THE FISCAL THEORY OF THE PRICE LEVEL: EVIDENCE FROM THREE CENTRAL EUROPEAN COUNTRIES

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Abstract

The paper investigates whether the fiscal theory of the price level (FTPL) offers a more plausible explanation to the recent developments in three Central European countries: the Czech Republic, Hungary and Poland. I follow the method of Canzoneri et al. (2001) to see if traditional theories or the FTPL gives a more plausible interpretation of these developments. After interpreting the impulse responses from the VAR models estimated for the countries and for different panels of these countries, the conclusion is that, while neither theory can be reject by the data, the FTPL adds little additional insights to the standard theories.

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1 Introduction

The 1990's has witnessed the remarkable transformation of former communist economies into capitalism. This process culminated in the accession of eight ex-communist countries to the European Union (EU) in 2004. The next (mandatory) step in the process of integration for these countries is to join the Economic and Monetary Union (EMU). To clear this hurdle the new accession countries will have to, among other requirements, fulfill strict limits on their public finances and demonstrate the ability to keep their price levels stable. Thus far only one country, Slovenia, has managed to do this, none of the other countries have been able to prove that their economic policies are in line with the requirements of the EMU and sustainable[1] . Recent political developments in most countries have cast serious doubts over the possibility of a sudden change in this situation. As noted in an overview of Central and Eastern Europe in *The Economist*: "... here is one striking fact. Not a single country of the EU-8 has a strong reformist government" (October 14, 2006). In fact, it seems that while most countries were keen on passing through tough economic reforms before the EU accession, the reform zeal was muted after they got in.

Some countries, most notably Hungary have done especially poorly in recent years as far as public finances are concerned. The budget deficit increased to above 10 percent of the gross domestic product (GDP) sending the debt to GDP ratio to around 70 percent, well above the 60 percent threshold of the Maastricht criterion. The question of this paper is how such developments affect other important macroeconomic variables, most importantly inflation. Recent literature in monetary economics has emphasized the role of fiscal authorities in the determination of the price level. The fiscal theory of the price level (FTPL) goes as far as to suggest a direct link between total government liabilities and the price level. Would such a link prevail, the sustainability of economic policies should be examined even more carefully.

[1]Estonia, Latvia and Lithuania are all in the Exchange Rate Mechanism II (ERM II), the last step before the entry to the EMU, but none of them was given green light to proceed, although they have served their mandatory two years in the ERM II. Slovakia is also in the ERM II and awaits judgement later this year, when it finishes its mandatory two years.

In this paper I analyze the developments in three Central European economies: the Czech Republic, Hungary and Poland. The investigation is limited to these countries primarily because of data concerns. Since these economies have experienced very similar history since transition begun I do not only analyze the countries separately, but also group them into a panel and investigate if something more general can be found out about them.

The key difference between the fiscal theory of the price level and the more traditional explanations of price level determination hinges on the way fiscal policies are modeled. If Ricardian equivalence is assumed to hold at all periods, then the new theory offers no new insights into the determination of the price level. If, however, Ricardian equivalence is not assumed to hold, then the FTPL offers a fundamentally new way of price level determination. Thus, deciding whether fiscal policies are Ricardian or not is the main point of the paper. Canzoneri, Cumby and Diba (2001) have done that for the United States and the analysis in this paper follows their path. A vector autoregressive model is estimated for the three counties and for a panel of these economies, to shed some light on the relationship between the primary balance, total liabilities of the government and the discount factor. The impulse responses of these variables to a primary surplus shock is investigated to decide whether a Ricardian or a non-Ricardian interpretation of the data is more plausible.

The findings of the analysis are inconclusive; in most of the cases it is possible to interpret the impulse responses in both ways. While the Ricardian interpretation is always straightforward, the primary surplus pays off some debt, the non-Ricardian interpretation usually is rather complicated and rests on expectations about the correlation between the primary balance shock and the future values of the primary balance or the discount rate. The most interesting finding is the marked difference between the behavior of the countries before and after their EU accession.

The paper is organized as follows. The next section introduces the fiscal theory of the price level, section three discusses the empirical research done in the topic and sets up the econometric model that will be estimated. Section four then discusses the results of the analyzes, while the last section offers some concluding remarks.

2 The Fiscal Theory of the Price Level

This section is divided into three major parts. The first offers a thorough description of the fiscal theory of the price level (FTPL), part two compares this new theory to the existing views of price level determination while part three is devoted to an overview of the critiques of the FTPL.

2.1 The Theory

The FTPL offers a fundamentally new approach to price level determinacy, which is in stark contrast with the way most economists used to think about the determination of the price level. The theory advocated by Leeper (1991), Sims (1994), Woodford (1995, 1998, 2001), Cochrane (1998), and reviewed in Christiano and Fitzgerald (2000) and in Kocherlakota and Phelan (1999) adds a special role to the government. According to the FTPL it is possible for the government to use "policy instruments such as the taxes or debt policy, in conjunction with monetary policy to determine the time path of inflation", this feature of the government arises from the assumption that "the government can behave in a fundamentally different way from households" (Kocherlakota and Phelan (1999) p. 1). In particular the government is not obliged to satisfy its intertemporal budget constraint for all prices; instead it can choose policies which satisfy the budget constraint for some price level but not for all price levels. Such policies are dubbed non-Ricardian policies. From a more technical point of view, the difference between the standard theories and the FTPL is that the government budget constraint is interpreted as an equilibrium condition rather than a constraint that must hold in all states of the world (as in the standard monetary theories).

Next I will develop the theory formally following the discussion in Walsh (2003). The main objective is to demonstrate the difference between an economy where fiscal policy is Ricardian and an economy where the fiscal policy follows a non-Ricardian pattern. To keep the discussion simple consider a model with representative households a government and no capital. Households decide on their consumption path and on the amount of assets (government bonds and money) they are willing to hold, subject to their intertemporal

budget constraint:

$$D_t + P_t y_t - T_t \geq P_t c_t + M_t^d + B_t^d = P_t c_t + \frac{i_t}{1+i_t} M_t^d + \frac{1}{1+i_t} D_{t+1}^d \tag{1}$$

P_t being the price level at time t, $D_{t+1} = (1+i_t)B_t^d + M_t^d$ standing for financial wealth at the beginning of period $t+1$, c_t denoting real consumption, y_t being real gross output, i_t being the nominal interest rate, T_t denoting taxes paied by the households, M_t denoting the stock of money at the end of period t, while B_t is standing for the nominal stock of interest-bearing government bonds also at the end of period t. (Throughout the paper capital letters will denote nominal variables, while lowercase letters will stand for the respective real figures. The only exception is the interest rate.) The inequality in the budget constraint (equation 1) should be satisfied with a strict equality, if the households behave optimally. This budget constraint can be reformulated (after dividing by P_t and recursive substitution) as

$$d_t + \sum_{i=0}^{\infty} \lambda_{t,t+i}(y_{t+i} - \tau_{t+i}) = \sum_{i=0}^{\infty} \lambda_{t,t+i} \left[c_{t+i} + \frac{i_{t+i}}{1+i_{t+i}} m_{t+i}^d \right], \tag{2}$$

where $\lambda_{t,t+i} = \prod_{j=1}^{i} \frac{1}{1+r_{t+j}}$ is the discount factor and $(1+r_t) = \frac{1+i_t}{1+\pi_{t+1}}$ is the real interest rate, which is assumed to be determined exogenously.

The government budget constraint at period t takes the form

$$P_t g_t + (1+i_{t-1})B_{t-1} = T_t + M_t - M_{t-1} + B_t, \tag{3}$$

where g_t stands for real government consumption. Dividing both sides by the price level yields,

$$g_t + d_t = \tau_t + \frac{i_t}{1+i_t} m_t + \frac{1}{1+r_t} d_{t+1}, \tag{4}$$

where τ_t stands for real tax revenue. Recursive substitution for d_{t+i} gives,

$$d_t + \sum_{i=0}^{\infty} \lambda_{t,t+i}[g_{t+i} - \tau_{t+i} - \bar{s}_{t+i}] = lim_{T\to\infty} \lambda_{t,t+T} d_T, \tag{5}$$

where $\bar{s}_t = \frac{i_t}{1+i_t} m_t$ is the government's real seigniorage revenue.

