Evaluating the Use of Automatic Stabilization in Hungarian Fiscal Policy

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1. Introduction

In recent years, several countries have adopted new types of fiscal rules in response to the financial crisis of 2008. This has led to a vast literature on implementability of fiscal rules and their effect on the impact of government spending on economic variables. Adding to this literature, this paper compares the effects of two types of fiscal rules: a fiscal rule that characterizes following Maastricht criteria in Hungary and a rule incorporating a more explicit form of automatic stabilization used in Bulgaria. To draw this comparison, I set up a real business cycle model in which a fraction of households is assumed to be liquidity constrained. I compute impulse responses of key variables to a government spending shock and I also report measures of output and consumption variability implied by the model. In addition, I review some of the empirical evidence on the evolution of fiscal policy variables and macroeconomic aggregates in the recent past in Bulgaria and Hungary. I also discuss differences in the institutional framework behind the budget process of the two countries as these are relevant for the enforceability of fiscal rules.

Comparing time series for Hungary and Bulgaria, the observed path of debt:GDP ratio and other fiscal indicators differs greatly in recent years. Bulgaria has been more successful at maintaining macroeconomic stability and committing to its advertised fiscal policy of achieving and maintaining a debt:GDP ratio of at most 60% to fulfill Maastricht criteria. Results of the model, however, show no great differences between the effects of the fiscal rule Hungary has adopted and that of Bulgaria. Although impulse responses to a government spending shock differ across countries for the same fiscal rule, the model detects only very small differences in impulse responses within a country for the two fiscal rules being compared. While

this could be indicative of the fact that the model is overly simplistic, an alternative explanation is that rules themselves truly do not differ greatly in their effect on real variables. Instead, features of the institutional framework may have driven the diverging paths observed in fiscal variables in the two countries. Several of the features of the Hungarian budget process in comparison with those of Bulgaria or the features that the OECD identifies as best practices make commitment to any advertised fiscal rule less credible in the case of Hungary. Enforceability of a fiscal rule that aims for automatic stabilization by making tax revenue a function of the output gap as in the case of Bulgaria is particularly questionable given the lack of multi-year expenditure plans at the line item level in the Hungarian budget process.

The rest of the paper is organized as follows. Sections 2.1 to 2.4 present a description of fiscal policy in the two countries. Sections 2.1 and 2.2 compare fiscal rules and institutional framework of the two countries. Section 2.3 presents some of the facts related to the state of the economy and the evolution of fiscal policy variables in the recent past. Section 2.4 offers a brief review of modeling methods used in evaluating fiscal rules. Sections 3.1 to 3.4 present the model's description, calibration, baseline results and sensitivity analysis, respectively. Section 4 concludes.

2.1. Use of Fiscal Rules in Bulgaria and Hungary

Adoption of stringent fiscal rules in Bulgaria came as a consequence of a major economic and social crisis between 1996 and 1997. During this period, the country experienced a severe decline in real GDP, a surge in unemployment and a large increase in the fraction of the population below the poverty line (Hawkesworth et al. (2009) and Manilev (2013)). Hyperinflation and a debt crisis prompted immediate action to reform monetary and fiscal policy. Fully discretionary fiscal policy and the political dependence of the Central Bank needed to be abandoned to achieve fiscal stabilization. A new law governing the central bank's tasks adopted in 1997 no longer allowed direct loans from the central bank to the government and fixed the value of the Bulgarian lev to the Deutsch Mark.

Starting in 2002, to help reduce the debt burden on citizens and to aid EU accession, the Bulgarian government introduced measures that aimed for a budget surplus in case of a boom and allowed for a moderate deficit in a bust. In 2005, an informal coalition agreement between the three biggest parties in the Bulgarian parliament agreed to limit the amount of public spending below 40% of GDP in any given year and to use procyclical tax revenues to keep the debt:GDP ratio well below the 60% level set out in the Maastricht criteria. Formal fiscal rules include a law passed in 2000 to adopt a ceiling each January on the level that the country's debt was allowed to reach in the given year. Governments were able to keep these targets and reduce the target each year before the crisis. In 2010, a new rule was introduced setting a minimum level at 4.5 billion leva for the fiscal reserve held at the central bank. This rule was made necessary because reserves had begun to decline rapidly in 2009. A new Public Finance Law was passed in 2011. This comprised a number of fiscal

rules to restrict the extent to which discretionary fiscal policy could affect fiscal variables by constraining expenditures, budget deficit and government debt. The most important of these rules was the imposition of a 40% ceiling on debt and a maximum allowed actual deficit of 2%. An important objective of the law was to convince EU decision-makers that not only has Bulgaria managed to meet the requirements for joining the euro zone in the past few years but it will permanently abide by these rules in the period after joining the euro zone as well.

In practice, however, the coalition agreement of 2005 is being followed and this acts as a more restrictive constraint on fiscal policy than the Public Finance Law. Debt:GDP targets are currently being set below the 40% level and coalition agreements target a balanced budget over the course of the business cycle which means the average of the actual deficit levels turns out well below the 2% level set by law. The fact that debt levels are not too close to the legally specified levels helps credibility of fiscal rules because in this way there is some opportunity to increase debt levels if this becomes necessary. Credibility of the government following the rules above is also aided by low levels of taxation because this leaves headroom to increase tax rates in such a way that tax revenue is still strongly affected. On the whole, Bulgaria's fiscal stabilization following the crisis of 1997 was very successful and committing to fiscal rules that demand procycical tax revenues played a crucial part in the process.

Hungary does not rely on coalition agreements to determine fiscal rules as Bulgaria does. In their report on Budgeting in Hungary, the OECD (2007, p. 15) claim "Hungary has no fiscal rule in the sense of a long-term constraint on fiscal policy. Instead it has committed itself to a reduction path of the factual deficit in the EU Convergence Programme." This opinion reflects the OECD's view that the Maastricht

criteria by themselves are insufficient to guarantee relatively low levels of debt sustained in the long-run. In the same report, the OECD (2007, p. 15) also claim that "Budgetary adjustments motivated by short-term macroeconomic fluctuations bring a pro-cyclical element into budgetary policy and hamper the stabilizing effect of the budget. This can be avoided by, for example, using a fiscal rule that puts a ceiling on expenditures. Alternatively a cyclically adjusted deficit constraint can be used." The OECD therefore suggest (in their second alternative above) that Hungary should implement a type of fiscal rule similar to the coalition agreements of Bulgaria in that expenditures or revenues should be a function of the stage of the business cycle in the current period.

The Maastricht Treaty signed in 1992 is aimed at maintaining price stability in the euro area even as new EU member states adopt the euro as their official currency. The five convergence criteria include a limit on CPI-based inflation rates, an upper bound for the level of the interest rates paid on 10-year government bonds and the adoption of the exchange rate mechanism which sets a boundary to the extent to which the country's exchange rate to the euro is allowed to depreciate in the two years preceding the start of euro area membership. The remaining two criteria are more directly related to fiscal policy variables: debt:GDP ratio should not exceed 60% at the end of any fiscal year and actual deficit must not be above 3% of the country's GDP. Kopits and Symanski (1998, p. 223) provide a widely accepted definition of a fiscal rule as "a permanent constraint on fiscal policy, expressed in terms of a summary indicator of fiscal performance". Based on this definition, the Maastricht criteria can be thought of as a set of fiscal rules adopted by Hungary. However, there are some prerequisites including the existence of a medium-term budgeting framework that play an important part in the enforcement of fiscal rules.

Differences between Bulgaria and Hungary in this regard are presented in the following section.

2.2. Other Differences in Institutional Framework

Some of the key issues regarding fiscal policy are the enforceability of proposed action and expectations management. These issues are related to the institutional framework behind the budget process of a given country. Differences between Bulgarian and Hungarian regulations and practice regarding budget formulation, execution and transparency could therefore be important drivers of the final outcome of announcing a fiscal rule. These differences are discussed in turn below.

Bulgaria has recently introduced a number of new elements in its fiscal process while the OECD (2007) identifies the need for some of the reforms introduced in Bulgaria and elsewhere to be undertaken in Hungary's budgeting framework. Reform processes in Hungary have been slow and have not included the design of an explicitly set medium-term fiscal framework nor any element of performance budgeting.

