The Timing and Responsiveness of Fiscal Policy over the Business Cycle in Germany

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Abstract

This paper provides new empirical evidence on the timing and sensitivity of fiscal policy over the business cycle in Germany. Employing structural vector autoregressions with time-varying transmission parameters, we find that the responsiveness of the fiscal balance to output gap shocks varied substantially over the last decades. Combining output gap and fiscal balance reactions reveals three distinct fiscal regimes that gradually flow into each other. Increasing countercyclical reactions can be observed in the 1970s. This is followed by almost two decades of decreasing short-term but increasing medium-term countercylicality. A third regime is characterized by further decreases of the short-term countercyclicality, while fiscal policy turns acyclical in the medium-term perspective. Additional analyses show, that especially changes in the degree of trade openness and the employment ratio, along with the adoption of stronger inflation targeting have driven the decline of the sensitivity of German public finances.

Keywords: Cyclicality of fiscal policy; Structural VAR; Time–varying parameter
JEL codes: E62, E32, C32

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1 Introduction

A central idea in recent macroeconomic theory is that a countercyclical fiscal policy helps to smoothen the business cycle and to increase economic growth.[1] Along these lines, some authors have shown that countercyclical fiscal policy can improve welfare (see, for example, Kliem and Kriwoluzky, 2014). However, Hagen (1948) long ago stressed that the timing of fiscal policy is a crucial factor for these desirable effects. Measures implemented too late, even though the current economic situation has been assessed correctly, may lead to yet further destabilization and therefore negative effects on welfare. Only if the reaction of fiscal policy is countercyclical, it has the potential to smoothen the business cycle.[2]

Several studies have analyzed the question of the cyclicality of fiscal policy from an empirical perspective. Ballasone, Francese and Zotteri (2010) identify a procyclical pattern of fiscal policy for an EU 14 aggregate based on annual data from 1970-2004. This is also supported by Ballassone and Francese (2004), who find a procyclical pattern of overall fiscal policy in the EU, the US and Japan for annual data from 1970-2000. In contrast, Golinelli and Momigliano (2006) find a countercyclical timing of fiscal policy for an EMU 11 aggregate based on an annual real-time data (1988-2006). Studies like Gavin and Perotti (1997), on the other hand, argue on the basis of annual data (1968-1995) that overall fiscal policy has been generally countercyclical in developed countries and more procyclical in developing countries. This is further supported by Talvi and Vegh (2005), who argue that the strong procyclicality of fiscal policy in developing countries is caused by a higher volatility of the tax bases.[3]

One reason for the strongly differing findings in the literature might be that the fiscal policy reaction is not static. It may evolve over several periods and it may change its pattern over time. Therefore it is called for an analysis based on a dynamic and time-varying framework. Muscatelli, Tirelli and Trecroci (2002) and Aghion and Marinescu (2008) analyze the responsiveness of public finances to fluctuations in economic activity from such a time-varying perspective. Muscatelli et al. (2002) apply subsample analyses for Germany (among others) and point to a response pattern that has changed over time towards an acyclical reaction between 1971-1998. However, the applied abrupt regime changes approach may not capture the whole dimension of time variation in case of changes that occur more gradually. Aghion and Marinescu (2008) allow for more gradual time variation between 1970-2005 and find an increasing

[1] Priesmeier and Staehler (2011) present a detailed survey of the literature discussing the effects of smoothing business cycles on economic growth. See as well the discussion in Fatás and Mihov (2001).

[2] See, for example, Alesina and Perotti (1995) or Eslava (2011) for a more detailed account of the political economic transmission mechanisms. Chapter 5 of IMF (2008) presents a comprehensive overview on stabilization measures. Dolls et al. (2015) analyze the effectiveness of fiscal policy in euro area Member States under the current fiscal surveillance framework.

[3] There is a wide range of studies which focus on only one of the two sub-aggregates of overall fiscal policy: the "automatic reaction" of the budget deficit via the working of automatic stabilizers (see, for example, Debrun and Kapoor, 2010, or, Leigh and Stehn, 2009) and the discretionary fiscal policy channel, where the most common approach to identifying discretionary measures is "cyclical adjustment" (see, for example, Alesina and Perotti, 1995).

degree of countercyclicality in the US and the UK, whereas for an EMU 15 aggregate the counterycyclicylity is decreasing since the 1980s.[4] However, their static time series framework does not capture the possible dynamics of the interaction between fiscal balance and economic activity over several periods and Germany is not included as a single country in the analysis.

Against this background we present an in-depth analysis of the timing of fiscal policy over the business cycle in Germany that takes into account the possible dynamics and time variation. We particularly focus on the following questions:

1. What can we say about the sensitivity and the dynamics of the fiscal policy reaction to fluctuations in economic activity in Germany?

2. Do we observe a stable cyclical reaction pattern or has it changed over time - can we identify different regimes of cyclicality?

3. What economic forces cause changes in the fiscal reaction to economic shocks?

One aim of this study is to identify broad regimes of reaction patterns over a long-term horizon. In order to avoid that the results are distorted by the exceptional crisis years 2009-2010, we focus on a pre-crisis sample from 1970-2008. Our empirical analyses are based on structural vector autoregressions (SVAR). This enables us to take into account the endogeneity of fiscal policy and the business cycle as well as the dynamic character of the variables. To allow for possible time variation, we use a state space model with time-varying parameters that allows the coefficients to evolve gradually over time.[5]

The paper contributes to the literature in the following four ways. *First*, by employing quarterly data we derive insights on the sub-annual reaction of fiscal policy to fluctuations in economic activity. *Second*, we analyze the dynamic reaction pattern and sensitivity of the fiscal balance to output gap shocks and thereby study the cyclicality of fiscal policy. *Third*, using time-varying parameters enables us to investigate the possibility of changing cyclicality regimes over the sample horizon. And *fourth*, we study the driving forces of time variation in the fiscal policy reaction.

The paper is organized as follows. Section two briefly introduces our concept of the cyclicality of fiscal policy and presents the data employed. In section three we study the timing of fiscal policy based on time-invariant models that account for discrete regime changes. Time-varying structural analyses are performed in section four. Section five provides evidence on the driving forces of time variation in Germany. Section six concludes.

[4]Such evolvement has implications on the assessment of structural fiscal indicators – measures derived from constant parameter models tend to be biased, i.e. tend to be too high for the European case.

[5]A wide range of alternative specifications can be found in the time variation literature, including Markov-switching VARs (Paap and van Dijk, 2003, or Sims and Zha, 2006) and other regime-switching VARs (Koop and Potter, 2006). TVP VARs have recently become the most prominent tools in fiscal policy analyses (see e.g. Cimadomo, 2012, Cimadomo and D'Agostino, 2015, or Eickmeier, Lemke and Marcellino, 2015).

2 Cyclicality of fiscal policy and data

Generally, fiscal policy can be unrelated with the cycle (acyclical) or respond in a pro- or countercyclical way to economic developments. To assess the relationship of fiscal policy and the business cycle, a measure of the business cycle, a measure of the fiscal policy stance, and, finally, a definition of the acyclicality, countercyclicality and procyclicality of fiscal policies is required.

In this paper we follow broad majority of empirical studies which use the real output gap as an indicator for the business cycle (see Golinelli and Momigliano, 2009, or OECD, 2010)[6], as it divides economic development into phases in which output is below potential output (output gap smaller than zero), phases in which output is above potential output (output gap larger than zero), and phases in which the output equals potential output. This gives a clear-cut picture of "good" and "bad" economic times, while other measures – such as GDP growth rates – make additional and arbitrary definitions necessary. For the output gap variable, we have calculated the real GDP gap based on the quarterly national accounts database of the Deutsche Bundesbank. Nominal GDP was first realized by the chain-linked GDP deflator and then seasonally adjusted. In a second step, we applied the Hodrick-Prescott filter (Lambda=1600) to the real GDP series, which we prolonged with its own linear trend in the past (1960-1970) and the future (2009-2019) in order to avoid a distortion of the results at the lower and upper bounds of our series.[7] The real output gap was then calculated as the difference between actual real GDP and potential real GDP (measured by the HP-filtered trend) as a percentage of potential GDP.[8]

The most common indicator for the fiscal stance is the general government balance. In this paper we refer to the primary balance, because we analyze fiscal policy reactions to the business cycle and interest payments do neither react strongly to the cycle nor can they be changed easily by the government (see for support of this approach, Mélitz, 2000, Muscatelli et al., 2002, and Perotti, 2005).[9] We subtracted general government expenditures (excluding interest) according to the national accounts definition from general government revenues (mostly taxes and social security contributions) and divided the results by real trend GDP. Both, the expenditure and the revenue series are first realized with the chain-linked GDP deflator and then adjusted seasonally. As we want to analyze overall fiscal policy, we chose the cyclically unadjusted primary balance (which is influenced by automatic stabilizers and by discretionary fiscal policy measures) as indicator.

Concerning the relationship of the economic cycle and fiscal policy, the literature

[6]Some studies refer to the growth rate of output. See, for example, Lane (2003).

[7]Alternatively, we applied a one-sided Hodrick-Prescott filter, which did not affect our results substantially.

[8]This measure corresponds to the difference between log actual and log potential output, used, for example, by Muscatelli et al. (2002).

[9]Using primary balances is not uncontested (see, for example, Blanchard and Perotti, 2002, or Golinelli and Momigliano, 2009). However, it should be noted that the general timing pattern of fiscal policy over the business cycle is only slightly affected by interest spending, as we obtained very similar results using total deficits.

provides different approaches to defining cyclicality in practice. Related to standard Keynesian approaches as well as the theory of tax smoothing (see Barro, 1979), it seems straightforward to use the output gap and the primary balance in levels as it is done e.g. in Muscatelli et al. (2002) and Aghion and Marinescu (2008).[10] Then a positive primary balance (equalling a fiscal surplus) at the time of a positive output gap the fiscal stance can be expected to contribute to smoothing the business cycle and is therefore called "countercyclical". For the case of a negative output gap, a countercylical fiscal policy would demand negative primary balances (deficits). Fiscal policy would be termed "acyclical" if the primary balance is zero despite an output gap different from zero or if the output gap is zero but the primary balance differs from zero. In this paper we follow this dominating approach, as it establishes a straightforward, clear-cut and theory-based link between the state of the business cycle and fiscal policy.

Figure 1 shows the development of the real GDP gap (black line) and the government fiscal stance as the primary balance ratio (blue line).[11] We can already see that the two stationary series seem to move very closely together in some periods, while they diverge strongly during others. This may be taken as initial evidence for time-variation in the data.