Equation 5 is useful to highlight the main difference between the FTPL and the standard view of the budget constraint. According to the standard theory, the right hand side of the equation should be equal to zero for all price levels, and so Ricardian

equivalence would hold. The FTPL, however, does not place any restrictions on the right hand side.

How does the equilibrium in the economy come about? To see this one needs to consult the intertemporal budget constraint of the households (equation 2), and substitute for c_t and m_t^d the equilibrium conditions for the goods market in a simple economy with no capital $y_t = c_t + g_t$ and the equilibrium condition of the money market $m_t^d = m_t$, respectively. This gives then,

$$d_t + \sum_{i=0}^{\infty} \lambda_{t,t+i}[g_{t+i} - \tau_{t+i} - \frac{i_{t+i}}{1 + i_{t+i}} m_{t+i}] = 0. \tag{6}$$

Under Ricardian fiscal policies this equation was already imposed by assumption, whereas under a non-Ricardian regime this equation is a new constraint that should be fulfilled by the equilibrium paths of $(g_t, \tau_t, m_t, i_t, d_t, \lambda_{t,t+i})$. Rearranging this equation gives,

$$\frac{D_t}{P_t} = \sum_{i=0}^{\infty} \lambda_{t,t+i}[\tau_{t+i} + \bar{s}_{t+i} - g_{t+i}]. \tag{7}$$

From this equation the fundamental difference between a Ricardian and a non-Ricardian regime can easily be seen. In a non-Ricardian setup the only endogenous variable in the above equation is the price level, thus for an exogenous path of $(g_t, \tau_t, \bar{s}_t, D_t, \lambda_{t,t+i})$ it is the price level that has to adjust in order for the equilibrium condition to hold. In a Ricardian regime, however, this would not be the case, since the primary surplus (right hand side) would automatically adjust to assure fiscal solvency for any path of the price level (Canzoneri, Cumby and Diba (2001)).

2.1.1 Why are non-Ricardian regimes important?

The main point of the FTPL literature is that monetary authorities are not necessarily able to control inflation, as there might be other factors besides the money stock the affect the price level. For example Woodford (1995) argues that an interest rate peg might result in an indeterminate price level if the fiscal authority pursues non-Ricardian policies. Standard theories, on the other hand, imply that the quantity theory of money is the sole relationship that pins down the price level. As shown in Walsh (2003) this might not be the case. The quantity theory states that demand for real money balances

equal real money supply:

$$\frac{M_t}{P_t} = f(i_t) = f(r_t \frac{P_{t+1}}{P_t}). \tag{8}$$

However, since nominal interest rate is itself a function of the price level, equation 8 alone might not be able to determine the price level. Equation (8) is a difference equation that has an infinite number of possible solutions that would be consistent with a perfect-foresight equilibrium. One of these possible equilibria has the appealing property that it implies a constant price level path, whereas all other equilibria result in an explosive path for the price level. Standard theories treat the constant path as the equilibrium solution, while proponents of the FTPL argue that it is the additional equilibrium condition (the intertemporal budget constraint of the government, equation (7)) that chooses one of these possible equilibria, if and only if fiscal policy is non-Ricardian. If that were true, would it be reasonable to hold the central bank responsible for price stability? The answer of the fiscal theory of the price level is clearly no. As noted by Canzoneri et al. (2001 p.2) the FTPL is also able to explain why central banks are so concerned "about the constraints placed upon them by loose fiscal policies."

After understanding the fundamentally different results the FTPL offers compared to standard theories, an important question arises. There have been theories before the FTPL that argued in favor of a link between budget deficits and inflation, is the FTPL somehow different from these theories? This question will be addressed in the next section.

2.2 Theories of the Price Level

There are numerous theories of inflation in economics, which I will not go through in this paper. The goal of this section is to elaborate on the two most influential theories of price level determination: the orthodox monetarist view, and the regime of fiscal dominance.

2.2.1 The monetarist view

McCallum and Nelson (2006) have recently reviewed both the monetary and fiscal theories of price level determination, their findings will be used in this section. The monetarist view of inflation does not deal with the possibility of non-Ricardian regimes:

> "In an economic sense, the budget is always balanced. The only question is how the total tax is divided between open and above-board taxes and hidden taxes" (Friedman(1987))

Thus according to their view the Ricardian equivalence holds at every point in time, so they conclude that:

> "I dont think monetary policy has to be backed up by fiscal policy at all. I think monetary policy can curb inflation." (Friedman quoted in Larsen(1981))

This view has to be qualified somewhat, as even the monetarist acknowledge that a budget deficit can be inflationary if it is financed by printing money (through "hidden-taxes").

> "Government spending may or may not be inflationary. It clearly will be inflationary if it is financed by creating money" (Friedman(1987) p. 17)

After reviewing these and many other works by famous monetarist economists McCallum and Nelson (2006) concludes that according to the monetarist's view: "Fiscal expansion produces inflationary pressure insofar as it is accommodated by monetary policy, or is expected to be accommodated in the future." (p.17). So even the monetarist view allows for cases, where fiscal policy can cause inflation indirectly, through an increase in the money supply.

2.2.2 Fiscal dominance

The idea that certain ways of financing fiscal policies might result in inflation does not originate from the monetarists. One of the most influential articles about the role of fiscal policy in the determination of the price level is the paper by Sargent and Wallace (1981), which sheds light on some "unpleasant monetarist arithmetic". They also view the intertemporal budget constraint of the government as a constraint that has to hold at all times. Thus the value of the government debt has to equal the present value of future primary surpluses and seigniorage incomes. As a result a tax cut today will have to be financed by a respective increase in taxes or by a decrease in expenditures or by additional seigniorage incomes in the future. If the government does not adjust taxes and

expenditures, then the central bank will have to accommodate the tax cut by an increase in the money stock which will lead to an increase in the price level. Regimes where the monetary authorities passively accommodate fiscal policies are labeled as regimes of fiscal dominance.

As can be seen from the preceding discussion there is nothing irreconcilable between a system of fiscal dominance and the orthodox monetarist view, in fact fiscally dominant regimes fit very well into the monetarist framework. This, however, is not the case with the fiscal theory of the price level.

2.2.3 The real difference

The fundamentally new thing with the FTPL is that the price level is determined irrespective of the money stock. As Ricardian equivalence is not required to hold, there is no direct link from the fiscal policy to the monetary like in the case of fiscal dominance, where inflation is caused by an increase in the money stock triggered by loose fiscal policy. In the case of a non-Ricardian fiscal policy the additional equilibrium condition pins down the price level irrespective of the money stock, even if monetary policy is following monetary targeting rule, i.e. determines the stock of money directly.

In fact, McCallum and Nelson (2006) argue that the most interesting results of the FTPL emerge in cases where the central bank holds the nominal money stock constant, because in here the price level and the nominal stock of money can diverge indefinitely from each other, which is in stark contrast with all previous theories. In their view, on the other hand, the results where the monetary authority pursues an interest-rate peg produces, similar results to monetarism, the nominal stock of money and the price level move together.

2.3 Critique of the FTPL

The kind of price level determination advocated by the FTPL has received many criticism most notably from Buiter (2002), McCallum (2003), McCallum and Nelson (2006) and Niepelt (2004). Buitler criticized the approach that the government acts as an agent who can set the price level instead of an agent who is a price taker. Although he

does agree that the initial price level might be determined in the way the FTPL assumes it, he sees no further role of the fiscal policy in the determination of inflation. McCallum argues that the solution provided by the FTPL is irrelevant for plausible parameter values (McCallum and Nelson (2006)), and that the rational expectations solution of the FTPL is not learnable. Thus McCallum suggests that the FTPL's solution to the multiple equilibria problem is something actual policymakers should not be concerned with. Niepelt (2004) argues that non-Ricardian policies "are inconsistent with an equilibrium in which all asset holdings" reflect optimal household choices.

On the other hand, Harashima (2004) built a model that introduces an optimizing government into a general equilibrium framework. He argues that there is a fundamental difference between the government and the private sector, which is a different rate of time-preference. In his model this difference can only be reconciled by a steady inflation, which is caused by fiscal factors rather than monetary ones. Thus this model can be seen as a microfundation of the fiscal theory of the price level.