The OECD further points out that there is a great deal of uncertainty in market expectations regarding fiscal policy in Hungary given the current fiscal framework. The international trend is to improve expectations management through fiscal rules and transparency because it is considered that it interacts well with monetary policy expectations management to stabilize macroeconomic performance. Accordingly, Bulgaria has seen a series of structural and procedural reforms in the recent past. These include formulation of a multi-year budget and taking a top-down approach. Budget execution, internal audit and treasury functions have also been rethought.

Budget Formulation

OECD best practice (Hawkesworth et al., 2009) identifies making debate explicit and transparent as a very important feature of the budget formulation process. This is relevant for enforceability of fiscal rules because the credibility of the rule in the eyes of market participants is easier to judge if they have insight into whether fiscal rules drive debate in any way. In Bulgaria and Hungary, however, much of the debate between sides with opposing interests goes on in an informal setting and is kept away from the attention of the press and the general public.

Hungary has never formally announced a medium-term expenditure framework. In spite of the fact that Maastricht criteria have led in many EU countries (including Bulgaria) to the development of a more elaborate medium-term fiscal framework, Hungary remains focused on keeping its actual deficit figures in the current and the following fiscal year sufficiently low. In particular, there is a complete lack of adjustment of multi-year expenditures at the line-item level. This focus on actual spending has two implications for fiscal rule enforceability. Firstly, it may lead to overspending because when revenues are high in a boom, the Maastricht criteria can be maintained even with higher spending while in a recession it is hard to cut back on spending in a way symmetric to spending in a boom. Secondly, the fiscal stance becomes very volatile because when short-term forecasts on key macroeconomic aggregates change, this has an implication on the value of deficit that is likely to be measured after the fiscal year ends. This leads to continuous changes in spending plans even during the course of the fiscal year. In Bulgaria, these two issues have less potential to hinder expectations management since the reformed Bulgarian budget formulation process places great emphasis on planning for the medium term. Bulgaria has implemented a flexible framework so that

forecasts are made, objectives of the medium-term fiscal plan are decided and new expenditure ceilings are prepared each year.

The budget formulation phase of the Bulgarian budget process is relatively long as it lasts until October while the parliamentary approval process in Bulgaria takes only about two months. The medium-term budget process lasts until July before attention is finally devoted completely to the annual budget preparation process starting in July. Hungarian budget formulation starts in January, the government submits the budget proposal to Parliament by September 30 and Parliament approves the budget by December 15. This short period for parliamentary approval is in line with the fact that the role of parliament is weak relative to the role of government in Bulgaria and Hungary.

Role of Parliament in the Budget Process and Budget Execution

The Hungarian and Bulgarian legislature approves the budget proposed by the Ministry of Finance with only minor amendments. The parliamentary approval process involves hearings on the budget by various committees. These committees make amendment proposals which are voted on during the plenary sessions. However, the process results in few changes overall to the budget proposed by the executive.

During the execution phase, the Hungarian budget leaves very limited room for reallocation. Reallocation between line items is allowed but reallocation between chapters is only possible in a few exceptional cases. The Hungarian central government budget includes a contingency reserve to meet unforeseen expenditures

or to compensate for unexpected revenue shortfalls. The general reserve appropriation is mandated to be in the range of 0.5 to 2 percent of total expenditures. The government can use this amount in a discretionary way but has to ask the approval of parliament should it want to commit over 40% of the reserve fund in the first six months of the fiscal year. If the aggregate balance of the budget, including social security and extrabudgetary funds, deviates by more than 2.5% of total expenditure in the budget, an amendment to the annual budget law is mandated. However, since the party or coalition that forms the government practically always holds a majority in parliament, proposals for overexpenditure could get approved quite easily.

The Bulgarian budget process leaves more room for transfers. The Minister of Finance can transfer appropriations from one paragraph to another, if the totals, amount or purpose are not changed, with the agreement of both organizations. He/She can approve reallocation among the components of the budget classification, as long as first-level totals are not changed. Line ministries or first-level spending units can move money among second-level spending units within subparagraphs. More flexibility in reallocation of funds may help keep total spending constrained as planned.

Use of Performance Information

The Hungarian budget process is entirely focused on the current and upcoming fiscal year. There is no attention devoted to past years or performance of managers. Instead, expenditure levels are set at a very detailed line-item level allowing for minimal managerial flexibility. For now, Hungary does not follow the trend in OECD

countries to require the reporting of performance information as part of the budget process. Experiences from other countries including the United States show that requiring that goals be set even without having an effect on future appropriations leads to improved efficiency (Blöndal et al., 2003).

In Bulgaria, performance budgeting is in the process of being implemented. It was only in 2009 that for the first time, all central government ministries submitted program budgets. The development of a large number of performance measures and targets has been initiated. Bulgaria uses performance-informed budgeting, i.e., while performance information is important in decision-making, it is not the sole factor determining the amount of allocation of resources. Due to the radical differences between the performance-based approach and practices before such reforms were implemented, changes are somewhat slowly realized.

Auditing and Fiscal Transparency

The National Audit Office is responsible for external audit in Bulgaria. It has staff of only 11. The annual work plan is developed independently based on risk assessment, public interest, and history and it can incorporate governmental requests. Parliament is authorized to request up to five audits per year, but rarely uses this authority.

The supreme audit institution in Hungary is the State Audit Office (SAO). This institution is an independent body that answers directly to Parliament. In stark contrast to the small size of the Bulgarian external audit institution, the Hungarian SAO has over 600 staff. The body is largely independent from day-to-day politics

with president and vice-presidents elected by legislature for terms of 12 years. The SAO has a very broad mandate. Apart from the annual financial audit of the central government budget, which is composed of about 900 budgetary units, the SAO is also charged with auditing the local governments (around 3200). While the Bulgarian National Audit Office can also be tasked with both audit tasks of the central government and of local governments, the difference is that in practice it does not carry out a large number of audit tasks and very few of its tasks are related to local governments. The Hungarian SAO audits both central government and local governments every year. Still, each year only a sample can be audited. Aside from these, the SAO is responsible for audit of any public spending including that of private companies that receive public subsidies. Sampling is not completely random; some audits follow up on hints which may be received through formal or informal channels.

Reports and findings of the Hungarian SAO and the Bulgarian National Audit Office are all made available to the public. Since Hungarian external audit plays a more extensive role, it provides the public with more information than the Bulgarian external audit procedure. In general, however, the lack of transparency in Hungary makes it very difficult to engage in public debate on budgeting matters (OECD, 2007). In Bulgaria, transparency and public involvement are also at a rather low level, most of the existing public involvement in fiscal decisions is at the municipal level. The difference is, however, that reform initiatives to improve fiscal transparency are in place in Bulgaria.

On the whole, several of the features of the Hungarian budget process in comparison with those of Bulgaria or the features that the OECD identifies as best

practices make commitment to any advertised fiscal rule less credible in the case of Hungary. Enforceability of a fiscal rule that aims for automatic stabilization by making tax revenue a function of the output gap as in the case of Bulgaria is particularly questionable given the features of the Hungarian budget process. Without a stage of budget formulation focusing on developing a multi-year expenditure framework, it becomes uncertain that medium-term plans submitted in convergence programs sent to the EU can be carried through. The Hungarian budget process may lead to time-inconsistent decisions because the negative consequences of overspending in the current fiscal year come about in future years and these are not taken into account enough due to the lack of multi-year expenditure plans at the line item level.

2.3. Recent Fiscal Policy and its Outcomes

This section presents some of the facts related to the state of the economy and the evolution of fiscal policy variables in the recent past in Bulgaria and Hungary. The figures in this section use data from Eurostat. Debt and deficit levels have changed very differently in the two countries since the early 2000s. As shown in Figure 3 below, Bulgaria has been more successful at maintaining macroeconomic stability and committing to its advertised fiscal policy of achieving and maintaining a debt:GDP ratio of at most 60% to fulfill Maastricht criteria. Figure 1 shows that expenditures as a fraction of GDP are slightly higher than the EU15 average in Hungary and spending levels have risen slightly during the crisis in a similar way to the case of the EU15. Bulgaria, by contrast, functions on the principles of the free market and has a very small public sector compared to most European countries and especially in comparison with countries of the Eastern and Central European region.

Bulgaria has managed to return government spending to its pre-crisis level by 2010 while since 2007, spending on projects with funding from the EU have been beneficial for Bulgaria's long-term growth prospects (IMF, 2013).

