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Output-volatility reducing effect of automatic stabilizers: Evidence from nine EMU member states

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Abstract

In this paper, we empirically explore the output-volatility reducing role of automatic stabilizers in nine EMU member states comprising Austria, Finland, France, Germany, Ireland, Italy, Portugal, the Netherlands, and Spain for the period 1995-2017. Overall, the empirical results obtained by using the Pooled Mean Group estimator proposed by Pesaran et al. (1999) suggest that automatic stabilizers deliver a significant counter-effect on output volatility measured by the real GDP per capita volatility in the short run. More specifically, output-volatility responses to automatic stabilizers by a reduction between -1.2 and -9.7 percentage points depending on the proxy measure used for automatic stabilizers. However, the automatic stabilizing impact from taxes and government spending is statistically insignificant in the long run. The results support the view that automatic stabilizers are an important fiscal mechanism for the short-run output stabilization, but their output-volatility offsetting role is largely subject to what the proxy measures are used for automatic stabilizers.

Keywords: Automatic stabilizers, fiscal policy, dynamic heterogeneous panels, PMG estimator, EMU member states.

JEL Classification: E31, E32, E62.

1. Introduction

Following the benchmarking study of Ramey and Ramey (1995) over the output-volatility–growth link, there has been a widespread agreement in the literature that high output volatility¹ hampers long-term output growth. Even though the available literature is still far from reaching a consensus, theoretically Aghion et al. (2010) and empirically Ramey and Ramey (1995) provided credible evidence that high levels of output volatility pose a significant risk on a country's long-run output growth. Hence, mitigating output volatility is a challenging priority especially for the countries that exposure to economic fluctuations. However, how to do this and/or whether can they be offset through fiscal policy is a highly controversial issue in the existing literature, despite the fact that stabilizing economic fluctuations, in a broader perspective, is one of the three basic Musgravian objectives—macroeconomic stabilization, re-distribution of income, and re-allocation of resources—assigned to fiscal policy.

No doubt, the 2008/09 global crisis hit many countries across the world. The case of EMU member states² was not exceptional from this. But the crisis hit some EMU member states countries more than the others. The crisis experiences of the EMU member states, in conjunction

¹ In the literature, the terms output volatility and the business cycle are used interchangeably. Throughout this paper, however, we prefer to use the term output volatility. This is because the term business cycle might be misleading since it suggests a more regular pattern of swings in economic activity than appears in the data.

² The EMU member states consist of 19 countries of current 28 European Union member states that have adopted the Euro (€) as legal tender: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, and Spain. Needless to say, the EMU member states represent the Eurozone, officially called the Euro area.

with the others, have rekindled discussions about how to stabilize output volatility that the countries face.

The key point of the discussions has been that whether fiscal policy shortens the amplitude of output fluctuations, especially in times when monetary policy cannot fulfill its task properly or its task disappears as in the case of the recent global crisis. In an economic environment in which monetary policy cannot fulfill its functions properly, fiscal policy in general, automatic stabilizers³ in particular, has received a renewed interest and centered on the discussions. Much different from the past, the post-EMU process has upgraded the role of fiscal policy as a macroeconomic policy tool in smoothing-out output shocks, especially demand-induced ones. Besides, in an economic and monetary union like the EMU in which members are most likely to encounter asymmetric shocks, the single monetary policy may not be sufficiently effective in absorbing shocks. Intrinsically, this assigns further responsibilities to fiscal policy in the EMU member states. However, the fiscal rules related to budget deficits and government debt adopted by the Maastricht Treaty and Stability and Growth Pact restrict the room for national discretionary fiscal policies. In such a case, the sole fiscal policy device from which member states utilize is the automatic stabilizers. This comes to mean that the pact forces implicitly the member countries to consider only the automatic stabilizers in their stabilization efforts. As is known, automatic stabilizers are the cyclically induced changes in taxes and government expenditures, which tend to dampen upward and downward swings in output (Veld et al., 2013). They are self-acting fiscal instruments that cannot be controlled by policymakers, at least in the short run, but changing over the economic cycle. They react symmetrically to the economic cycle and therefore have the potential of absorbing asymmetric shocks to output.

Increasing worry about the effectiveness of discretionary fiscal policy that is frequently associated with the inside lag problem has led to the emerging of increasing attention to the non-discretionary fiscal policy; that is, automatic stabilizers. One of the major superiority of automatic stabilizers over discretionary fiscal policy is their inside lag is to be zero. Perhaps due to this reality, what we see from the existing literature is that automatic stabilizers have received growing academic attention throughout the past decade as they had never before. So much so that it has been even argued in the era of the post-2008/09 global crisis that discretionary fiscal policy should leave its place to the automatic stabilizers even though there has been no consensus over its effectiveness and strength.

Against this backdrop, several questions bear in one's mind as such that in times when the room for monetary maneuvering is limited by interest rates which close to their zero lower bound, or when countries deliberately abandon independent monetary policies to join a currency union or adopt a fixed exchange rate, can fiscal policy be a unique tool for macroeconomic policy family to provide and maintain output stabilization? or how fluctuations in economic activity can be smoothed-out through the government's fiscal policy actions in the face of an ineffective monetary policy resulted from, say, extremely low or even negative interest rates? As part of the best macroeconomic policy implementations, actively using fiscal policy along with monetary policy in fighting downturns has become the focal point of discussions in the post-crisis period, albeit ineffectiveness of monetary policy alone. Related to fiscal policy, however, some other questions have also arisen in one's mind: is there any credible role for discretionary and/or non-discretionary fiscal policy? if so, what are their appropriate roles? Is discretionary or non-discretionary fiscal policy more effective in smoothing-out the volatility of output? Do automatic

³ In the literature, the terms "automatic stabilizers", "fiscal stabilizers", "built-in stabilizers", "automatic fiscal policy", "automatic fiscal stabilizers", and "economic stabilizers" are typically used interchangeably. Throughout the present paper, however, we prefer to use the first concept: "automatic stabilizers".

stabilizers properly fulfill their function? are they sufficiently enough in mitigating output volatility in bad times? do governments need discretionary fiscal action apart from automatic stabilizers?

This paper seeks to examine empirically the output-volatility reducing impact of automatic stabilizers in nine EMU countries (Austria, Finland, France, Germany, Ireland, Italy, Portugal, the Netherlands, and Spain) over the period 1995-2017. Put differently, the present paper endeavors to find an answer to the question of how the automatic stabilizers are effective in offsetting output volatility. Needless to say, whole member states are subject to a centralized monetary policy, but not a discretionary fiscal policy, since they adhere to the common economic policies of the EMU like other members. Nevertheless, we know that discretionary fiscal policymaking is somewhat restricted by the EMU through fiscal rules that were set out in the Maastricht criteria and then the Stability and Convergence Programs. Even so, it is an open question of how much these rules constrain the misuse of discretionary fiscal policy by the member states. Under such circumstances, focusing on the automatic stabilizers and giving a further role to them in output stabilization by expanding their capability become crucially important for these states to get the maximum benefit from the fiscal policy in the broadest sense.

Thanks to the stability programs of the EMU, the goal set out in points to the importance of having a budgetary position of close to zero deficits or in surplus for the member states and thereby implicitly expresses that the member states should have a budgetary position of close to zero deficits or in surplus by which automatic stabilizers should play an active role in economic cycles as well as smooth-out it counter-cycle manner. This leaves remarkable room for us to study the output-volatility dampening effect of the automatic stabilizers in the EMU member states above. However, there has been no clear-cut answer yet on how much output stabilization is delivered by the automatic stabilizers remains a mystery for both researchers and policymakers. As highlighted by Fatás and Mihov (2012), although the automatic stabilizers were widely seen as “doing their thing”, no one has questioned their role in reducing economic fluctuations till very recent decades.

This paper contributes to the existing literature over such connection in three main ways: First, most of the earlier empirical studies have concentrated on the linkage between automatic stabilizers and output volatility by using just one or two proxy measures—this is, either income tax or unemployment compensations, or both—for automatic stabilizers. Hence, it is obvious that by just considering one or two proxy measures, attempting to gauge the output-volatility reducing effect of automatic stabilizers may be neither satisfactory nor robust. Because the output-volatility reducing effect of automatic stabilizers may vary with how to measure automatic stabilizers. In this paper, therefore, we take the issue of automatic stabilizers from a broader perspective and then consider wide-ranging proxy measures of automatic stabilizers that are related to both revenue and expenditure sides of the government budget. Second, contrary to most available empirical studies that employ just one or two proxy variables for automatic stabilizers, we incorporate reasonably comprehensive control variables as specific channels through which automatic stabilizers are likely to affect output volatility. The inclusion of such variables to our estimation model would make more sense because automatic stabilizers may not be powerful enough to mitigate the volatility of output per se. By doing so, we seek to investigate the output-volatility reducing impact of automatic stabilizers based on a more generalized model that allows us avoiding misspecification which may bias the results.

The present paper also differs from previous literature in terms of its econometric model specification. We chose the Pooled Mean Group (PMG) estimation technique developed by

Pesaran et al. (1999) to estimate dynamic heterogeneous panel models. To our knowledge, it has not been used in any similar study until now. Related literature acknowledges that using a dynamic econometric specification is beneficial because it well-matches up with the theoretical predictions and provides alternative solutions for eliminating other models' shortcomings. Then, more accurate results can be acquired by utilizing from such econometric specification and thus the results can be used for appropriate macroeconomic policy suggestions.

The rest of the paper proceeds as follows. The next section first looks into theoretical arguments and then reviews the related literature on the effectiveness of automatic stabilizers. This is followed in Section 3 by the empirical analysis, while the empirical results are presented in Section 4. The final section, Section 5, concludes together with some policy recommendations.

2. Theoretical arguments and related literature

2.1. Theoretical arguments

Automatic stabilizers have received interest to some extent in academic circles since the mid-1940s. Even so, they have remained a disinterested fiscal-policy topic throughout the following decades in a quite long time. Indeed, reviewing the extant literature in detail, one can easily realize that there have been few studies on the automatic stabilizers almost by the 1990s. This lack of interest in the automatic stabilizers may in part be explained by the view that fiscal policy is not an appreciate instrument of macroeconomic-policy family in general, the automatic stabilizers are not a suitable way of fiscal policy implementations in particular, and in part be explained by difficulties in both measurement and econometric estimation procedure related to automatic stabilizer. Nonetheless, what we see from the existing literature is that there has been an increasingly growing interest in automatic stabilizers starting especially from 2000 onwards.

In general, fiscal policy is made up of two main parts: discretionary fiscal policy and non-discretionary fiscal policy. Automatic stabilizers represent the latter. They are the fiscal mechanism that is widely regarded as the automatic-stability ensuring powers—or forces.⁴ They are built into the government budgetary system in various forms of taxes, particularly income taxes, and transfer payments and welfare programs (e.g. unemployment compensations, social farm price supports, and family and corporate savings) that automatically offset output volatility by stimulating the economic activity during recession times and moderating during boom times. Automatic stabilizers, in a sense, undertake a regulatory function in the economy and ensure “a prompter and self-correcting fiscal response” (Baunsgaard and Symansky, 2009: 4) against the cyclical swings in the economic activity without any deliberate government action or case-by-case government involvement. They provide a faster decision-making process, less uncertainty for not only households but also business environment (Göndör, 2012), and a shield against government interventions in addition to the advantages of speed, predictability, reversibility, and operating even in an environment where fiscal institutions are weak (Jha et al., 2014).