3 Empirical Studies

Understanding the controversial predictions of the FTPL it is interesting to see if the empirical studies can lend support to its unorthodox results. After reviewing the fiscal theory it should be evident that it is only important in cases where the fiscal policy is non-Ricardian. Only in these cases is the FTPL able to take over the role of the nominal anchor. On the other hand, non-Ricardian policies mean less restriction on the theoretical model (see the explanation of equation 5), so the FTPL allows the data to speak for itself and decide whether the additional restriction (Ricardian equivalence) is in fact true. These considerations lead Woodford (1995) to suggest that Ricardian regimes should be regarded as rather special cases.

Canzoneri et al. (2001), on the other hand, have argued that many models of fiscal policy would qualify as a Ricardian regime, thus fiscal policy would not be able to provide the nominal anchor in these instances. Formally they show that a simple fiscal policy rule like $s_t = a_t * d_t + \epsilon_t$ (ϵ being a random variable) would be a Ricardian policy as long as $limsupa_t > a^* > 0$. This means that a fiscal policy rule, which responds to the amount of government liabilities by arbitrarily small changes in the primary surplus and arbitrarily infrequently may also result in a Ricardian regime, provided that these infrequent adjustments still happen an infinite number times over the infinite time horizon. So for example a small adjustment in every century is enough to make the fiscal policy Ricardian. To summarize the theoretical considerations, one can argue that although Ricardian regimes may present a borderline case from a theoretical point of view (Woodford) many real-life policies would actually fall into the set of these borderline cases (Canzoneri et al.).

The results from the empirical analyzes are mixed. Canzoneri et al. (2001) prove their point on the plausibility of Ricardian regimes by investigating annual postwar (1951-1995) data from the United States and conclude that a Ricardian-regime looks more plausible than a non-Ricardian one. They arrive at the same conclusion for different subperiods in their sample. However David, Leeper and Chung (2004), find that the fiscal theory is relevant in a regime-switching environment, where there is a positive probability of a non-Ricardian policy.

Thams (2006), using similar technique as Canzoneri et al. (2001), finds evidence

that fiscal policy is able to explain the inflation differences between Germany and Spain in the 1990's. He found that while fiscal policy had no influence on prices in Germany, the development of the fiscal policy in Spain affected the price level. Moreover Darrat (2000) did find some evidence supporting the FTPL using Greek data. The inconclusiveness of the empirical research on the FTPL results primarily from the fact that it is impossible to formulate testable restrictions from the theory, because the validity of the theories depend on agents' expectations about the *future* policy measures. This point will be explained in detail in the following section.

3.1 The problem of identification

The biggest obstacle in deciding whether the fiscal theory of the price level is at work is the identification problem. If only equilibrium outcomes are observed, than it is impossible to distinguish between the FTPL and the standard theory, since, in equilibrium, they both respect the government budget constraint. As Sims (1994 p. 381) puts it: "Determinacy of the price level under any policy depends on the public's belief about what the policy would do under conditions that are never observed in equilibrium."

To circumvent the identification problem, Canzoneri et al. (2001) estimated a vector autoregressive (VAR) model in the three variables (primary balance over GDP, total liabilities over GDP, discount factor) and looked at the impulse responses from this model to find out which theory is more compatible with the data. To see the rational behind this model consider the government's budget constraint (equation 3), the central piece of the theory. For the empirical analysis it is more convenient to interpret B_t and M_t as the stocks of outstanding government liabilities *at the beginning* of period t. Then the government budget constraint should be written as,

$$B_t = (T_t - P_t g_t) + (M_{t+1} - M_t) + \frac{B_{t+1}}{1 + i_t}. \tag{9}$$

Dividing both sides by nominal GDP ($P_t y_t$), instead of just the price level P_t as in the case of equation 3, makes the resulting variables easier to interpret. After rearranging terms the resulting equation will be,

$$\frac{M_t + B_t}{P_t y_t} = \left[\frac{T_t - P_t g_t}{P_t y_t} + \frac{M_{t+1}}{P_t y_t}\frac{i_t}{1 + i_t}\right] + \left[\frac{y_{t+1}/y_t}{(1 + i_t)(P_t/P_{t+1})}\right]\left[\frac{M_{t+1} + B_{t+1}}{P_{t+1} y_{t+1}}\right] \tag{10}$$

The left-hand side is liabilities over nominal GDP, the first term on the right hand side is primary balance (surplus) (including central-bank transfers to the government) to GDP ratio, while the last term in the equation is the discount factor multiplied by liabilities over GDP ratio in the subsequent period. Using the notations from chapter 2 this equation can be simplified to,

$$\frac{d_t}{y_t} = \frac{s_t}{y_t} + \beta_t \frac{d_{t+1}}{y_t} \tag{11}$$

where $s_t = \frac{T_t - P_t g_t}{P_t} + \bar{s}_t$ and $\beta_t = \frac{y_{t+1}/y_t}{(1+i_t)(P_t/P_{t+1})}$ stands for the discount factor. Iterating equation 11 forward and taking expectations will give,

$$\frac{d_t}{y_t} = \frac{s_t}{y_t} + E_t \sum_{j=t+1}^{\infty} \left(\prod_{k=t+1}^{j-1} \beta_k \right) \frac{s_j}{y_j} \tag{12}$$

Equations 11 and 12 are the cornerstones of the empirical analysis. The econometric model is a vector autoregression in the three variables contained in equation 11

$$\begin{bmatrix} \frac{s_t}{y_t} \\ \frac{d_t}{y_t} \\ \beta_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} + \sum_{s=1}^{p} \begin{bmatrix} B_{11}(s) & B_{12}(s) & B_{13}(s) \\ B_{21}(s) & B_{22}(s) & B_{23}(s) \\ B_{31}(s) & B_{32}(s) & B_{33}(s) \end{bmatrix} \begin{bmatrix} \frac{s_{t-1}}{y_{t-1}} \\ \frac{d_{t-1}}{y_{t-1}} \\ \beta_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix} \tag{13}$$

where $B(s)$ are the estimated coefficients and u_t denotes the disturbance term. Since the VAR model is linear in the right hand side variables, and the relationship between variables in equation (11) is not linear the estimated model should be regarded as an approximation of equation (11). The point of interest are the impulse response graphs produced by the model to a shock to the $\frac{s_t}{y_t}$ variable.

Canzoneri et al. (2001) tried to interpret these impulse responses in both a Ricardian and a non-Ricardian fashion. The interpretations can most easily be formulated using equation 12. While neither theory can be falsified this way, the plausibility of the interpretation can be used as a guide to determine which theory is supported by the data. The lack of falsification results from the fact that agents beliefs about the behavior of the government in the (perhaps arbitrarily distant) future can validate both the Ricardian and the non-Ricardian interpretation. In particular, they note that the effect of a positive shock to the primary surplus is rather straightforward in a Ricardian regime, it pays off some debt. In the case of a non-Ricardian regime, however, the nominal debt figure should be uncorrelated with the primary surplus. This appears to be an easy way to distinguish

between the two regimes, but unfortunately it is not completely valid, because one has to take into account the correlation between a positive innovation in the primary surplus today and the future values of the surplus (or the discount rate). If they are uncorrelated, i.e. there is no autocorrelation in the primary surplus series and no correlation between the primary surplus and the discount factor, then the simple logic above is right.

If, however, an improved primary balance today implies further improvements in the future values of the surplus or the discount rate, then according to the present value budget constraint of the government (equation 12) the liabilities over price level ratio should also increase in a non-Ricardian regime. This can only come about through an increase in the price level, since the amount of nominal liabilities is fixed. Thus a positive correlation in the primary surplus figures (or with the discount factor) would result in an *increase* in the liabilities over price level figure in a non-Ricardian regime, while the improved primary balance would be used to pay off some debt in a Ricardian policy framework (see equation 6), resulting in a *decrease* in the liabilities per price level figure, which means that, regardless of the prevailing correlations, the two policy regimes could be separated after investigating their impulse responses.