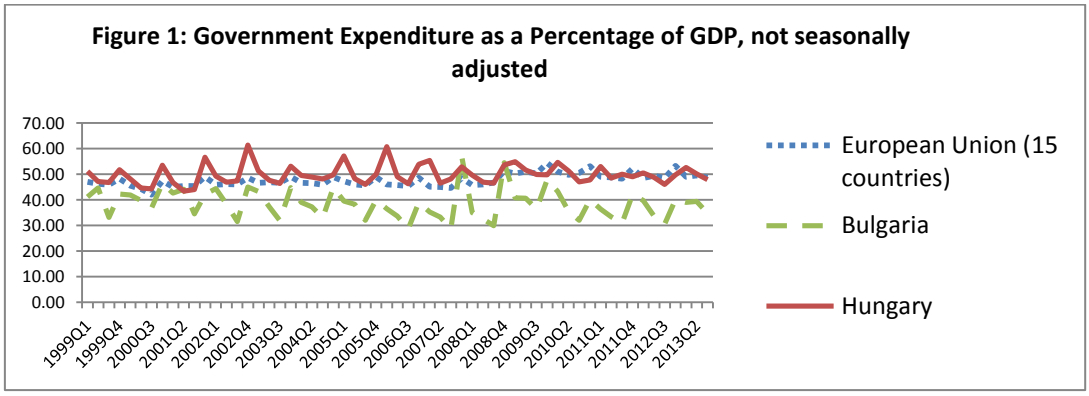


Figure 2 shows government revenues as a fraction of GDP. Revenues have been kept close to the pre-crisis level in both Hungary and countries of the EU15 on average with the introduction of special taxes to offset a declining tax base. Hungary has also resorted to a number of one-off measures, the most noticeable of which was the consequence of the transfer of private pension assets from the previous year to the 2011 budget. Meanwhile the income tax system was simplified in both countries with the introduction of flat-rate income taxes of 16% in Hungary and 10% (which is lowest in the EU) in Bulgaria.

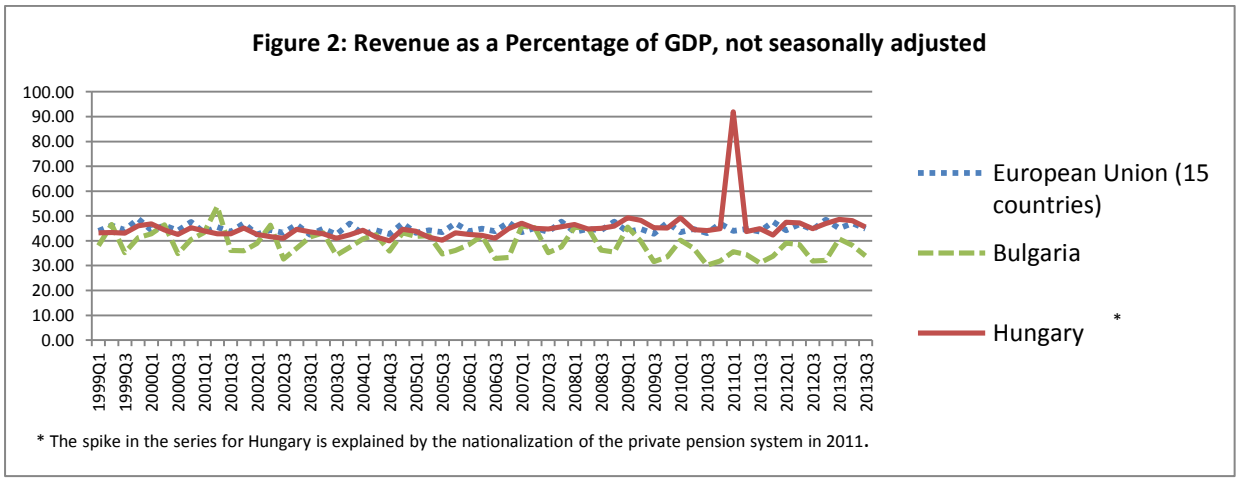
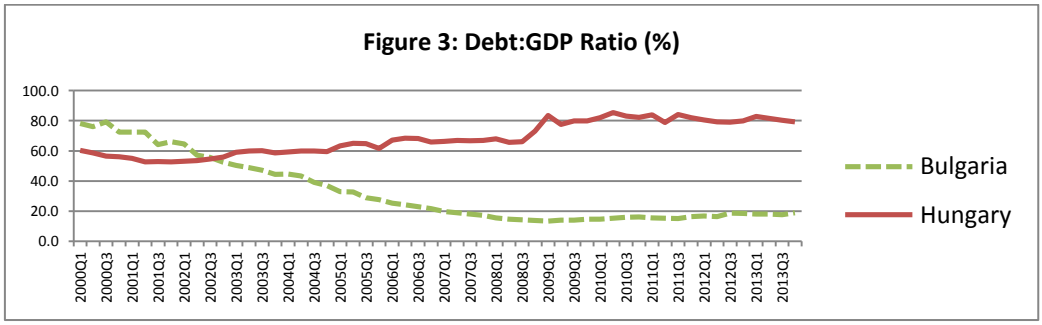


Figure 3 presents the stark contrast between the evolution of debt to GDP ratios in the two countries. Hungary's ratio is more volatile but displays a clear rising trend over the past 14 years while Bulgaria's declined rapidly in the period leading up to the crisis moving in an opposite direction compared to the trend in most European countries in the period. Bulgaria has also managed to cut back on spending to compensate for some of the reduced revenue since 2008. Fiscal easing in Hungary has come about since EU accession in 2004 despite preparation of convergence programs that outlined how Hungary planned to meet the criteria for joining the euro zone. Monetary policy in the two countries is very different with the Bulgarian lev's value fixed at 1.99583 euro. The IMF(2013) argue in their article IV consultation that this fixed exchange rate rule has helped Bulgaria avoid the negative consequences of exchange rate depreciation experienced by other countries in the region. With monetary policy constrained in this way, it is left to fiscal policy to keep the economy on track in Bulgaria. The floating exchange rate system used in Hungary has left fiscal policy vulnerable to wild fluctuations in debt refinancing costs as much of debt is held in foreign currencies.



GDP growth has been quite high on average in both countries. Figures 4 and 5 show that despite similar growth paths, personal consumption expenditures have increased a lot more in real terms in Bulgaria in most quarters. Demand-driven growth in Bulgaria has led to an increase in the tax base that has allowed for

reduction of labor and corporate income taxes without a large impact on overall tax revenue. Personal consumption expenditures used in Figure 5 are a measure of the goods and services purchased by households and non-profit institutions serving households who are resident in the given country (NPISHs). NPISHs are defined as institutions which provide goods and services for free or below market price and are not controlled by the government.

