax rates, and a phase of falling tax revenues in the wake of tax cuts.

Fundamentally, we address two questions in this paper. First, we analyze if the bracket creep affects the governments' compliance with the debt rule. The upper limit of the German debt rule is exclusively adjusted to business cycle fluctuations. For revenue cycles due to bracket creep, however, it does not account. Hence, governments need to develop an individual strategy for smoothing such cycles. In a model-theoretic analysis we show that a violation of the debt rule by short-termist governments is more likely, if the bracket creep is not automatically corrected by an appropriate indexation formula. Second, we investigate the importance of revenue fluctuations that arise from cold progression compared to business cycle fluctuations. We decompose the German wage tax fluctuations into three components: the revenue growth caused by the cold progression, the tax reform-related income changes (including the reforms to correct the bracket creep) and the cyclical revenue fluctuations.

The German case can be seen as representative for other countries, in which income redistribution is largely achieved by a progressive personal income tax. In Germany, in 2016, the marginal income tax rate started at 14 percent and reached a maximum of 45 percent. According to the OECD tax database, similarly large differences between minimum and maximum marginal income tax rates can be found in many other developed countries, like Japan, France, the Netherlands, South-Korea, Luxemburg or Portugal.

2 Model and Problem

2.1 The basic model

We consider a two-period model, $t = 1, 2$, with a continuum of households that measures one. In periods 1 and 2 each household inelastically offers one unit of labor on a labor market and decides to take actions $x_t \in [0, 1]$. These actions can be interpreted as superior work effort or investment in human capital in the respective period. Households that take the action in period t ($x_t = 1$) earn a premium m_t additional to the basic salary w_t . Those who refrain from taking the action ($x_t = 0$) just earn w_t . Accordingly, the period income y_t of a household is given by:

$$y_t = \begin{cases} w_t, & \text{if } x_t = 0 \\ w_t + m_t, & \text{if } x_t = 1. \end{cases} \quad (1)$$

Taking the action goes along with disutility $\beta_t x_t$ for the household. The marginal disutility β_t , $\beta_t > 0$, may vary in time and across the population. The distribution of types β_t is described by the cumulative distribution function $F_t(\beta_t)$, $F_t'(\cdot) > 0$. It exhibits two typical labor market properties. First, households have heterogeneous abilities for high-paid jobs. Accordingly, the less able households face higher marginal costs when taking the action. In other words, they need more resources to reach the critical level of work effort or human capital endowment to get hired for a high-paid job. Second, the marginal costs β_t crucially depend on the current economic development. During economic downturns there is a relatively small demand for high-skilled labor and job promotions are carried out less often. Hence, employers set relatively high standards (in terms of work effort and human capital endowment) so that β_t is higher than in better

economic situation.

Households' preferences are characterized by the following increasing, concave utility function:

$$U \equiv U_1(y_1 - \tau_1 - \beta_1 x_1) + \delta U_2(y_2 - \tau_2 - \beta_2 x_2), \quad (2)$$

where δ , $\delta < 1$ is a discount factor and τ_t an income tax. More specifically, we consider a two-part tax tariff with a marginal tax rate σ_t and a lump-sum part a_t :

$$\tau_t = y_t \sigma_t - a_t, \text{ for } t = 1, 2. \quad (3)$$

The average tax rate is given by:

$$\bar{\tau}_t = \sigma_t - \frac{a_t}{y_t}, \text{ for } t = 1, 2. \quad (4)$$

There is an interpersonal redistribution effect between high and low income households as the average tax rate is below the marginal tax rate. The optimal labor market decision x_t^* of utility-maximizing household writes:

$$x_t^* = \begin{cases} 1, & \text{if } m_t(1 - \sigma_t) \geq \beta_t, \\ 0, & \text{otherwise.} \end{cases} \quad (5)$$

From the households' optimal effort response (5) we can derive the tax revenue R_t earned by the government:

$$R_t = \sigma_t(w_t + m_t X_t) - a_t, \quad (6)$$

where $X_t = F(m_t(1 - \sigma_t))$ signifies the aggregate supply of additional work effort (the part of the population that earns a premium). The budget constraints of the government

in period 1 and 2 are given by:

$$\sigma_1(w_1 + m_1X_1) + h_1 = a_1, \quad (7)$$

$$\sigma_2(w_2 + m_2X_2) - h_1(1 + r) = a_2, \quad (8)$$

where h_1 is public debt that can be taken by the government in period 1. The debt repayment takes place in period 2. The market interest rate is given by r . Differentiation of the government budget constraints (7) and (8) w.r.t. σ_t shows that the income tax distorts aggregate work effort or human capital accumulation:

$$\frac{da_t}{d\sigma_t} = w_t + (X_t + X'_t\sigma_t)m_t, \text{ for } t = 1, 2.$$

We assume that fiscal policy is politically motivated. Government decision-makers try to maximize the expected number of votes in the upcoming elections by setting taxes and public debt levels. The underlying voting probability is a positive function of households' benefit from the government's fiscal policy in periods 1 and 2. Hereafter the government objective function is described by the short-cut (households' welfare):

$$W = E[U_1(\sigma_1, a_1, h_1)] + \widehat{\delta}E[U_2(\sigma_2, a_2, h_1)]. \quad (9)$$

The government has an excessive focus on short-term outcomes at the expense of the long-term fiscal performance. We may for example think of the case where incumbent politicians give a top priority to the results of the next election. This is why they discount future periods by a rate higher than a social planner, whose calculatory interest rate corresponds to r . Accordingly, the underlying discount factor $\widehat{\delta}$ in the government object function is below $1/(1 + r)$.

The government chooses a combination of policy instruments σ_t, a_t in both periods as well as h_1 in period 1 that maximizes the objective function (9). Inserting the government budget constraints (7) and (8) into (9) yields the following optimization problem:

$$\max_{a_1, a_2, h_1} \sum_{t=1}^2 \left(\int_{-\infty}^{k_t} \widehat{\delta}^{t-1} (U_t(w_t(1 - \sigma_t) + a_t)) F(\beta_t) d\beta_t + \int_{k_t}^{+\infty} \widehat{\delta}^{t-1} (U_t(w_t(1 - \sigma_t) + a_t + (m_t(1 - \sigma_t) - \beta)x_t)) F(\beta_t) d\beta_t \right),$$

where k_t stands for the critical value of β , where households are indifferent between taking the action and abstaining from it, i.e. $k_t = (1 - \sigma_t)m_t$. The first order conditions of the optimal marginal tax rates write:

$$1 + \frac{X'_1 m_1}{\bar{y}_1} = \frac{E[U'_1(w_1(1 - \sigma_1) + a_1 + m_1(1 - \sigma_1) - \beta_1) | x_1 = 1]}{E[U'_1(w_1(1 - \sigma_1) + a_1 + x_1(m_1(1 - \sigma_1) - \beta_1))]}, \quad (10)$$