The real problem arises when an improvement in the primary surplus today is accompanied by a deterioration in the primary balance (or the discount factor) at a later point in time. In this case, if the future deficits (or discount factors) are big enough, the present value of the future surpluses would fall, resulting in an increase in the price level and so in a *fall* in the liabilities over price level ratio in a non-Ricardian regime. In a Ricardian regime the increased primary surplus could pay off some debt initially, which would also result in *drop* in the liabilities over price level figure. Thus this method is also unable to differentiate the between the two cases under all possible circumstances, but at least in some cases it can provide an answer, assuming that the we can extrapolate the observed correlations in the past to the future.

The initial response of the liabilities over GDP ratio was negative and significant for up to 10 years, while the surplus per GDP series showed little persistence after the initial shock, depending on the model it turned insignificant after one or two periods. These findings were reported to be robust to different model specifications (in models

that included the discount factor and also in model where it was omitted). After trying to interpret the impulse responses both ways, the authors found that a non-Ricardian regime could only explain the developments if there was a negative serial correlation in the primary balance over GDP series or if a negative correlation between the primary balance over GDP and the discount rate were in place. Exploring the database, however, they found significant positive autocorrelation in the surplus per GDP series up to ten years, meaning that an even stronger negative relationship is required at more distant lags for the non-Ricardian explanation to be plausible. Since these correlations were not found in the data they concluded that the Ricardian interpretation of the impulse responses is more plausible.

3.2 Model selection and the Data

VAR models are quite convenient econometric tools, since they do not require the time-series to be stationary. The only requirement is that the disturbance terms should not be autocorrelated, in this case the ordinary least squares estimate of the parameters will be unbiased. I estimated each model with four lags initially, then used the Schwarz (Bayesian) Informational Criterion to select the right VAR model. This criterion is known for its tendency to favor more parsimonious models, which is very welcomes in this analysis, since the datasets are rather small. The best VAR models selected by the information criterion were always stable, i.e. their impulse responses did converge, although this takes quite a few periods in some cases. Before turning to the estimation results a few comments on the dataset are needed.

The data was mainly collected from the International Financial Statistics (IFS) database of the International Monetary Fund, but some series were taken from the database of the National Bank of Hungary and from the National Bank of Poland (for details please refer to the Data Appendix). The variables used in the estimation are primary surplus plus seigniorage ($\frac{i_t}{1+i_t}m_t$) for s_t, where m is the monetary base [2], while total liabilities include total debt plus the monetary base. The discount factor is computed as $\beta_t = \frac{y_{t+1}/y_t}{(1+i_t)(P_t/P_{t+1})}$, with y_t being the real GDP figure, P_t being the GDP deflator, and i_t

[2]Except for the Czech Republic where the 'money' series from the IFS is used.

is the nominal interest rate on 3-month Treasury bills [3].

The sample that is used in the estimations consists of three Central European countries: the Czech Republic, Hungary and Poland. For the Czech Republic quarterly data was available from 1994 to the end of 2006. The Polish sample was somewhat shorter, it starts in 1996, while the Hungarian data series is the shortest as it only starts in 1997. The obvious advantage of collecting quarterly data is that there are roughly 40 observations even in the Hungarian sample which enables the study of the countries individually. This advantage, however, comes at a cost: most variables involved in the analysis exhibit severe seasonal fluctuations. These were eliminated by the X12 seasonal adjustment algorithm of the US Census Bureau, which is a built-in procedure in the E-views software package that was used for the econometric analysis. (The graph of each variable used in the regressions can be found in Appendix 1.) A short panel of annual data was also compiled from the individual country databases. Annual data are a simple sum of the quarterly figures for flow variables, while the figures for the last quarter were used as annual data for the stock variables.

[3]for Poland the Treasury bill series is too short so I used the money market rate.

4 Results

As a first exercise, I investigated all countries separately and tried to see if some evidence of non-Ricardian policies could be found in the full dataset for these countries. To check the robustness of the models a VAR model was estimated on a panel compiled from the annual observations in the three countries. Then I combined the individual country data into an unbalanced panel and split the full period (1994-2006) into two eras: pre-accession (1994-2002) and post-accession (2003-2006) periods. The idea is that there appears to be a major difference between the way these countries conducted economic policy before the accession and thereafter. As articulated in an article in *The Economist* in "...the countries of the east, which have so wrenchingly changed since the collapse of communism...you will not find one united, modernizing government [today]." (October 14, 2006). Thus it would be interesting to see whether the FTPL is more supported by the data from the later period than by the dataset from the earlier one. Although all three countries joined the European Union in May 1, 2004, the rational behind my choice of the cut-off date is that the EU Accession Treaty was signed in December 2002 by all three countries. The presented impulse responses show the response of the three variables to a one standard deviation primary balance shock (the initial shock was created by the 'generalized impulse' function of E-views). The graphs include the two standard deviations band along the impulse responses. The responses in all cases were robust to the ordering of the VAR and to the inclusion of additional lags.

4.1 The Czech Republic

4.1.1 Brief review of recent fiscal policies in the Czech Republic

The first annual budget deficit was recorded in 1996 after three consecutive years (1993-1995) of positive balances. The burdens of successive bank bail-outs, natural disasters (floods), general welfare benefits in addition to an expensive healthcare and state funded pay-as-you-go pension system pushed the budget into the red ever since. Up until 1998 the budget was always planned to be balanced, but this has never materialized, even though for example 1997 saw a major fiscal adjustment (a restriction worth of about 3 percent of

the GDP) during the fiscal year. In the following years it became more and more obvious that the budget deficit is a structural deficit and not just a result of fluctuations the business cycle. 2003 marked the thorough in term of budget deficits (although there were some one-off items behind the figure), by that time virtually all international organizations (IMF, World Bank, OECD and the European Commission) were arguing in favor of deep structural reforms in the budget, without any success. Increasing GDP growth since 2003, however, has increased both the revenue side of the budget and the denominator of the deficit to GDP ratio, resulting in a marked drop of the deficit over GDP figure, from close to 9 percent in 2003 to just below the 3 percent threshold level of the Maastricht criterion in 2005. Since the end of 2006 the state budget started to deteriorate again and the country seems to move away from the Maastricht criterion. In fact, the government has officially abandoned its earlier plan to join the EMU in 2010.

At a first glance it would be difficult to argue in favor of Ricardian equivalence based on this review. At the same time, however, one should keep in mind that, as shown in Canzoneri et al (2001), being non-Ricardian requires a lot from a fiscal policy in terms of non-responsiveness to previous deficits. The figures in the review above do not exactly correspond to the figures used in the empirical analyzes[4]. The deficit figures in the review refers to the total deficit, whereas the FTPL is about the primary balance figures, moreover the FTPL also includes seigniorage revenues.

4.1.2 Impulse Responses

The selected VAR model for the Czech Republic includes a constant and two lags. The VAR with only one lagged term was unstable, its impulse responses diverged. As can be seen from Figure 1 the shock in the first period induces a positive and significant change in the primary balance figure for six periods before it becomes insignificant. The initial response of the liabilities over GDP figure is a decline by about 3 percentage point to the roughly 2.5 percentage point shock, which shows that due to the positive autocorrelation in the primary balance series the liabilities adjust by more than one-for-one. The decrease in the liabilities over GDP ratio remains significant for 14 periods. The discount factor

[4]For the graph of the variables used in the regressions please see the Data Appendix.

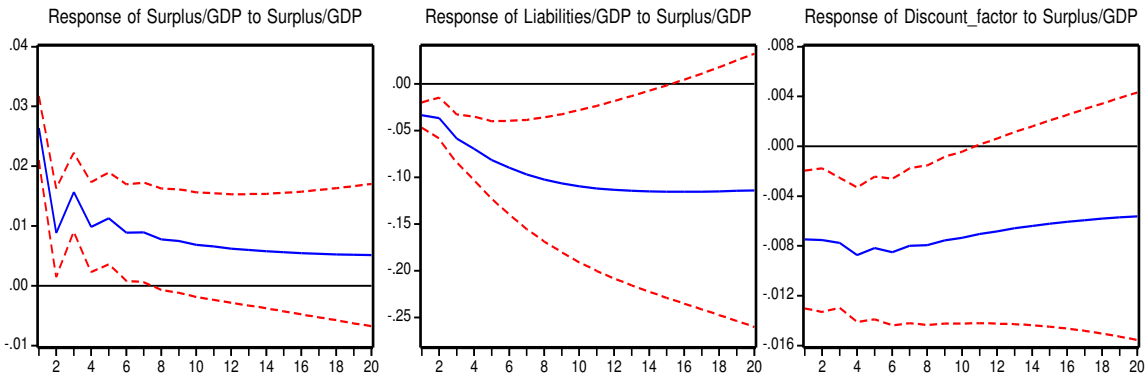

Figure 1: Impulse Responses of the VAR for the Czech Republic

also declines significantly for 10 periods.