Figure 4: Real GDP Growth, seasonally adjusted

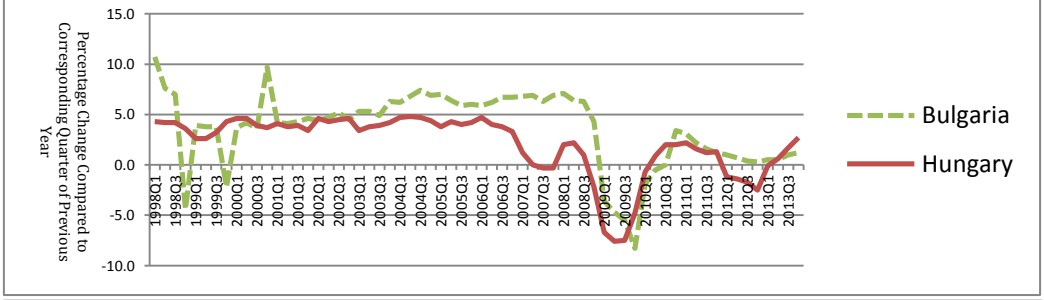
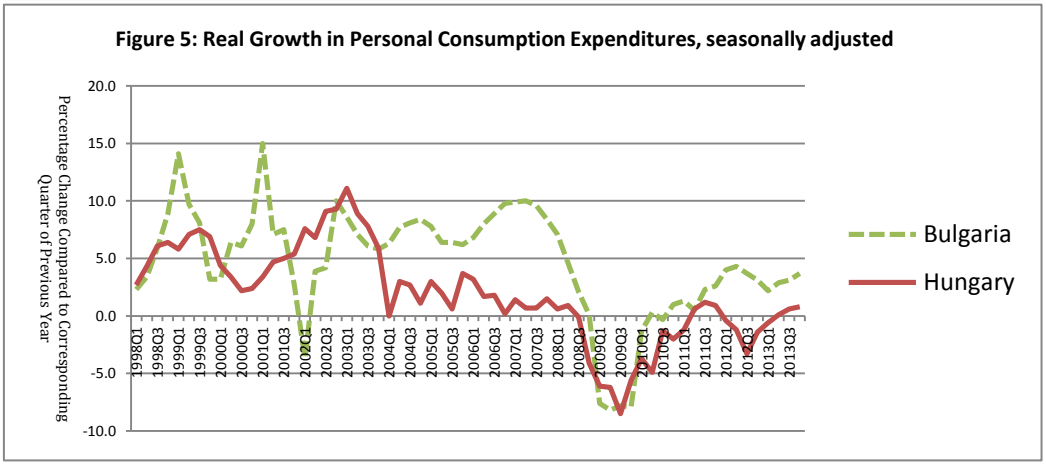
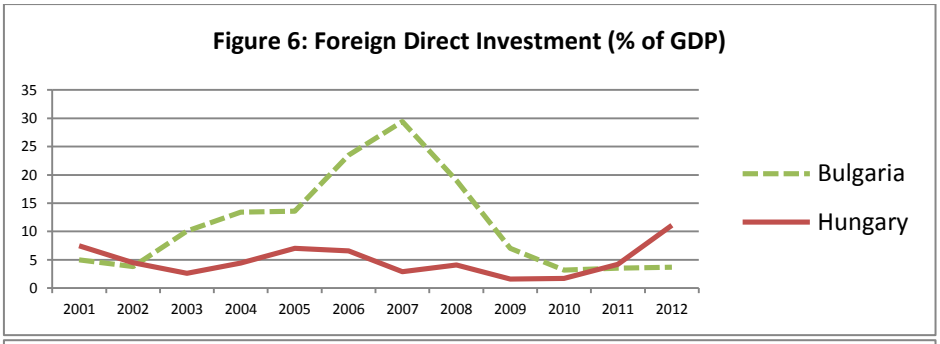
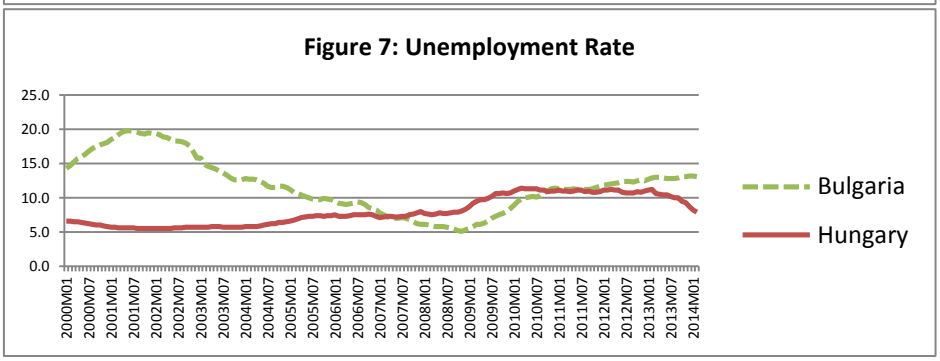


Figure 5: Real Growth in Personal Consumption Expenditures, seasonally adjusted



As shown in Figures 6 below, foreign direct investment has been high in both countries and has contributed to the countries' growth in an important way. The injection of foreign capital was particularly high in Bulgaria before 2009 which also led to a decline in the unemployment rate (Figures 7) which had reached a peak of 19.8% by June, 2001.





Despite stronger values of indicators of macroeconomic and financial stability, Bulgaria is less stable politically than most European countries with turmoil in neighboring Greece and Turkey and high unemployment levels, tax reforms and spending cuts leading to frequent protests. An increase in economic growth in both countries is contingent on recovery of trading partners which remains highly uncertain. In recent reports (IMF (2013), OECD (2014)), the IMF and the OECD both convey the view that countries in the whole region of Central and Eastern Europe are unlikely to do well in terms of growth even on the medium run. Experts at these organizations suggest that not only is recovery from the 2008 crisis slow but due to problems including an ageing population and emigration of young people with high educational levels, even medium-term growth prospects suggest only very slow convergence to richer EU countries in both Hungary and Bulgaria.

2.4. Modeling Approaches to Evaluating Fiscal Rules

In an early paper concerning fiscal rules and automatic stabilization, Blanchard (1990) identifies the main difficulty in evaluating fiscal rules as distinguishing the effect of changes in economic variables and the effect that is actually due to policy. He further lists the three main types of analysis that still characterize most of the literature on evaluating fiscal policy: debt sustainability, the effect of policy on aggregate demand and welfare effects for different groups of society. In response to the financial crisis of 2008, several countries have adopted new fiscal rules which lead to a large increase in the literature on the effects of these rules. Kopits and Symansky (1998) highlight the fact that although the question of the impact of government spending on economic variables is fundamental to macroeconomics, there is no widespread agreement on the answer. The reason this is the case is not just the complexity of the question but also that the answer is specific to a given country in a given economic situation using resources in a given way. It may therefore be the case that while one fiscal rule has better effects of automatic stabilization in one country, another rule may deliver better results in this regard for another country.

A number of papers have used econometric methodology and looked for natural experiments to evaluate effects of fiscal policy. While this type of methodology cannot be used to evaluate a fiscal rule in a particular country before it is implemented, some of the implications of this literature are important for interpretation of results obtained using structural models. Blanchard and Perotti (1999) derive results that suggest the debt:GDP ratio matters for the response of private consumption and other variables to a change in government spending. Bi and

Leeper (2010) use evidence from Sweden to conclude that adoption of certain classes of fiscal rules can act to reduce the risk premium that the market assesses to sovereign debt and that such an effect can even be found during a bust. They further emphasize the importance of the tax rate in the economy and how a fiscal rule may affect the shape of the Laffer curve. In the model section of this paper, I take the approach of attributing automatic stabilization to tax revenues rather than expenditures. Jan et al. (2012) show that in EU countries, around 90% of automatic stabilization is indeed attributable to revenue under the assumption that the budget with no automatic stabilization (used as a benchmark) is one where expenditure and revenue levels are held fixed.

Papers that analyze the effects of fiscal rules using DSGE models typically assume some form of heterogeneity among households. Without this element, the Ricardian equivalence result holds (assuming taxes are lump-sum) so that agents consume out of their lifetime income thus most fiscal rules are perfectly ineffective if there exists just one type of infinitely lived representative agent. Blanchard (1985) and Yaari (1965) use an overlapping generations setting in continuous time to model heterogeneity. A simpler approach that has become popular in recent years is to assume that a fraction of consumers is liquidity constrained and cannot borrow or save. Campbell and Mankiw (1990) were the first to suggest this methodology in an RBC framework, arguing that some empirical regularities are better explained under these assumptions than in the preceding RBC literature.

Galí (2007) uses a new-Keynesian model with rule-of-thumb agents that also features nominal rigidities in price setting, a union setting wages and monopolistic competition among firms. The model generates a positive response of real consumption to a shock to government spending. Galí argues that this result is in

line with empirical evidence which he finds using VAR methodology. Their baseline calibration assumes half of the agents in the economy are rule-of-thumb agents. For lower values of the fraction of liquidity-constrained consumers, however, the response of consumption turns out to be negative or zero. Sandica and Alupoaiei (2013) obtain similar results calibrating the model Galí uses to the Romanian economy. In previous work, however, Smets and Wouters (2003) and Coenen and Straub (2004) use similar assumptions to those of Galí but obtain a negative response of consumption to a government spending shock.

To the best of my knowledge, there hasn't yet been a paper that presents a comparative analysis evaluating the effects of fiscal rules in Bulgaria and Hungary. This is not necessarily a gap in the literature that it is vital to fill. My contribution is rather to add to the literature that seeks to evaluate the effects of switching between fiscal rules. I choose to focus on Hungary and Bulgaria because these two countries are located close to each other geographically, cultural differences are small, yet there are large differences in institutional framework, adopted fiscal rules and the observed path of fiscal variables in the past few years.