⁴ Though there is no a commonly agreed-upon definition of automatic stabilizers in the literature, it is possible to provide alternative definitions for automatic stabilizers. For example, McKay and Reis (2016: 141) define (automatic) fiscal stabilizers as “... the rules in the law that make fiscal revenues and outlays relative to total income change with the business cycle”. Martner (2000: 32) describes them as “... those types of public income and expenditure which are directly linked with the economic cycle”. Tödter and Scharnagl (2004: 1) use the definition of “cyclically induced changes in taxes and government expenditures which tend to stabilize aggregate output ...” for the automatic stabilizers. However, in the literature, to the best of our knowledge, a widely cited definition belongs to Auerbach and Feenberg (2000: 37) who interpret automatic (fiscal) stabilizers as “... those elements of fiscal policy that tend to mitigate output fluctuations without any explicit government action”.

Also, Tam and Kirkham (2001) make the point that automatic stabilizers have some additional merits, which may be itemized as follows. First, they act more rapidly than other alternative stabilization instruments. Second, they, in contrast to the discretionary fiscal policy, do not induce the inside lag problem. Third, they play a buffer role against potential job losses by insuring unemployed individuals.

Indeed, as an integral part of fiscal policy, automatic stabilizers have the potential to stabilize output volatility without involving any discretionary fiscal policy action by the government. They kick-in when a shock gives rise to aggregate economic activity to decrease or increase (Auerbach and Hassett, 2002). As automatic budgetary devices, they show a self-functioning reaction to economic fluctuations. Provided that they are properly designed and the fiscal sustainability is preserved through prudent fiscal positions and low government debt, they “provide timely and symmetrical adjustments which cushion cyclical fluctuations” (ECB, 2002: 33).

Automatic stabilizers contain those components of the government budget that acts to offset the economic cycles through automatic changes in taxes and government spending. In the related literature, income tax with progressive structure is widely viewed as the most important automatic stabilizer. Such a tax offsets the multiplier effect of economic shocks, especially demand-induced ones, via marginal taxation of income fluctuations. Notably, a progressive personal income tax with high marginal tax rates has a strong potential in reducing output volatility in after-tax income and private consumption without necessitating any explicit discretionary policy changes.⁵

However, it is important to acknowledge that from a broader perspective, aside from progressive personal income tax, the subsequent budgetary items are also commonly regarded as potential automatic stabilizers: i) corporate income tax; ii) indirect taxes (notably VAT); iii) unemployment compensations, and; iv) social security contributions.⁶ This hints to the fact that they may vary substantially from country to country, depending on individual country circumstances and conditions (the structural and political characteristics, budgetary system, and the like). For instance, a recent study by McKay and Reis (2016) list automatic stabilizers for the US as progressive income taxes (personal income taxes), proportional taxes (corporate income taxes, property taxes, sales, and excise taxes) on the revenue side of the government budget, unemployment benefits and safety-net programs (supplemental nutrition assistance, family assistance programs, security income to disabled, and others) on the expenditure side. It is noteworthy mentioning here that the present paper looks at automatic stabilizers from the broadest perspective and thus examines the automatic output-volatility stabilizing impact from taxes and government spending at the disaggregated level.

It is expected, at least theoretically, from these budgetary items that they must counteract output volatility and thereby mitigating up and down swings in output level. How changes in each of these budgetary items perform as automatic stabilizers critically depend on how they react against the changes in the economy’s output level. Put it differently, the extent to which the changes in budgetary items play a countercyclical role depends very much on how well they are synchronized with the economic cycle (IMF, 2008: 161). To understand this, one should look at either the elasticity of the automatic stabilizers in conjunction with their size as regards output (see Cottarelli and Fedelino, 2010). In practice, however, just a few of them—two of them are progressive personal income tax and unemployment insurance—fully performs their functions as automatic stabilizers. The personal income tax is the leading automatic stabilizer insofar as it has some additional supportive features, as we pointed out a bit earlier. Pechman (2018) explains the

⁵ See Auerbach and Feenberg (2000), and Auerbach and Hassett (2002) for a further discussion.

⁶ See, *inter alia*, Fatás and Mihov (2001), Meyermans (2002), McKay and Reis (2016) for different considerations.

automatic-stabilizer feature of the personal income tax with the progressive structure with the following words: “When incomes fall, some people who were formerly taxable drop below the taxable level; others are pushed into lower tax brackets. When incomes rise, more people become taxable and others move into higher tax brackets. The result is that the yield of the individual income tax rises and falls more than in proportion to changes in income. Since consumption depends to a considerable extent on disposable personal income, automatic changes in individual income tax liabilities keep consumption more stable than it otherwise would be” (p. 1146). On the expenditure side, however, the key automatic stabilizer is unemployment compensation. Unemployment payments help maintains consumption smoothly as output and employment fall in the economy. In Pechman’s (2018) words, “[a]s incomes go up and employment increases, unemployment compensation declines” (p. 1146).

The extent and role of the automatic stabilizers are effective in offsetting output volatility is a matter of concern for researchers and policymakers alike. To diagnose this, one should take a closer look at the following two things that are closely linked to each other: disposable income and household consumption. A change in cyclically sensitive government expenditures, for instance, unemployment benefit schemes and/or taxes, affect spending in the economy mostly through its impact on disposable income and hence household consumption (OECD, 1999). For that reason, to make a proper assessment of the effectiveness of the automatic stabilizers, one should consider that the extent to which increases in disposable income and private consumption stem from automatic stabilizers. Then, the extent to which increases in private consumption in response to the automatic stabilizer-driven increases in the households’ disposable income. So indeed, the automatic stabilizers can dampen volatility in economic activity in the short run on condition that they pose an influence on consumption and the disposable income of households through their components, including taxes and unemployment benefits.⁷ On this point, Veld et al. (2013) argue that the stabilizing power of the automatic stabilizers on consumption relies largely on the share of liquidity- and credit-constrained households. To the authors, if the aforesaid share drive consumption spending up, the smoothing-out effect of the automatic stabilizers will also be stronger.

The degree of the effectiveness of automatic stabilizers effective depends on various factors. The factors include, amongst others, the progressivity of the tax system and its progressiveness degree⁸, the generosity of unemployment benefit systems and the sensitivity of unemployment to output volatility, the nature of the shocks the economy faced (demand- vs. supply-side and/or temporary vs. permanent). In the literature, there is a well-established evidence that the effectiveness of the automatic stabilizers tends to co-move with the government size (see, inter alia, OECD (1993), van den Noord, 2000; Fatás and Mihov, 2001; Brunila et al., 2003; Blanchard et al., 2010; Debrun and Kapoor, 2010). Namely, the bigger size of the government sector means the larger size of automatic stabilizers. However, as firmly emphasized by IMF (2008), one should keep in mind that larger size of government may harm economic growth in the long run and thus create a conflict between output stability and economic efficiency. To avoid such a problem, for example, fiscal policymakers can concentrate very much on better design of automatic stabilizers rather than trying to make bigger their size in enhancing the effectiveness of automatic stabilizers.

⁷ See OECD (1999), Auerbach and Feenberg (2000), and Veld et al. (2013) for a more in-depth discussion.

⁸ More generally, the structure of the tax system affects the size and therefore the power of automatic stabilizers. A number of other tax system-related factors such as the share of progressive taxes within total tax revenue, the size of tax avoidance and evasion, the form of tax collection (with withholding or with return?), the size of informal economy, the coverage and size of tax expenditures, etc. influences the size as well as the power of the automatic stabilizers.

As will be explained in detail in the subsequent subsection, the types and features of shocks experienced by the country influence the government budget and thereby the magnitude of the automatic stabilizers. In the existing literature, there is also a widely held view that if a shock to output is only the demand-side and temporary, automatic stabilizers may just give an anticipatory response to these shocks (Brunila et al., 2003).⁹ To overcome permanent supply-side shocks through automatic stabilizers, for example, is highly unlikely since it “requires adjustment to the new equilibrium rather than output stabilization” (Veld et al., 2013: 155). Furthermore, a range of country-specific considerations including the degree of trade openness, the flexibility of domestic markets (including labor, product, and financial markets) also influences the effectiveness of the automatic stabilizers.

2.2. Related literature

In an early study, Romer and Romer (1994) examined the relative effectiveness of monetary and fiscal policies in ending eight U.S. post-war recessions and found that the discretionary fiscal policies have a weak impact in getting the US economy out from downturns. The authors documented that contrary to the discretionary fiscal policy, which has several shortcomings including fiscal lags, ineffectiveness, crowding-out effect, inflexibility, distortions of interventions and so forth, automatic stabilizers produce a significant stabilizing effect in all recovery cases in terms of the magnitude, timing, and consistency. Likewise, Cohen and Follette (2000) provided evidence in favor of automatic stabilizers for the same country. The former paper showed that automatic stabilizers play a modest role in dampening the short-run effect of demand-side shocks on GDP growth. However, they noted that in the presence of adverse supply shock, e.g. an oil-price shock, the effectiveness of the automatic stabilizers substantially weakens. Further to that, the authors argued that such shocks push both real output and prices in opposite directions, resulting in zero automatic stabilization. The authors concluded that automatic stabilizers are “quietly and modestly doing their thing” (Cohen and Follette, 2000: 60). Somewhat differently, Auerbach and Feenberg (2000) argued that tax-based automatic stabilizers can be more beneficial especially in times of having difficulties in conducting counter-cyclical fiscal policy.

Further evidence by OECD (1999) showed that the automatic stabilizers provide a fall in output volatility by a range of 25-33% in the US and France, 50% in the Netherlands, and 33% for New Zealand, respectively. OECD’s (1999) study concluded that the positive effects of the automatic stabilizers on output volatility in recession times are larger in relation to those of discretionary fiscal policy, but their effects are somewhat smaller compared to those of monetary policy.

A well-known paper by Fatás and Mihov (2001) argued that the larger the size of government the greater the non-discretionary fiscal policy response in support of economic activity in a downturn, resulting in lower output volatility. Using data from 20 OECD countries and some US states, the authors also documented the existence of a strong and robust adverse correlation between government size (a widely used proxy for automatic stabilizers and measured as the average share of government spending in GDP) and output volatility (measured as the standard deviation of GDP growth). Based on their findings, the authors drew attention to the moderating effect of automatic stabilizers on output volatility by providing evidence of a strong negative correlation between the size of government and output volatility for whole the sample countries they considered. More specifically, according to the authors’ findings, a one percentage-point increase in the size of automatic stabilizers dampens output volatility by eight basis points in the

⁹ However, it is worth noting here that in practice it is not easy to identify the shocks whether they originate from demand- or supply-side and/or whether they are temporary or permanent.

OECD countries. In the US, on the other hand, the fall in the volatility is significantly larger. Veld et al. (2013) attribute this to the fact that some government expenditures like wages and transfer payments are not dropped in bad times, but are raised in good times. By the same token, a recent IMF (2015) study demonstrated that automatic stabilizers are more effective in dampening output volatility in advanced countries compared to developing ones.