The decline in the liabilities over GDP ratio has a straightforward interpretation in a Ricardian setting; as noted in the previous section, the increased surplus pays off some debt. Due to the negative effect on the discount factor, however, the results can also be interpreted in a non-Ricardian way. The decrease in the discount factor makes the future surpluses less important and so the liabilities to GDP ratio has to decrease (see equation 12). The effect of the discount factor, however, has to be rather pronounced as it has to countervail the positive serial correlation in the surplus over GDP figure, to make the right hand side of equation 12 decline.

4.2 Hungary

4.2.1 Brief review of recent fiscal policies in Hungary

The dataset starts right after a fiscal consolidation in 1996, followed by a major overhaul of the pension system in 1999. The positive effects of the fiscal consolidation were visible until 2001, when the country just missed the 3 percent criterion for the budget deficit. In 2002 the deficit started to widen considerably, marked by a 9.6 percent deficit ratio in 2002 (which included some one-offs due to the change in accounting principles). Since 2002 the government has failed to implement the much needed structural reforms in either of the healthcare, education or social welfare systems that could result in a lasting

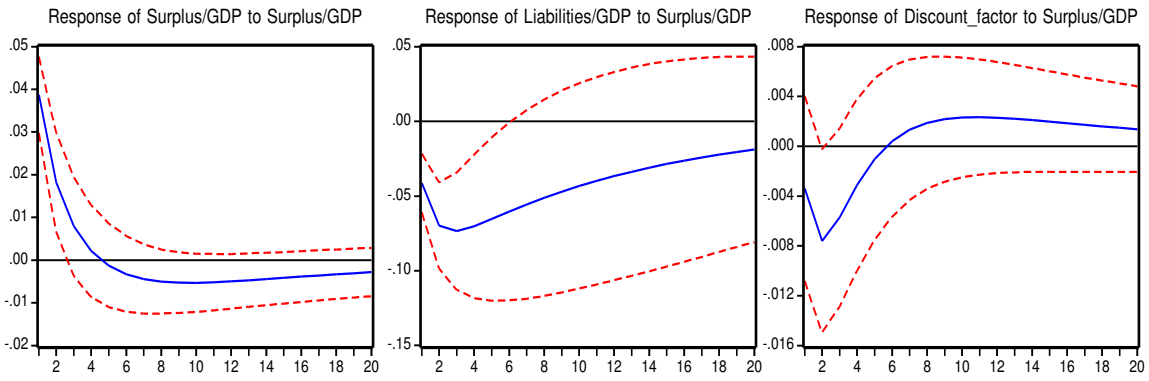

Figure 2: Impulse Responses of the VAR for Hungary

effect on the budget deficit, which increased to a staggering 10.1 percent of the GDP in 2006.

4.2.2 Impulse responses

The selected model here includes a constant and only one lagged term of the right hand side variables. Figure 2 shows that the positive primary balance shock is much less persistent than in the Czech case; here it becomes insignificant after the second period. The liabilities over GDP ratio basically responds with a one-for-one decline to the initial primary surplus shock. The discount factor does not show a significant response, neither in the first periods after the shock nor in the more distant future. The impulse responses are robust to the inclusion of another lag into the model, except for the discount factor which would become even more insignificant.

The interpretation of these responses is again fairly easy in a Ricardian policy framework. On the other hand, as there is neither a significant negative autocorrelation in the primary surplus over GDP series nor a significant negative correlation between the primary surplus over GDP series and the discount factor, a non-Ricardian policy framework would be unable to account for the impulse responses produced by the model.

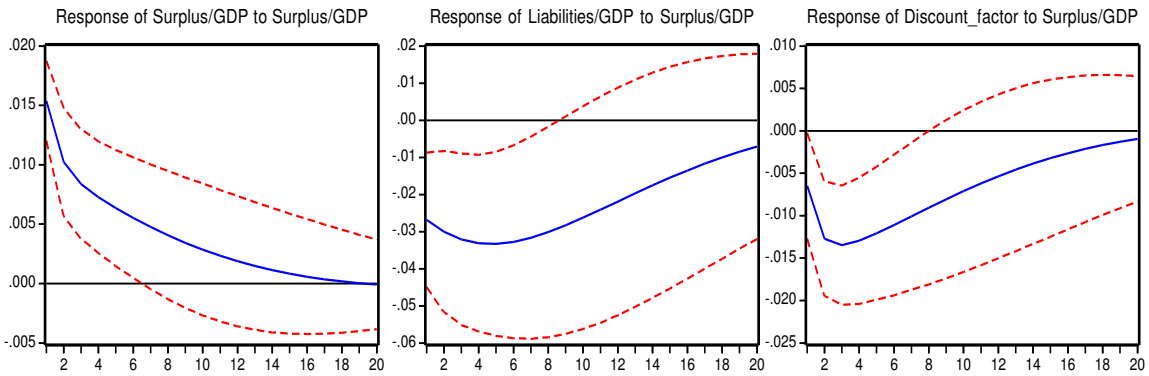

Figure 3: Impulse Responses of the VAR for Poland

4.3 Poland

4.3.1 Brief review of recent fiscal policies in Poland

The situation of Poland is rather delicate from the point of view of this paper, as the country happens to have a budget rule in its constitution. Would the debt to GDP ratio increase to above 55 percent, the government would be forced to introduce a budget for the next year that would push the figure below that level by he end of the next year. Moreover, if the debt would increase to 60 percent of the GDP the government would be forced to run a balanced budget in the subsequent fiscal year. As a result, the left hand side of equation 11 is not free to adjust to changes on the right hand side [5], so the only way to satisfy the government budget constraint is, in cases where the constitutional rule binds, to run Ricardian policies. As for the recent history of fiscal policies the story is similar to the Czech case. Recent years have seen an improvement in the balance owing primarily to buoyant economic growth, but the struggle to reduce social transfers and direct more funds to infrastructure investment is still very much alive.

4.3.2 Impulse responses

In the case of Poland the selected model also includes a constant and one lagged term. Adding one more lag would result in similar impulse responses as in the case of

[5]Remember that M_t and D_t are assumed to be exogenous.

the Czech Republic, the interpretation of these responses, however, would not change. As shown in Figure 3 the positive shock to the primary surplus series is persistent, it results in a significantly positive primary balance even after 5 periods. The liabilities over GDP figure declines more than one-for-one in the first period and this decline continues for 8 periods. The initial decline in the discount factor is barely significant, but the following values of this variable are significant and negative up to eight periods, when they become insignificant.

Again the impulse responses are compatible with a Ricardian fiscal policy. However, the negative response of the discount factor to the primary surplus over GDP shock, just like in the case of the Czech Republic, makes it impossible to completely rule out the possibility of a non-Ricardian regime. The fact that the non-Ricardian regime cannot be rejected even in the face of the exiting constitutional rules might look surprising, but considering that these regulation are yet to play a role in practice it should not be considered as a shortcoming of the model.