3.1. The Model

The economy consists of a continuum of households, a continuum of firms and a fiscal authority. Agents live forever and households and firms optimize in a forward-looking way while the government plays a passive role obeying a budget constraint and enforcing a fiscal rule. Households are of two types. A fraction λ of households is liquidity constrained which means they are unable (or unwilling) to either borrow or save. The rest of the households are assumed to be Ricardian, having access to a full set of contingent securities.

The utility function for both types of households is:

$$u(c_t^i, l_t^i) = \ln(c_t^i) + a\ln(l_t^i)$$

where c_t^i denotes private consumption, l_t^i denotes the fraction of the agent's time endowment devoted to leisure activities and *i=o,r*; *o* refers to Ricardian households and *r* to rule-of-thumb households.

Each household maximizes:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \ln(c_t^i) + a\ln(l_t^i) \right\}$$

The Ricardian household does so subject to:

$$k_{t+1}^o + b_{t+1}^o = (1-\delta)k_t^o + w_t n_t^o + r_t^k k_t^o - c_t^o - t_t^o + R_{t-1} b_t^o \quad (1)$$

Its optimality conditions are:

$$\frac{1}{c_t^o} = \beta E_t \left[\frac{1}{c_{t+1}^o} (1 - \delta + r_{t+1}^k) \right] \quad (2)$$

$$\frac{a}{1-n_t^o} = \frac{w_t}{c_t^o} \tag{3}$$

$$\frac{1}{c_t^o} = \beta R_t E_t \left[\frac{1}{c_{t+1}^o} \right] \tag{4}$$

where all variables are in real terms: w_t stands for wages, r_t^k is net return the Ricardian household receives at the beginning of period t for holding one unit of capital stock for one period, R_{t-1} is the gross return the household attains for holding a unit of a risk-free government bond from period t-1 to period t (paying one unit of consumption good in period t). Note that the timing convention is different for returns to holding capital and bonds to emphasize the fact that R_{t-1} is known at period t-1 while r_t^k only becomes known with certainty in period t. Further variables are k_t which stands for capital stock held by households at the beginning of period t, b_t are bond holdings at the beginning of period t, n_t denotes labor supply and t_t are lump-sum taxes (or transfers, if negative) paid by households. Lump-sum taxes are assumed to be equal for all households.

The budget constraint for non-Ricardian households simplifies because they do not save in either bonds or capital:

$$c_t^r = w_t n_t^r - t_t \tag{5}$$

so that the non-Ricardian household just consumes its disposable income every period. Rule-of-thumb households do optimize with respect to labor and consumption so that even though they are liquidity-constrained they can adjust their labor supply in response to an increase in taxes. Sandica and Alupoaiei (2013) among other

authors who use this type of model assume $n_t^r = n_t^o$ so that rule-of-thumb households do not optimize with respect to any variable. But this assumption is based on a different labor market structure. In particular, wages are set by an economy-wide union and firms choose hours given these wages. Households agree to supply these hours as wages are assumed to be high enough to induce all households to meet firms' labor demand. In my version of the model, however, a competitive labor market is assumed in which each type of household chooses its labor supply given the market wage so that labor supply can be different for Ricardian and non-Ricardian households. Therefore, there is an intratemporal optimality condition derived from the utility maximization problem of rule-of-thumb households:

$$\frac{a}{1-n_t^r} = \frac{w_t}{c_t^r} \tag{6}$$

Rule-of-thumb consumers can compensate for a high level of taxes by adjusting labor supply upwards but they solve a static problem so they do not smooth consumption over time in the sense that Ricardian agents do. It is also assumed that government spending yields no utility for either type of household.

Aggregate quantities are a weighted sum of the corresponding variables for each consumer type:

$$c_t = \lambda c_t^r + (1-\lambda) c_t^o \tag{7}$$

$$n_t = \lambda n_t^r + (1-\lambda) n_t^o \tag{8}$$

$$k_t = (1-\lambda) k_t^o \tag{9}$$

$$b_t = (1-\lambda) b_t^o \tag{10}$$

$$i_t = (1-\lambda) i_t^o$$

where i_t denotes investment in time t.

Firms operate in a perfectly competitive market and produce a single, homogenous good. They also solve a static problem maximizing output minus production costs: $y_t - w_t n_t - r_t^k k_t$ subject to the production function:

$$y_t = z k_t^{\alpha} n_t^{1-\alpha} \tag{11}$$

The resulting optimality conditions are:

$$w_t = (1-\alpha) z k_t^{\alpha} n_t^{-\alpha} \tag{12}$$

$$r_t^k = \alpha z k_t^{\alpha-1} n_t^{1-\alpha} \tag{13}$$

The market clearing condition for goods is:

$$y_t = c_t + i_t + g_t \tag{14}$$

where g_t denotes government consumption and i_t refers to investment by households.

Government spending is driven by an exogenous stochastic process:

$$g_t = (1-\rho)\bar{g} + \rho g_{t-1} + \varepsilon_t^g \tag{15}$$

where ε_t^g is normally distributed with mean 0 and variance σ^2 and $\bar{g}$ denotes steady-state government spending while ρ gives the persistence of a shock to government spending.

The government budget constraint states that the government finances its expenditures by lump-sum taxes on households and by issuing bonds:

$$b_{t+1} + t_t = R_{t-1} b_t + g_t \tag{16}$$

This analysis assumes a closed economy. In practice, a substantial fraction of Hungarian and Bulgarian government bonds is bought by foreign investors. However, even assuming a small open economy, both types of agents would make the same consumption and leisure choices as in the model presented here provided that the foreign real interest rate was equal to the domestic rate. Rule-of-thumb agents do not borrow at all. When the Ricardian agent buys government bonds, it is fully aware that it will get back the present value of these bonds with certainty in the future. The Ricardian household has perfect foresight and unlimited access to saving through investing in capital. Therefore its labor supply and consumption decisions are not affected by the government issuing debt just as in the case of rule-of-thumb agents. The only thing that matters for households' choices in the context of this model is the impact of a rise in government spending on taxation, not whether debt is financed domestically or externally.

In the paper I examine the consequences of three fiscal rules: a balanced budget rule, a rule that sets a target for the debt:GDP ratio and reacts to changes in government spending and a rule that captures a more direct form of automatic stabilization. These rules are:

$$\Delta b_t = 0 \quad \forall t \tag{17}$$

$$\frac{t_t - \bar{t}}{\bar{y}} = \phi_b \frac{b_t - \bar{b}}{\bar{y}} + \phi_g \frac{g_t - \bar{g}}{\bar{y}} \tag{18}$$

$$\frac{t_t - \bar{t}}{\bar{y}} = \phi_b \frac{b_t - \bar{b}}{\bar{y}} + \phi_y \frac{y_t - \bar{y}}{\bar{y}} \tag{19}$$

The fiscal rule given by equation (18) is characteristic of the rule Hungary claims to follow in the sense that the Stability and Growth Pact requires setting a target Debt:GDP level and the criteria also suggest the reduction of actual budget deficit. Deficit is constrained by the rule's implication that revenues adjust upward in case of a positive shock to government spending. In addition to setting a target for Debt:GDP, Bulgaria has also recently introduced strict measures of automatic stabilization as described above, hence the specification in equation (19) which has lump-sum tax revenue depending explicitly on the deviation of output from its steady-state level.

Equations (1) through (16) and either of the fiscal rules (17), (18) or (19) give a competitive equilibrium solution to the model for a given set of parameter values.

3.2. Calibration

Calibrating the Fraction of Rule-of-Thumb Agents

Campbell and Mankiw (1989) were the ones who originally proposed a model in which forward-looking agents and rule-of-thumb agents coexist. Their main motivation for taking this approach was to develop a test for a form of the permanent income hypothesis by estimating the λ fraction of rule-of-thumb agents in the economy and testing whether this fraction differs significantly from zero. In his influential paper, Robert Hall (1978) presents the permanent income hypothesis according to which an expected change in aggregate disposable income of households should not explain the expected change in aggregate consumption in real terms. Hall models the economy as one that is populated by a single type of fully rational agent who optimizes over an infinite horizon. Assuming the potential existence of rule-of-thumb agents, however, Campbell and Mankiw estimate the fraction of rule-of-thumb households in the US at values between 0.316 and 0.698 depending on the chosen econometric specification. These estimates are found to be statistically significant while it is evident that even the smallest estimate they obtain indicates a large deviation from Hall's result in an economic sense. In this section, I present Campbell and Mankiw's methodology and use their approach to get estimates for the parameter λ separately for Bulgaria and Hungary.