Reviewing the current literature thoroughly, what we see is that a sizeable body of the literature on the effectiveness of automatic stabilizers considers the issue in the EU-wide context under various macroeconomic calibration models. These models have been built on both micro and macro data.¹⁰ However, differently from what we use in our study, these studies are characterized by a largely employed estimation technique; that is the simulation method. Put clearly, virtually all the studies that attempt to gauge the effectiveness of the automatic stabilizers European countries' context use the simulation method. A case point is Meyermans (2002). The author examined the effect of the automatic stabilizers on output volatility in the euro area and found that the automatic stabilizing impact is not sufficiently robust. However, the author underscored the fact that automatic stabilizers contribute to postponing full adjustment. Similar to Meyermans (2002), Veld et al. (2013) investigated the effectiveness of the automatic stabilizers in the euro area context and found that the automatic stabilizers eliminate 13% of the reduction in GDP by comparison with a benchmark budget with fixed levels of revenues and expenditure. The authors concluded that the output-smoothing effect of the automatic stabilizers crucially depends on how the counterfactual budget—that is, the budget without the automatic stabilizers—is defined.

Barrell and Pina (2003) studied the effectiveness of the automatic stabilizers in ten Eurozone economies¹¹ and revealed that the automatic stabilizers reduce output volatility only by about 11% when the sample countries are considered as a whole. Based upon their findings, the authors contended that stabilizers work through disposable income and that they are most effective in the presence of demand-side shocks, and in particular to private consumption. However, they drew attention to the fact that supply-side shocks impede the effectiveness of the automatic stabilizers. Further to Barrell and Pina (2003), an overlapping study by Brunila et al. (2003) took the view that the automatic stabilizers are relatively powerful in the event of shocks to private consumption, while their power weakens in the case of shocks to private investment and exports. Overall, the authors made a stronger claim, insisting that automatic stabilizers tend to be largely ineffective in the case of supply-side shocks.

A different study than the reviewed studies just above comes from Cuaresma et al. (2011). In their panel study on the EU countries, the authors re-assessed the output-smoothing impact of the automatic stabilizers by using two alternative models. Accordingly, the linear model yields highly mixed results. The basic OLS results indicate that automatic stabilizers reduce the amplitude of business cycle fluctuations. However, this effect became insignificant when accounting for potential endogeneity of government size. Contrary to the linear model, the results of the non-linear model setting reflect a smoothing-out effect on business cycle volatility for lower levels of government size. But this effect tends to revert to high levels in countries encountered in higher rates of government expenditure.

¹⁰ Aside from the study by Doll et al. (2012), all the other studies on European countries we review in the present paper overwhelmingly use macro data for simulations. In the case of the US, Auerbach and Feenberg (2000) implement micro data for simulations.

¹¹ These countries: Germany, France, Italy, the Netherlands, Belgium, Spain, Portugal, Austria, Ireland, and Finland.

A comparative study by Dolls et al. (2012) examined the effectiveness of income taxes and transfer systems in the EU and US. The study found evidence that the size of automatic stabilization depends to a large extent on the types of shocks experienced by the economy. Further to that, the authors argued that there is no homogeneity across the EU members in terms of shock absorption capacity of the automatic stabilizers, varying from one country to another. For instance, according to the results of the study, the effectiveness of the automatic stabilizers in Eastern and Southern European countries in relation to Continental and Northern European countries is substantially smaller. Based on their empirical findings, the authors' comparative study concluded that social transfers, particularly transfers to the jobless people rather than generous systems of unemployment insurance, in the case of Europe play a crucial role in aggregate-demand stabilization.

In examining the effectiveness of the automatic stabilizers, opting for appropriate proxy measures for automatic stabilizers is another key point that should not be ignored. However, the existing literature does not provide convincing evidence concerning budgetary items place in which side of the government budget is more appropriate in automatically mitigating the volatility of output. For instance, van den Noord (2000) and Fatás and Mihov (2001) put forward that the expenditure side of the government budget is more effective than its revenue side in offsetting output volatility. European Commission (2002), by contrast, puts forward that the revenue side of the government budget is more effective in stabilizing output volatility. On this matter, Karras and Song (1996) noted that larger size of automatic stabilizers is not necessarily preferable since larger size correspondence to higher tax burden or an overly generous benefits system, both with potentially large deadweight costs.

Among empirical studies, some other studies, such as Brunila et al. (2003), Tödter and Scharnagl (2004), and Dolls et al. (2012), drew attention to the importance of that a timely counter-cyclical response of fiscal policy to demand-side shocks plays a crucial role in offsetting output volatility. For Germany, for instance, Tödter and Scharnagl (2004) presented evidence that the automatic stabilizers absorb approximately 15-20% of an exogenous demand shock. If the shocks stem from supply-side factors, however, not only the automatic stabilizers but also discretionary fiscal policy would not be an effective policy tool.¹²

Taken together, we can safely argue that the existing literature is highly far from providing a clear-cut consensus on neither the nature, nor size, and effectiveness of the automatic stabilizers. Several factors explain this, including differences in estimation method (methodology, sample selection, analytical tools, and the like), proxy measures used for automatic stabilizers, and some country-specific properties (the overall size of the government, trade-openness degree, the structure of tax system, the generosity of unemployment benefit schemes, availability of strong institutional and political systems, and so on).¹³ This is to say that the size of the automatic stabilizers and their effectiveness varies with not only methodological issues but also the structural and political characteristics of the country and its economy under consideration.

More importantly, as also argued just before, types of economic shocks experienced by the economy (e.g. demand-side shocks vs. supply-side shocks and/or permanent shocks vs. transitory shocks) influence the magnitude of automatic stabilizers in a considerable degree. Aside from all these, the definition and coverage of automatic stabilizers should not be ignored as well. They

¹² There are several factors that are unfavorable to discretionary fiscal policy. These are, among many others, fiscal lags, political interference, irreversibility, inflexibility, crowding out effect, practical problems in measuring and forecasting the state of the economy, difficulties in determining how much fiscal stimulus or austerity is needed at any particular point in time, institutional constraints restricting timely use of fiscal policy, triggering unnecessary volatility and therefore harming long-term growth.

¹³ See OECD (1993, 1999), Fatás and Mihov (2001), and Veld et al. (2013) for more detailed information.

also affect both the size and effectiveness of automatic stabilizers. Succinctly, the estimated size and effectiveness of automatic stabilizers tend to vary with the understanding of the notion of the automatic stabilizers.

3. Econometric analysis

3.1. Model specification

As outlined in previous sections, automatic stabilizers are one of the premier factors that are effective in reducing output volatility, albeit at the theoretical level. Both the revenue and expenditure sides of the government budget are two principal proxies for automatic stabilizers. Following leading studies available in the literature on automatic stabilizers, including Galí (1994), Fatás and Mihov (2001), Galí and Perotti (2003), IMF (2008), Cottarelli and Fedelino (2010), and Debrun and Kapoor (2010), we recognize the government size as the major proxy for automatic stabilizers in the present paper. In all these studies, it is safely argued that government size is positively related to automatic stabilizers while they are negatively associated with output volatility. This implies that the larger the government size the less output volatility. At least theoretically, the expectation from the automatic stabilizers is that they should be tighter during upturns and looser during downturns. This implies that effective automatic stabilizers would mitigate the amplitude of output volatility, especially those which originate from demand-side shocks. For that reason, the expected sign of coefficients on automatic stabilizers—measured by real GDP per capita growth volatility in the present paper—would be negative.

As somewhat different from the relevant studies, such as Debrun and Kapoor (2010), Cottarelli and Fedelino (2010) and Munir and Riaz (2019), we establish our multivariate model with a set of potential control variables that are explained in detail in data sub-section. By doing so, we propose to isolate the possible effects of these variables from an automatic stabilizer on output volatility. Put briefly, to estimate empirically the output-volatility reducing effects of automatic stabilizers, we set up our model in the following equation form:

$$y_{it} = \beta_0 + \beta_1 AS_{it} + \beta_2 Z_{it} + \beta_3 U_i + e_{it} \quad (1)$$

where y_{it} is the dependent variable (real GDP per capita growth volatility as the proxy of output volatility), AS_{it} is the automatic stabilizers proxied¹⁴ by government size and measured by using 12 alternative measures, each of which can be an automatic stabilizer insofar as they show sensitivity with respect to changes in output. Z_{it} is a set of control variables, U_i is the fixed- or automatic stabilizers-effect term, and e_{it} is the error term.

3.2. Dataset

To investigate the output-volatility reducing effect of automatic stabilizers, this paper utilizes the PMG estimation method of Pesaran et al. (1999). On the basis of available data, the states in the sample are nine EMU member states covering Austria, Finland, France, Germany, Ireland, Italy, Portugal, the Netherlands, and Spain. We work with annual data and the study period

¹⁴ It is important to note that as emphasized earlier, there is no clear-cut consensus in the literature on either type of automatic stabilizers and/or their potential effectiveness. Some researchers argue that the smoothing-out effect of automatic stabilizers arise from the cyclical sensitivity of government revenue whereas others associate them with government expenditure. Some others recognize progressive personal income tax and unemployment benefits as the unique representatives of automatic stabilizers. Owing to all these reasons, we consider nearly all options as automatic stabilizer indicators.

ranges from 1995 to 2017. The lack of sufficient harmonized data obligates us to study with only the above-mentioned states for the chosen period.

Unlike most of the previous studies that analyze the effectiveness of automatic stabilizers by employing aggregate data, in this paper, we study with disaggregated data. Studying with the disaggregated data allows us to look at the issue from a broader perspective. Against this backdrop, we consider the followings that are in both the revenue and expenditure sides of the government budget as the potential proxy measures for automatic stabilizers: total tax revenue (TR), taxes on goods and services (TOGS), social security contributions (SSC), taxes on income, profits and capital gains of individuals (TIPCG), taxes on income, profits and capital gains of corporates (TIPCGC), health expenditures (HE), education expenditures (EE), social protection expenditures (SP), incapacity expenditures (IE), pension expenditures (PE), unemployment payments (UP), and family benefits (FB).

On the other hand, as explained in the model section, we incorporate six control variables to our estimation model represented in Eq. (1) by Z_{it} . The inclusion of the control variables to the model helps us reduce the misspecification problem. In establishing control variables that are associated with output volatility, we draw on the existing literature. In line with the literature, our control variables are terms of trade volatility (ToTV), household final consumption volatility (HFCV), total investment volatility (TIV), unemployment rate (UR), GDP deflator inflation (DEF), and total credit to the private non-financial sector (TCNFS).