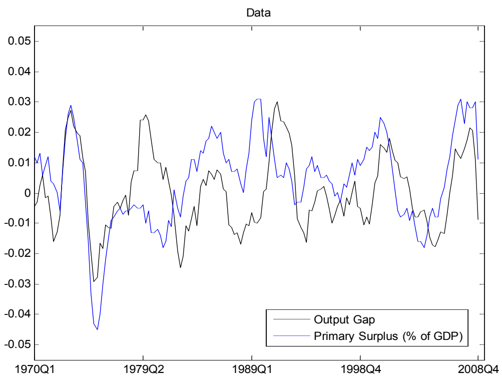


Figure 1: Output gap and fiscal stance (seasonally adjusted), 1970Q1-2008Q4

3 Benchmark results and time variation

Our aim is to analyze the timing of fiscal policy over the business cycle - an attempt which is directly affected by the importance of the dynamic reactions of the variables and the endogeneity of fiscal policy and the business cycle. These two aspects can be tackled in an intuitive way by employing vector autoregressions (VARs) and by assessing the the structural relations between the business cycle and fiscal policy, tracing the effects of exogenous and unanticipated shocks in economic activity.

[10] Alternative approaches rely either on the change of the primary balance (see e.g. Alesina et al., 2008) or on changes of both variables, the output gap and the primary balance (see, for example, Lane, 2003, or Leigh and Stehn, 2009).

[11] All level variables are adjusted for German reunification.

To identify these shocks, we use a **B**–model approach where the residuals are orthogonalized based on a Cholesky-type decomposition of the variance-covariance matrix (Sims, 1980).[12] This implies a recursive structure of the economy determined by the ordering of the variables. In our case the output gap is put first and thus the fiscal stance reacts contemporaneously to the output shock, whereas there is no feedback reaction running from the structural primary balance to the output gap within the quarter the output gap shock occurs. Decisive for this ordering is that we are analyzing especially on the reaction of the fiscal stance to economic shocks and not so much the reaction of the economy to fiscal shocks.[13] However, we also changed the order of the variables in sensitivity analyses. Apart from the expected changes in the contemporaneous reactions, this did not have large impacts on the overall course.

3.1 Structural analyses based on time-invariant SVARs

As a benchmark for all following analyses, we start our investigation with a time-invariant two-dimensional VAR of order two with a constant. Multivariate least-squares (LS) are used to obtain time-invariant values for the coefficients. The optimal lag order is set according to the Schwartz information criteria (SC), autocorrelation analysis and with respect to the fact that the time-invariant VARs will be taken as a reference for the time-varying parameter models that may be overparameterized in case of high lag orders. To analyze the impact of the identified output gap shock on fiscal policy over longer horizons, we compute impulse response functions, which can be interpreted as forward-looking budgetary reaction functions over a horizon of 20 periods (5 years).

Figure 2 (continuous line with quads) shows the corresponding impulse response functions (within 95% confidence intervals - dashed lines) of the output gap itself and of the overall fiscal stance following a positive 1 pp shock in the output gap.[14]

The left panel of figure 2 shows the reaction of the output gap to a shock in itself. Here, the one-off shock leads in the first period after the shock to a further widening of the output gap before the output gap starts to close in the second period.[15] After six quarters the output gap is no longer significantly different from zero. The point estimate decreases further until the reaction becomes slightly but insignificantly negative

[12]Structural shocks and the identification scheme are assumed to be time-invariant over the sample. With respect to the estimated residuals of the constant parameter VAR and measurement residuals of the time-varying parameter model, this seems to be a reasonable specification because the structure of the residuals does not change over time and we are using real economic data.

[13]The reverse approach of modeling of a contemporaneous reaction of the economy to fiscal policy shocks would make sense especially within an analysis of fiscal stimuli on the economy. However, in this case the fiscal variable included should only take discretionary fiscal policy shocks (and not as well automatic stabilizers) into account. Furthermore, a contemporaneous reaction significantly different from zero in the balance due to fast automatic stabilization seems to be more intuitive than a significant reaction of the economy to fiscal shocks within the same quarter.

[14]Continuous and dotted lines are related to the benchmark model including identified exogenous regime changes (see 3.2). There are no significant differences between the impulse responses.

[15]The "overshooting" of the output gap in the first period after the shock indicates that GDP growth rates exceed trend GDP growth rates before the growth rate of actual GDP starts to fall below the trend growth rate between periods one and two and the positive gap thus slowly begins to close.

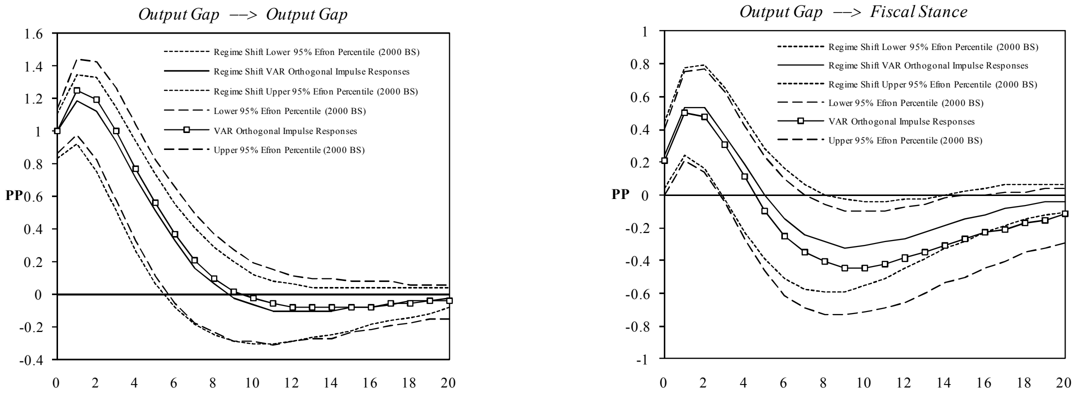


Figure 2: Impulse responses of time-invariant SVAR and SVAR with disrete regimes

from quarter ten on, where actual output falls below trend output.[16] Afterwards, the system tends to its equilibrium where actual output equals trend output again.

The primary balance (right panel of figure 2) reacts immediately and significantly positively to the output gap shock with a contemporaneous increase of 0.22 percentage points. As discretionary fiscal policy is rarely able to react within the same quarter to output gap shocks, this reaction can be interpreted as the isolated working of automatic stabilizers.[17] Thereafter, the fiscal stance reaction increases further to the maximum of around 0.50 percentage points in the first and the second quarter. Combining these fiscal stance reactions with the output gap reactions would - in terms of deficit elasticity - equal values of 0.22 in the contemporaneous and 0.40 in the first and second quarter after a shock. Afterwards, the effect on the stance decreases and is no longer significantly different from zero between quarters three and four. Around quarter seven, the effect on the fiscal stance even starts to turn significantly negative. The highest negative effect is reached with -0.44 percentage points in period nine. From then onwards, the negative effect starts to fade out - parallel to the adjustment of output to the new equilibrium level.

To evaluate the timing of fiscal policy now, we have to bring together the development of the output gap and of the fiscal stance. According to our definition in section 2, fiscal policy is clearly countercyclical in the first three quarters as significant surpluses are accompanied by positive output gaps. Between quarter five to nine, we observe a significant negative effect on the fiscal stance after quarter six, although the output gap is no longer significantly different from zero. This reflects acyclical fiscal policy.

[16]It is not uncommon for the economy to go through such a period of underutilization before the new equilibrium level is reached. This might result from expectation or inventory adjustment effects.

[17]In general the primary balance captures the automatic stabilization and, if there may be systematic discretionary policy measures, this share of discretionary policy too. However, in Germany, where the parliament needs to be involved in the decision-making process for discretionary measures, decision and implementation lags are very likely, and thus the probability of systematic discretionary policy reactions that occur in the same quarter of the shock is very low (Leigh and Stehn, 2009). In subsequent horizons, systematic discretionary policy measures, can be as well part of the reaction. The fiscal shocks capture all non-systematic policies, i.e. only the non-systematic discretionary measures.

Taken together, the benchmark model indicates the fiscal policy reaction to be strongly countercyclical at first and then to become acyclical in the second year after a shock.[18]

3.2 Time variation: discrete regime changes and gradually evolving fiscal policy

As we consider a rather long sample horizon from 1970 to 2008, the reactions of the fiscal balance to output gap shocks might have changed over time. In such cases a constant parameter model would be inappropriate. For instance, variations could result from changes in how the fiscal balance reacts to economic changes (e.g. because of structural changes in the tax system or in monetary policy) or, alternatively, from changes in the structure of the economy itself and the way in which it reacts to economic shocks. In general, structural changes can occur abruptly and time point-specifically, for example, due to abrupt and far-reaching economic or political changes. Or they can evolve gradually, for example, if the structure of the public sector and e.g. social security changes over time or economic agents adjust only slowly.

We test for such specifications of time variation in the benchmark model using conventional Chow-type tests and recursive least squares coefficients.[19] Bootstrapped p-values from 1974Q3 to 2004Q4 are plotted in figure 3 (in the first row). Both tests indicate significant instability for the benchmark model especially in the seventies. In addition, we tested whether abrupt regime changes can explain the discovered time variation. Therefore, we implemented a wide range of exogenously identified structural breaks and re-tested the benchmark models.[20] First, we tested the hypothesis of a partisan regime shift in 1982Q4 when the conservative-liberal government came into power and lasted until 1998Q4. This is not significant. In a second step two different post second oil crisis regimes – each of them with two different starting points in 1980Q1 and 1982Q4 - are tested: the first assuming one regime for the remaining sample horizon, the second assuming the same regime to last only until the fall of the Berlin Wall (1989Q4). On a 10 percent level, only the post second oil crisis regimes, which start in 1980Q1 and lasts until reunification, is estimated to lead to marginal but significantly smaller output gaps (-0.002). When implementing this "oil crisis to reunification regime" and the transitory oil crisis dynamics, only the corresponding break-point tests shown in the second row of figure 3 now reject the null hypothesis of

[18]The feedback effects of the fiscal stance on the output gap (not shown in the figures above) are clearly insignificant and rather non-Keynesian, as the impact of increasing surpluses on the output gap is indicated to be positive. However, this finding is well in line with existing VAR studies for the German case (see, for example, Muscatelli et al., 2002).

[19]We use bootstrap versions of the Chow break-point test (BP) and sample-split test (SS) according to Candelon and Lütkepohl (2001). Testing is based on a minimum of 16 observations in the sub-samples at the end and the beginning. The slight evidence for instability at the end of the test sample has to be regarded cautiously due to the small number of observations.

[20]In all versions we included significant impulse dummies in 1979Q2 and 1982Q3 to capture the massive transitory effects on public finances and the output gap related to the second oil crisis. Alternatively, we implemented different regimes for the time between the two oil crises using shifts (1975-1982, 1977-1980, 1979-1982 and 1980-1982). None of them proved significant.