$$1 + \frac{X'_2 m_2}{\bar{y}_2} = \frac{E[U'_2(w_2(1 - \sigma_2) + a_2 + m_2(1 - \sigma_2) - \beta_2 | x_2 = 1)]}{E[U'_2(w_2(1 - \sigma_2) + a_2 + x_2(m_2(1 - \sigma_2) - \beta_2))]}, \quad (11)$$

$$\widehat{\delta}(1 + r) = \frac{E[U'_1(w_1(1 - \sigma_1) + a_1 + x_1(m_1(1 - \sigma_1) - \beta))]}{E[U'_2(w_2(1 - \sigma_2) + a_2 + x_2(m_2(1 - \sigma_2) - \beta))]}, \quad (12)$$

where \bar{y}_t is the average income $w_t + m_t X_t$. Equations (10) and (11) depict a typical *trade-off between interpersonal equity and efficiency* in period 1 and 2 respectively. An increase of the lump-sum part a_t calls for an increase of the marginal tax rate σ_t . However, at the same time it distorts the aggregate supply of work effort. The two conditions make clear that the government accepts more welfare differences between high- and low-income households, the higher the efficiency costs $\frac{X'_t m_t}{\bar{y}_t}$. Equation (12) expresses the *inter-temporal tax smoothing condition*. Accordingly, expenditure differences between period

1 and 2 should be evened out until the *inter-temporal marginal rate of substitution*, expressed by the right-hand side of equation (11), equals the relative time preference rate of the government decision makers, on the left-hand side. Impatient policy-makers whose relative time preference rate $\widehat{\delta}(1+r)$ is below one postpone households' tax burden into the future by reducing σ_1 and increasing h_1 and σ_2 . If the policy makers' relative preference rate coincides with one, debt financing would be solely used to smooth tax revenues across periods 1 and 2.

2.2 Fiscal Illusion

In the previous section we have implicitly assumed that prices remain constant over time. Consider now an economy with a positive and constant inflation rate π . We assume that households' income is adjusted to inflation in each period:

$$y_1 = (w_0 + x_1 m_0)(1 + \pi), \quad (13)$$

$$y_2 = (w_1 + x_2 m_1)(1 + \pi), \quad (14)$$

where w_0 and m_0 are wage parameters valid in a proceeding period 0. An adjustment of wages to inflation augments the average tax burden $\bar{\tau}_t$ if the tax parameter a_t remains unchanged. The additional tax burden caused by inflation in a time span between $t - q$ and t amounts to:

$$f(t - q, t) = \left(1 - \frac{a_t}{a_{t-q}} \frac{1}{(1 + \pi)^q}\right) \frac{a_{t-q}}{y_{t-q}}. \quad (15)$$

By equation (15) the bracket creep increases the tax burden, as long as the tax parameter a_{t-q} is smaller than $a_t(1+\pi)$. We assume that households have a closer look at an increase of the marginal tax rate σ_t than at a bracket creep with an equivalent burden. In this

vain, let the behavioral average tax burden, i.e. the tax burden that is apprehended by households in period t , be denoted by $\bar{\tau}_t^B$. Households underestimate the impact of a change in a_t on the average tax burden $\bar{\tau}_t^B$ if the bracket creep is sufficiently small. If the bracket creep passes a certain threshold, households get more attentive to the problem and invest more time and effort to correctly estimate their individual tax burden.

Assumption 1 *Let v_t be the rate of attention to a tax policy, i.e. the proportion of a tax variation that is noticed by the taxpayer. For variations of the marginal tax rate σ_t and for relatively large variations of the ratio a_t/y_t the rate of attention is equal to one. For relatively small variations of the ratio a_t/y_t the rate of attention is below one. Respectively, the following conditions holds:*

$$\frac{d\bar{\tau}_t^b}{d\sigma_t} = 1$$

$$\frac{d\bar{\tau}_t^b}{d(a_t/y_t)} = \begin{cases} < -1, & \text{if } f_t < \frac{a_t - q}{y_t - q} - \frac{a_t}{y_t - q(1 - \pi)} \\ = -1, & \text{otherwise.} \end{cases}$$

If the votes-maximizing government has a strong focus on short-term outcomes, it tries to exploit the households' fiscal illusion. By Assumption 1 the threshold is reached after one period of non-correction. Hence, in the second period the political pressures for a tax reform reverts back to a normal value ($v_t = -1$). Respectively, we formulate a modified government objective function depending on the perceived tax effects perceived by taxpayers:

$$W^B = E[U_1^B] + \delta E[U_2^B], \quad (16)$$

where $U_t^B(y_t - \bar{\tau}_t^B y_t - x_t \beta_t - h_1)$ represents households' perceived utility contingent on the behavioral average tax burden $\bar{\tau}_t^B$ as well as on debt level h_1 . Thus, the politicians' optimization problem in the presence of fiscal illusion is given by:

$$\max_{a_1, a_2, h_1} E[U_1^B] + \widehat{\delta} E[U_2^B], \quad (17)$$

The first order conditions of the modified optimization problem write:

$$v_1 \left(1 + \frac{X'_1 m_1}{\bar{y}_1} \right) = \frac{E[U_1^{B'}(w_1(1 - \sigma_t) + a_1 + m_1(1 - \sigma_1) - \beta_1 | x_1 = 1)]}{E[U_1^{B'}(w_1(1 - \sigma_t) + a_1 + x_1(m_1(1 - \sigma_1) - \beta_1))]}, \quad (18)$$

$$v_2 \left(1 + \frac{X'_2 m_2}{\bar{y}_2} \right) = \frac{E[U_2^{B'}(w_2(1 - \sigma_t) + a_2 + m_2(1 - \sigma_2) - \beta_2 | x_2 = 1)]}{E[U_2^{B'}(w_2(1 - \sigma_t) + a_2 + x_2(m_2(1 - \sigma_2) - \beta_2))]}, \quad (19)$$

$$\widehat{\delta}(1 + r) = \frac{E[U_1^{B'}(w_1(1 - \sigma_t) + a_1 + x_1(m_1(1 - \sigma_1) - \beta))]}{E[U_2^{B'}(w_2(1 - \sigma_t) + a_2 + x_2(m_2(1 - \sigma_2) - \beta))]} \quad (20)$$

Equations (18) and (19) highlight that the efficiency-equity trade-off crucially depends on the households rate of attention v_t . The marginal costs of taxation are relatively low (high) if households pay low (high) attention to the bracket creep in the current period. A small reduction of the ratio between the lump-sum payment and income a_t/y_t passes more or less unnoticed. This is why the government decision-makers gain some leeway to reduce the marginal tax rate σ_t .