In this connection, we begin by the trade openness variable. The literature generally put trade openness to first place in explaining the drivers of output volatility (see, e.g., Rodrik, 1997; ILO, 2004). Trade openness is widely measured as the ratio of the total value of exported- plus imported goods and services to GDP in terms of a certain currency unit. The current theoretical literature provides two different views about trade openness–output volatility nexus. The first view suggests that output volatility is the consequential effects of exposure to international markets. According to this view, increased international trade produces considerable volatility in output. Namely, more trade openness exposes a country to more output volatility because more open economies are likely to come across higher shock incidence and thus more vulnerable to economic shocks. The second view argues that countries with higher trade openness are probable to less prone to output volatility partly due to the increased sectorial/intra-industry specialization that can boosts trade volume and therefore reduces output volatility. Following the available theoretical and empirical discussions that produce somewhat ambiguous evidence as regards the relationship between the trade openness and output volatility, we posit that trade openness may affect output volatility either negatively or positively, depending on the sectoral and foreign trade structure of the country under scrutiny.¹⁵

The second control variable that we take into account in explaining the determinants of output volatility is inflation. As in the former variable, available literature offers conflicting explanations concerning the relationship between inflation volatility and output volatility. Using US data, for instance, Blanchard and Simon (2001) provided evidence of a strong correlation not only between output volatility and inflation level but also between movements in output volatility and movements in inflation volatility. On the contrary, Fountas et al. (2002) used data from Japan and found some evidence that higher inflation is associated with lower output and output volatility. Referencing this evidence and some others in the same line, we assume that inflation or inflation volatility may either positively or negatively affect output volatility, depending on several factors,

¹⁵ For the detailed theoretical and empirical discussions on the connection of trade openness with output volatility, see Razin and Rose (1992), Krugman (1993), Easterly et al. (2001), Kose et al. (2003), Bejan (2004), Down (2007), and Haddad et al. (2013).

including low vs. high inflation, period (short vs. long run). Thus, the expected sign of it could be positive or negative. For the measurement of inflation, we consider a broader price index concept—that is, the GDP deflator. This is because the GDP deflator measures the average price of the final good and services produced in the economy and gives an idea regarding the effect of inflation on a nation's output.

The subsequent third and fourth control variables used in our estimation model are consumption and investment spending. In parallel to the available literature, we consider volatilities in both consumption and investment spending as two other major drivers of output volatility. As is very well known, consumers' consumption decision is largely determined by their perception about whether swings in current income are permanent or transitory. If they surmise that swings in current income are temporary, then they will tend to raise their consumption. Otherwise, they reduce. Almost the same things could be said for the firms' investment decisions. If they perceive that current swings in their sales are transitory, they will tend to enhance their investment. If it is permanent, they will tend to reduce their investment. Speaking in general terms, consumption, and investment spending exhibit a parallel co-movement in an economy. For example, in bad times, both decrease or in good times, both increase. There may be several reasons for this. But, the chief reason is that the drivers of both variables are almost the same. However, investment differs from consumption in that it reflects a more volatile pattern than consumption. Despite this reality, investment accounts for a relatively smaller part of GDP than that of consumption. On balance, we can argue that both variables have equally important in explaining output volatility. Based on the explanations above, we posit that volatility both in consumption (proxied by household final consumption) and investment spending (proxied by total investment) co-move with volatility in output in the same direction.

The unemployment rate is another key driver of output volatility. Traditionally, the macroeconomics literature explains the nexus between the unemployment rate and output volatility on the ground of Okun's law. The law states that a decrease of 3 percent in GDP leads to an increase in the unemployment rate by a one percentage-point. In addition to what Okun argues, intuition suggests that there is a bidirectional causal relationship between unemployment and output volatility. Accordingly, unemployment can affect output volatility or vice versa. So, it can be safely claimed that higher unemployment rates produce larger volatility in output.

An increasing number of studies assign a significant role in financial development in output or output volatility. For instance, it has been extensively argued in the literature since the 1970s that financial sector development provides increased savings along with capital accumulation and thereby higher output. Similarly, more and more recent endogenous growth models consider financial sector development as an important ingredient of a nation's output (see, in particular, Benhabib and Spiegel, 1994; Greenwood and Smith, 1997; Amable and Chatelain, 2001; Akimov et al., 2009; among many others). All these studies underline the role of financial sector development in output enhancing via a number of ways, such as raising savings, stimulating investment, reducing the cost of external finance, increasing efficiency of capital allocation, and ensure more productive technological choices, and so on. In this paper, we regard the ratio of domestic credit to the non-financial private sector as a proxy for the financial sector development following the same line with the literature. Considering the arguments above, we assume that total credit to the private non-financial sector to GDP moves in parallel with output volatility.

The terms of trade volatility variable is the final control variable that we considered as one of the potential drivers of output volatility. Generally speaking, changes in the terms of trade influence output to the extent that they alter the volume of imports that can be purchased for a given volume of exports and thereby the real domestic income of the economy (Andrews and Rees, 2009). However, it is worth noting that the transmission of terms of trade shocks to the whole economy may differ from one country to another depending on country-specific factors, including exchange rate regime, the stance of monetary policy, labor-sector rigidity or flexibility, degree of financial sector development. Especially those countries with higher openness degree to international trade are very probable to be vulnerable to terms of trade shocks. This is because terms of trade shocks, first and foremost, influence the tradable sector of the economy (Beck et al., 2006). Briefly, we expect that terms of trade shocks negatively affect output volatility.

All data we employed collected from international resources. Data on all the proxy variables used for automatic stabilizers are gathered from the OECD's global revenue statistics database, except the data on education and health expenditures that are compelled from the Eurostat database. Data on real GDP per capita growth volatility¹⁶—that is, the proxy measure we used for output volatility—and the control variables come from the IMF database. The descriptions and sources of the variables we used are listed in detail in Table A1 in the Appendix. By the way, all these variables are expressed as a ratio of GDP and taken in logarithm.

The summary statistics of the series tabulated in Table A2 in the Appendix suggest that the highest output volatility, on average, is observed in Ireland, confirming that this country is the largest one within the sample states in terms of output volatility. However, on average, France and Austria have less output volatility within the sample states.

When total tax revenue (TR), taxes on goods and services (TOGS), social security contributions (SSC), taxes on income profits a capital gains individuals (TIPCG), and taxes on income profits and capital gains of corporates (TIPCGC) are considered, the highest averages are recorded in the sample countries France, Finland, France, Finland, and the Netherlands, respectively. When it comes to the government expenditures (covering health expenditures (HE), education expenditures (EE), social production expenditures (SP), incapacity expenditures (IE), pension expenditures (PE), unemployment payments (UP), and family benefits (FB)) the highest averages are recorded in the sample countries France, Portugal, Ireland, Finland, Italy, Spain and Finland, respectively.

The empirical unconditional correlations between the control variables presented in Table A3 in the Appendix. The values by state offer mixed (positive or negative) linkage with both the real GDP per capita growth volatility and all the explanatory variables. The correlations are either positive or negative, but weak. On the other hand, as is illustrated in Table A4 in the Appendix, the empirical correlations between proxy-measures used for automatic stabilizers are quite similar for the whole sample states.

3.3. Methodology

This sub-section outlines the general framework of panel cointegration and stationarity tests and the PMG estimator method proposed by Pesaran et al. (1999) that we use as the estimation technique in this paper. In the following, we summarize these tests by largely drawing from the related literature, such as Westerlund (2006), Narayan et al. (2010), and Jouini (2015).

¹⁶ Real measure is preferable on theoretical grounds to nominal measures largely and conventionally advocated in the related literature.

3.3.1. Panel cointegration test and stationarity

In what follows, we explain the Lagrange multiplier (LM) tests proposed by Westerlund (2006) for cointegration and Carrion-i-Silvestre et al. (2005) for stationarity, respectively. Westerlund's (2006) test is largely used as it allows for the possibility of multiple structural breaks both in the level and trend of a cointegrated panel regression. The Westerlund's (2006) test begins with the following equations:

$$y_{i,t} = z'_{i,t} \gamma_{i,j} + x'_{i,t} \beta_i + e_{i,t} \quad (2)$$

$$i = 1, 2, \dots, N, \quad j = 1, 2, \dots, M_i + t, \quad t = 1, 2, \dots, T.$$

where T is the number of observations, N is the number of individual members in the panel, and M refers to the number of structural breaks. $x_{i,t}$ is a k -dimensional vector of regressors and $z_{i,t}$ is a vector of deterministic components. β_i and $\gamma_{i,j}$ are the vector of parameters.

When it comes to the panel LM test statistic, it is defined as:

$$Z(M) = \sum_{i=1}^N \sum_{j=1}^{M_i+1} \sum_{t=T_{i,j-1}+1}^{T_{ij}} [(T_{i,j} - T_{i,j-1})]^{-2} \hat{\omega}_{i12}^{-2} S_{it}^2 \quad (3)$$

$S_{it} = \sum_s^t = T_{i,j-1} + 1 \hat{\varepsilon}_{it}$ the residuals of the above model and $\hat{\sigma}_i$ is the Newey and West (1994) estimator of the long-run standard deviation based on $\hat{\varepsilon}_{it}$. ε_{it} is the disturbance term.

There exists a cointegration among variables when the LM observed value is less than any critical value. This is because, under the alternative hypothesis, the LM statistic diverges to positive infinity.

3.3.2. Pooled Mean Group estimation approach

Using a panel data model to examine the relationship between automatic stabilizers and output volatility has several advantages. For instance, we can take into account the cross-sectional characteristics between the sample states simultaneously and then capture the dynamic interaction between the automatic stabilizers and output volatility. In the present study, we use the PMG estimation technique to consider a lower degree of heterogeneity, as it imposes homogeneity in the long-run coefficients while still allowing for heterogeneity in the short-run coefficients and error variances.

Pesaran et al. (1999) propose two estimating procedures. One is the Mean Group (MG) estimator, the other is the Pooled Mean Group (PMG) estimator. The MG estimator consists of averaging separate estimates for each group in the panel. According to Pesaran and Smith (1995), this estimator provides consistent estimates of the parameters' averages. It also allows the parameters to be freely independent across groups and does not consider potential homogeneity between groups.

When it comes to the PMG estimator, its main characteristic is that it allows the short-run coefficients, including the intercepts, the speed of adjustment to the long-run equilibrium values and error variances to be heterogeneous country by country while the long-run slope coefficients are homogeneous across countries. This is particularly useful when there are reasons for expecting

that the long-run equilibrium relationship between the variables is similar across countries or, at least, a subset of them. The short-run adjustment is allowed to be country-specific, because of the largely different impact of the external shocks, stabilization policies, and the like. Furthermore, the PMG estimator highlights the adjustment dynamic between the short and the long run. The reason for this is that the short-run dynamics and error variances should be the same, which tend to be less compelling. Not imposing equality of short-run slope coefficients allows the dynamic specification to differ across countries. Therefore, the long-run relationship between automatic stabilizers and output volatility is expected to be identical from one country to another. Conversely, the short-run coefficients are expected to be country-specific. The null hypothesis of the homogeneity of the long-run coefficients can be verified by using the Hausman test.

Assuming that output volatility and automatic stabilizers are $I(1)$ and cointegrated, ε_{it} is supposed to be $I(0)$ for all i and is independently distributed across t . Following Pesaran et al. (1999), with a maximum of one lag for all variables, the dynamic heterogeneous panel regression can be incorporated into the error-correction model using the autoregressive distributed lag ARDL (p, q) technique as in Eq. (3):

$$\Delta Vol_{i,t} = \sum_{j=1}^{p-1} \gamma_j^i \Delta Vol_{i,t-j} + \sum_{j=0}^{q-1} \delta_j^i \Delta X_{i,t-j} + \varphi^i [Vol_{i,t-1} - \{\beta_0^i + \beta_1^i X_{i,t-1}\}] + \varepsilon_{it} \quad (3)$$

where Vol is the real GDP per capita volatility, X is a set of independent variables including proxy variables used for automatic stabilizers, p is the lag of the dependent variable, q is the lag of the independent variables, γ and δ represent the short-run coefficients of lagged dependent and independent variables respectively, β are the long-run coefficients, and φ is the coefficient of the speed of adjustment to the long-run equilibrium. The subscripts i and t represent country and time indexes, respectively.