4.4 Central Europe

The previous analysis was carried out on quarterly data, due mainly to the lack of a sufficient number of observations at lower data frequencies. Testing the fiscal theory of the price level this way, however, raises an important theoretical issue. The difference between Ricardian and non-Ricardian policies lies primarily in their responsiveness to the level of government debt (or debt over GDP ratio). In practice governments decide about their budget once a year and have little room to manoeuver during the fiscal year, thus the quarterly data could show little response of the primary balance to the liabilities mainly due to institutional reasons. Another, more technical, problem with this approach is that it requires the data to be seasonally adjusted to give meaningful impulse responses, but this process might influence the results in unforeseeable and unwanted ways. Pooling the annual data from these countries into a panel would enable an estimation of the VAR model on about as many observations as in the case of the individual countries, and so it offers a natural way of testing whether the results presented above are driven by either of the two aforementioned issues. The drawback of the panel estimation is that one has to

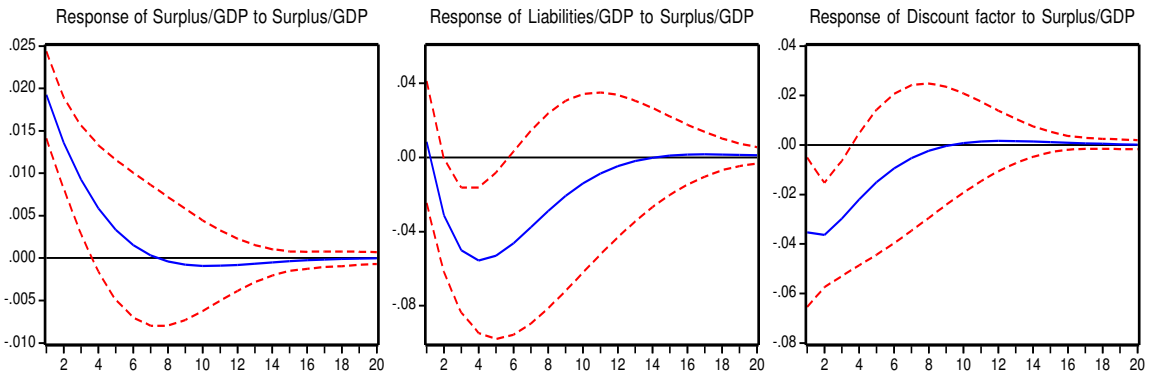

Figure 4: Impulse Responses of the VAR for the Central European annual panel data

assume that the response of the variables of interest to a certain shock is the same in all three countries. Although the studied economies have much in common, this might be a bit too rude generalization.

Pooling the data results in an unbalanced panel, with three cross-sections (the three countries) and 13 annual observations for the Czech Republic 11 for Poland and 10 for Hungary. Due to the construction of the discount factor and the lag in the VAR model further two observations are lost for each country, so altogether there are 28 annual observations to work with in the estimation. I chose a fixed effect panel model, because the unobserved individual country characteristics (e.g.: political stability, economic policy orientation of the political elite) are likely to be correlated with the disturbance term in the model. This kind of endogeneity poses no problem in a fixed effects model, while it would bias the estimates in a random effects model.

Due to data limitations and comparability a VAR model with only one lag included on the right hand side, along with a constant and country dummy variables for Hungary and Poland is estimated. The impulse responses of the VAR are shown in Figure 4. The primary balance series appears to have positive serial correlation at the first few lags, as the initial shock becomes insignificant only after 3 periods. The response of the liabilities over GDP ratio is somewhat mysterious, it does not show a significant response to the shock initially, but it starts to decline after the second period and this trend is

significant up until the fifth period after the shock. The discount rate displays the same pattern as in the previous cases, an initial decline followed by a gradual increase back to the equilibrium level.

The interpretation of these responses does not fit exactly into the framework used for the individual countries, because of the sluggish reaction of the liabilities over GDP series. Apart from the lag in the decline of that figure it seems to be consistent with the Ricardian regime. It would be even more difficult to explain the developments in a non-Ricardian style. The positive autocorrelation in the primary surplus should push the real value of the liabilities higher, which is actually case, but the initial move in the Liabilities/GDP figure is insignificant. Later the decline in the discount factor (if it is substantially large) could explain the decline in the liabilities over GDP ratio. The problem, with this reasoning is, that there is no timing in the FTPL. Since it is a perfect foresight equilibrium, agents should be aware of such future development and act accordingly by the time of the shock. Thus unfortunately the panel was also unable to unambiguously confirm that one or the other theory is at work.

4.5 Subperiods

As noted in the introduction to this section, while all of the new member states, appeared to be keen on implementing economic reforms, sometimes painful ones, before the accession, this trend has stopped after they entered the EU. So the sample is split into two subsamples: pre- and post-accession, the cut-off date being end of 2002 the date of the Copenhagen summit, where the Accession Treaties were signed. The point of this section is to investigate whether the new member countries changed their fiscal policy framework after their EU accession.

The analysis will again be carried out on a panel dataset constructed from the quarterly series of the individual countries. The estimation of the VAR model was again done by the fixed effects estimation, for the same reasons as in the case of the annual dataset. Degrees of freedom considerations were the primary reasons for using quarterly data, which again were seasonally adjusted using the X12 routine.

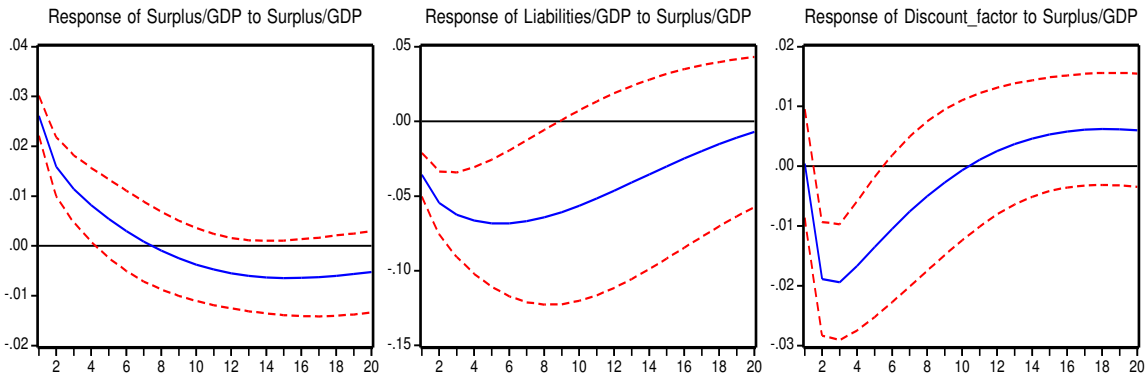

Figure 5: Impulse Responses of the VAR for the pre-accession period

4.5.1 The pre-accession period

The selected VAR model is still the one with only one lagged term and a constant along the country dummies for Poland and Hungary. The impulse responses, shown in Figure 5 are similar to those obtained for the individual countries. The primary balance series exhibits some serial correlation for a few lags, but after four lags the effect of the initial shock becomes insignificant. The liabilities over GDP variable responds by a one-for-one decrease to the shock and declines further in the subsequent period. The effect of the shock is significant for 8 periods. The discount factor shows some evidence of a negative correlation with the primary surplus figure in the first five lags, but then the effect of the shock evaporates. These finding are basically the same as in the cases of the individual countries and in the case of the annual panel, the figures could have been copied from the Polish or the Hungarian case, with the only difference being the thinner bands for the significance levels.

Unfortunately, these responses again fall into the category where the Ricardian and non-Ricardian policies cannot be distinguished. The decline in the discount factor lends some support to the plausibility of a non-Ricardian regime, while the simple interpretation of a Ricardian system is not falsified by the responses either.

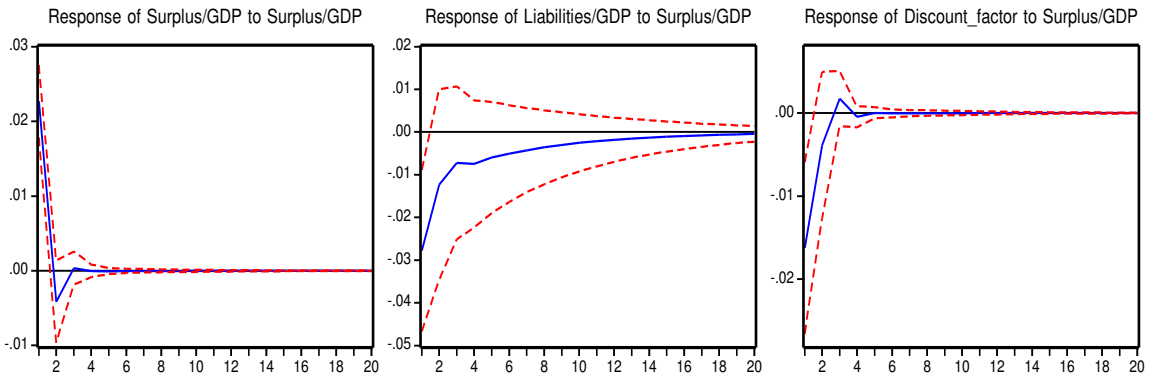

Figure 6: Impulse Responses of the VAR for the post-accession period

4.5.2 The post-accession period

The VAR model that best describes the data is the same as above. The impulse responses in Figure 6, however, are quite different from those in Figure 5. The effect of the positive primary balance shock is not persistent at all. All changes occur right after the shock and become insignificant from there on. Both the liabilities and the discount factor responds to the positive shock with a significant decline, thus the results are again inconclusive, it is still possible to interpret the responses with both theories. The difference in the responses, however, compared to the pre-accession period is striking. These impulse responses are robust to shifting the cut-off date a year back or forth. It confirms the prior beliefs that the countries were less likely to carry out sustained fiscal policies after the accession, then in the run off to the EU as indicated by the much lower serial correlation in the Surplus/GDP series. The economic policies that were undertaken, however, fit perfectly into the framework of Ricardian policies, which shows that it really takes a lot for a fiscal policy to be non-Ricardian.