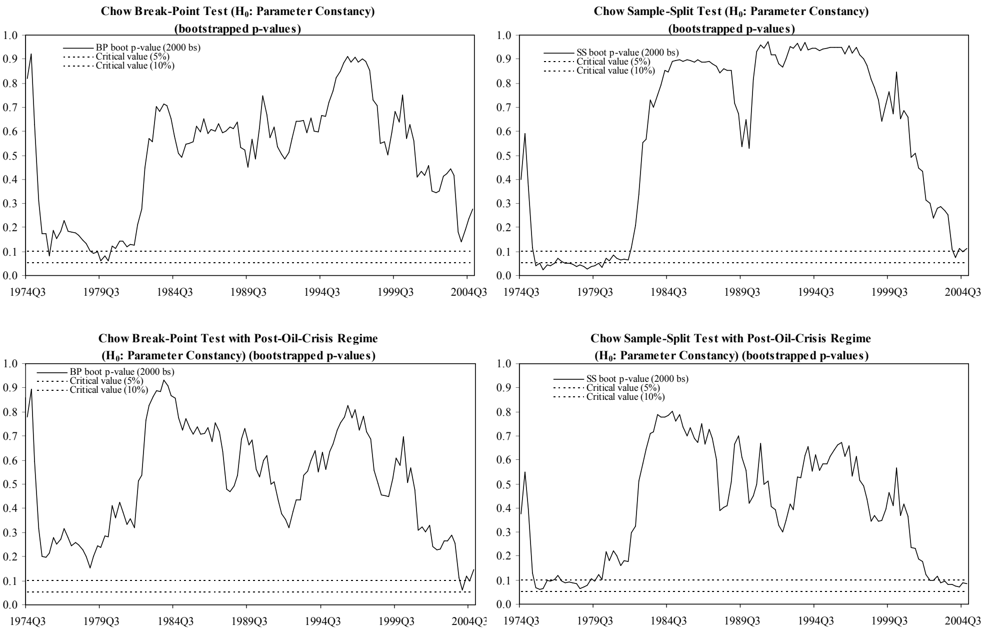


Figure 3: Results of break-point and sample-split tests

instable parameters. Nevertheless, the sample split tests still indicate some instability at the beginning of the sample. Thus, allowing for discrete parameter changes may not capture the full range of time variation found in the German data.

Instead, changes may occur more gradually, which is indicated by Chow-type tests on smaller sub-samples and recursive least squares estimates which provide evidence for significant gradual evolvement of the parameters, in particular, within the first decade (1970 to 1980) and around the time of German reunification in 1990/1991. Therefore, we will adopt a more general model that allows for such evolvement of parameters in the next section.

4 A time-varying parameter (TVP) VAR approach

The presented evidence for parameter instability in time-invariant models speaks in favour of time-varying reaction schemes. To capture this in a adequate way we need a more general, time-varying parameter (TVP) model that allows the coefficients - and thus the corresponding impulse responses - to evolve gradually over time.[21] An intuitive framework to illustrate such time-varying relations between economic variables is a *state space model* where the reduced-form coefficients - the states – are allowed to

[21] A wide range of alternative specifications have been suggested in the time variation literature, including Markov-switching VARs (e.g. Paap and van Dijk, 2003, or Sims and Zha, 2006) and other regime-switching VARs (Koop and Potter, 2006). However, TVP VARs have become the most prominent tools in recent applied analyses of fiscal policy issues (see, for example, Kirchner, Cimadomo and Hauptmeier, 2010).

evolve according to a stochastic process, represented by a *state equation* or a law of motion. Given this, the states can be calculated recursively from measurable data based on a certain time-varying data-generating process, represented by a *measurement equation* - in our case a TVP VAR.

According to our research question on the responsiveness of fiscal policy, time variation is introduced in a way that allows the systematic policy propagation parameters - but not the structure of the measurement error variances covariances - to potentially evolve over time as observations are added, i.e. our analyses are based on a *homoscedastic* state space model. We apply a fairly parsimonious two-dimensional TVP VAR of order two including an intercept as linear measurement equation.[22] For each observation t this equation is written below in time-dependent, stacked and vectorized form,

$$y_t = Z_t \beta_t + \varepsilon_t, \quad t = 1, ..., T. \tag{1}$$

The 2×1 vector y_t contains the observations for output gap and primary surplus, and ε_t the independent measurement errors that follow a zero-mean, normally distributed process with *time-invariant* residual variance covariance matrix H. The column vector β_t contains the ten states. The regressor matrix Z_t is not restricted and only contains a time-varying constant as an exogenous explanatory variable. It is of dimension 2×10. Our sample size is $T = 154$ observations excluding $p = 2$ two presample values.

According to our economic hypothesis, which postulates that changes in systematic structure of the fiscal stance reaction or the reaction of the economy usually occur slowly and over certain periods (persistent regimes), the law of motion for the parameters is given by a *vector random walk process*.[23] This setting ensures highly persistent and stochastically trended policy propagation parameters, i.e. it is able to capture the gradual evolvement of regimes.[24] Moreover, random walks are typically well-suited to forecasting macroeconomic time series. Our linear state equation is

$$\beta_t = \beta_{t-1} + \eta_t, \quad t = 1, ..., T, \tag{2}$$

where η_t is the independent, zero-mean and normal 10×1 vector of state residuals that has a diagonal *time-invariant* 10×10 variance covariance matrix, Q.[25]

We estimate this *normal, linear and homoscedastic state space model* by classical methods, i.e. by Maximum Likelihood (ML) using Kalman filtering (KF) recursions.[26] To

[22]Hence, the number of variables is $n = 2$, the number of lags $p = 2$ and the number of states is $m = n + pn^2 = 10$.

[23]See, for example, Kirchner et al., 2010, or Eickmeier, Lemke and Marcellino, 2011 and 2015.

[24]Gradual evolvement, or in other words, low fluctuations of a state given a certain level requires rather tight variances of the state residuals $var(\eta_t)$. For large values the states start to move a lot from period to period which is rather unrealistic concerning fiscal policy reactions.

[25]$E(\varepsilon_t) = 0$, $E\left(\varepsilon_t \varepsilon_t'\right) = H$, $E(\varepsilon_t \varepsilon_s') = 0$, for all $s \neq t$ and $E(\eta_t) = 0$, $E\left(\eta_t \eta_t'\right) = Q$, $E(\eta_t \eta_s') = 0$, for all $s \neq t$, and $E(\varepsilon_t \eta_s') = 0$ holds.

[26]According to Eickmeier et al. (2015), this is feasible and straightforward for our case, as we refer to "a model representation that allows equation-by-equation estimation, where each equation with time-varying parameters is represented as a linear state space model."

start the recursions, initial state values are required. Based on the defined Gaussian system, the initial state vector is normally distributed with expected value b_0 and variance covariance matrix P_0, $\beta_0 \sim N(b_0, P_0)$. The choice of initial moments leaves some degrees of freedom to us, while this information may have significant impacts on the outcome. In general, different solutions to this initialization problem exist. In this paper, we refer to an initialization based on LS estimates for a time-invariant VAR of the same order (see, for example, Eickmeier et al., 2015). For a "training sample" (TS) of the initial 20 quarters of our sample horizon the expected state value and the covariance matrix – which is multiplied by factor four to make it more diffuse – are $b_0 = \hat{\beta}^{LS_{TS}}$ and $P_0 = 4\hat{\sigma}^2_{\beta^{LS_{TS}}}$.[27]

Finally, the degree of time variation needs to be defined. The general pattern of the evolvement was set according to a random walk process with diagonal residual covariance matrix Q. The variances on the main diagonal of this matrix determine the range of the residual fluctuations and thus the possible flutuation possible from a state value to the next periods state value, i.e. the degree of potentially captured time variation. They are the key leverage in time-varying analyses (see also the discussion in Eickmeier et al., 2015). In general, two different strategies are possible to specify Q. First, it can be estimated in a comprehensive estimation approach (results are presented in appendix A). And second, it can be set according to a priori information that is available. The first approach is frequently related to heavy problems with overparametrization and instability of the estimated TVP VARs (so it is for our case).[28] Therefore, we decided to reduce the parameter space by the exogenous choice of Q. Related to the choice of Q, there is a significant *trade-off* between simply fitting the data and the degree of economic structure potentially captured in the estimation, which speaks in favor of rather conservative choices.[29] Also, with respect to our hypothesis of only gradual evolvement, we implement relatively small values for the variances on the main diagonal, which is common in the literature. Setting $Q = I_{10}10^{-9}$, we allow for the same degree of time variation across all states, while the variances are very close to the ones generated in the constant parameter case and close to the ones of the

[27]Sensitivity is checked by less restrictive non-informative initial values using a zero-mean and very large variances as benchmark, $b_0 = 0$, $P_0 = I_{10} \cdot 10^5$. No significant differences arise. Only for the initialization postulated by Doan, Litterman and Sims (1984) with a set of predefined specification parameters the results differ. This is not surprising given the restrictive (zero/one) constraints on the initial state vector and the restrictive degree of time variation captured in the covariance matrix of the states.

[28]The probability to estimate state coefficients larger than one, or, alternatively, eigenvalues of the companion matrices that lie outside the unit-circle increases seriously for large values of the covariance matrix. An effective strategy to counter this problem in the comprehensive approach is to include a stationarity correction algorithm within the ML procedure while using a tight initialization (e.g. LS-based). However, for our case, this leads to stationary, but still very fluctuating responses, which stands in contrast to our hypothesis.

[29]The larger the state residual variances are, the better the data fit is, as the size of the measurement residuals decreases. However, the smaller the measurement residuals are, the lower is the degree of economic structure potentially captured in the model. Conversely, for smaller settings the time-varying models get closer to the constant parameter case. And for all elements equal to zero, the TVP model reduces to the constant case.

frequently applied approach of Doan, Litterman and Sims (1984).[30] This specification enables us to estimate stable TVP VARs that allow for gradual evolvement of fiscal policy regimes.

4.1 Structural analyses based on time-varying SVARs

The maximum likelihood parameter estimates of the state space model introduced in the last section indicate significant gradual evolvement of the ten reduced-form states over the sample horizon after a stabilizing period at the beginning (see figure 4 for the estimates in two-standard deviation bounds).

To analyze the dynamic impacts of output gap shocks on the fiscal stance, we rely again on forward-looking fiscal policy reaction functions. In contrast to section 3, these systematic reaction functions can now evolve gradually over time in their sensitivity and pattern, except for the contemporaneous period, because the estimated measurement residual covariance matrix is *homoscedastic*. We implement the same time-invariant **B**-model identification scheme as introduced for the constant parameter case in order to identify output gap shocks. Non-parametric bootstrapping (1,000 iterations) is used to compute median impulse responses at each point of time.