Households optimize their consumption spending by maximizing their utility function:

$$E_t \sum_{s=0}^{\infty} \left(\frac{1}{1+\theta} \right)^s U(C_{t+s})$$

where U is increasing and concave and θ is the subjective discount rate of the representative consumer. The budget constraint is

$$\sum_{s=0}^{\infty}\left(\frac{1}{1+r}\right)^{s}(C_{t+s}-w_{t+s})=A_t$$

where r is the real interest rate assumed to be constant over time, A_t are assets from human capital and w_t are exogenously given earnings. The optimality condition obtained by solving this model is

$$E_tU'(C_{t+1})=\left(\frac{1+\theta}{1+r}\right)U'(C_t)$$

Assuming $r=\theta$ and that marginal utility is linear, the random walk result follows according to which $E_tC_{t+1}=C_t$ so that $\Delta C_t=\varepsilon_t$ where ε_t has zero mean and moves only in response to an unexpected change in permanent income.

The authors make the additional assumption that the fraction of income that accrues in a given period to each type of household corresponds exactly with their share in the population. So if Y_t denotes aggregate disposable income then disposable income for rule-of-thumb households is λY_t. Since rule-of-thumb consumers consume their current income, indexing these agents by 1, $C_{1t}=Y_{1t}=\lambda Y_t$ which implies $\Delta C_{1t}=\Delta Y_{1t}=\lambda\Delta Y_t$. For optimizing households, the random walk result derived above holds, so that $\Delta C_{2t}=(1-\lambda)\varepsilon_t$. This formulation implies the following relation between changes in disposable income and aggregate consumption:

$$\Delta C_t=\Delta C_{1t}+\Delta C_{2t}=\lambda\Delta Y_t+(1-\lambda)\varepsilon_t$$

This equation suggests the approach of running a regression with change in consumption as the dependent variable and change in disposable income as the independent variable to get an estimate for the fraction of households that consume their current income. In order to have a homoscedastic error term, however, it is preferable to divide both ΔC_t and ΔY_t by the lagged level of disposable income, Y_{t-1}. OLS estimates using these scaled variables are reported in Table 1 below.

Table 1: Estimates for λ

	λ	s.e.	p-value	R^2	N
Bulgaria	0.55	0.56	0.01	0.11	10
Hungary	0.46	0.15	0.36	0.39	17

Unfortunately, net disposable income data have only been collected in some recent years and only on an annual basis for Bulgaria and Hungary. The time series I use are annual real disposable personal income per capita and annual private consumption of nondurable goods in real terms obtained from the Eurostat database. Disposable income and private consumption are not adjusted for spending on individual goods and services by government and NPISHs on behalf of the household. Data on real disposable income are available from 2002 to 2012 for Bulgaria and from 1995 to 2012 in the case of Hungary, hence the reported low number of observations. Campbell and Mankiw argue that instrumenting for disposable income using lagged values of consumption and disposable income is a better approach. However, this would require a longer time series like those available for the United States since use of instrumental variables greatly increases standard errors. One way to run the above specification with more data would be to proxy for net disposable income using quarterly data for real GDP. While this would

undoubtedly lead to lower standard errors, it may not give the desired effect because depending on source of the change in GDP, the change may or may not be associated with a change in net disposable income of households. For US data, Campbell and Mankiw find a correlation between real GDP and real disposable income of 0.55 which suggests GDP could be a poor proxy variable.

Another potential concern is the existence of an omitted variable bias in the context of the regression specification used above to estimate λ. In particular, the existence of a risk premium may give an incentive for agents to save more. Therefore, the γ coefficient on the risk premium would be expected to be negative in the alternative specification $\Delta C_t = \lambda \Delta Y_t + \gamma rp_t + \varepsilon_t$ where rp_t denotes the risk premium at time t. Risk premium is unobserved because it is difficult to design experiments to elicit an accurate measure of agents' subjective discount rate θ. However, since risk premium is countercyclical and disposable income is procyclical, the correlation between ΔY_t and rp_t should be negative. This would imply an overall positive bias on the above estimate for λ.

It is common practice in the literature in papers typically focused on a single economy to just assume a value for λ as is the case in a famous application of rule-of-thumb behavior in Galí et al. (2007). Because this is a comparative analysis, however, I prefer to take estimates from Table 1 to assuming values without any estimation.

Calibrating Other Parameters

Table 2 shows parameter values for both countries. To calibrate fiscal parameters ρ and $\frac{\bar{g}}{y}$, I use historical data (1995Q1-2013Q4) for government spending while debt:GDP ratios are calibrated to announced fiscal policies as described in section 2.1 above. Estimates for ρ are obtained by estimating an AR(1) process for the detrended government spending series in the case of either country.

Table 2: Calibration for Bulgaria and Hungary

parameter	Bulgaria	Hungary
λ	0.55	0.46
ρ	0.99	0.88
$\frac{\bar{g}}{y}$	0.38	0.5
$\frac{\bar{b}}{y}$	0.4	0.6
ϕ_b	0.292	0.292
ϕ_g	0.123	0.123
ϕ_y	0.207	0.602
a	4.313	4.335
α	0.33	0.33
β	0.99	0.99
δ	0.025	0.025

The values for policy parameters ϕ_b and ϕ_g in fiscal rule (18) are taken from Sandica and Alupoaiei (2013) who use these values in their analysis of the Romanian economy. These values imply a plausible path for a reaction to a government spending shock. However, since the magnitudes and relative size of these parameters is ultimately at the government's discretion at the time of setting a fiscal

rule, I vary these parameters in the sensitivity analysis section below to show the impact of these changes on results. In the baseline case for fiscal rule (19), I set ϕ_b to the same value as in fiscal rule (18) and set ϕ_y such that the response on impact of output to a government spending shock matches the impact response using fiscal rule (18). In this way, the calibration of the fiscal parameters in the two fiscal rules is chosen to be as similar as possible. Thus, results show whether the same effect can be reached using either fiscal rule or whether there are significant differences in the implied responses other than the impact response of output.

To obtain the parameter a, I use the assumption made above that Ricardian and rule-of-thumb consumers share the same form of utility function. Combining optimality conditions above leads to the following expression:

$$a = (1-\alpha)\frac{\bar{y}}{\bar{c}}\frac{1-\bar{n}}{\bar{n}}$$

I use data for real consumption and GDP from Eurostat and data for hours worked from the Total Economy Database to find the weight for leisure in preferences. Elgin and Yucel (2013) use the same method to measure weight for leisure in preferences and find evidence of substantial variation among industrialized countries in the value of parameter a. According to their measures, values for 52 countries range from 1.6 to 8.2 and have a standard deviation of 0.9. Nevertheless, the measures for Bulgaria and Hungary turn out to be virtually identical.

For the remaining three parameters, α, β and δ, I use values commonly used in the literature which are practically the same as those in either of the DSGE papers cited above.

3.3. Results

In the presentation of results below, I use the same model but using different calibrations for the two countries as detailed in Table 2. The notation used in the titles of plots is the same as the notation used in presenting the model in section 3.1 and each figure contains a plot for impulse responses assuming each type of fiscal rule. The figures show impulse responses to an exogenous shock to government expenditure of the magnitude of 1% of steady-state output. All impulse responses are expressed in terms of units of steady-state output except for return to capital (r) and interest rate on bonds (rb) which are given in percentage points.

Due to increased taxation, both types of agents face a negative wealth effect in each of the cases below to which both agents react by decreasing their private consumption. This crowding out effect is offset somewhat by increased investment on the part of Ricardian households in the case of Bulgaria. In all cases below, however, the negative wealth effect on consumption is stronger than the impact on investment which leads to an output multiplier below 1 both on impact and in the long-run. Moreover, in the case of Hungary, the effect of the shock on investment is negative driving the output multiplier further down. Ricardian agents disinvest in the case of Hungary because the shock is perceived as being less persistent than in Bulgaria and agents who can borrow therefore smooth consumption by decreasing their capital stock. Since rule-of-thumb agents have no access to borrowing, they suffer a greater drop in their consumption levels than Ricardian agents do. This is the case especially for the less persistent shock experienced in Hungary.