4.6 Discussion of the findings

To sum up the results, the analysis in this paper is inconclusive; it cannot rule out the possibility of non-Ricardian regimes. The only exception is the case of Hungary, where the primary balance series shows no significant autocorrelation after the second period and the response of the discount factor to a primary surplus shock is insignificant, although as can be seen from the last graph in Figure 2 the response is basically on the borderline of being significant. Thus in the Hungarian case the non-Ricardian argument cannot be saved, based on the impulse responses. This line of reasoning, however, places too much emphasis on the precision of the VAR estimation (i.e. the standard deviation bands), which is a bit odd given the small degrees of freedom. Investigating the auto-correlations and the cross-correlation of the two series directly, instead of through their impulse responses, results in a similar conclusion as in the case of the Czech Republic, Poland and the other cases. These figures show that there is significant positive serial correlation in the Surplus/GDP series for up to six lags and a negative correlation between the primary balance and the discount factor for four lags (see Appendix), thus the non-Ricardian interpretation can still be saved.

This qualification is important as it would have been a counter-intuitive finding for Hungary to emerge as the best example of a Ricardian regime, in the light of the fiscal expansion in recent years in Hungary. Another remedy for the surprising finding could be, that the Hungarian dataset starts just after a major fiscal reform. It should, however, be noted that the impulse responses for Hungary are not much different from those for Poland or from those for the three-country panel before the EU accession, neither in their magnitude nor in their shape.

The results for the different subperiods seem to constitute the hardest critique of the fiscal theory of the price level. While the change in the behavior of the fiscal authorities supports the prior expectations based on the prevalence of the "reform fatigue" in the region, the results are still very much in line with Ricardian policies, which underscores the point of Canzoneri et al. (2001). Another interesting similarity between their article and this paper are the impulse response figures and their interpretations. In all setups in Canzoneri et al. (2001) and in five out of six cases in this paper (with the only excep-

tion being the annual panel) the response of the Liabilities/GDP variable to a positive primary balance shock is a decline, which is the case where Ricardian equivalence has a straightforward explanation, while that of the FTPL is rather complicated. Thus it would be difficult to conclude that the fiscal theory of the price level improves substantially our understanding of the studied cases.

5 Concluding remarks

Recent years have witnessed the emergence of a new theory of price determination, which attributes primary importance to the government in pinning down the price level. It views the government's intertemporal budget constraint as an equilibrium condition rather than a constraint that should be satisfied in all states of the world. In equilibrium it is the price level in the economy that will adjust to ensure that this equilibrium condition is met. To make such an adjustment possible, the government cannot behave in a way most economists used to think about them. In cases where Ricardian equivalence holds, the government will be unable to pin down the price level, as its budget constraint would hold for many possible paths of the price level. Instead it should adopt non-Ricardian fiscal policies to take over the role of the nominal anchor. From a theoretical point of view this appears to be a generalization of the existing theory as it enables the abandoning of one commonly used assumption, the Ricardian equivalence.

Proponents of the fiscal theory of the price level usually emphasize this theoretical advantage of the new theory, but the value of this generality is rather dubious. The more general theoretical framework results in less explicit answers to practical issues, for example to questions about the role of fiscal and monetary policy in the determination of the price level in certain episodes of the economic history. This paper tried to decide whether the orthodox view of price determinacy or the new theory is at work in three Central European countries (the Czech Republic, Hungary and Poland) after they moved from communism to a market economy. The results are inconclusive, which is not surprising given the lack of testable restrictions provided by the new theory. In the absence of such restrictions, the paper follows the method of Canzoneri et al. (2001) to differentiate between orthodox theories and the FTPL using the impulse responses of a VAR model in the variables of primary surplus over GDP, liabilities over GDP and the discount rate. While this method is no panacea, it does offer some hope to find evidence in favor of one or the other theory under certain circumstances. Unfortunately, these circumstances, which concern the sign of the correlation between the variables in the VAR, are not met. Thus in the end both the standard theory and the FTPL can be used to explain the observed developments, but the explanation of the FTPL requires additional assumptions

about the future values of the correlations between the variables, while the Ricardian view offers a straightforward interpretation of the impulse responses. The most striking result concerns the shift in fiscal policies that one can observe after the countries signed their Accession Treaty. Since 2003, the results show no trace of sustained fiscal policies, measured by the persistence of a Surplus/GDP shock. But even these short-sighted policies are perfectly in line with the Ricardian policy framework.

The findings of the paper underscore the point formulated by most critiques of the FTPL (e.g. Canzoneri et al. (2001) and McCallum and Nelson (2006)): while non-Ricardian policies might be a more general framework than Ricardian ones, the latter one already includes most of the economic policies that emerge in practice. Thus assuming Ricardian policies is not an important restriction from a practical point of view.

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A Regression outputs

A.1 The Czech Republic

VAR Estimates

Sample (adj.): 1994Q3 2006Q3

Included observations: 49

S.E. in ( ) t-stats in [ ]

	Surplus/GDP	Liabilities/GDP	Discount factor
Surplus/GDP(-1)	0.247499	-0.097453	-0.195755
	(0.17727)	(0.35866)	(0.13514)
	[1.39614]	[-0.27171]	[-1.44858]
Surplus/GDP(-2)	0.522976	-0.913108	-0.051510
	(0.14314)	(0.28960)	(0.10912)
	[3.65356]	[-3.15294]	[-0.47206]
Liabilities/GDP(-1)	-0.087958	1.250929	0.023521
	(0.09199)	(0.18612)	(0.07013)
	[-0.95613]	[6.72099]	[0.33540]
Liabilities/GDP(-2)	0.069987	-0.282143	-0.014427
	(0.08989)	(0.18186)	(0.06852)
	[0.77860]	[-1.55141]	[-0.21054]
Discount factor(-1)	0.082361	-1.015763	0.211918
	(0.18857)	(0.38152)	(0.14375)
	[0.43676]	[-2.66241]	[1.47423]
Discount factor(-2)	0.081420	0.636846	0.360587
	(0.19411)	(0.39272)	(0.14797)
	[0.41946]	[1.62161]	[2.43690]
C	-0.121064	0.468273	0.405547
	(0.17762)	(0.35935)	(0.13540)
	[-0.68160]	[1.30309]	[2.99525]

	Surplus/GDP	Liabilities/GDP	Discount factor
R-squared	0.691323	0.988187	0.741672
Adj. R-squared	0.647226	0.986500	0.704768
Sum sq. resids	0.029219	0.119604	0.016979
S.E. equation	0.026376	0.053364	0.020106
F-statistic	15.67741	585.5880	20.09730
Log likelihood	112.3786	77.84907	125.6780
Akaike AIC	-4.301169	-2.891799	-4.843998
Schwarz SC	-4.030909	-2.621539	-4.573738
Mean dependent	0.036285	1.687865	0.962492
S.D. dependent	0.044408	0.459282	0.037004

Determinant resid cov. (dof adj.)	4.09E-10
Determinant resid cov.	2.57E-10
Log likelihood	332.3911
Akaike criterion	-12.70984
Schwarz criterion	-11.89906

A.2 Hungary

VAR Estimates

Sample (adj.): 1997Q2 2006Q3

Included observations: 38

S.E. in ( ) t-stats in [ ]