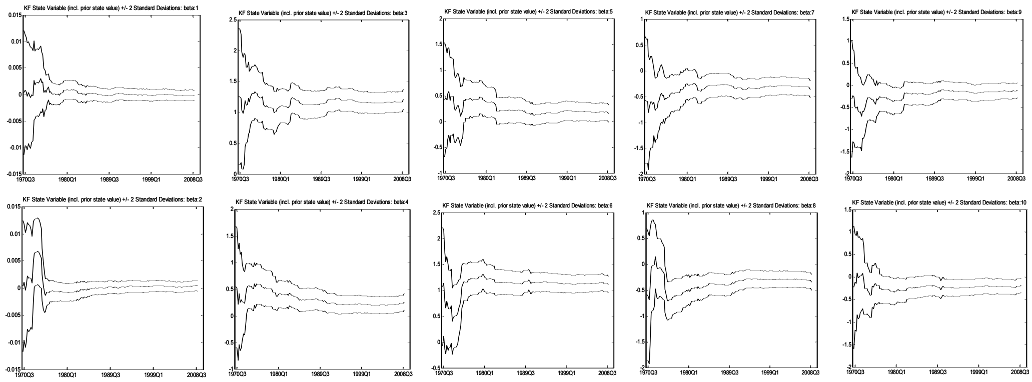


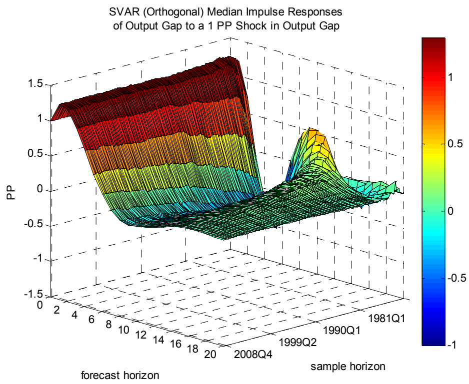
Figure 4: Estimated states +/- two standard deviations

Time varying reactions of the business cycle and the fiscal stance

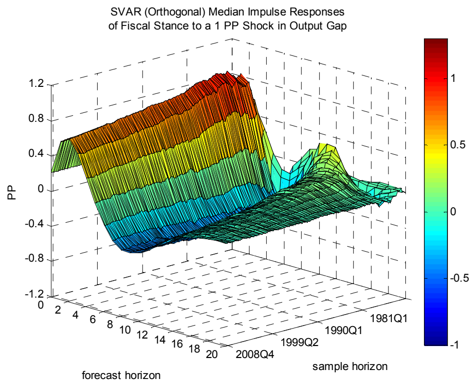
How does the time variation of the output gap and fiscal stance reaction to shocks in economic activity look like? For a forecast horizon of 20 quarters (five years), figures 5a and 5c show the effect of a 1 percentage point (pp) output gap innovation on the real output gap and the real primary balance from a three-dimensional perspective over the sample horizon 1971Q4–2008Q4 after a stabilizing period - including the initialization

[30]See, for example, Muscatelli, Spinelli and Trecroci (2007) or, for a fiscal policy application, Muscatelli, Tirelli, Trecroci (2002). The authors use a specification in which the residual covariance matrix is a product of a "tightness" leverage and the initial state covariance matrix that depends on LS estimations for the states, $P_0 10^{-7}$.

- of 6 quarters is taken into account.[31] Figures 5b and 5d additionally show a two-dimensional perspective. Furthermore, single impulse responses of relevant periods are compared in figure 6. In the following we distinguish between *short-term* reactions that account for one and half year (quarter 0 to 5), *medium-term* reactions that can be found between quarter 6 to 11 (up to year three after the shock) and *long-term* reactions from quarter 12 to 20 (year three to year five).



(5a)



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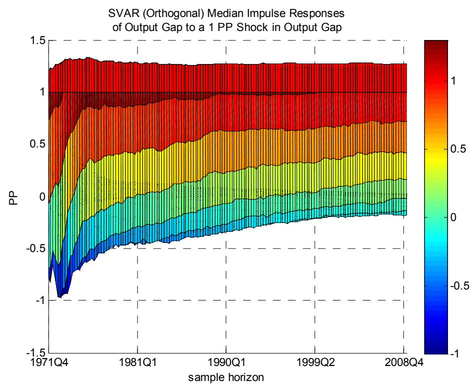

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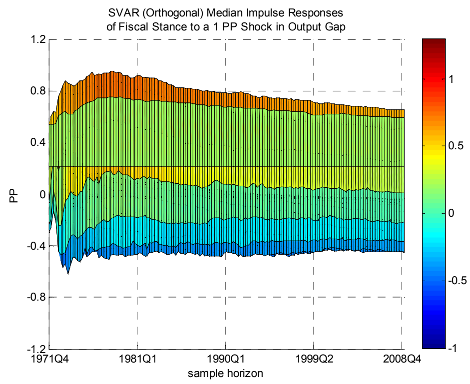

(5d)

Figure 5: Median impulse responses of the TVP SVAR

Reaction of the output gap: The reaction pattern of the output gap is generally in line with the findings from the linear benchmark model in section 3 (see figures 2 and 6). Nevertheless, the implemented time-variation provides some useful additional information. With respect to the evolvement of the dynamic reaction of the output gap to shocks in economic activity, the following three stylized facts are important:

- The short-term "overshooting" of the output gap – following the contemporane-

[31]Temperature plots are presented in appendix B.

ous quarter – increases substantially at the beginning of the sample from 1.23 in 1971Q4 to 1.33 pp in 1974Q4, then decreases only slightly to 1.30 pp in the following periods and remains on this level for the rest of the sample until 2008Q4.

- The reduction of the positive output gaps in the quarters following the "overshooting" becomes slower and less strong over the sample horizon. The minimum reaction moderates until it is no longer significantly different from zero around the end of the 1990s. Furthermore the minimum reaction is slowly shifted backwards. In 1971Q4, for example, the negative effect reaches a minimum of close to -0.77 pp already in the fifth quarter after the shock while in 2008Q4 the minimum is not reached before the ninth quarter and stands only at -0.16 pp (which is no longer significantly different from zero).[32]

- The long-term reaction fades out to zero and is very similar throughout the whole sample.

Reaction of the fiscal stance: The contemporaneous reaction of the fiscal stance - which is likely to reflect the isolated working of automatic stabilizers as discretionary fiscal policy is hardly able to react to economic shocks within the same quarter - is countercyclical (i.e. positive) and equals 0.22 percentage points. This is the same value as in the time-invariant model, which results from the rather conservative choice for the degree of time variation (measurement covariance matrix close to LS case). Thereafter, the development differs substantially from the benchmark model (see also figures 2 and 6). The following three stylized facts are most important:

- The strongest short-term reaction of the fiscal stance is observed in the first and the second quarter after the shock. In particular, the reaction in the second quarter after the shock increases strongly throughout the first decade of the sample (from 0.51 in 1971Q4 to 0.96 pp in 1979Q4). Thereafter it decreases gradually to 0.65 pp in 2008Q4.

- The deterioration of the fiscal stance reaction in the medium term slows down over time but is related to lower minimum levels that are shifted backwards. At the beginning of the sample (1971Q4) the minimum equals -0.29 pp and is reached in the fifth quarter, while at the end (2008Q4) the minimum is reached at -0.46 pp in quarter 9.

- In the long term the reactions fade out. For the earlier part of the sample the reaction converges to zero from positive values, while the later part of the sample shows a gradual increase from the negative minima.

Figure 6 summarizes the developments in the cyclicality and sensitivity of fiscal policy by showing four median impulse response functions related to the three regimes identified.

[32]Significance is analyzed based on the 95% confidence intervals of the single impulse responses of this period.

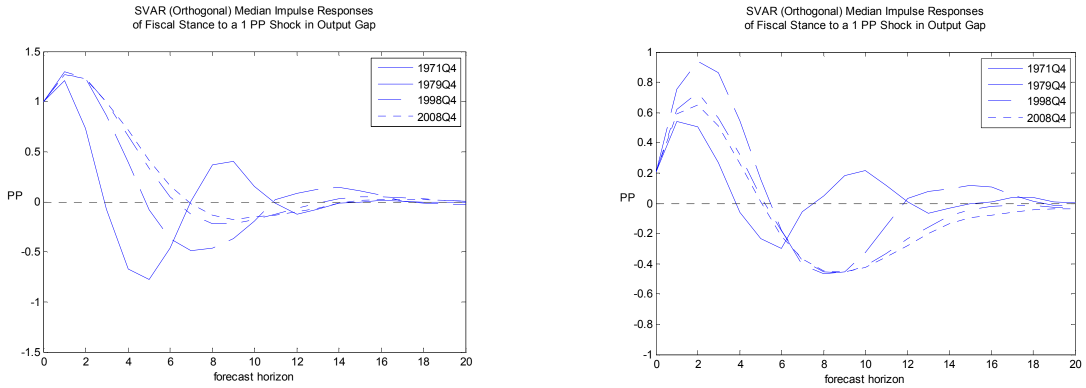

Figure 6: Single median impulse responses at four different periods

Identification of fiscal policy regimes: According to the applied dynamic conception of cyclicality (see section 2), the relation between the reactions of the output gap (state of the business cycle) and the fiscal stance to shocks in economic activity are now evaluated. In addition to the direction of the reactions (positive or negative), the time-varying framework provides us a second dimension to distinguish between regimes: The sensitivity of the reaction. This sensitivity evolves gradually over time and thereby delivers important additional information on the pattern of cyclicality. We are now not only able to distinguish between a counter- or procyclical reaction, but we can also assess whether this reaction is increasingly or decreasingly countercyclical. Hence, regime changes may appear as well based on changes in the size of the fiscal reaction.

Bringing together the general development of fiscal balance and output gap (see figure 5), we can distinguish three different regimes over the sample: the first from 1971 to 1979, the second from 1980 to 1998 and the third from 1999 to 2008. Figure 7 presents an illustration in which strong countercyclicality is marked in green, moderate countercyclicality in yellow and acyclical fiscal policy is marked in red.

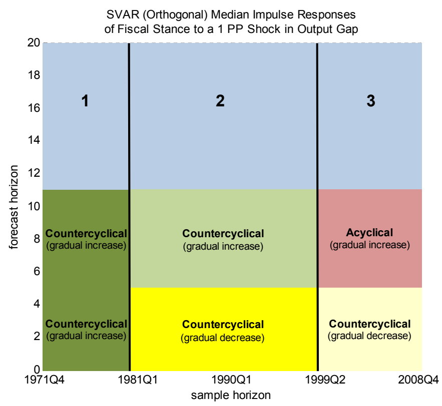

Figure 7: Cyclicality regimes in Germany from 1971:4 to 2008:4

1. 1971–1979: Increasing countercyclical short- and medium-term fiscal reactions

At the beginning of the first regime in 1971, the fiscal balance follows the strong expansion of the output gap after the shock in economic activity and then decreases in a similar pattern as the output gap. However, there is some indication for a time lag of one quarter between the output gap and the fiscal stance reaction: the fiscal stance remains (in contrast to the output gap) on a high level even two quarters after the shock and while the effect on the output gap turns negative in quarter 3 after the shock, the fiscal stance stays positive until quarter 4. This pattern continues as the effect on the output gap reaches its minimum in quarter 5, while the minimum of the fiscal stance reaction can be observed in quarter 6. From quarter 8 on, both effects are positive and then slowly converge to zero. Taken together, the close co-movement of the output gap and the fiscal stance reaction (with a time lag of one quarter) reflect a strong countercyclical fiscal policy throughout the short and the medium term.