The trade-off between efficiency and equity therefore changes towards less redistribution and a smaller tax wedge on the labor market. The redistributive motive of the government is to transfer money where it attracts the highest amount of votes. If households do not pay attention to a bracket creep, the government does not attach importance to its correction. However, the possibility to exploit the taxpayers' inattention is limited in time. If the inflation effect reaches a critical level, taxpayers pay more attention to

the purchasing power effect of the bracket creep. Consequently, after a certain period of time, the marginal costs of taxation increase again.

The first order conditions (18) and (19) pin down two likely situations. Either the bracket creep has been corrected in period 0, so that the taxpayers' rate of attention in period 1 (v_1) is below -1 and the rate of attention in period 2 (v_2) is equal to -1 or vice-versa. In both cases the government tries to smooth the altering taxing power that goes along with the households' fiscal illusion. By equation (20) the government engages more intensively in debt financing if $v_1 < v_2$ holds and chooses a lower borrowing if $v_1 > v_2$.

The fiscal consequences of the bracket creep are two-fold. On the one hand, it increases the governments taxing power as it causes fiscal illusion. On the other, it changes the interpersonal distribution of the after tax income in the economy. In particular, the inflation effect triggers a creeping alignment of the average tax rates of low- and high-income households. In this stylized model with a simple two-part tax tariff this leads especially to an added burden for low-income households.

Fiscal illusion, which is a result of the bracket creep, can be prevented by an appropriate indexation of the tax tariff. The bracket creep $f(t - q, t)$ takes a value of zero in each period if the lump-sum payment a_t is automatically corrected such that $a_{t-q}(1 + \pi)^q$ holds. In this respect the indexation of the tax tariff solves two problems. First, it assures that the tax revenue is less volatile across period 1 and 2. Second, it takes care that the redistributive effect of the tax system between households with high and low income does not fluctuate for political reasons. Then, the government's need to smooth

tax revenues by means of debt financing is less prominent.

The indexation formula describes the tax burden in a more salient way. However, the automatic correction does not limit the governments field of fiscal action. The government has the opportunity to freely change the tax parameter in each period by an adjustment of the tax law. Indeed, a change of the tax law is much more visible for taxpayers than a creeping change of the tax-income ratio, so that the indexation of the tax tariff can suppress a major part of the fiscal illusion.

3 Balanced budget rule

3.1 The rule

In this section we assume that a debt rule is introduced in the budget process. The purpose of the rule is to overcome the problem of inefficient high debt levels. To achieve this objective the rule stipulates that the government's new indebtedness must not pass an upper bound amounts to h_1^* . In case the government breaks this rule it has to pay a penalty in the subsequent period and faces the following costs:

$$c_2(h_1) \begin{cases} = 0, & \text{if } h_1 \leq h_1^* \\ > 0, & \text{if } h_1 > h_1^*, \end{cases} \quad (21)$$

The penalty can be interpreted either as a monetary or a non-monetary position. In line with the German budget rule where excessive debts enter on a control account and must be repaid in a limited delay, the cost function $c_2(h_1)$ can be understood as a repayment plan. In this case, condition (21) exhibits positive marginal costs $c_2'(h_1) > 0$. If the violation of the rule becomes known to the wide public, the cost position c_2 entails

also political costs which may induce positive marginal costs as well as a lump-sum component.

The upper bound h_1^* , that is specified in the rule, should depend on the current economic condition and give the government a sufficient leeway for tax smoothing. Respectively, we assume that the upper bound is equal to h_1^* fulfills the first order condition of the social planners maximization problem w.r.t. h_1 :

$$1 - \frac{E[U'_2(y_2 - \tau_1 - h_1^*(1 + r) - \beta x)]}{E[U'_1(y_1 - \tau_1 + h_1^* - \beta x)]} = 0. \quad (22)$$

Condition (22) includes a business cycle adjustment procedure. If the economy is in a better state in period 2 than in period 1, the marginal cost of taking the action x_2 is relatively low and the premium m_2 relatively high respectively. Accordingly, it is relatively easy for the government to raise funds in the second period in comparison to the first period. Then a sufficient high upper bound h_1^* gives the government an appropriate scope to smooth expenditure levels between the two periods. In the special case where economic conditions are identical in both periods there is no need for tax smoothing so that the upper bound h_1^* . The modified government budget constraint in period 2 is given by:

$$R_2 - h_1(1 + r) - c_2 = 0. \quad (23)$$

In the following step, we analyze the government's fiscal policy incentives in the case where a budget rule is implemented. Thereby we distinguish two different settings. The first assumes that the tax tariff contains an inflation index so that tax parameters are steadily adjusted to the inflationary increase of prices. The second considers a tax system without an inflation adjustment formula.

3.2 Fiscal policy in the *presence* of an indexed tax tariff

Initially, we analyze the government's budget policy in the case where the tax tariff is indexed. Bracket creeps that stem from wage adjustments to inflation are immediately eliminated. Different to the model framework in section 2, the government now is confronted with a debt limit. The modified optimization problem writes:

$$\begin{aligned} \max_{\sigma_1, \sigma_2, h} E[U_1] + \widehat{\delta} E[U_2] \\ \text{s.t. (21)} \end{aligned} \quad (24)$$

The first order conditions w.r.t. a_2 and h_1 alter in the following way:

$$1 + \frac{X'_1 m_1}{\bar{y}_1} = \frac{E[U'_1(w_1(1 - \sigma_t) + a_1 + m_1(1 - \sigma_1) - \beta_1) | x_1 = 1]}{E[U'_1(w_1(1 - \sigma_t) + a_1 + x_1(m_1(1 - \sigma_1) - \beta_1))]}, \quad (25)$$

$$1 + \frac{X'_2 \sigma_2}{\bar{y}_2} = \frac{E[U_2(w_2(1 - \sigma_t) + a_2 + m_2(1 - \sigma_2) - \beta_2 - c_2 | x_2 = 1)]}{E[U_2(w_2(1 - \sigma_t) + a_2 + x_2(m_2(1 - \sigma_2) - \beta_2 - c_2))]}, \quad (26)$$

$$\widehat{\delta}(1 + r) = \frac{E[U'_1(w_1 + a_1 + x_1(m_1(1 - \sigma_1) - \beta))]}{E[U'_2(w_2 + a_2 - c_2 + x_2(m_2(1 - \sigma_2) - \beta))]}, \text{ if } h_1 \leq h_1^*, \quad (27)$$

$$\frac{\widehat{\delta}(1 + r)}{(1 - c'_2)} = \frac{E[U'_1(w_1 + a_1 + x_1(m_1(1 - \sigma_1) - \beta))]}{E[U'_2(w_2 + a_2 - c_2 + x_2(m_2(1 - \sigma_2) - \beta))]}, \text{ if } h_1 > h_1^*. \quad (28)$$