4. Econometric results

The results of the LM stationary test are reported in Table 1. The table suggests that the LM stationarity test results for all model specifications are in favor of unit root for the variables at all levels and stationarity for all the variables in first differences, which implies that all series are integrated of order one. We, then, proceeded to test for cointegration to check the existence of the long-run link between the variables. As to the results given in Table 2, they show that the LM cointegration test supports the existence of a long-run relationship between the proxy measures used for automatic stabilizers and output volatility. Based on this result, it can be said that there is credible evidence in favor of the effects of automatic stabilizers on output volatility for the sample states. The evidence is robust for all the proxy measures we used for automatic stabilizers since the cointegration test is statistically insignificant for all models considered. We present a break date in trend in order to take into account the structural break that implies that the break models fit a step function through this trend. The results presented in Table 2 indicate the selection of the break dates for the sample states. The most detected break date seems to be 2007, which provides strong evidence for this shifting point. Other break dates we detected are 2008, 2012, and 2013, respectively.

On the basis of the existence of a long-run equilibrium relationship between the variables, we can estimate the error correction model to diagnose the effect of each proxy measure used for automatic stabilizers on output volatility over both the short and long run. Prior to discovering these effects, however, we wish to ensure whether the long-run response of output volatility to independent variables is almost the same across the sample states. The results we obtained by

making use of the mentioned test are given in Table 3. We observe from the table that there exist common long-run coefficients across the sample states irrespective of the chosen proxy measure for automatic stabilizers since the test does not reject the null hypothesis of equal long-run parameters.

In what follows, we discuss the empirical findings in detail. The empirical results, presented in Table 3, suggest that the proxy variables used for automatic stabilizers are not found to be relevant drivers of output volatility in nine EMU member states in the long run. This is because the corresponding coefficients of such variables are positive but statistically insignificant at conventional levels. For instance, a 10% increase in TR, TOGS, SSC, TIPCG, TIPCGC, HE, EE, SP, IE, PE, UP, and FB increases real GDP per capita growth volatility only by 0.031, 0.005, 0.023, 0.017, 0.043, 0.027, 0.041, 0.074, 0.052, 0.080, 0.061, 0.043 percentage-points, respectively. These empirical findings allow us to suggest that the automatic stabilizers are very weak, or not strong enough, in stabilizing output volatility in the long-run.

Returning to Table 4, it illustrates the results of the short-run PMG results. As can be seen from the table, the adjustment of output volatility to the long-run equilibrium is negatively driven by short-run adjustments for all proxy measures used for automatic stabilizers. This implies that automatic stabilizers have a negative and statistically significant impact on output volatility in the short run. More specifically, a 10% increase in TR, TOGS, SSC, TIPCG, TIPCGC, HE, EE, SP, IE, PE, UP, and FB leads to a reduction in output volatility (proxied by real GDP per capita growth volatility) by -0.025, -0.012, -0.033, -0.047, -0.026, -0.073, -0.068, -0.077, -0.074, -0.097, -0.092 and -0.084 percentage-points, respectively. Another striking empirical finding is that the impact of these variables on output volatility in the short-run is quite larger than what we found for the long run that is also statistically insignificant. What is more, the stabilizing impact of each automatic stabilizer on output volatility is not equal magnitude over the short run. The budgetary items that place in the expenditure side of the government budget are more effective in stabilizing output volatility in relation to those that are in the revenue side in the sample states.

Over the long run, the positive and statistical significance of the proxy measures used for automatic stabilizers persists even automatic stabilizer measure changes in the estimation models we constructed (see Table 3). Nevertheless, in the short run, all the proxy measures used for automatic stabilizers exert a negative as well as statistically significant effect on output volatility. However, it is important to underline once again that the output-volatility reducing impact of automatic stabilizers varies with the considered proxy measure for automatic stabilizers.

The short-run error correction term, as shown in Table 4 below, is negative and statistically significant in all the models we constructed. The results of the speed of adjustment imply the presence of the cointegrating relationship between the variables we considered. Besides, the results we found indicate that the linkage between output volatility and independent variables are characterized by high predictability and that the spread movement is mean-reverting. The adjustment speed from short-run disequilibrium towards the long run depends on the type of proxy measures used for automatic stabilizers since the error correction term varies across models. The coefficients of the speed of adjustment lie in the ranges of -0.305 and -0.830.

In estimating the effectiveness of the automatic stabilizers, opting for appropriate proxy measures for automatic stabilizers is another key point that should not be ignored. However, the available literature provides no clear-cut evidence regarding which side of the government budget is more

appropriate in mitigating output volatility. Our empirical results, unlike what is argued in most of the earlier studies, suggest that the expenditure side of the government budget is more effective than its revenue side in offsetting output volatility in the sample states. Our results also broadly overlap with the results of previously conducted studies on the effectiveness of automatic stabilizers, such as van den Noord (2000) and Fatás and Mihov (2001), which provide evidence that the expenditure side of the government budget is more effective in relation to the revenue side of it in offsetting output volatility. The most striking reason for this is that government spending feed directly into aggregate demand while the tax side of the government budget, part of the revenue is saved or dissaved (Swanepoel and Schoeman, 2003).

In harmony with theory, the empirical results show that automatic stabilizers dampen output volatility and by implication exert a stabilizing impact on output in the short run in all the sample states. Several studies, including van den Noord (2000), Swanepoel and Schoeman (2003), Darby and Melitz (2008), Debrun and Kapoor (2010), Furceri (2010), and Furceri and Zdzienicka (2012), are also found the negative relationship between automatic stabilizers and output volatility—or its different forms represented as output fluctuation, business cycle, macroeconomic volatility, output shock. In simple words, automatic stabilizers have considerable potential in reducing volatility in output in the short run as long as the case of nine EMU member states is considered.

Table 1. LM stationary test results.

Variable	Level $I(0)$ / First-diff $I(1)$.	Intercept	Trend	Breaks in intercept	Breaks in trend
RGPCV	$I(0)$	4.396(0.000)*	4.112(0.000)*	4.134(0.000)*	7.304(0.000)*
	$I(1)$	2.551(0.120)	1.204 (0.040)	0.166 (0.230)	4.277 (0.004)
ToTV	$I(0)$	6.403(0.000)*	3.110 (0.001)*	2.557(0.000)*	3.976 (0.000)*
	$I(1)$	4.128(0.503)	2.680 (0.188)	0.060 (0.040)	0.439 (0.011)
HFCV	$I(0)$	11.804(0.003)*	5.080 (0.000)*	3.967(0.002)*	4.010 (0.000)*
	$I(1)$	5.305 (0.330)	0.244 (0.055)	2.550(0.050)	0.001 (0.013)
TIV	$I(0)$	4.791 (0.000)*	4.061 (0.003)*	3.409 (0.000)*	5.339 (0.000)*
	$I(1)$	1.718 (0.932)	2.128 (0.789)	1.306(0.004)	0.201 (0.003)
DEF	$I(0)$	2.506 (0.000)*	4.048 (0.005)*	4.115(0.002)*	4.339(0.000)*
	$I(1)$	0.213 (0.011)	1.102 (0.003)	2.332 (0.001)	0.507(0.003)
UR	$I(0)$	3.802 (0.002)*	5.213 (0.000)*	6.496 (0.000)*	2.970 (0.001)*
	$I(1)$	3.334 (0.117)	0.978 (0.697)	0.170 (0.030)	0.122 (0.003)
TCNFS	$I(0)$	7.396 (0.000)*	3.045 (0.000)*	1.345 (0.001)*	2.354 (0.000)*
	$I(1)$	2.189 (0.260)	0.127 (0.450)	0.064 (0.151)	0.605 (0.002)
TR	$I(0)$	5.402 (0.000)*	3.282 (0.000)*	3.203(0.103)*	3.114 (0.000)*
	$I(1)$	5.111 (0.160)	0.578 (0.340)	1.180 (0.621)	1.577 (0.003)
TOGS	$I(0)$	4.551 (0.000)*	6.139 (0.002)*	2.173(0.000)*	9.380 (0.002)*
	$I(1)$	2.176 (0.128)	2.326 (0.004)	1.010 (0.002)	1.690 (0.000)
SSC	$I(0)$	11.472 (0.000)*	5.324 (0.000)*	3.565 (0.000)*	3.545 (0.000)*
	$I(1)$	2.603 (0.678)	1.457 (0.107)	0.974 (0.015)	1.143 (0.001)
TIPCG	$I(0)$	6.302 (0.002)*	4.733 (0.000)*	1.302 (0.011)*	2.209 (0.040)*
	$I(1)$	5.317 (0.704)	3.145 (0.436)	0.445 (0.000)	0.033 (0.000)
TIPCGC	$I(0)$	4.139 (0.000)*	4.337 (0.000)*	3.257 (0.270)*	4.133 (0.001)*
	$I(1)$	1.667 (0.016)	1.125 (0.003)	0.146 (0.000)	0.033 (0.003)
HE	$I(0)$	8.356 (0.001)*	3.571 (0.000)*	1.355 (0.003)*	4.433 (0.000)*
	$I(1)$	1.764 (0.205)	0.447 (0.001)	0.144 (0.010)	1.774 (0.002)
EE	$I(0)$	3.774 (0.002)*	4.221 (0.003)*	3.317 (0.000)*	2.552 (0.003)*
	$I(1)$	1.121 (0.055)	0.690 (0.005)	0.908 (0.001)	0.208 (0.001)
SP	$I(0)$	4.116 (0.001)*	3.016 (0.000)*	3.144 (0.000)*	3.916 (0.000)*
	$I(1)$	1.896 (0.314)	1.443 (0.025)	0.390 (0.055)	0.201 (0.003)
IE	$I(0)$	2.707 (0.000)*	6.005 (0.000)*	5.320 (0.000)*	2.133 (0.000)*
	$I(1)$	0.158 (0.114)	2.113 (0.022)	2.255 (0.022)	0.055 (0.002)
PE	$I(0)$	7.439(0.000)*	4.013(0.001)*	1.488 (0.000)*	5.017(0.000)*
	$I(1)$	0.105 (0.004)	1.400 (0.024)	0.905 (0.005)	2.105 (0.002)
UP	$I(0)$	4.204 (0.000)*	3.004 (0.001)*	2.005 (0.000)*	4.831 (0.000)*
	$I(1)$	1.598 (0.210)	1.033 (0.230)	0.128 (0.013)	0.705 (0.012)
FB	$I(0)$	6.120 (0.000)*	3.034 (0.002)*	3.705 (0.000)*	3.905 (0.000)*
	$I(1)$	4.190 (0.002)	2.103 (0.013)	1.179 (0.004)	1.408 (0.003)

Notes: RGPCV is real GDP per capita growth volatility; ToTV is terms of trade volatility; HFCV is household final consumption volatility; TIV is total investment volatility; DEF is GDP deflator inflation; UR is unemployment rate; TCNFS is total credit to the private non-financial sector; TR is total tax revenue; TOGS is taxes on goods and services; SSC is social security contributions; TIPCG is taxes on income profits a capital gains individuals; TIPCGC is taxes on income profits and capital gains of corporates; HE is health expenditures; EE is education expenditures; SP is social production expenditures; IE is incapacity expenditures; PE is pension expenditures; UP is unemployment payments, and FB is family benefits; respectively. *stands for non-stationary at a 1 % level of statistical significance. The values in parentheses refer bootstrap p -value.