Moving on from 1971 to 1979 we find that the short-term output gap reaction in the first quarter after the shock has increased.[33] This does also hold for the second quarter after the shock where the reaction nearly reaches the level of the first quarter. The periods when the reactions turn negative and reach their minimum are both postponed two quarters, from quarter 3 to 5 and from 5 to 7. In general, the fiscal stance reaction follows this postponement and turns now negative in the 6^{th} quarter and reaches its minimum in the 8^{th} quarter. Therefore, the general countercyclical pattern (including the time lag of one quarter) remains valid.

However, the relative scale of the countercyclical reaction increases strongly because the fiscal stance expands disproportionally strongly compared to the output gap: In the second quarter, for example, the fiscal balance reaction increases even from 0.51 pp in 1971Q4 to 0.96 pp in 1979Q4 (+0.45 pp), while the output gap reaction increased only from 1.23 to 1.30 pp (+0.07 pp) in the first quarter. If we take into account that the increase in the second quarter of the output gap reaction is stronger than in the first quarter (from 0.73 to 1.24 pp), the fiscal stance reaction in the third quarter, applying the one-period time lag, increases much stronger (from 0.26 to 0.89 pp). With respect to the medium term, the minimum of the fiscal stance reaction decreased from -0.29 pp in 1971Q4 to -0.47 pp in 1979Q4 (-0.18 pp), while the minimum of the output gap reaction even increased from -0.77 in 1971Q4 to -0.49 pp in 1979Q4 (+0.28 pp).

Overall, these findings indicate a large gradual increase of countercyclical reactions in the first regime based on the over-proportionally strong expansion of the fiscal balance when compared to the output gap reaction in the short and medium term.

2. 1980–1998: Decreasing short-term and increasing medium-term countercyclical fiscal reactions

The second regime starts in 1980 and lasts for roughly twice as long as the first regime. The general reaction patterns of the output gap and the fiscal balance are unchanged

[33] More precisely, it increases only until 1974 (to 1.33). Then it decreases slightly to 1.30 and remains on this level

– sustaining a countercyclical fiscal policy reaction throughout this regime. One interesting observation is that the time lag between the output gap and the fiscal balance reaction nearly vanishes regarding the medium term. At the end of this regime (1998Q4) the output gap and the fiscal stance turn negative and reach their minimum in the same quarter (quarter 9 after the shock).

Moving from 1980 to 1998, the short-term output gap reaction does not change substantially in the first two quarters after the shock. Thereafter it decreases somewhat slower than before. In 1998Q4 the output gap reaction turns negative in quarter 7 after the shock and reaches its minimum in quarter 9 (again a postponement by two quarters as during the first regime). Furthermore the minimum negative reaction becomes less pronounced and significant. In 1998Q4 the minimum lies only at -0.20 pp (after -0.49 pp in 1979Q4 and -0.77 pp in 1971Q4) and is almost insignificant. With respect to the fiscal stance, the short-term reaction is reduced (particularly in the second and third quarter after the shock), while the negative medium term reaction remains nearly unchanged.

Combining the development of the fiscal balance and the output gap, this implies a gradual decrease of countercyclicality of in the short term (stable output gap reaction but decreasing fiscal policy reaction) but an increasing countercyclicality in the medium term (decreasing output gap reaction but stable fiscal policy reaction).

3. 1999–2008: Largely acyclical medium-term fiscal reactions

The third regime starts in 1999 and is of similar length as the first regime. The general short-term reaction patterns of the output gap and the fiscal balance are nearly unchanged. The short-term reaction remains countercyclical. However, in the medium term the negative output gap reaction is no longer significantly different from zero, while the fiscal balance reaction remains almost unchanged. Therefore, the medium-term reaction becomes acyclical, because the fiscal balance reaction is negative while the output gap is neutral.

The strength of the countercyclical reaction is gradually decreasing in the short term, as the output gap reaction is almost constant, but the fiscal stance reaction is somewhat moderated. As above the medium term output gap reaction fades out and the fiscal balance reaction remains unchanged, i.e. the fiscal balance does not follow the moderation of the output gap reaction and therefore becomes acyclical.

Summary: Taken together, we find that the countercyclicality of the fiscal stance reaction to output gap shocks first increases and then decreases gradually over the sample horizon leading to three distinct regimes. In the first regime the fiscal stance reaction to output gap shocks increases over-proportionally strongly and pushes up countercyclicality in the short and in the medium term. Thereafter the fiscal policy reaction moderates over-proportionally strongly in the short term, leading to a gradual decrease in countercyclicality, while the countercyclicality in the medium term even increases (as the medium-term output gap reaction moderates over-proportionally strongly). Finally, in the third regime from 1999 onwards, countercyclicality decreases in the short term. In the medium term the over-proportionally strong moderation of the output gap makes the fiscal balance reaction acyclical.

5 Economic driving forces of fiscal policy responsiveness

In section 4 we have shown that the responsiveness of fiscal policy to shocks in economic activity has changed over the sample horizon. What economic forces have caused this change? In this part we use linear regression techniques to analyze the influence of possible driving forces on the long-run changes in the responsiveness of the German fiscal balance to the business cycle.[34]

Our focus is on the long-run determinants as the change in the fiscal stance reactions occurs gradually and over the long run. Accordingly, the empirical evaluation is based on a cointegration approach for the sample horizon from 1974Q1 to 2008Q4.[35]

An analysis of the fiscal balance sensitivity by investigating the median impulse responses at each quarter after the shock would obviously go beyond the scope of this study. Instead, we select the most salient median responses, half a year after the shock for the analysis of changes in the short-run sensitivity and, the responses two years after the shock to analyze changes in the medium-term sensitivity.[36]

5.1 Economic driving forces

The sensitivity of the fiscal policy reaction to output gap shocks can generally be influenced by changes in the working of automatic stabilizers and by changes in discretionary fiscal policy. What are economic factors that drive changes in these two channels in the long run? The public finance literature shows that automatic stabilizers work especially via the effect of output gap shocks on tax revenues, and, on the expenditure side, via changes in employment (see e.g. van den Noord, 2000). In addition there are several broader economic hypotheses on the responsiveness of fiscal policy. Leading hypotheses concern trade openness, the impact of inflation targeting and the degree of fiscal centralization.

Tax progressivity. One important channel for automatic stabilization is income taxation (see e.g. Dolls et al., 2015). Here, progressive taxes play an important role, because economic up- and downturns affect the revenues of the progressive taxes overproportionally strongly. "A progressive income tax with high marginal tax rates could substantially reduce fluctuations in after-tax income and, so the argument goes, private spending, without the need for any explicit policy changes" (see Auerbach and Feenberg, 2000, p. 37). Thus, a change in the fiscal balance reaction could be expected, if the progressiveness of the income tax increases.

Employment. A second important channel for automatic stabilization are changes in the employment situation of a country. A negative shock in economic activity can lead to a loss in employment and a rise in unemployment – which activates the au-

[34] See e.g. Kirchner et al. (2010) for a related approach.

[35] The measure for fiscal centralization is only available from 1974Q1 on. Starting in 1974 seems to be reasonable, also because the heavy fluctuations at the beginning of the 1970s are excluded.

[36] More precisely, medium-term sensitivity refers to the impulse response function at horizon eight multiplied by minus one due to its original upward trend. This keeps the sensitivity measure consistent as negative but increasing measures indicate decreasing sensitivity.

tomatic stabilizers via unemployment compensation (see, for the general mechanism, Dolls, Fuest, and Peichl, 2012). A long-term increase in the employment ratio could, for example, reduce public finances' sensitivity, because the share of those affected by negative economic shocks (e.g. by losing their jobs) as part of the overall number of those financing the unemployment insurance decreases, and the resulting deficits of the unemployment insurance could be relatively smaller (or additional spending is covered by reserves facilitated by increased employment). We therefore propose the employment level as possible driving force for fiscal policy sensitivity.

Trade openness. The view that globalization has effects on the welfare state in highly developed countries of the western hemisphere is widely shared in the economic literature. However, there is a fierce ongoing debate on the direction of the influence on public finances. According to Alesina and Perotti (1997), an increasing degree of trade openness may reduce the responsiveness of fiscal policy to fluctuations in economic activity. International competition decreases the room for taxation and welfare state spending, and, therefore, reduces c.p. the importance of automatic stabilization (efficiency hypothesis). In contrast, Rodrik (1997) argues that increasing market integration leads to a more important role for governments in smoothing the effects of negative economic shocks on their population which would be related to a more sensitive fiscal balance in the long run (compensation hypothesis).[37]

Inflation targeting. A stronger targeting of stable inflation rates, historically represented by decreasing inflation rates, may reduce the responsiveness of fiscal policy to fluctuations in economic activity through the closing debt-monetarization channel. As governments can expect stronger inflation targeting by independent central banks, the channel for the monetarization of fiscal deficits closes down and consolidation issues, particularly in indebted economies, become the key focus. In addition, effects on the sensitivity of fiscal policies could result from "bracket creep", i.e. from higher inflation that pushes nominal income into higher tax brackets. This would result in an increase of the fiscal policy reaction (via tax revenues) to economic shocks in regimes with increasing inflation.

Fiscal centralization. Changes in the degree of German fiscal federalism could also influence the sensitivity of public finances in the long run. Oates (1997) argues that local governments are more capable to tailor efficient fiscal policy reactions to locally differing economic shocks. A lower degree of fiscal centralization could therefore be related to a lower overall responsiveness of fiscal policy. Along the same line Blankart (2007) stresses that local competition between smaller jurisdictions limits the room for public spending and thereby for overly strong reactions of public finances. In contrast, Worthington and Dollery (1999) argue that the absence of responsibility on the local level in a system of fiscal equalization mechanisms (as the German one) might lead to stronger spending reactions to economic shocks (also known as the "fly-paper effect").

[37] Wood (1994) provides hypothesis related to the Heckscher-Ohlin model of international trade. Increasing trade may generate an increasing degree of income inequality in highly developed countries, while decreasing the inequality in developing countries. Governments may therefore increase public activity.

5.2 Data

Figure 8 presents our short- and medium-term fiscal sensitivity measures (the fiscal responses half a year and and two years after a shock in economic activity) and the measures related to the possible driving forces.To evaluate the impact of tax progressivity, we rely on the ratio of the indices for average gross and net wages and salaries, which results largely from the wage and income tax.The employment ratio is measured by the total number of employed persons over the resident population. We measure trade openness by the total trade volume (exports plus imports) over GDP. Based on its importance for monetary policy decisions in Germany and Europe, the annual rate of change in the index of consumer prices (CPI) is an appropriate indicator to measure the degree of inflation targeting from an ex-post perspective. Our proxy for fiscal centralization in Germany is the ratio of federal to local (states and municipalities) expenditures.[38] To control for general economic development we include real GDP per capita (logaritmized). A level shift dummy is used to control for German reunification in 1991. All variables are seasonally adjusted.