The tax policy in period 1 is not affected by the budget rule. However, the government's scope for interpersonal redistribution is reduced in period 2 if a penalty has to be paid after a violation of the debt limit in period 1. The tax reaction $d\sigma_2/dc_2$ is undetermined. Equation (26) shows the government's tax response of the imposition of a penalty in period 2. Concerning the government's optimal choice of the debt level h_1 , we have to consider two cases. First, if the government complies with the rule, the respective first order condition is given by equation (25). As there is no penalty, the

government would face the same trade-off as in the case depicted in the previous section. Second, if the government debt exceeds the upper bound h_1^* , the first order condition is represented by (26). Equation (26) makes clear that there are two ways to implement a socially optimal debt policy. Either the flat penalty c_2 is sufficiently large so that the corner solution $h_1 = h_1^*$ occurs or the penalty rate c_2' is as least as high as $1 - \widehat{\delta} - \widehat{\delta}r$.

3.3 Fiscal policy in the *absence* of an indexed tax tariff

In this subsection, we consider the case where the tax tariff is not automatically corrected by an indexation formula. This is why the government takes into account the behavioral effect that stems from the bracket creep. Hence, the government's optimization problem w.r.t. the budget rule writes:

$$\begin{aligned} \max_{\sigma_1, \sigma_2, h} E[U_1^B] + \widehat{\delta}E[U_2^B] \quad (29) \\ s.t. (20) \end{aligned}$$

The first order conditions write:

$$v_1 \left(1 + \frac{X_1' m_1}{\bar{y}_1} \right) = \frac{E[U_1'(w_1(1 - \sigma_t) + a_1 + m_1(1 - \sigma_1) - \beta_1) | x_1 = 1]}{E[U_1'(w_1(1 - \sigma_t) + a_1 + x_1(m_1(1 - \sigma_1) - \beta_1))]}, \quad (30)$$

$$v_2 \left(1 + \frac{X_2' m_2}{\bar{y}_2} \right) = \frac{E[U_2(w_2(1 - \sigma_t) + a_2 + m_2(1 - \sigma_2) - \beta_2 - c_2 | x_2 = 1)]}{E[U_2(w_2(1 - \sigma_t) + a_2 + x_2(m_2(1 - \sigma_2) - \beta_2 - c_2))]}, \quad (31)$$

$$\widehat{\delta}(1 + r) = \frac{E[U_1^{B'}(w_1 + a_1 + x_1(m_1(1 - \sigma_1) - \beta))]}{E[U_2^{B'}(w_2 + a_2 - c_2 + x_2(m_2(1 - \sigma_2) - \beta))]} \text{ if } h_1 \leq h_1^*. \quad (32)$$

$$\frac{\widehat{\delta}(1+r)}{(1-\alpha)} = \frac{E[U_1^{B'}(w_1 + a_1 + x_1(m_1(1-\sigma_1) - \beta))]}{E[U_2^{B'}(w_2 + a_2 - c_2 + x_2(m_2(1-\sigma_2) - \beta))]} \text{ if } h_1 > h_1^*. \quad (33)$$

Analogously to section 2.3. we can distinguish two starting points. Either the bracket creep has been corrected in period 0, so that the taxpayers' rate of attention in period 1 (v_1) is below -1 and the rate of attention in period 2 (v_2) is equal to -1 or vice-versa. In the first case ($v_1 < v_2$) the government has relatively high fiscal power in period 1 due to the taxpayers low rate of attention concerning the bracket creep. Accordingly, for the government it is relatively easy to fulfill the numerical target of the budget rule. In the second case ($v_2 < v_1$), complying with the budget rule however is more difficult. As the taxpayers' rate of attention is relatively high, the government sees itself confronted with a high pressure to correct the bracket creep.

As has been shown in the theoretical model, in the short-run, governments may have an incentive to raise additional tax revenues by the non-correction of the bracket creep. However, as soon as taxpayers realize that the tax burden has increased due to a bracket creep, the pressure on the government to lower it also increases. As a consequence, governments' incentives for breaking the debt limit in order to reduce the tax burden are rising. Accordingly, tax revenue fluctuations are a product of three factors: (i) additional revenues caused by cold progression, (ii) revenue changes caused by tax reforms, among them reforms correcting for a bracket creep, and (iii) revenue fluctuations caused by the business cycle. In the following, we decompose these three factors to analyze to which extent each factor influences the tax revenue fluctuations.

4 Decomposing Fluctuations in German Wage Tax Revenues

4.1 Quantifying additional tax revenues due to a bracket creep

The bracket creep is quantified as follows: first, actual (gross) personal wage tax revenues of a base year (R_{tbase}) are taken as a starting point. Second, the additional wage tax revenues due to nominal wage increases by inflation will be estimated for the following years. Therefore, two variables are required: The increase in gross wages per capita (Δw_t) and the elasticity of personal income tax revenues with respect to gross wages per capita ($\mathcal{E}_{R,w,t}$)⁸, with

$$\mathcal{E}_{R,w,t} = \frac{\frac{dR_t}{R_t}}{\frac{dw_t}{w_t}} = \frac{dR_t}{dw_t} \frac{w_t}{R_t} \quad (34)$$

The elasticity of wage tax revenues with respect to gross wages per capita is equal to one in case of a proportional tax scale. However, in the case of a progressive tax system, the elasticity takes a value higher than one. For this elasticity, we draw back on the literature according to which the elasticity is around 1.75 (see e.g. Bouthevillain et al. 2001, Van den Noord 2000).

Since we are interested in the effect of an increase of nominal wages to the extent of inflation (Δp_t), we set the wage raise equal to the rate of inflation, i.e. the increase in harmonized consumer prices:

$$\Delta w_t = \Delta p_t \quad (35)$$

⁸Personal income tax revenues in Germany consist of taxes on wages and assessed income paid by non-incorporated firms. While taxes on wages usually increase over time, revenues of income taxes paid by non-incorporated firms increase in economic upswings but decrease in economic downturns. Thus, for the latter, there is no continuous bracket creep. Moreover, the basis of assessed income tax is difficult to measure. Hence, our calculations do only consider taxes on wages, whose share in Germany's total personal income tax revenues is around 80 percent.