Table 2. LM cointegration test results and structural breaks.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Test Statistics												
Intercept	0.449 (0.501)	0.255 (0.155)	1.186 (0.031)	1.629 (0.316)	1.366 (0.805)	1.007 (0.883)	1.317 (0.702)	1.364 (0.179)	1.808 (0.131)	0.990 (0.236)	1.169 (0.070)	1.610 (0.905)
Trend	1.046 (0.550)	1.356 (0.070)	0.822 (0.053)	1.692 (0.650)	0.457 (1.760)	0.363 (1.808)	0.150 (0.139)	0.032 (1.493)	0.708 (1.350)	0.225 (0.016)	1.625 (0.363)	1.184 (0.175)
Breaks in intercept	0.827 (1.274)	0.179 (0.869)	0.227 (17.441)	1.700 (3.139)	0.500 (1.120)	0.090 (1.610)	11.034 (0.225)	1.150 (0.059)	0.084 (1.184)	15.603 (1.139)	0.780 (0.559)	0.264 (1.280)
Breaks in trend	0.184 (1.302)	0.592 (0.764)	0.665 (23.790)	1.011 (0.780)	0.552 (1.190)	0.073 (0.998)	8.131 (0.027)	1.908 (1.005)	0.057 (0.088)	0.266 (32.899)	0.026 (1.282)	0.113 (1.185)
Structural breaks												
Austria	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Finland	2007	2007	2015	2007	2007	2007	2007	2007	2007	2007	2007	2007
France	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
Germany	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
Ireland	2007	2007	2007	2007	2007	2007	2008	2008	2012	2012	2012	2012
Italy	2007	2007	2007	2007	2007	2007	2007	2007	2013	2013	2007	2007
Netherland	2007	2007	2007	2007	2007	2007	2007	2007	2007	2010	2007	2008
Portugal	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007
Spain	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008

Notes: For model 1, proxy measure used for automatic stabilizer (AS) is total tax revenue (TR); for model 2 AS is taxes on goods and services (TOGS); for model 3 AS is social security contributions (SSC); for model 4 AS is taxes on income profits a capital gains individuals (TIPCG); for model 5 AS is taxes on income profits and capital gains of corporates (TIPCGC); for model 6 AS is health expenditures (HE), for model 7 AS is education expenditure (EE), for model 8 AS is social production expenditures (SP), for model 9 AS is incapacity expenditures (IE), for model 10 AS is pension expenditures (PE), for model 11 AS is unemployment payments (UP), for model 12 AS is family benefits (FB) respectively. Real GDP per capita growth volatility (RGPCV) denotes the dependent variable in all models. The first values refer to LM statistic and the values in parentheses refer bootstrap p -value, respectively.

Table 3. PMG long-run results.

Explanatory variables	Dependent variable: Real GDP per capita growth volatility											
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
AS	0.031 (0.017)	0.005 (0.055)	0.023 (0.044)	0.017 (0.033)	0.043 (0.055)	0.027 (0.048)	0.041 (0.033)	0.074 (0.037)	0.052 (0.055)	0.080 (0.071)	0.061 (0.052)	0.042 (0.033)
ToTV	0.116*** (0.016)	0.204*** (0.044)	0.310*** (0.057)	0.211*** (0.016)	0.096** (0.044)	0.018*** (0.033)	0.044** (0.055)	0.150*** (0.067)	0.110*** (0.017)	0.310*** (0.033)	0.170*** (0.066)	0.027** (0.042)
HFCV	0.080 (0.055)	0.066 (0.027)	0.014 (0.033)	0.020 (0.016)	0.066 (0.055)	0.033 (0.066)	0.064 (0.055)	0.014 (0.034)	0.033 (0.055)	0.015 (0.044)	0.096 (0.049)	0.055 (0.048)
TIV	-0.020* (0.044)	-0.055* (0.052)	-0.084* (0.066)	-0.047* (0.055)	-0.088* (0.076)	-0.098* (0.563)	-0.077* (0.503)	-0.021* (0.033)	-0.063* (0.066)	-0.036* (0.077)	-0.041* (0.039)	-0.036* (0.042)
DEF	-0.015** (0.055)	-0.064** (0.032)	-0.073** (0.040)	-0.044** (0.055)	-0.027** (0.033)	-0.055** (0.014)	-0.027** (0.039)	-0.066** (0.034)	-0.045** (0.022)	-0.085** (0.055)	-0.066** (0.029)	-0.076** (0.030)
UR	-0.048** (0.027)	-0.031** (0.066)	-0.062** (0.019)	-0.055** (0.019)	-0.031** (0.044)	-0.045** (0.022)	-0.017** (0.044)	-0.083** (0.050)	-0.031** (0.033)	-0.055** (0.028)	-0.055** (0.011)	-0.078** (0.033)
TCNFS	0.035 (0.066)	0.050 (0.033)	0.064 (0.011)	0.077 (0.032)	0.088 (0.033)	0.048 (0.019)	0.066 (0.022)	0.049 (0.055)	0.017 (0.019)	0.022 (0.033)	0.092 (0.072)	0.033 (0.027)

Notes: For model 1, proxy measure used for automatic stabilizer (AS) is total tax revenue (TR); for model 2 AS is taxes on goods and services (TOGS); for model 3 AS is social security contributions (SSC); for model 4 AS is taxes on income profits a capital gains individuals (TIPCG); for model 5 AS is taxes on income profits and capital gains of corporates (TIPCGC); for model 6 AS is health expenditures (HE), for model 7 AS is education expenditure (EE), for model 8 AS is social production expenditures (SP), for model 9 AS is incapacity expenditures (IE), for model 10 AS is pension expenditures (PE), for model 11 AS is unemployment payments (UP), for model 12 AS is family benefits (FB) respectively. Real GDP per capita growth volatility (RGPCV) denotes the dependent variable in all models. ToTV is terms of trade volatility; HFCV is household final consumption volatility; TIV is total investment volatility; DEF is GDP deflator inflation; UR is unemployment rate; TCNFS is total credit to the private non-financial sector. For each model, the values refer to the observed value of the LM statistic and the bootstrap p -value, respectively. The values in parentheses are the asymptotic standard errors. For each variable, the bottom value is the p -value associated with the Hausman test statistic for equal long-run parameters. ***, ** and * stand for statistical significance at 1%, 5%, and 10% levels, respectively.

Table 4. PMG short-run results.

Explanatory variables	Dependent variable: Real GDP per capita growth volatility											
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
AS	-0.025** (0.022)	-0.012* (0.022)	-0.033** (0.033)	-0.047** (0.011)	-0.026** (0.011)	-0.073** (0.017)	-0.068** (0.016)	-0.077** (0.013)	-0.074** (0.032)	-0.097** (0.034)	-0.092** (0.025)	-0.084** (0.010)
ToTV	-0.033** (0.014)	-0.076** (0.021)	-0.049** (0.017)	-0.052** (0.045)	-0.084** (0.015)	-0.065** (0.022)	-0.054** (0.019)	-0.058** (0.016)	-0.065** (0.022)	-0.067** (0.011)	-0.054** (0.035)	-0.045** (0.060)
HFCV	0.050 (0.040)	0.068 (0.036)	0.046 (0.032)	0.057 (0.055)	0.057 (0.019)	0.079 (0.013)	0.035 (0.022)	0.060 (0.015)	0.040 (0.033)	0.055 (0.014)	0.033 (0.019)	0.077 (0.044)
TIV	-0.070** (0.021)	-0.046** (0.033)	-0.660** (0.034)	-0.088** (0.017)	-0.044** (0.019)	-0.068** (0.053)	-0.090** (0.041)	-0.055** (0.021)	-0.068** (0.055)	-0.034** (0.033)	-0.055** (0.017)	-0.039** (0.023)
DEF	-0.128*** (0.019)	-0.131*** (0.025)	-0.115*** (0.018)	-0.132*** (0.032)	-0.117*** (0.021)	-0.048** (0.011)	-0.101*** (0.033)	-0.092** (0.071)	-0.018* (0.013)	-0.067** (0.018)	0.115*** (0.015)	0.199*** (0.023)
UR	-0.067** (0.080)	-0.055** (0.001)	-0.018* (0.036)	-0.046** (0.004)	-0.054** (0.006)	-0.067** 0.015	-0.010* 0.011	-0.070** 0.019	-0.033** 0.092	-0.025* 0.023	0.127*** 0.036	0.013* 0.061
TCNFS	0.067 (0.023)	0.046 (0.049)	0.033 (0.061)	0.022 (0.044)	0.031 (0.025)	0.039 (0.019)	0.055 (0.060)	0.066 (0.070)	0.018 (0.011)	0.053 (0.022)	0.066 (0.013)	0.038 (0.061)
D(AS)	-0.050 (0.022)	-0.049 (0.053)	-0.066 (0.045)	-0.071 (0.033)	-0.013 (0.025)	-0.050 (0.011)	-0.017 (0.070)	-0.080 (0.014)	-0.013 (0.066)	-0.041 (0.055)	0.016 (0.017)	0.015 (0.030)
D(ToTV)	0.017 (0.047)	0.044 (0.022)	0.027 (0.048)	0.021 (0.033)	0.043 (0.022)	0.057 (0.053)	0.033 (0.022)	0.120 (0.011)	0.103 (0.011)	0.107 (0.038)	0.009 (0.016)	0.059 (0.060)
D(HFCV)	0.055 (0.052)	0.033 (0.015)	0.066 (0.022)	0.055 (0.009)	0.019 (0.070)	0.041 (0.013)	0.120 (0.018)	0.079 (0.025)	0.019 (0.067)	0.057 (0.015)	0.068 (0.033)	0.077 (0.017)
D(TIV)	-0.044 (0.038)	-0.090 (0.021)	0.066 (0.055)	0.022 (0.019)	0.077 (0.011)	0.066 (0.009)	-0.470 (0.004)	-0.033 (0.019)	-0.068 (0.011)	0.017 (0.019)	0.046 (0.033)	0.120 (0.011)
D(DEF)	-0.070 (0.016)	-0.052 (0.004)	-0.067 (0.015)	-0.060 (0.055)	-0.120 (0.012)	-0.139 (0.033)	-0.055 (0.022)	-0.301 (0.010)	-0.043 (0.022)	-0.021 (0.033)	0.048 (0.019)	0.046 (0.040)
D(UR)	-0.044 (0.017)	-0.049 (0.032)	-0.039 (0.041)	-0.079 (0.021)	-0.170 (0.221)	-0.066 (0.366)	-0.060 (0.072)	-0.005 (0.053)	-0.109 (0.022)	-0.049 (0.031)	0.034 (0.044)	0.028 (0.209)
D(TCNFS)	0.022 (0.055)	0.037 (0.032)	0.066 (0.029)	0.028 (0.011)	0.050 (0.055)	0.073 (0.034)	0.066 (0.070)	0.057 (0.077)	0.029 (0.079)	0.055 (0.044)	0.034 (0.040)	0.056 (0.039)
Adj.speed	-0.434*** (0.005)	-0.313*** (0.002)	-0.340*** (0.144)	-0.776*** (0.117)	-0.830*** (0.103)	-0.620*** (0.119)	-0.305*** (0.105)	-0.533*** (0.102)	-0.566*** 0.128	-0.832*** 0.266	-0.430*** 0.109	-0.331*** 0.179
Trend	0.003 (0.066)	0.005 (0.044)	0.014 (0.880)	0.031 (0.011)	0.031 (0.019)	0.021 (0.033)	0.004 (0.081)	0.013 (0.044)	0.003 (0.019)	0.009 (0.022)	0.011 (0.015)	0.016 (0.029)
Intercept	1.307*** (0.043)	2.458*** (0.051)	4.809 (0.011)	5.708*** (0.062)	3.244*** (0.042)	7.133*** (0.020)	3.511*** (0.031)	7.023*** (0.041)	1.222*** (0.021)	2.041*** (0.051)	4.035*** (0.033)	2.113*** (0.227)