Figure 8: Impulse Responses for Hungary

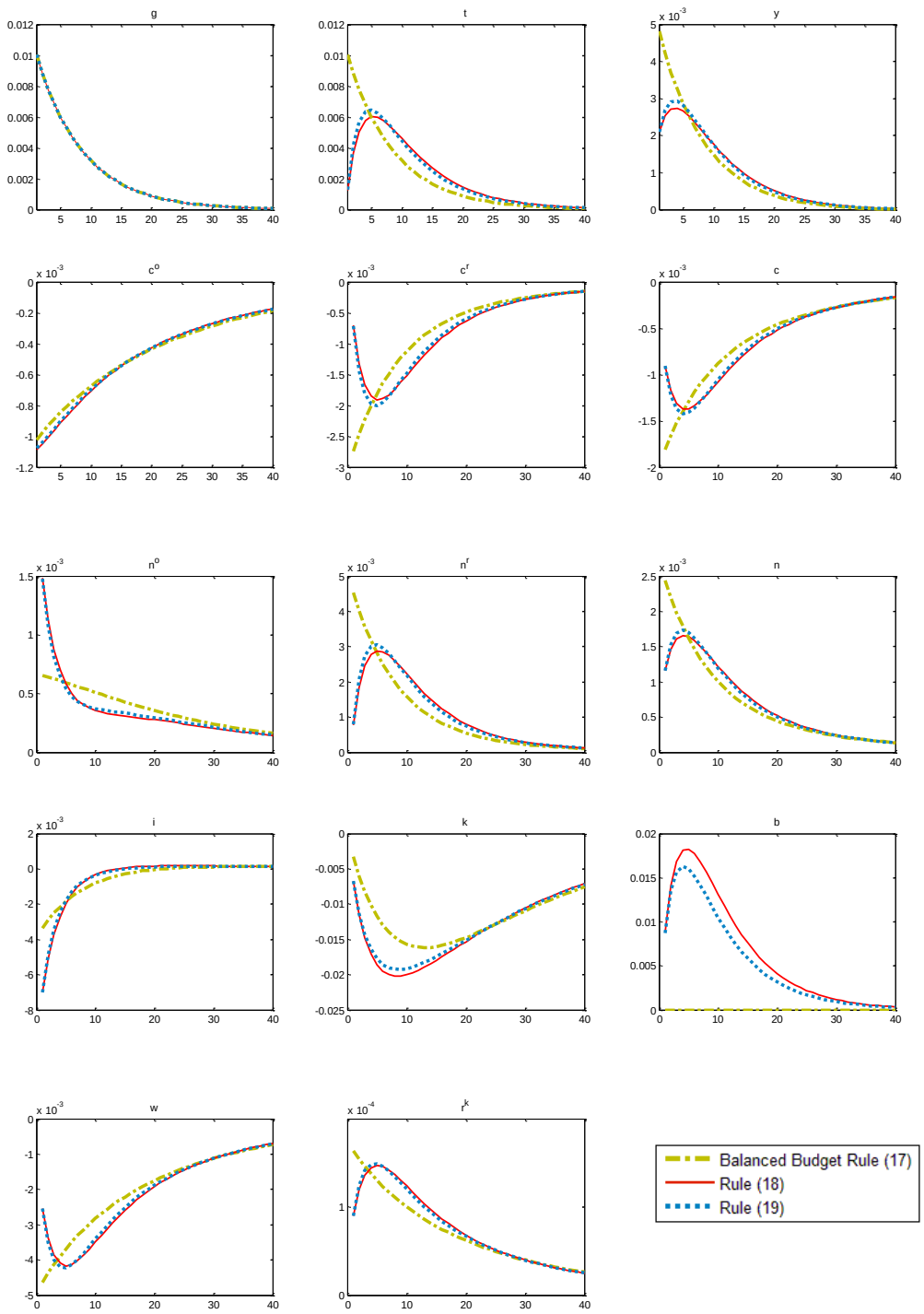
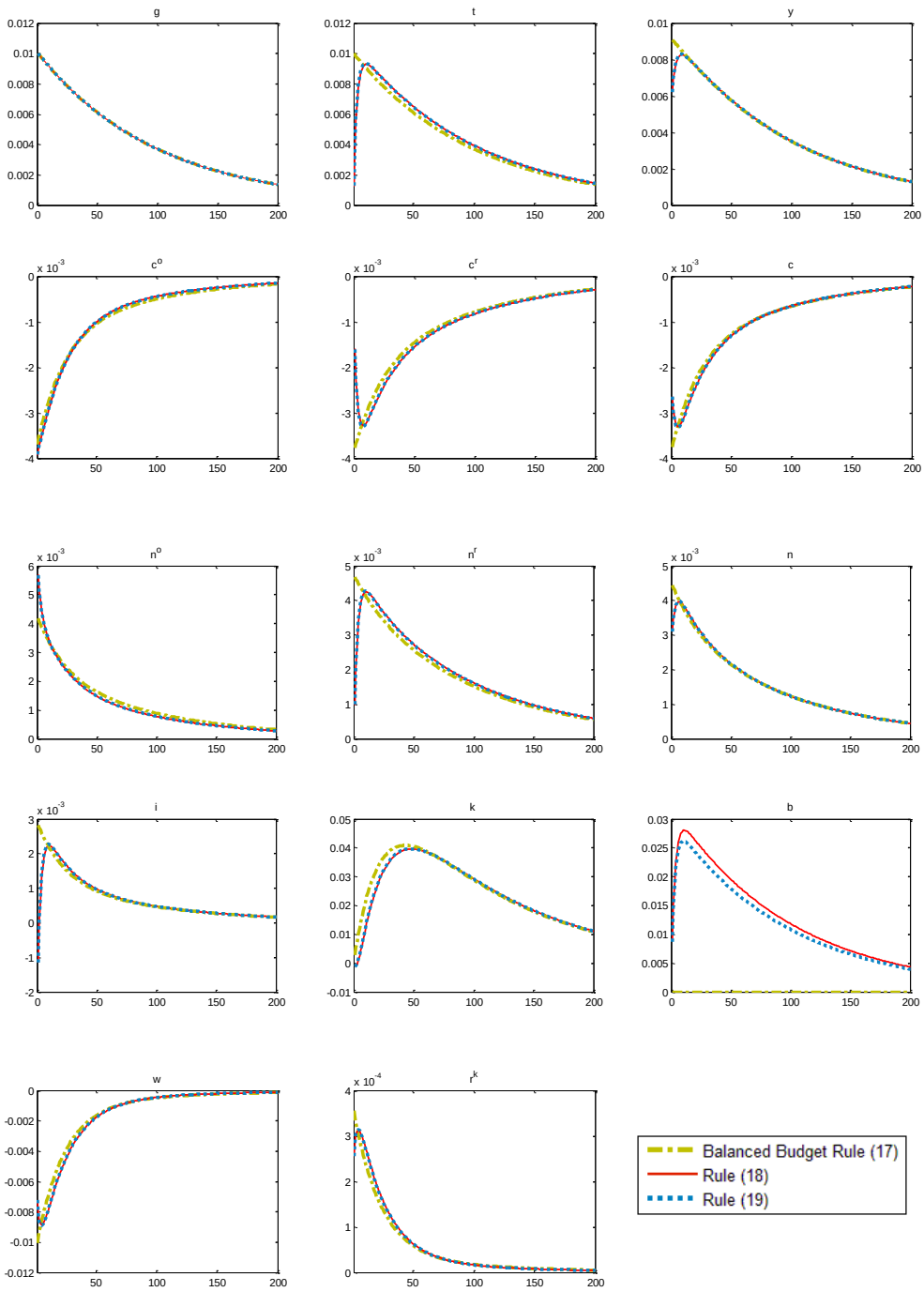


Figure 9: Impulse Responses for Bulgaria



The other reaction of agents to the negative wealth effect is to increase their labor supply. The Ricardian household bases its decisions mainly on the present value of taxes. However, it is also aware that rule-of-thumb households will react strongly to changes in actual levels of taxation in future periods. In particular, rule-of-thumb households gradually raise labor supply between the first and fifth quarters following the shock. This drives down real wages. Anticipating such an effect, the Ricardian households grab the opportunity to greatly adjust their labor supply upwards as soon as the shock hits to increase their savings before the periods of high taxation.