On the basis of these variables, we first calculate the increase in wage tax revenues in case of a proportional tax scale (R_t^{prop}) as follows:

$$R_t^{prop} = R_{t-1} \Delta p_t \quad (36)$$

where R_{t-1} stands for income tax revenues in $t - 1$. Thereby, it is assumed that total employment, real wages, as well as individual average and marginal tax rates are constant. The latter assumption corresponds to a proportional tax scale. In a second mode of calculation we drop the assumption of constant individual tax rates. Instead, income tax revenues in a progressive tax system (R_t^{prog}) are calculated by multiplying tax revenues of the base year (R_{t-1}) by the product of the rate of inflation and the elasticity of personal income tax revenues with respect to gross wages per capita, which is set to 1.75:

$$R_t^{prog} = R_{t-1} \Delta p_t \mathcal{E}_{R,w,t} \quad (37)$$

Thereby, we consider the fact that in Germany's progressive personal income tax system, inflation leads to a shift of taxpayers into higher marginal and thus average tax rates along the tax scale. As a consequence, tax revenues increase much more than in case of a proportional income tax scale. We calculate the additional tax revenues caused by a bracket creep for periods where the tax scale remains unchanged.⁹ Those years where tax reforms came into force act as the base year. The results are shown in table 1. While the results for a proportional tax scale can be found in line [4] of the table, the results for the progressive German income tax scale are depicted in line [5]. For comparison

⁹According to table 1, the base years are 1995, 1997, 1998, 1999, 2000, 2001, 2003, 2004, 2006, 2008, 2009, 2012, 2013 and 2014.

to the estimated tax revenues, actual tax revenues are depicted in line [8] of table 1. Of course, actual tax revenues R_t deviate from the estimated values R_t^{progr} , since the former are determined by other factors than the rate of inflation and the elasticity of personal income tax revenues with respect to gross wages per capita: First, changes in total employment have an impact on income tax revenues. Second, in the real world, real wages are not constant, as assumed in our calculations. An increase in real wages would additionally boost income tax revenues. Third, changes in tax laws, for instance relieve taxpayers from increasing tax burdens due to a bracket creep and have substantial effects on government's wage tax revenues.

Then, a bracket creep (BC_t), line [6] in table 1, is calculated by subtracting the estimated tax revenues in presence of a proportional tax scale from the revenues emerging from the German progressive tax scale. This difference is then multiplied by the quotient of total employment in period t (N_t) to total employment in the base year (N_{tbase}).

$$BC_t = (R_t^{progr} - R_t^{prop}) \frac{N_t}{N_{tbase}} \quad (38)$$

Thereby, we also consider the impact of employment changes on the additional tax revenues induced by 'cold' progression. While employment increases should boost additional receipts, employment reductions should lower them due to a bracket creep. However, the impact of employment changes should be rather small. On the basis of the additional wage tax revenues vis-à-vis a base year, yearly revenue increases due to a bracket creep ($BC_{t,yoy}$) can be calculated by:

$$BC_{t,yoy} = BC_t - BC_{t-1} \quad (39)$$

In recent years, under the impact of the economic crisis in the Euro Area, inflation rates were comparatively low, also in Germany. While in the period 2000 to 2013, consumer prices rose on average by 1.7 percent, in 2014 and 2015, consumer price inflation was below one percent. However, for the years ahead, inflation is expected to rise. For instance, in its spring forecast 2017, the International Monetary Fund expects inflation in consumer prices to rise up to 2.4 percent in 2022.¹⁰ Against this background, with regard to institutionalized debt brakes, fluctuations in tax revenues caused by additional revenues due to a bracket creep and revenue shortfalls due to necessary tax reliefs will become more and more important.

4.2 Revenue Losses caused by Tax Reliefs

Since the mid-1990s, income tax reforms were carried out. Most of them aimed at reducing the tax burden. Data quantifying income tax reliefs were drawn from the German Federal Ministry of Finance.¹¹ Figure 1 shows the additional income tax revenues caused by bracket creep ($BC_{t,yoy}$), taken from line [7] in table 1, as well as changes in income tax revenues caused by tax reforms. All values in figure 1 display revenue changes over the previous year. As can be seen, there were three periods with large tax reliefs: In 2000 and 2001, from 2003 to 2005 and in 2009 and 2010. Of course, these tax reliefs did not only aim at compensating taxpayers for a bracket creep. Instead, tax reforms after 1999 were rather a reaction to low growth rates of the German economy in the 1990s, caused by severe structural problems. Increasing international competition, especially the integration of Eastern European and East Asian countries into the world economy, and

¹⁰IMF World Economic Outlook Database (2016).

¹¹See Federal Ministry of Finance, Financial Reports (Finanzberichte), 1997-2016, Berlin.

high structural unemployment in Germany forced the German government to carry out structural reforms, including tax reliefs. The tax reliefs in 2009 and 2010 were primarily a reaction to the worldwide economic and financial crisis.

Figure 1 reveals periods where additional income tax revenues due to a bracket creep exceeded shortfalls in revenues by tax reforms (1996 to 1998, 2006, 2007, 2011 to 2013), and periods where shortfalls in revenues due to tax reliefs were higher than additional receipts from a bracket creep (1999 to 2005, 2008 to 2010, as well as in 2014 and 2015). Overall, in the period of observation, tax reliefs were higher than additional tax revenues caused by bracket creep, but both, income tax revenue fluctuations are not negligible.

4.3 The Cyclical Component of Income Tax Revenues

As the previous analysis have shown, progressive tax systems may entail considerable fluctuations of tax revenues. In the following, revenue fluctuations induced by the business cycle will be quantified for Germany. With respect to debt limits, only the latter are subtracted from tax revenues. Therefore, the cyclical component of tax revenues, in this case personal income tax revenues, must be identified. The analysis are based on a production function-approach, which is also used by EU Member States for calculating cyclically adjusted budget balances. Calculating the cyclical components of budget balances requires two important inputs. First, the position of the economy in the business cycle and, second, the reaction of different government expenditures and revenues to changes in the cyclical position of the economy (Mourré et al. 2013). With respect to tax revenues, the cyclical component depends on the elasticity of a tax category, in this case personal income taxes (*ITR*), with respect to a cyclical indicator. The cyclical in-

indicator used in the European Commissions' production function approach is the output gap (OG). The elasticity $\mathcal{E}_{ITR,OG}$ can be subdivided into two components: The elasticity of tax revenues with respect to the tax base, and the elasticity of the tax base with respect to the cyclical indicator (Girouard and André 2005). In case of personal income taxes, the sum of salaries and wages (W) is taken as the tax base. Hence, $\mathcal{E}_{ITR,OG}$ is defined as follows:

$$\mathcal{E}_{ITR,OG} = \mathcal{E}_{ITR,W}\mathcal{E}_{W,OG} \quad (40)$$

According to Girouard and André (2005), the elasticity of income tax revenues with respect to the sum of salaries and wages is 2.3 for Germany, while the elasticity of the sum of salaries and wages with respect to the output gap is around 0.7.¹² The output gap in period t (OG_t) is defined by:

$$OG_t = \frac{Y_t - Y_t^P}{Y_t^P} \quad (41)$$

where Y_t stands for the gross domestic product in period t and Y_t^P for the production potential in period t . Thus, OG_t is the relative output gap, i.e. the actual output in relation to the potential output. The cyclical component of personal income taxes in period t (CC_t) is calculated by the following equation:

$$CC_t = \mathcal{E}_{ITR,OG}OG_tR_t \quad (42)$$

where R_t depicts revenues from taxes on wages. By equation (42), the cyclical component of personal income tax revenues in Euro can be calculated, see table 2. Column [7] of table 2 depicts the cyclical component of personal income tax revenues in Germany