Notes: For model 1, proxy measure used for automatic stabilizer (AS) is total tax revenue (TR); for model 2 AS is taxes on goods and services (TOGS); for model 3 AS is social security contributions (SSC); for model 4 AS is taxes on income profits a capital gains individuals (TIPCG); for model 5 AS is taxes on income profits and capital gains of corporates (TIPCGC); for model 6 AS is health expenditures (HE), for model 7 AS is education expenditure (EE), for model 8 AS is social production expenditures (SP), for model 9 AS is incapacity expenditures (IE), for model 10 AS is pension expenditures (PE), for model 11 AS is unemployment payments (UP), for model 12 AS is family benefits (FB) respectively. Real GDP per capita growth volatility (RGPCV) denotes the dependent variable in all models. ToTV is terms of trade volatility; HFCV is household final consumption volatility; TIV is total investment volatility; DEF is GDP deflator inflation; UR is unemployment rate; TCNFS is total credit to the private non-financial sector. For each model, the values refer to the observed value of the LM statistic and the bootstrap *p*-value, respectively. The values in parentheses are the asymptotic standard errors. ***, ** and * stand for statistical significance at 1%, 5%, and 10% levels, respectively.

5. Conclusions and Some Policy Recommendations

In this paper, we examined the output-volatility reducing effect of automatic stabilizers in nine EMU member states by utilizing the PMG estimation technique. Overall, our empirical results confirm that automatic stabilizers exert a considerable counter-impact on output volatility, but this is the only valid case in the short run.

In a broad sense, as in many other relevant empirical studies, our empirical results seem to be sensitive to the proxy measures of automatic stabilizers considered, the sets of control variables incorporated to our estimation model, study period, the countries under examination, and the estimation techniques used. Nonetheless, keeping in mind all these stylized facts, we can make the following generalized arguments on the ground of our empirical results: i) automatic stabilizers are the fiscal instruments that are effective only in the short run; ii) automatic stabilizers work through not only revenue side but also expenditure side of the government budget. However, government expenditure-based automatic stabilizers are more effective in stabilizing output volatility than tax-based automatic stabilizers. Most probably, this is because the government expenditure directly influences aggregate demand, whereas taxes in most cases indirectly affect it; iii) in the expenditure side of the government budget, the most effective automatic stabilizer is pension-related expenditures, whereas the less effective one is education-related expenditures. In the revenue side of the government budget, however, the most potent automatic stabilizer is taxes on income, profits and capital gains of individuals, whereas the weakest one is taxes on goods and services; iv) the extent of the automatic stabilizers varies across the sample countries.

Taken together, the evidence from this paper suggests that automatic stabilizers generate a considerable volatility-reducing impact on output in the sample states. Even so, in view of their size and effectiveness, this evidence does not change the subsequent realities with regard to automatic stabilizers: i) they are only fiscal mechanism that will be used for combatting demand-side shocks rather than supply-side shocks; ii) they are only the mechanism that is effective in the short run; iii) they may be an alternative to discretionary fiscal policy in just good times. In case of severe downturns, however, they can only be a complementary instrument of the discretionary fiscal policy to stabilize the economy, rather than a rival or alternative of it.

Nevertheless, to enhance the effectiveness of automatic stabilizers in output stabilization while reducing dependency on discretionary fiscal policy, the EMU member states can take several measures. In this regard, for example, re-designing taxes in an automatic stabilizer-friendly manner, strengthening safety-net programs (e.g. establishing an easily administrated mechanism in which the amount of food stamps for well-targeted vulnerable families automatically increase during downturns, extending and/or increasing unemployment benefits), raising both the efficiency and flexibility of the market mechanism together with institutions could be beneficial. One further note on tax-based automatic stabilizers is related to their fiscal drag- and taxflation-inducing effects. In times of inflationary boom, automatic increases occur in income taxes, especially in those with progressive structure. This leads to “bracket creep” phenomena, resulting in an inflation-induced artificial increase in tax burdens of taxpayers, what is so-called “taxflation” if there is no compensatory mechanism, such as de facto legislative alteration, or indexed system. In times of downturn, however, income taxes with progressive structure may harm increases in disposable income of economic agents, retarding or considerably preventing to get the economy out of recession, creating what is so-called “fiscal drag”. Not to allow such cases and thereby to get better results related to the output volatility-reducing role of automatic stabilizers, necessary well-timed measures should be taken by the government.

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Appendix

Table A1. Description of variables and data sources.

Variable	Description/Measurement	Source
Dependent Variable	RGPCV Real GDP per capita growth volatility	IMF, World Economic Outlook Database
Independent Variables	Alternative Interest Variables (Alternative Proxy Variables for Automatic Stabilizers)	TR Total tax revenue, in % of GDP
		TOGS Taxes on goods and services, in % of GDP
		SSC Social security contributions, in % of GDP
		TIPCG Taxes on income, profits, and capital gains of individuals, in % of GDP
		TIPCGC Taxes on income, profits, and capital gains of corporates, in % of GDP
		HE Health expenditures, in % of GDP
		EE Education expenditures, in % of GDP
		SP Social protection expenditures, in % of GDP
		IE Incapacity expenditures, in % of GDP
		PE Pension expenditures, in % of GDP
		UP Unemployment payments, in % of GDP
		FB Family benefits, in % of GDP
	Control Variables	ToTV Terms of trade volatility
		HFCV Household final consumption volatility, in % of GDP
		TIV Total investment volatility, in % of GDP
		DEF Inflation measured as the annual change in the GDP deflator over the previous year, in %
		UR Unemployment rate measured as the ratio of the number of people who are unemployed to the number of people in the labor force (unemployment/labor force)
		TCNFS Financial sector development measured as a credit to the private non-financial sector, in % of GDP

Note: Volatility is measured as a six-years moving standard deviation of the related variable taken in the form of volatility.

Table A2. continued.

State	RGPCV	ToTV	HFCV	TIV	DEF	UR	TCNFS	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
Netherlands																			
Mean	0.016	2.336	1.240	1.251	88392.0	5.317	239.643	0.362	0.108	0.135	0.066	0.031	6.260	4.286	5.452	3.470	4.997	1.573	1.491
Maximum	0.022	3.932	1.986	1.649	101611	7.733	289.10	0.387	0.113	0.147	0.083	0.041	8.100	4.700	7.000	3.735	5.472	3.707	1.840
Minimum	0.010	0.949	0.491	0.850	70189.0	3.137	178.30	0.348	0.104	0.120	0.055	0.020	4.000	3.800	4.000	2.767	4.487	0.868	1.570
Std.dev.	0.003	1.012	0.579	0.229	10563.7	1.325	35.083	0.011	0.002	0.008	0.007	0.006	1.442	0.281	0.986	0.463	0.336	0.604	0.172
Prob.	0.420	0.383	275	0.465	0.330	0.563	0.523	0.421	0.820	0.404	0.651	0.517	0.254	0.430	0.376	0.174	0.356	0.000	0.928
Obs.	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Portugal																			
Mean	0.022	21.144	1.415	3.150	89853.7	8.603	174.347	0.315	0.129	0.083	0.057	0.030	6.530	5.547	4.608	2.058	10.383	1.031	1.122
Maximum	0.029	30.284	1.801	4.774	108164.0	16.183	231.400	0.344	0.137	0.092	0.077	0.036	7.900	6.300	5.900	2.315	13.953	1.608	1.446
Minimum	0.015	10.882	1.085	2.051	65227.00	3.925	92.600	0.292	0.115	0.075	0.050	0.022	5.400	4.000	3.700	1.776	7.100	0.612	0.690
Std.dev.	0.004	6.239	0.211	0.979	13685.09	3.591	41.803	0.016	0.004	0.005	0.008	0.003	0.653	0.705	0.679	0.196	2.457	0.275	0.218
Prob.	0.581	0.543	0.591	0.231	0.347	0.375	0.366	0.299	0.156	0.508	0.020	0.904	0.614	0.197	0.353	0.339	0.349	0.692	0.317
Obs.	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Spain																			
Mean	0.020	22.566	1.299	2.940	88376.39	16.894	157.565	0.329	0.092	0.116	0.069	0.026	5.708	0.421	1.360	2.403	9.108	2.325	1.064
Maximum	0.021	32.497	1.715	4.580	102313.0	26.095	216.000	0.363	0.101	0.120	0.075	0.046	6.800	1.600	1.600	2.616	11.169	3.352	1.474
Minimum	0.013	1.755	0.745	1.810	64608.0	8.233	79.7000	0.297	0.067	0.112	0.061	0.017	5.100	0.100	1.100	2.240	7.826	1.637	0.404
Std.dev.	0.003	7.045	0.275	0.956	13496.69	5.765	47.658	0.015	0.007	0.002	0.004	0.007	0.549	0.487	1.146	0.084	1.182	0.587	0.307
Prob.	0.536	0.521	0.594	0.394	0.249	0.399	0.380	0.758	0.000	0.376	0.450	0.089	0.409	0.011	0.493	0.841	0.224	0.225	0.208
Obs.	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23

Note: RGPCV is real GDP per capita growth volatility; ToTV is terms of trade volatility; HFCV is household final consumption volatility; TIV is total investment volatility; DEF is GDP deflator inflation; UR is unemployment rate; TCNFS is total credit to the private non-financial sector; TR is total tax revenue; TOGS is taxes on goods and services, social security contributions; SSC is social security contributions; TIPCG is taxes on income profits a capital gains individuals, TIPCGC is taxes on income, profits and capital gains of corporates; HE is health expenditures; EE is education expenditures; SP is social production expenditures; IE is incapacity expenditures; PE is pension expenditures; UP is unemployment payments; and FB is family benefits, respectively.

Table A3. Empirical correlations among control variables.