5.3 Stationarity and cointegration

In a first step stationarity of the variables is analyzed. Results of unit root tests (ADF) are presented in appendix C. On a five percent level, there is statistical evidence that the short- and medium-term sensitivity, the measure for the degree of tax system progressivity, the employment ratio, the openness variable, the inflation variable and economic development are all driven by unit roots (some of the variables additionally include a deterministic linear trend) and that they are stationary in first differences, $I(1)$. Fiscal centralization measure seems to be stationary in levels and thus it cannot really have a long-run impact on the fiscal responsiveness. It is therefore excluded from the "core set" of economic driving forces. Nevertheless, it is a useful control variable.

To test for long-run relations between our core set of driving forces (in different versions) and the sensitivity of public finances cointegration is evaluated based on two residual-based approaches, the Phillips-Ouliaris (PO) and the Engle-Granger (EG) test.

With respect to the short-term sensitivity, there is statistical evidence for a robust long-run relation between the responsiveness of fiscal policy, employment, trade openness and the inflation variable.[39] If "tax progressivity" is included in the regressions, this leads to acception of the null in each procedure. However, as tax progressivity is found insignificant in each long-run regression, we will only refer to versions excluding it.

In contrast, the medium-term responsiveness (reaction two years after the shock) does not include so much economic long-run information. There is statistical evidence

[38] We rely on spending instead on revenues, as the room for political decisions at the local and regional levels in Germany is substantially larger with respect to expenditures than to revenues.

[39] For the baseline model and the weaker 10 percent level, both tests reject the null of no cointegration. Using five percent only the PO test rejects. This evidence becomes weaker if the control variables are additionally included (only the PO test rejects the null of no cointegration).

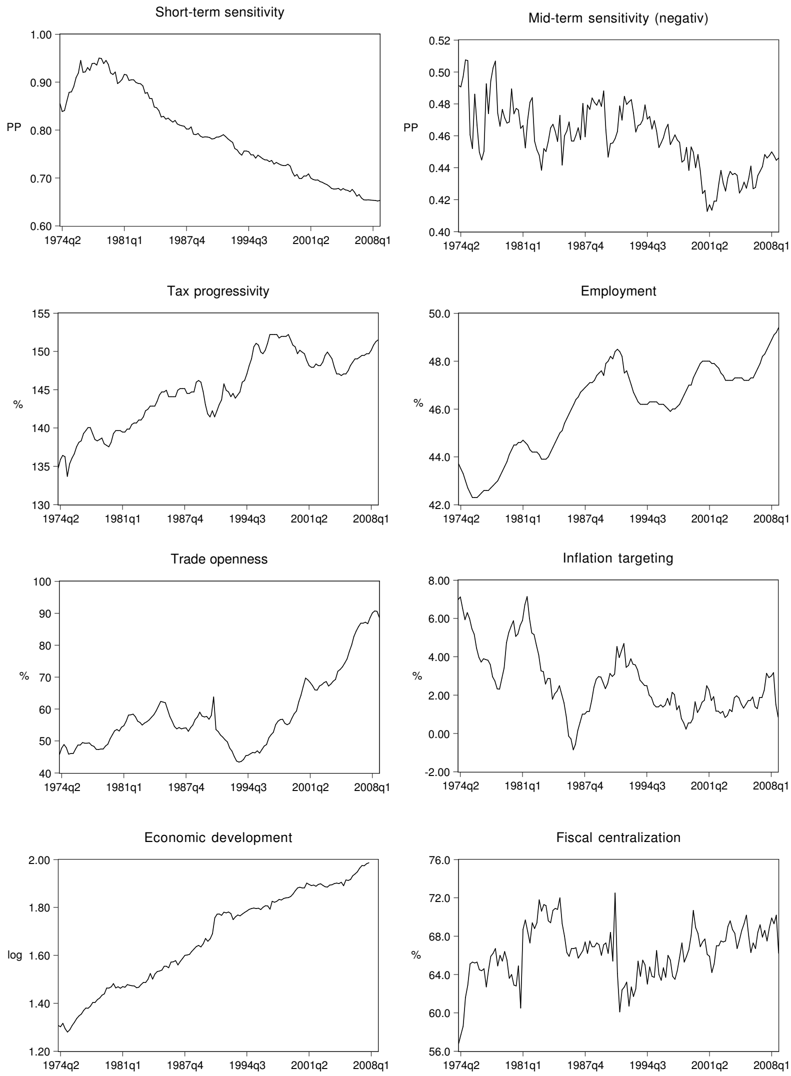

Figure 8: Fiscal responsiveness and driving forces, 1974:1 - 2008:4

for a robust long-run relation between the sensitivity of fiscal policy and trade openness. This evidence remains valid if we additionally control for the employment over population ratio and the inflation rate. Here, only the inflation rate is significant, but becomes insignificant whenever the degree of employment is excluded from the estimation. The results do not depend so much on the inclusion of the again insignificant tax progressivity. In general, the inclusion of insignificant variables strengthens the null of no cointegration.

5.4 Estimation results

Based on these cointegration findings our linear regression set-up includes at most the full set of $k = 6$ regressors captured in the $(1 \times k)$ vector X_t and loaded by the $(k \times 1)$ vector of the cointegrating coeffients into the equation for each period t. The model additionally employs an intercept and a level shift dummy in 1991Q1 due to the effects from German reunification. All deterministic terms are captured in D_t^{ir}. According to the Dynamic OLS (DOLS) approach, r leads and q lags of the cointegrating regressors in first differences are included to eliminate the feedback between the variables and to generate asymptotically efficient estimates. The following model is estimated,

$$ir_t^h = X_t' \beta_i^{ir} + D_t^{ir} \gamma + \sum_{j=-q}^{r} \Delta X_{t+j}' \delta + u_t. \tag{3}$$

Short-term responsiveness: The estimation results (see appendix C) indicate that the development of the employment ratio had the largest impact on the development of the short-run sensitivity, followed by the degree of openness and the inflation rate.

A one percentage point (pp) increase in the employment ratio significantly decreases the short-term sensitivity by 0.026 to 0.028 pp in the long run. As the employment ratio increased by almost seven percentage points over our sample, it has contributed the largest part, 0.18 to 0.20 pp. (between one-half and two-thirds), to explaining the total decline (0.31 pp) in the short-term sensitivity.

The degree of trade openness has a significant negative impact on the short-term responsiveness of the fiscal balance. Based on the regression specification that does not consider any insignificant core variables or controls, (see eq. (1b) and (3b) in appendix C), a one percentage point increase in openness leads to a decline in the sensitivity of between 0.001 and 0.002 pp. This supports the efficiency hypothesis and contradicts the compensation hypothesis. Given an increase in trade openness of around 50 pp between 1974 and 2008, changes in openness explain a decrease of around 0.05 to 0.10 pp in the total decline of the sensitivity of 0.31 pp (up to one third).

A stronger inflation targeting has a significant positive impact on the short-term sensitivity of the fiscal balance. A one percentage point increase in the inflation rate is related to an increase in the sensitivity measure of between 0.013 and 0.016 pp. This supports the hypotheses of a closed down debt-monetization channel or bracket creeping. Based on the moderating trend of inflation over our sample (from 7 percent at maximum to around 2 percent) price developments explain between rd. 0.07 pp points of the short-term sensitivity development.

The impact of fiscal centralization is significant and positive, but very small (0.005 pp). As this measure is stationary, it has no real long-run effect. German reunification in 1991 is found to decrease the sensitivity significantly, whereas tax progressivity and general economic development do not have significant long-run impacts on short-term fiscal policy responsiveness.

Medium-term responsiveness: For the – admittedly much smaller - decline in the medium-term sensitivity (two years after the shock) the development of trade openness seems to be particularly decisive. The efficiency hypothesis is also supported w.r.t. the medium-term reaction. A one percentage point increase in trade openness causes a significant decline of, on average, 0.001 pp in the medium-term fiscal responsiveness in all regressions.[40] The total 50 pp increase in openness contributes substantially with 0.05 pp to the rather small overall medium-term sensitivity decline of around 0.06 percentage points (more than 3/4 of the change).

In the augmented regressions only inflation targeting seems to have a significant long-run impact on sensitivity. However, this channel is significant only if we simultaneously control for the employment variable, which is insignificant with respect to the medium-term sensitivity. Therefore, these results have to be regarded with some caution.[41]The employment ratio and the degree of tax progressivity, as well as the controls for economic development and fiscal centralization do not have significant impacts on the medium-term responsiveness of German fiscal policy. The impact of German reunification negative, but insigficant in many specifications.

6 Conclusion

In this paper, we provide empirical evidence on the timing and the responsiveness of fiscal policy over the business cycle in Germany. Based on time-varying parameter models for quarterly data from 1970 to 2008 we are able to derive new insights on the short-, medium- and long-term cyclicality and on the responsiveness of fiscal policy, while taking into account changing reaction patterns.Moreover, we empirically study the economic driving forces behind the observed gradual evolvements in the reaction scheme of the fiscal stance.

When combining the output gap and the fiscal balance reactions on unanticipated economic activity shocks to analyze cyclicality, we find three distinct fiscal regimes: 1971–1979, 1980–1998 and 1999–2008. The first regime is characterized by increasingly countercyclical short-term reactions of fiscal policy. The second regime shows countercyclical short-term reactions, which are gradually decreasing in the short and gradually increasing in the medium term. The third regime is characterized by a decreasing countercyclicality in the short and an acyclical fiscal reaction in the medium term.

Using a dynamic time series framework enables us, to further distinguishing between the short-, medium- and long-term responsiveness of fiscal policy. We find that the short-term sensitivity of the fiscal balance (response half a year after a shock in economic activity) decreases from around 0.96 pp at the end of the 1970s to 0.65 pp at the end of the sample - a decline of nearly one third. The medium-term sensitivity (response two years after a shock) is substantially lower and decreases less pronounced - from around 0.50 pp to 0.44 pp over the sample horizon.

[40]Except in model (3d), which is obviously misspecified including only openness and the stationary centralization variable.

[41]In the specification without any other insignificant core variable or control than employment (see eq. (1b) in table D.2b), the impact of inflation targeting is estimated at 0.004 pp only significant at the 10 percent level. In this case, the overall moderation inflation would accounts for around 0.02 percentage points in the sensitivity decline.

What drives this time variation in the German fiscal policy reaction? We test several economic hypotheses related to the working of automatic stabilizers and to economic developments like increasing trade openness, inflation or fiscal centralization based on a cointegration approach.