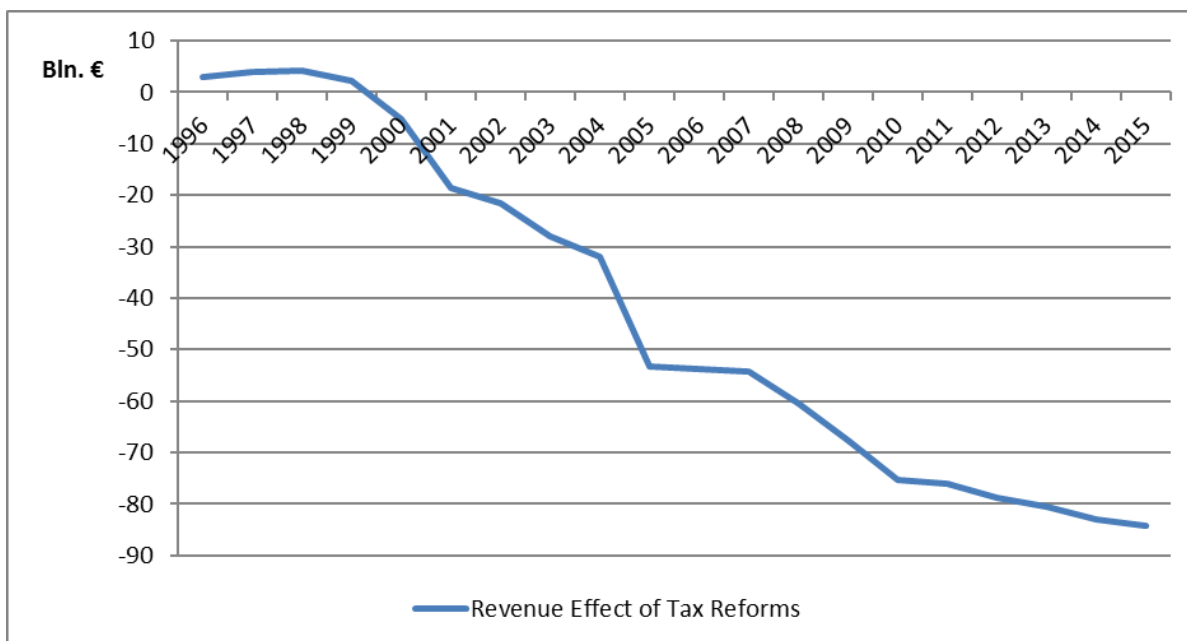
¹²see also Mourré et al. (2013)

between 1991 and 2015. As can be seen, the cyclical component of wage tax revenues was strongly positive at the beginning of the 1990s, which is mainly due to the economic boom in the course of the German reunification. During the next phase of economic recovery (2000 to 2001), the positive cyclical component reached a maximum of 4.33 bln. Euro. In the next upswing (2006 to 2008), the yearly average of the cyclical component was even higher and amounted roughly to 5 bln. Euro. In the cyclical downturns from 1993 to 1999 as well as from 2003 to 2005, the total cyclical shortfall in wage tax revenues accumulated to more than 15 bln. Euro. During the Great Recession (2009 to 2010), it even reached a total of 21 bln. Euro. On first sight, revenue fluctuations caused by the business cycle seem to be lower than fluctuations caused by a bracket creep and tax reliefs.

Figure 2 depicts Germany's wage tax revenues (R_t), the cyclically adjusted wage tax revenues ($R_t - CC_t$) (left scale) and the cyclical component of the wage tax revenues (right scale) from 1996 to 2015. Moreover, the figure shows wage tax revenue adjusted by bracket creep and tax reforms ($R_t - CC_t$, adjusted by fluctuations due to tax reforms and bracket creep). As can be seen from figure 2, cyclically adjusted wage tax revenues seem to fluctuate almost in the same manner as the original values. This is probably due to the fact that the latter are not corrected by changes in tax laws and additional revenues caused by bracket creep.

In contrast, the graph representing cyclically adjusted wage tax revenues corrected by revenue fluctuations caused by bracket creep personal income tax reforms is more

Figure 3: Effects of Tax Reforms on German Wage Tax Revenues (Billion Euro vis-à-vis 1995)



Sources: Federal Ministry of Finance, Financial Reports 1997-2016, own calculations.

continuous. This supports the results from above that revenue fluctuations rather caused by bracket creep tax reforms than by the business cycle.

Standard deviations of revenue fluctuations, caused by a bracket creep and tax reliefs on the one hand and revenue fluctuations caused by the business cycle on the other, provide further support. While between 1996 and 2015 the standard deviation of the former was around 5 bln. Euro, the standard deviation of revenue fluctuations due to cyclical variations amounted only to 4.3 bln. Euro. The comparatively higher importance of a bracket creep and tax reforms on fluctuations in wage tax revenues becomes even more obvious if the period of the Great Recession with extraordinary business cycle fluctuations is not considered: Between 1996 and 2008, the standard deviation of revenue fluctuations caused by a bracket creep and wage tax reforms was 5.8 bln. Euro, compared

to 3.9 bln. Euro for revenue fluctuations due to business cycle variations.

Figure 3 shows the revenue effects of tax reforms on German wage tax receipts between 1996 and 2015. The graph in figure 3 explains the divergence in wage tax revenues (originally as well as cyclically adjusted) and wage tax revenues adjusted by bracket creep tax reforms depicted in figure 2. The more or less horizontal run of the original and the cyclically adjusted wage tax curves in figure 2 from 1999 onwards until 2010 is caused by noticeable tax cuts in 1999, 2000, 2001, 2002 and 2005. Afterwards, massive tax releases occurred on the basis of economic stimulus packages in the course of the Great Recession in 2009 and 2010. Since then, personal income tax reforms consisted only in constitutionally necessary increases of allowances.

5 Conclusion

At least in the short-term, voters do not perceive tax increases caused by bracket creep. This enables the government to increase revenues without political resistance and market distortions. However, taxpayers' attention typically rises in the medium term, when the bracket creep has lead to a sufficiently high increase of the tax burden. Then, at the latest, politicians aiming to be reelected tend to enact tax reliefs. As a consequence, wage tax revenues should not only fluctuate with the business cycle, but also with a political cycle. In the latter, periods of increasing wage tax revenues caused by bracket creep alternate with periods of tax reliefs in order to reduce the increased tax burden of voters.