Table 3: Consumption and Output Variability (model standard deviations)

	Y, Bulgaria	Y, Hungary	C, Bulgaria	C, Hungary
balanced budget	0.0661	0.0100	0.0181	0.0048
fiscal rule (18)	0.0650	0.0082	0.0183	0.0048
fiscal rule (19)	0.0651	0.0085	0.0183	0.0048

Output multipliers are higher for the persistent shock in Bulgaria and are higher on impact in the case of a balanced budget rule than for the two more sophisticated fiscal rules. Accordingly, the highest multiplier on output among all specifications is the impact multiplier for Bulgaria for the balanced budget rule at 0.91. Consumption and labor supply responses are also higher in the case of Bulgaria and the responses to all variables are more persistent due to higher persistence of the shock itself. The shape of impulse responses, however, is very similar for both countries in response to either of the two fiscal rules. The one exception in this respect is investment as discussed above. Table 3 presents standard deviations implied by each of the models above for output and consumption in the case of both countries. The table shows that output variability is reduced by both types of fiscal rules due to a smoother taxation scheme in response to the exogenous spending increase.

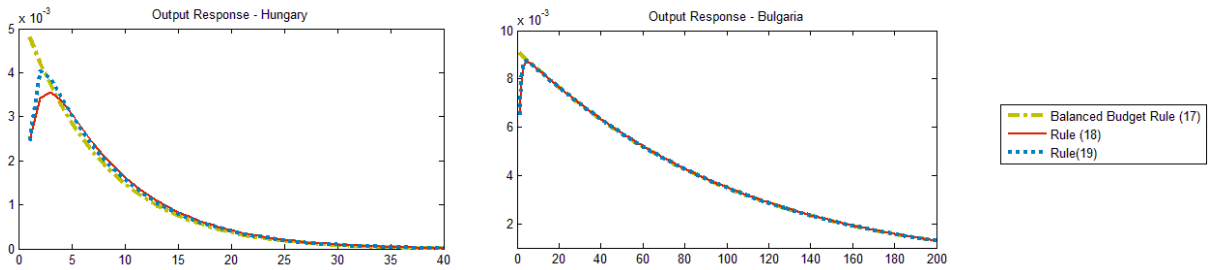
Fiscal rules (18) and (19) act to delay the largest amount of taxes paid to the fifth quarter. This leads the largest responses of rule-of-thumb households to be delayed accordingly. Responses for Ricardian households, however, remain highest on impact for either type of fiscal rule. Given the relatively high fraction of rule-of-thumb consumers in the economy, the aggregate responses turn out to also have peaks a few periods after impact. Relative to the simple fiscal rule of having a balanced budget every period, the other two rules act to prolong the responses of prices, taxes, consumption, labor supply and output. However, peak responses of the above variables are smaller for both countries assuming fiscal rules (18) and (19).

The most important comparison in light of the question studied in this paper is that of the effect of fiscal rules (18) and (19) in a given country. These results are found to be remarkably similar. The parameters of fiscal rules in the case of both countries are matched such that the response of output on impact is equal for each country in the case of the two studied fiscal rules. However, following the impact response of output, variables are allowed to evolve according to the implications of the model. Even so, the shapes of impulse responses for all variables are virtually identical. Effects are also very close in terms of their magnitudes. Output response differences are microscopic in the case of Bulgaria and very small for Hungary. As Table 3 shows, there is no difference in the variability of consumption comparing the two fiscal rules while output variability is slightly higher in case of fiscal rule (19) for Hungary, a difference that can be seen on close inspection comparing the impulse response figures themselves. From this, it can be inferred that according to the model, the same policy goals can be reached in either country using either fiscal rule.

3.4. Sensitivity Analysis

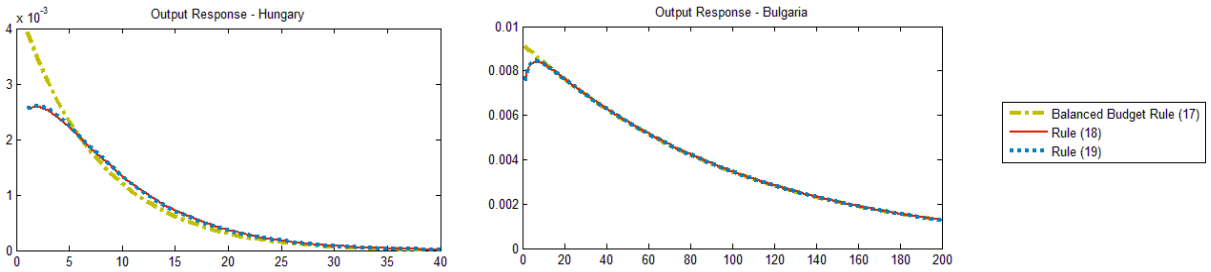
To assess the impact of changing the policy parameters ϕ_b, ϕ_g and ϕ_y in the fiscal rules above, I double the value of ϕ_b and ϕ_g. I then adjust ϕ_y for each country such that the impact response of output is the same for both fiscal rules (18) and (19) in the same way as the impact response was set equal in the baseline case above. Therefore, the results presented for Hungary in Figure 10 below are output responses for the calibration $\phi_b = 0.584$, $\phi_g = 0.246$ and $\phi_y = 0.3864$ with all other parameters left at their baseline values given in Table 2 above. For Bulgaria, $\phi_b = 0.584$, $\phi_g = 0.246$, $\phi_y = 1.0172$ and all other calibration values are as given for Bulgaria in Table 2.

Figure 10: Varying Fiscal Rule Parameters



Since all policy parameters are set to be higher than in the baseline case, the effect is that the extra debt incurred by the spending shock must be repaid faster. The results show that this implies output has a stronger response on impact than in the baseline case but output reverts back faster to its initial steady-state value. Crucially, however, the difference between the effects of fiscal rules (18) and (19) within a country are still very similar. This result is therefore robust to changes in policy parameters within the framework of this model.

Figure 11: Varying Fraction of Rule-of-Thumb Households (λ)



The results of Figure 11 are derived taking a similar approach to that used for policy parameters above to analyze the sensitivity of baseline results to a change in the fraction of rule-of-thumb households in the economy. As argued in section 3.2 above, the results I find using Campbell and Mankiw's methodology could overestimate the parameter λ. I therefore present results here for values of λ that are 0.2 lower than in the baseline calibration for each country, i.e. 0.35 for Bulgaria and 0.26 for Hungary (other parameter values are as in the baseline case). While reducing λ has a small positive effect on the impact multiplier for output, the result that fiscal rules (18) and (19) give similar results within a country still holds. Moreover, this result holds also for adjusting the value of λ upwards with respect to the baseline calibrations (this is not reported here in the form of further graphs).

4. Conclusion

The model presented above is very stylized. Features of nominal rigidities and more sophisticated approaches to modeling consumer heterogeneity can be used to get impulse responses and theoretical moments that are more realistic. However, it need not be the case that any of these changes should have an effect on the result which is the focus of my analysis. Comparison of impulse responses of the two studied fiscal rules may still yield very similar results despite changes in the impulse response functions themselves. Indeed, despite large differences between results for the baseline case and the cases examined in the sensitivity analysis section above, the conclusion with respect to the comparison of impulse responses for the two fiscal rules remains the same as in the baseline case.

The main conclusion of model results is that the same objectives can be achieved using either the type of fiscal rule that characterizes following Maastricht criteria by Hungary or the type of fiscal rule incorporating an explicit response of taxes to a change in the output gap. According to the model, therefore, the difference in the empirical evidence observed in the past years is not due to the difference between the two rules as suggested by OECD reports cited above but rather due to factors that are not captured by the model. An alternative explanation relative to that of the OECD is that rather than differences in the fiscal rules themselves, differences in institutional framework may have driven the diverging paths observed in fiscal policy variables in the two countries. This interpretation would lead to the policy implication that attention needs to be focused on how the institutional framework is suited to the government making a credible commitment to the fiscal rule. Both types of fiscal rules discussed above have similar effects of reducing output variability. Therefore,

differences in institutional framework discussed in section 2 could be more important drivers of different paths of fiscal variables in the two countries than differences between the theoretical effectiveness of the types of fiscal rules the countries claim to be implementing. The validity of this policy conclusion could be further explored by generating impulse responses from other DSGE models to test if the above result still holds.

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