We find that the time variation in the short-term sensitivity of fiscal policy is largely driven by developments in the employment ratio. There is statistical evidence for the general hypothesis that larger employment ratios come along with a lower reaction of public spending following shocks in economic activity - possibly because deficits of the unemployment insurance become less important relatively to the contributions paid. In addition, we find evidence for the efficiency hypothesis. According to this hypothesis an increasing degree of trade openness reduces the room for fiscal policy reactions due to an increasing competition between governments in the allocation of tax revenues. A small but significant impact stems as well from the inflation rate, with the observed decrease in the inflation rate leading to a less sensitive fiscal policy reaction. This could support the hypothesis that lower inflation restricts fiscal policy reactions to economic shocks by reducing the room for debt-monetization or by reducing the importance of bracket-creeping (cold progression).

Concerning the medium-term sensitivity of fiscal policy in Germany, we find that the trade openness channel plays by far the most important role. The increase in trade openness explains around 75 percent of the decline in the fiscal responsiveness. Once more, this supports the efficieny hypothesis.

Looking ahead, the study opens interesting avenues for future research. Fruitful issues would be to investigate the timing and responsiveness of the fiscal stance on a more disaggregated level, for example, with a focus on different tax revenue categories or expenditure items. Such analyses could derive additional information on the transmission mechanism of shocks in economic activity to public finances. Transferring our approach to other countries (EMU and non-EMU members) could help to compare changes between countries and analyze how the countercyclicality of the fiscal stance reaction differs across countries and, for example, whether it has diverged or converged before and after EMU.

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A Results of comprehensive estimation approach

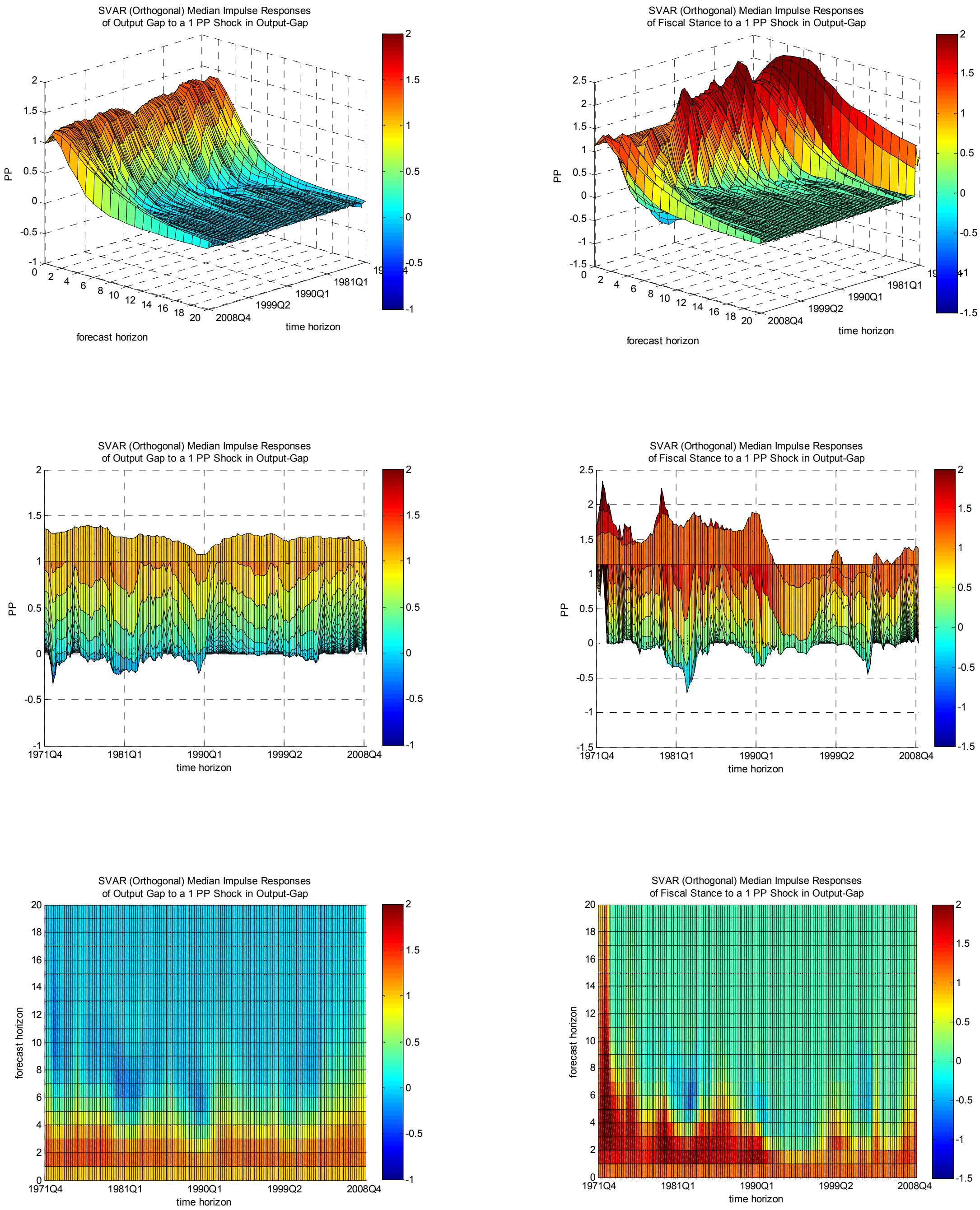

Figure A.1: Median impulse responses of the TVP SVAR (3D) (comprehensive)

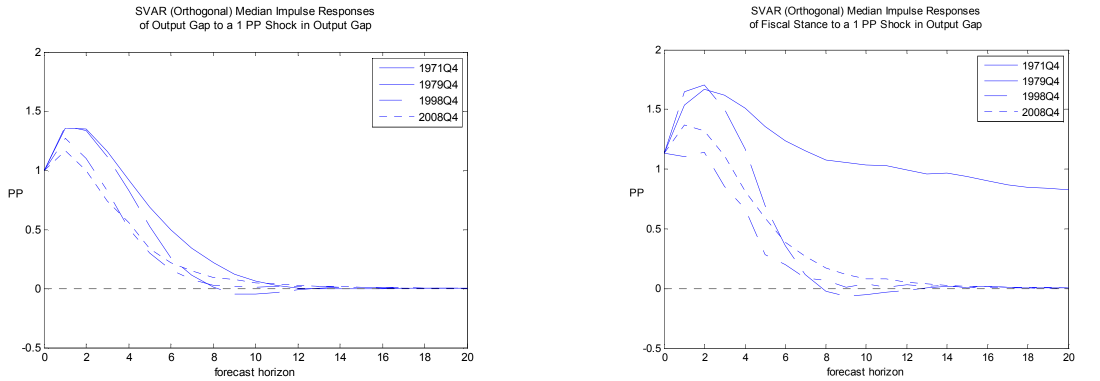

Figure A.2: Median impulse responses of the TVP SVAR (2D) (comprehensive)

B Additional plots of impulse responses

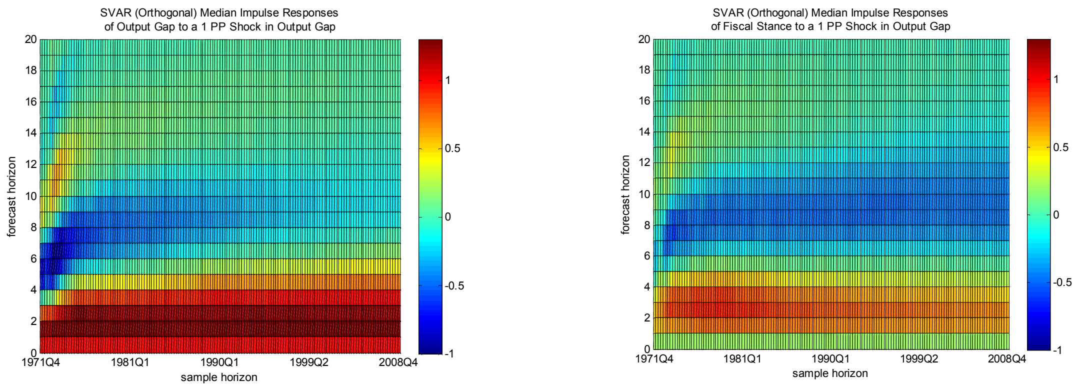

Figure B.1: Median impulse responses of the TVP SVAR (temperature plots)

C Driving forces: Time series properties and estimation results

Table D.1: Augmented Dickey Fuller (ADF) tests on unit roots [a, b, c, d]

Sample	**1974Q1 - 2008Q4**						
	Level						
Deterministic	Constant			Constant and trend			
Driving forces	ADF-statistic	c	lag	ADF-statistic	c	tr	lag
Short-term sensitivity	-0.35		3	-3.34 *	***	***	3
Mid-term sensitivity	-2.43	**	4	-3.07	***	**	4
Trade openness	0.83		0	-0.24			0
Employment	-1.21		2	-3.07	***	***	2
Inflation targeting	-2.65 *	*	4	-2.92	**		4
Tax progressivity	-1.69	*	1	-2.59	***	**	1
Economic development	-1.36	**	0	-1.49	*		0
Fiscal centralization	-4.21 ***		1	-4.10 ***	***		1
	First differences						
Deterministic	None			Constant			
Driving forces	ADF-statistic	none	lag	ADF-statistic	c		lag
Short-term sensitivity	-5.82 ***		2	-6.19 ***	**		2
Mid-term sensitivity	-12.95 ***		3	-12.92 ***			3
Trade openness	-5.98 ***		1	-9.56 ***	**		0
Employment	-3.21 ***		1	-3.38 **			1
Inflation targeting	-6.29 ***		3	-6.37 ***			3
Tax progressivity	-8.49 ***		0	-8.69 ***			0
Economic development	-9.28 ***		0	-10.84 ***	***		0
Fiscal centralization	-15.69 ***		0	-15.67 ***			0

[a] Lag length by Schwarz Information Criterion (SIC), max =13.

[b] Null hypothesis of a unit root. *, **, *** indicates rejection at the 10%, 5%, 1% level.

[c] The terms c and tr represent a constant and a linear trend. Here, *, **, *** indicate significance at the 10%, 5%, 1% level of significance.

[d] Short-term sensitivity refers to the impule response function at forecast horizon two. Mid-term sensitivity refers to the impulse response function at horizon eight, multiplied by minus 1 due to its original upward trend, to keep the sensitivity measure consistent.