Debt brakes do typically focus on structural budget balance. Therefore, fiscal balance

is corrected by the impact of business cycle fluctuations, but not by additional revenues due to bracket creep or revenue shortfalls caused by tax reliefs. Hence, as long as the bracket creep is not corrected, progressive tax scales support the compliance of debt brakes. However, tax reliefs in connection with fiscal drag may endanger the fulfillment of the budget rule. An analysis for Germany reveals that such wage tax revenue fluctuations have a similar amount as fluctuations caused by the business cycle.¹³

Progressive tax systems are a common feature in highly developed countries. Since in recent years lots of these countries introduced debt brakes, the problem can be generalized. One solution could be safety margins against the reference value of the debt brake. However, from a politico-economic perspective it is questionable whether governments will comply with such margins, which are not legally binding. An alternative could provide strategies to smooth tax revenues discretionary. However, incentives for politicians to smooth tax revenues over time are low due to politico-economic reasons. Thus, an indexation of progressive tax scales would probably be the superior alternative. An indexation of the progressive tax scale to consumer price inflation would automatically smooth tax revenues, whilst the redistributive purpose of the progressive tax system would remain in force.

¹³Of course, revenue fluctuations caused by the business cycle are difficult to determine. For instance, the method used by the European Commission is based on the output gap. But the size of the output gap is quite uncertain (see e.g. Barrell, R.; Hurst, I. and Mitchell J. (2007): *Uncertainty Bounds for cyclically adjusted Budget Balances*, in: Larch, M. and Martins, J. N. (eds.): *Fiscal Policy Making in the European Union, An Assessment of current Practice and Challenges*; London, New York; Routledge, pp. 187-206.

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Appendix

Table 1: Additional Tax Revenue due to Fiscal Drag in Germany

	Year	Tax Scale 1996/1997			Tax Scale 1998		Tax Scale 1999		Tax Scale 2000		Tax Scale 2001	
		1995	1996	1997	1997	1998	1998	1999	1999	2000	2000	2001
[1]	$\varepsilon_{R,w,t}$	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
[2]	N_t (mln.)	34.2	34.1	34.0	34.0	34.4	34.4	35.0	35.0	35.9	35.9	35.8
[3]	Δp_t (%-change yoy)		1.2	1.5	1.5	0.6	0.6	0.6	0.6	1.4	1.4	1.9
		Billion Euro										
[4]	R^{prop}_t [4] _t $i^*(1+[3]_t/100)$	144.5	146.3	148.5	152.6	153.5	157.6	158.6	163.2	165.5	166.7	169.8
[5]	R^{prog}_t [5] _t $i^*(1+([3]_t*[1]_t)/100)$	144.5	147.6	151.5	152.6	154.2	157.6	159.3	163.2	167.2	166.7	172.2
[6]	BC_t vis-à-vis t -base at employment level in t ([5] _t - [4] _t)*([N] _t /[N] _{tbase})		1.30	2.97		0.70		0.72		1.76		2.37
[7]	$BC_{t,yoy} = BC_{t+1} - BC_t$		1.30	1.67		0.70		0.72		1.76		2.37
[8]	R_t	144.5	150.6	152.6	152.6	157.6	157.6	163.2	163.2	166.7	166.7	163.7

	Year	Tax Scale 2002/2003			Tax Scale 2004		Tax Scale 2005/2006			Tax Scale 2007/2008			Tax Scale 2009	
		2001	2002	2003	2003	2004	2004	2005	2006	2006	2007	2008	2008	2009
[1]	$\varepsilon_{R,w,t}$	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
[2]	N_t	35.8	35.6	35.1	35.1	35.1	35.1	34.9	35.2	35.2	35.8	36.4	36.4	36.4
[3]	Δp_t	1.9	1.4	1.0	1.0	1.8	1.8	1.9	1.8	1.8	2.3	2.8	2.8	0.2
[4]	R^{prop}_t	163.7	166.0	167.7	167.6	170.6	158.5	161.6	164.5	158.1	161.7	166.2	176.8	177.1
[5]	R^{prog}_t	163.7	167.7	170.7	167.6	172.9	158.5	163.8	169.0	158.1	164.4	172.5	176.8	177.4
[6]	BC_t		1.71	2.93		2.26		2.25	4.52		2.78	6.47		0.27
[7]	$BC_{t,yoy}$		1.71	1.23		2.26		2.25	2.27		2.78	3.69		0.27
[8]	R_t	163.7	166.7	167.6	167.6	158.5	158.5	153.9	158.1	158.1	167.0	176.8	176.8	174.4

	Year	Tax Scale 2010/2011/2012				Tax Scale 2013		Tax Scale 2014		Tax Scale 2015	
		2009	2010	2011	2012	2012	2013	2013	2014	2014	2015
[1]	$\varepsilon_{R,w,t}$	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
[2]	N_t	36.4	36.5	37.0	37.5	37.5	37.9	37.9	38.3	38.3	38.7
[3]	Δp_t	0.2	1.1	2.5	2.1	2.1	1.6	1.6	0.8	0.8	0.1
[4]	R^{prop}_t	174.4	176.3	180.8	184.6	189.9	192.9	199.2	200.8	208.7	208.9
[5]	R^{prog}_t	174.4	177.8	185.6	192.4	189.9	195.2	199.2	202.0	208.7	209.1
[6]	BC_t		1.44	4.89	8.07		2.30		1.21		1.58
[7]	$BC_{t,yoy}$		1.44	3.45	3.18		2.30		1.21		1.58
[8]	R_t	174.4	169.3	180.5	189.9	189.9	199.2	199.2	208.7	208.7	220.6