Austria	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.382	1				
TIV	0.559	-0.201	1			
DEF	0.577	-0.890	0.108	1		
UR	0.263	-0.730	0.074	0.680	1	
TCNFS	0.516	-0.834	0.174	0.838	0.448	1
Finland	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.040	1				
TIV	-0.574	-0.641	1			
DEF	0.413	0.845	-0.898	1		
UR	-0.023	-0.574	0.697	-0.629	1	
TCNFS	0.585	0.713	-0.940	0.563	-0.557	1
France	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.631	1				
TIV	-0.244	0.723	1			
DEF	0.456	-0.786	-0.584	1		
UR	0.023	-0.042	-0.161	-0.169	1	
TCNFS	0.360	-0.753	-0.618	0.971	-0.033	1
Germany	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.612	1				
TIV	0.291	-0.433	1			
DEF	0.373	-0.719	-0.199	1		
UR	-0.333	0.420	0.522	-0.546	1	
TCNFS	-0.626	0.394	0.349	-0.725	0.768	1
Ireland	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.670	1				
TIV	0.574	-0.253	1			
DEF	0.384	0.077	0.622	1		
UR	0.692	-0.707	0.270	-0.141	1	
TCNFS	0.747	-0.531	0.668	0.762	0.480	1
Italy	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.030	1				
TIV	-0.369	0.227	1			
DEF	0.596	0.559	-0.294	1		
UR	0.028	0.464	0.790	-0.027	1	
TCNFS	0.752	0.399	-0.490	0.549	-0.164	1
Netherlands	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	0.982	1				
TIV	0.677	0.565	1			
DEF	0.633	0.706	0.180	1		
UR	0.491	0.383	0.887	0.048	1	
TCNFS	0.700	0.735	0.329	0.647	0.164	1
Portugal	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	-0.297	1				
TIV	0.426	0.054	1			
DEF	0.407	-0.921	0.038	1		
UR	0.680	-0.601	0.540	0.701	1	
TCNFS	0.443	-0.866	-0.170	0.704	0.693	1
Spain	ToTV	HFCV	TIV	DEF	UR	TCNFS
ToTV	1					
HFCV	0.357	1				
TIV	0.556	-0.234	1			
DEF	0.592	0.007	0.716	1		
UR	0.546	-0.324	0.233	0.075	1	
TCNFS	0.658	0.294	0.446	0.936	-0.031	1

Note: ToTV is terms of trade volatility; HFCV is household final consumption volatility; TIV is total investment volatility; DEF is GDP deflator inflation; UR is unemployment rate; and TCNFS is total credit to the private non-financial sector, respectively.

Table A4. Empirical correlations among automatic stabilizers indicators.

Austria	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.767	1										
SSC	0.649	0.618	1									
TIPCG	0.721	0.259	0.162	1								
TIPCGC	0.246	-0.171	-0.264	0.386	1							
HE	-0.211	-0.532	-0.132	0.238	0.266	1						
EE	0.428	0.742	0.547	-0.114	-0.543	-0.792	1					
SP	0.257	0.483	0.487	0.007	-0.609	-0.266	0.596	1				
IE	0.431	0.803	0.431	-0.124	-0.398	-0.580	0.934	0.538	1			
PE	0.034	-0.280	0.335	0.232	0.036	0.798	-0.430	0.184	-0.582	1		
UP	0.170	0.489	0.534	-0.255	-0.441	-0.332	0.505	0.664	0.542	-0.047	1	
FB	-0.015	0.427	0.195	-0.427	-0.530	-0.683	0.723	0.656	0.774	-0.432	0.672	1
Finland	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.537	1										
SSC	0.501	0.601	1									
TIPCG	0.720	0.145	0.363	1								
TIPCGC	0.292	-0.422	-0.585	0.293	1							
HE	-0.460	0.320	0.252	-0.566	-0.795	1						
EE	0.303	0.149	0.719	0.477	-0.378	-0.007	1					
SP	0.455	0.755	0.837	0.298	-0.625	0.310	0.580	1				
IE	0.511	0.240	0.715	0.605	-0.201	-0.200	0.911	0.645	1			
PE	-0.018	0.685	0.518	-0.285	-0.774	0.798	-0.009	0.639	-0.096	1		
UP	0.723	0.397	0.703	0.744	-0.101	-0.381	0.733	0.714	0.786	-0.020	1	
FB	0.553	0.489	0.913	0.479	-0.405	0.034	0.844	0.823	0.917	0.254	0.856	1
France	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.262	1										
SSC	0.313	0.562	1									
TIPCG	0.546	-0.518	-0.524	1								
TIPCGC	-0.048	-0.016	-0.520	0.114	1							
HE	0.401	-0.570	0.117	0.561	-0.512	1						
EE	-0.336	0.775	0.262	-0.740	0.092	-0.807	1					
SP	0.512	-0.493	0.009	0.646	-0.293	0.774	-0.776	1				
IE	-0.086	0.897	0.426	-0.678	-0.015	-0.679	0.585	-0.732	1			
PE	0.641	-0.320	0.285	0.552	-0.501	0.902	-0.725	0.345	-0.534	1		
UP	0.154	0.293	0.299	-0.058	-0.441	0.225	0.292	-0.127	0.375	0.149	1	
FB	0.214	-0.063	-0.588	0.608	0.103	0.015	-0.112	0.121	-0.051	0.081	0.152	1
Germany	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.393	1										
SSC	0.395	-0.162	1									
TIPCG	0.899	0.335	0.244	1								
TIPCGC	0.276	-0.001	-0.408	0.060	1							
HE	0.453	0.578	-0.031	0.362	0.147	1						
EE	0.445	0.186	-0.190	0.417	0.416	0.764	1					
SP	-0.510	0.264	-0.538	-0.564	0.134	0.203	0.013	1				
IE	0.230	-0.271	0.881	0.205	-0.562	-0.263	-0.382	-0.676	1			
PE	-0.763	-0.308	0.043	-0.743	-0.466	-0.310	-0.462	0.458	0.108	1		
UP	-0.827	-0.358	-0.063	-0.805	-0.376	-0.551	-0.602	0.359	0.112	0.829	1	
FB	0.630	0.398	0.595	0.468	-0.140	0.666	0.402	-0.214	0.358	-0.294	-0.513	1
Ireland	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.760	1										
SSC	-0.166	-0.313	1									
TIPCG	0.519	0.843	-0.068	1								
TIPCGC	0.423	0.521	-0.677	0.213	1							
HE	-0.165	-0.281	0.671	-0.230	-0.653	1						
EE	0.561	0.498	0.584	0.574	-0.400	0.472	1					
SP	0.092	-0.013	0.889	0.103	-0.688	0.865	0.709	1				
IE	-0.071	-0.183	0.544	-0.060	-0.785	0.908	0.656	0.346	1			
PE	-0.161	-0.292	0.548	0.011	-0.725	0.754	0.612	0.443	0.473	1		
UP	-0.144	-0.240	0.684	0.035	-0.785	0.658	0.625	0.603	0.510	0.567	1	
FB	-0.207	-0.313	0.651	-0.281	-0.633	0.981	0.424	0.472	0.305	0.724	0.637	1

Table A4. continued.

Italy	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.697	1										
SSC	0.613	0.195	1									
TIPCG	0.928	0.576	0.578	1								
TIPCGC	-0.456	-0.537	-0.022	-0.480	1							
HE	0.628	0.285	0.276	0.698	-0.774	1						
EE	-0.414	-0.484	-0.424	-0.464	0.101	-0.003	1					
SP	0.602	0.733	0.424	0.599	-0.548	0.408	-0.460	1				
IE	0.781	0.570	0.557	0.790	-0.739	0.790	-0.320	0.784	1			
PE	0.879	0.778	0.534	0.856	-0.745	0.727	-0.445	0.803	0.932	1		
UP	0.776	0.753	0.613	0.750	-0.607	0.525	-0.533	0.917	0.885	0.933	1	
FB	0.641	0.670	0.089	0.598	-0.836	0.748	-0.028	0.547	0.751	0.799	0.613	1
Netherlands	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.307	1										
SSC	0.708	-0.197	1									
TIPCG	0.298	0.262	0.129	1								
TIPCGC	0.316	0.068	-0.034	-0.653	1							
HE	0.047	0.281	0.143	0.749	-0.803	1						
EE	0.104	0.259	0.245	0.801	-0.863	0.856	1					
SP	-0.013	0.173	0.137	0.782	-0.859	0.956	0.867	1				
IE	0.266	-0.362	0.306	-0.219	0.373	-0.679	-0.304	-0.580	1			
PE	0.602	-0.053	0.758	0.526	-0.324	0.349	0.582	0.411	0.330	1		
UP	0.406	-0.186	0.455	-0.087	0.316	-0.453	-0.162	-0.337	0.738	0.532	1	-
FB	-0.574	0.302	-0.763	-0.025	-0.162	0.139	-0.034	0.074	-0.483	-0.709	-0.684	1
Portugal	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.426	1										
SSC	0.842	0.141	1									
TIPCG	0.848	0.107	0.717	1								
TIPCGC	0.344	-0.014	0.093	0.091	1							
HE	-0.143	-0.260	0.212	-0.307	-0.037	1						
EE	-0.787	-0.356	-0.630	-0.807	-0.048	0.492	1					
SP	0.793	0.161	0.896	0.824	-0.142	0.052	-0.735	1				
IE	-0.801	-0.115	-0.883	-0.697	-0.140	-0.154	0.699	-0.833	1			
PE	0.797	0.083	0.943	0.734	0.028	0.285	-0.624	0.908	-0.944	1		
UP	0.329	0.060	0.516	0.387	-0.383	0.427	-0.227	0.588	-0.546	0.701	1	
FB	0.411	-0.043	0.716	0.197	0.054	0.746	-0.010	0.498	-0.558	0.686	0.519	1
Spain	TR	TOGS	SSC	TIPCG	TIPCGC	HE	EE	SP	IE	PE	UP	FB
TR	1											
TOGS	0.671	1										
SSC	0.080	-0.491	1									
TIPCG	-0.017	-0.037	-0.511	1								
TIPCGC	0.817	0.302	0.443	-0.372	1							
HE	-0.306	-0.630	0.303	0.342	-0.350	1						
EE	-0.332	0.114	-0.614	0.155	-0.307	-0.524	1					
SP	-0.422	-0.144	-0.532	0.627	-0.749	0.567	0.082	1				
IE	-0.196	-0.714	0.419	0.218	-0.022	0.707	-0.250	0.182	1			
PE	-0.206	-0.007	-0.461	0.643	-0.623	0.598	-0.204	0.875	0.100	1		
UP	-0.746	-0.678	-0.094	0.449	-0.720	0.598	0.209	0.578	0.442	0.418	1	
FB	0.093	-0.388	0.591	0.027	0.075	0.821	-0.865	0.171	0.512	0.364	0.140	1

Note: TR is total tax revenue; TOGS is taxes on goods and services, social security contributions; SSC is social security contributions; TIPCG is taxes on income profits a capital gains individuals, TIPCGC is taxes on income, profits and capital gains of corporates; HE is health expenditures; EE is education expenditures; SP is social production expenditures; IE is incapacity expenditures; PE is pension expenditures; UP is unemployment payments; and FB is family benefits, respectively.