Table D.2a: Driving forces of *short-term* fiscal policy sensitivity (Sample: 1974Q1 - 2008Q4) [a, b, c, d]

	Short-term sensitivity													
Driving forces	(1a)		**(1b)**		(2a)		(2b)		(3a)		**(3b)**		(4)	
Tax progressivity	-0.001				-0.001				-0.001				-0.001	
	(0.002)				(0.002)				(0.001)				(0.002)	
Employment	-0.025	***	**-0.026**	***	-0.028	***	-0.029	***	-0.027	***	**-0.028**	***	-0.026	***
	(0.004)		**(0.002)**		(0.006)		(0.008)		(0.003)		**(0.003)**		(0.006)	
Trade openness	-0.001	***	**-0.001**	***	-0.002	***	-0.002	***	-0.002	***	**-0.002**	***	-0.002	***
	(0.000)		**(0.000)**		(0.000)		(0.000)		(0.000)		**(0.000)**		(0.000)	
Inflation targeting	0.013	***	**0.013**	***	0.014	***	0.015	***	0.015	***	**0.016**	***	0.014	***
	(0.003)		**(0.002)**		(0.003)		(0.002)		(0.002)		**(0.002)**		(0.003)	
Controls														
Economic development					0.107		0.112						0.032	
					(0.147)		(0.164)						(0.116)	
Fiscal centralization[e]									0.005	***	**0.005**	***	0.004	***
									(0.001)		**(0.002)**		(0.001)	
Deterministic														
Constant	2.152	***	**2.074**	***	2.068	***	2.029	***	1.915	***	**1.818**	***	1.925	***
	(0.228)		**(0.108)**		(0.267)		(0.153)		(0.178)		**(0.102)**		(0.243)	
Reunification	-0.053	***	**-0.056**	***	-0.088	***	-0.090	**	-0.040	***	**-0.042**	***	-0.056	**
	(0.010)		**(0.006)**		(0.031)		(0.037)		(0.009)		**(0.007)**		(0.024)	
Stats and Diagnostics														
Observations	131		**131**		131		131		131		**131**		131	
Adjusted R²	0.98		**0.98**		0.98		0.98		0.98		**0.98**		0.99	
Durbin-Watson statistic	0.73		**0.57**		0.85		0.62		0.99		**0.83**		1.03	
Cointegration tests	*stat*	*p*	***stat***	***p***	*stat*	*p*	*stat*	*p*	*stat*	*p*	***stat***	***p***	*stat*	*p*
Phillips-Ouliaris														
tau	-5.217	0.008	**-4.923**	**0.007**	-5.784	0.004	-5.813	0.001	-5.234	0.018	**-4.992**	**0.015**	-5.797	0.009
z	*-34.511*	*0.052*	**-34.244**	**0.022**	*-34.745*	*0.104*	-34.892	0.049	*-34.629*	*0.106*	**-35.001**	**0.048**	*-34.771*	*0.185*
Engle-Granger														
tau	-5.055	0.012	**-4.681**	**0.014**	-5.852	0.003	-5.882	0.001	-5.080	0.027	**-4.784**	**0.026**	-5.861	0.007
z	*-27.808*	*0.159*	***-28.055***	***0.073***	*-29.148*	*0.232*	*-29.474*	*0.123*	*-28.281*	*0.259*	***-29.574***	***0.121***	*-29.454*	*0.349*

[a] Dependent variables are median impulse responses from the identified TVP-VAR half a year after the shock, measured in percentage points. Explanatory variables are measured in percent.

[b] Cointegration equations are estimated by Dynamic OLS (DOLS) with four leads and four lags (due to the quarterly frequency) of the differenced regressors to generate asymptotically efficient estimates and eliminate the endogeneity (long-run correlation) of the regressors. This shortens the available sample, 1974Q1 - 2008Q4, to an adjusted sample, 1975Q2 - 2007Q4. Estimates for the related nuisance parameters are not shown. To generate reliable long-run coefficient covariances (and the related standard deviations) we used the Newey-West covariance matrix estimator with non-prewhitened Bartlett kernel and a Newey-West fixed bandwidth of 5.000. Moreover, the long-run variance estimate is degree-of-freedom

[c] Standard deviations are reported in parentheses. Asterisks *,**,*** indicate significance at the 10%, 5%, 1% level.

[d] We refer single equation residual-based cointegration tests, the Phillips-Ouliaris and the Engle-Granger test. These tests differ in their method of accounting for serial correlation in the cointegration residuals. The first test uses the non-parametric approach based on Phillips-Perron (estimtating the long-run variance using a Bartlett kernel and a Newey-West fixed bandwidth of 5.00). The second test refers to a parametric augmented Dickey-Fuller (ADF) approach which is also used in the stationarity analyses (lag choice using Schwarz Information Criterion with max 12). Both tests have the null hypothesis that series are not cointegrated. Italic numbers indicate no cointegration even at the stronger 5% level.

[e] Fiscal centralization is a stationary variable.

Table D.2b: Driving forces of *mid-term* fiscal policy sensitivity (Sample: 1974Q1 - 2008Q4) [a, b, c, d]

	Mid-term sensitivity												
Driving forces	(1a)	**(1b)**	(1c)	**(1d)**	(2a)	**(2b)**	(2c)	(2d)	(3a)	**(3b)**	(3c)	*(3d)*	(4)
Tax progressivity	0.000				0.000				0.000				-0.001
	(0.001)				(0.001)				(0.002)				(0.023)
Employment	0.002	**0.001**			0.001	**0.001**			0.002	**0.001**			0.000
	(0.002)	**(0.003)**			(0.006)	**(0.006)**			(0.002)	**(0.003)**			(0.010)
Trade openness	-0.001 ***	**-0.001 *** **	-0.001 ***	**-0.001 *** **	-0.001 ***	**-0.001 *** **	-0.001 ***	-0.001 ***	-0.001 **	**-0.001 *** **	-0.001 ***	*-0.001*	-0.001 **
	(0.000)	**(0.000)**	(0.000)	**(0.000)**	(0.000)	**(0.000)**	(0.000)	(0.000)	(0.000)	**(0.000)**	(0.000)	*(0.000)*	(0.000)
Inflation targeting	0.004 *	**0.004 * **	0.001		0.004 *	**0.004 ** **	0.002		0.003	**0.003 * **	0.000		0.003
	(0.002)	**(0.002)**	(0.001)		(0.002)	**(0.002)**	(0.000)		(0.003)	**(0.002)**	(0.001)		(0.003)
Controls													
Economic development					0.014	**0.035**	0.035	0.023					0.079
					(0.105)	**(0.000)**	(0.000)	(0.033)					(0.099)
Fiscal centralization [e]									-0.001	**-0.001**	-0.002	*-0.003* **	-0.002
									(0.002)	**(0.001)**	(0.002)	*(0.001)*	(0.002)
Deterministic													
Constant	0.443 **	**0.478 *** **	0.520 ***	**0.520 *** **	0.415	**0.415 ** **	0.466 ***	0.491 ***	0.516 **	**0.529 *** **	0.627 ***	*0.686* ***	0.601 *
	(0.192)	**(0.115)**	(0.018)	**(0.015)**	(0.283)	**(0.017)**	(0.074)	(0.041)	(0.249)	**(0.139)**	(0.097)	*(0.083)*	(0.323)
Reunification	-0.003	**-0.002**	-0.012 ***	**-0.012 *** **	-0.008	**-0.016**	-0.022	-0.020 *	-0.005	**-0.005**	-0.016 ***	*-0.017* ***	-0.026
	(0.007)	**(0.006)**	(0.004)	**(0.004)**	(0.020)	**(0.022)**	(0.015)	(0.011)	(0.014)	**(0.008)**	(0.005)	*(0.005)*	(0.002)
Stats and Diagnostics													
Observations	131	**131**	131	**131**	131	**131**	131	131	131	**131**	131	*131*	131
Adjusted R^2	0.68	**0.62**	0.55	**0.49**	0.65	**0.63**	0.55	0.52	0.67	**0.61**	0.54	*0.51*	0.66
Durbin-Watson statistic	1.20	**0.99**	0.78	**0.70**	1.18	**1.02**	0.84	0.75	1.25	**0.98**	0.74	*0.71*	1.26
Cointegration tests	*stat p*	***stat p***	*stat p*	***stat p***	*stat p*	***stat p***	*stat p*	*stat p*	*stat p*	***stat p***	*stat p*	*stat p*	*stat p*
Phillips-Oularis													
tau	-5.608 0.002	**-5.575 0.001**	-5.181 0.001	**-5.015 0.000**	-5.462 0.009	**-5.380 0.005**	-5.337 0.002	-5.019 0.001	-5.936 0.002	**-5.773 0.001**	-5.646 0.001	*-5.615 0.000*	-5.934 0.006
z	-52.145 0.001	**-51.711 0.000**	-45.116 0.001	**-43.088 0.000**	-49.535 0.007	**-48.796 0.003**	-48.558 0.001	-43.432 0.001	-56.747 0.002	**-54.106 0.001**	-51.707 0.000	*-51.586 0.000*	-56.552 0.004
Engle-Granger													
tau	-5.564 0.003	**-5.523 0.001**	-5.186 0.001	**-5.014 0.000**	-5.444 0.010	**-5.347 0.005**	-5.306 0.002	-5.009 0.001	*-4.500 0.105*	***-4.490 0.054***	-4.394 0.029	*-5.615 0.000*	*-4.516 0.178*
z	-51.085 0.002	**-50.476 0.001**	-45.236 0.001	**-43.067 0.000**	-49.115 0.008	**-48.054 0.004**	-47.878 0.001	-43.231 0.001	-40.479 0.041	**-40.015 0.019**	-37.647 0.011	*-51.586 0.000*	*-40.535 0.081*

[a] Dependent variables are median impulse responses from the identified TVP-VAR two years after the shock, measured in percentage points and multiplied by -1 (due to consistency with short-term sensitivity measure). Explanatory variables are measured in percent.

[b] Cointegration equations are estimated by Dynamic OLS (DOLS) with four leads and four lags (due to the quarterly frequency) of the differenced regressors to generate asymptotically efficient estimates and eliminate the endogeneity (long-run correlation) of the regressors. This shortens the available sample, 1974Q1 - 2008Q4, to an adjusted sample, 1975Q2 - 2007Q4. Estimates for the related nuisance parameters are not shown. To generate reliable long-run coefficient covariances (and the related standard deviations) we used the Newey-West covariance matrix estimator with non-prewhitened Bartlett kernel and a Newey-West fixed bandwidth of 5.000. Moreover, the long-run variance estimate is degree-of-freedom adjusted.

[c] Standard deviations are reported in parentheses. Asterisks *,**,*** indicate significance at the 10%, 5%, 1% level.

[d] We refer single equation residual-based cointegration tests, the Phillips-Oularis and the Engle-Granger test. These tests differ in their method of accounting for serial correlation in the cointegration residuals. The first test uses the non-parametric approach based on Phillips-Perron (estimtating the long-run variance using a Bartlett kernel and a Newey-West fixed bandwidth of 5.00). The second test refers to a parametric augmented Dickey-Fuller (ADF) approach which is also used in the stationarity analyses (lag choice using Schwarz Information Criterion with max 12). Both tests have the null hypothesis that series are not cointegrated. Italic numbers indicate no cointegration even at the stronger 5% level.

[e] Fiscal centralization is a stationary variable.