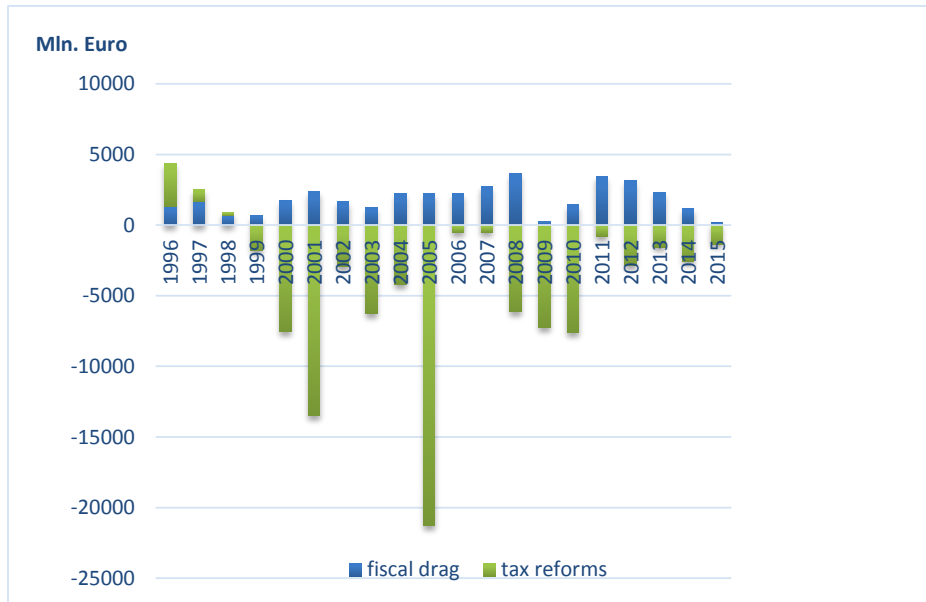
Sources: Federal Statistical Office, Federal Ministry of Finance, own calculations.

Table 2: Cyclical Component of Income Tax Revenues in Germany

[1]	[2]	[3]	[4]	[5]	[6]	[7]
Year	$\varepsilon_{ITR,OG}$	$Y_t - Y_t^P$ (Bln. €)	Y_t^P (Bln. €)	OG_t	R_t (Bln. €)	CC_t (Bln. €)
1991	1.87	67.0	1512.8	0.044	109.5	8.65
1992	1.87	56.1	1639.2	0.034	126.5	6.99
1993	1.87	-3.5	1752.1	-0.002	131.9	-1.76
1994	1.87	1.9	1828.4	0.001	136.3	-1.08
1995	1.87	-0.3	1899.2	0.000	144.5	-1.41
1996	1.87	-17.1	1943.4	-0.009	150.6	-3.82
1997	1.87	-12.2	1979.3	-0.006	152.6	-2.93
1998	1.87	-3.6	2021.8	-0.002	157.6	-2.53
1999	1.87	4.2	2060.7	0.002	163.2	-2.29
2000	1.87	31.8	2084.7	0.015	166.7	1.92
2001	1.87	35.2	2144.6	0.016	163.7	3.20
2002	1.87	3.9	2205.4	0.002	166.7	-0.07
2003	1.87	-41.7	2261.7	-0.018	167.6	-4.98
2004	1.87	-45.6	2316.2	-0.020	158.5	-5.22
2005	1.87	-59.7	2360.5	-0.025	153.9	-5.04
2006	1.87	-5.3	2398.6	-0.002	158.1	2.09
2007	1.87	43.7	2469.6	0.018	167.0	8.05
2008	1.87	44.9	2516.9	0.018	176.8	6.00
2009	1.87	-119.3	2579.5	-0.046	174.4	-15.51
2010	1.87	-39.7	2619.8	-0.015	169.3	-6.04
2011	1.87	29.2	2673.9	0.011	180.5	2.01
2012	1.87	8.9	2745.9	0.003	189.9	0.34
2013	1.87	-18.9	2839.8	-0.007	199.2	-1.97
2014	1.87	-13.6	2929.3	-0.005	208.7	0.11
2015	1.87	-11.8	3037.7	-0.004	220.6	0.63

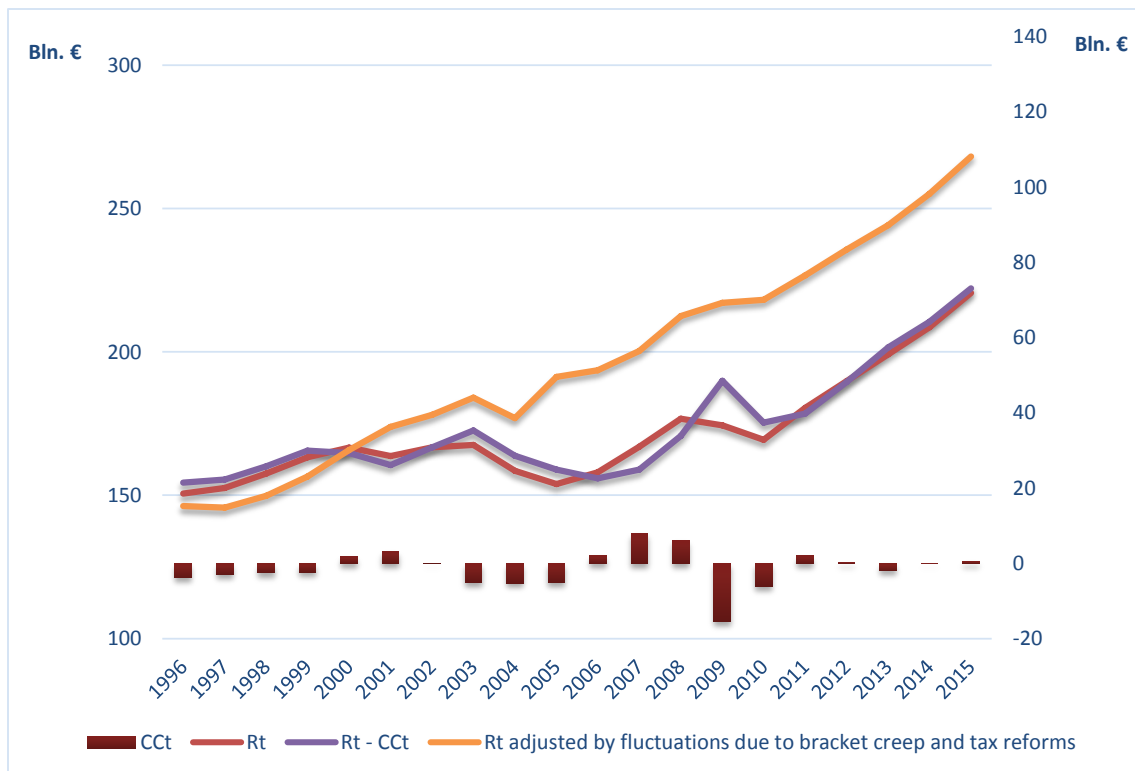
Sources: Mourré et al. (2013), Federal Ministry of Finance (2016), Federal Ministry of Economics and Technology (2016), own calculations.

Figure 1: Fluctuations in Income Tax Revenues by bracket creep and tax reforms



Sources: Federal Statistical Office, Federal Ministry of Finance, own calculations.

Figure 2: German wage tax revenues and wage tax revenues adjusted by fluctuations due to business cycle, bracket creep and tax reforms



Sources: Mourré et al. (2014), Federal Ministry of Finance (2016), Federal Ministry of Economics and Technology (2016), own calculations.

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