	Surplus/GDP	Liabilities/GDP	Discount factor
Surplus/GDP(-1)	0.495066	-0.891158	-0.168408
	(0.14020)	(0.24280)	(0.08342)
	[3.53119]	[-3.67030]	[-2.01884]
Liabilities/GDP(-1)	0.044960	0.960832	-0.009821
	(0.03209)	(0.05557)	(0.01909)
	[1.40112]	[17.2895]	[-0.51439]
Discount factor(-1)	-0.266711	-1.288953	0.438266
	(0.23997)	(0.41559)	(0.14278)
	[-1.11143]	[-3.10148]	[3.06946]
C	0.140512	1.335640	0.554596
	(0.24596)	(0.42598)	(0.14635)
	[0.57127]	[3.13549]	[3.78953]

	Surplus/GDP	Liabilities/GDP	Discount factor
R-squared	0.513920	0.903914	0.511530
Adj. R-squared	0.471031	0.895436	0.468430
Sum sq. resids	0.050975	0.152889	0.018046
S.E. equation	0.038720	0.067058	0.023039
F-statistic	11.98246	106.6170	11.86839
Log likelihood	71.74660	50.87726	91.47577
Akaike AIC	-3.565610	-2.467224	-4.603988
Schwarz SC	-3.393233	-2.294847	-4.431610
Mean dependent	0.036436	2.711812	0.925889
S.D. dependent	0.053238	0.207376	0.031599

Determinant resid cov. (dof adj.)	1.77E-09
Determinant resid cov.	1.27E-09
Log likelihood	227.4403
Akaike criterion	-11.33896
Schwarz criterion	-10.82183

Sample: 1997Q1 2007Q1

Included observations: 39

$Corr(Surplus/GDP(t), Discountfactor(t+i))$

i	lead
0	-0.611*
1	-0.5663*
2	-0.4255*
3	-0.3682*
4	-0.3709*
5	-0.1713
6	-0.1029
7	-0.0118
8	0.067
9	0.077
10	0.1518

$*$ denotes significant values at a 95 percent level.

A.3 Poland

VAR Estimates

Sample (adj.): 1996Q2 2006Q3

Included observations: 42

S.E. in ( ) t-stats in [ ]

	Surplus/GDP	Liabilities/GDP	Discount factor
Surplus/GDP(-1)	0.645452	-0.450143	-0.545377
	(0.14689)	(0.58735)	(0.19674)
	[4.39424]	[-0.76640]	[-2.77210]
Liabilities/GDP(-1)	0.052347	0.785511	0.024600
	(0.02551)	(0.10199)	(0.03416)
	[2.05230]	[7.70177]	[0.72008]
Discount factor(-1)	-0.262362	0.309056	0.564236
	(0.12074)	(0.48281)	(0.16172)
	[-2.17291]	[0.64013]	[3.48894]
C	0.135266	0.138263	0.350901
	(0.08744)	(0.34966)	(0.11712)
	[1.54689]	[0.39542]	[2.99604]

	Surplus/GDP	Liabilities/GDP	Discount factor
R-squared	0.784430	0.840069	0.845586
Adj. R-squared	0.767411	0.827443	0.833395
Sum sq. resids	0.009003	0.143952	0.016151
S.E. equation	0.015392	0.061548	0.020616
F-statistic	46.09229	66.53429	69.36373
Log likelihood	117.8097	59.59949	105.5366
Akaike AIC	-5.419511	-2.647595	-4.835076
Schwarz SC	-5.254019	-2.482102	-4.669584
Mean dependent	-0.002234	1.949629	0.912656
S.D. dependent	0.031916	0.148167	0.050509

Determinant resid cov. (dof adj.)	2.16E-10
Determinant resid cov. (dof adj.)	1.60E-10
Log likelihood	294.9138
Akaike criterion	-13.47209
Schwarz criterion	-12.97561

A.4 Central European (annual) panel

VAR Estimates

Sample (adj.): 1995 2005

Included observations: 28

S.E. in ( ) t-stats in [ ]

	Surplus/GDP	Liabilities/GDP	Discount factor
Surplus/GDP(-1)	0.631678	-1.904998	-1.258702
	(0.11596)	(0.52482)	(0.50349)
	[5.44722]	[-3.62984]	[-2.49995]
Liabilities/GDP(-1)	0.021037	0.746213	0.002194
	(0.02693)	(0.12186)	(0.11691)
	[0.78127]	[6.12348]	[0.01877]
Discount factor(-1)	-0.035860	0.021736	0.345181
	(0.03567)	(0.16142)	(0.15486)
	[-1.00539]	[0.13466]	[2.22897]
C	0.022659	0.194219	0.700649
	(0.04126)	(0.18672)	(0.17913)
	[0.54920]	[1.04016]	[3.91132]
HUN	-0.038933	0.536337	0.023855
	(0.05526)	(0.25008)	(0.23992)
	[-0.70456]	[2.14463]	[0.09943]
POL	-0.037103	0.275407	-0.043445
	(0.03684)	(0.16674)	(0.15997)
	[-1.00704]	[1.65168]	[-0.27159]

	Surplus/GDP	Liabilities/GDP	Discount factor
R-squared	0.776231	0.991812	0.549665
Adj. R-squared	0.725374	0.989951	0.447316
Sum sq. resids	0.008148	0.166885	0.153598
S.E. equation	0.019245	0.087096	0.083557
F-statistic	15.26310	532.9524	5.370496
Log likelihood	74.26062	31.98691	33.14841
Akaike AIC	-4.875759	-1.856208	-1.939172
Schwarz SC	-4.590286	-1.570735	-1.653700
Mean dependent	0.011026	1.629115	1.018647
S.D. dependent	0.036723	0.868820	0.112394

Determinant resid cov. (dof adj.)	1.42E-08
Determinant resid cov.	6.89E-09
Log likelihood	143.9081
Akaike criterion	-8.993437
Schwarz criterion	-8.137020

A.5 Central European (quarterly) panel - pre-accession period

VAR Estimates

Sample (adj.): 1994Q2 2002Q4

Included observations: 85

S.E. in ( ) t-stat in [ ]

	Surplus/GDP	Liabilities/GDP	Discount factor
Surplus/GDP(-1)	0.667816	-0.768182	-0.697253
	(0.09193)	(0.25251)	(0.14746)
	[7.26463]	[-3.04217]	[-4.72851]
Liabilities/GDP(-1)	0.041710	0.967102	0.023420
	(0.01506)	(0.04137)	(0.02416)
	[2.76958]	[23.3780]	[0.96948]
Discount factor(-1)	-0.163109	-0.137987	0.375846
	(0.05861)	(0.16100)	(0.09402)
	[-2.78289]	[-0.85708]	[3.99765]
C	0.113072	0.228454	0.600848
	(0.05809)	(0.15958)	(0.09319)
	[1.94637]	[1.43164]	[6.44782]
HUN	-0.067898	0.018835	-0.044498
	(0.02046)	(0.05619)	(0.03282)
	[-3.31898]	[0.33519]	[-1.35601]
POL	-0.047176	-0.040318	-0.090649
	(0.01327)	(0.03645)	(0.02129)
	[-3.55516]	[-1.10611]	[-4.25868]

	Surplus/GDP	Liabilities/GDP	Discount factor
R-squared	0.684382	0.983130	0.616181
Adj. R-squared	0.664406	0.982063	0.591889
Sum sq. resids	0.053859	0.406378	0.138581
S.E. equation	0.026110	0.071722	0.041883
F-statistic	34.26045	920.8011	25.36528
Log likelihood	192.3620	106.4730	152.1958
Akaike AIC	-4.384988	-2.364070	-3.439901
Schwarz SC	-4.212565	-2.191648	-3.267479
Mean dependent	0.042492	1.898658	0.913170
S.D. dependent	0.045072	0.535518	0.065561

Determinant resid cov. (dof adj.)	4.32E-09
Determinant resid cov.	3.47E-09
Log likelihood	466.0469
Akaike criterion	-10.54228
Schwarz criterion	-10.02501

A.6 Central European (quarterly) panel - post-accession

VAR Estimates

Sample: 2003Q1 2006Q3

Included observations: 44

S.E. in ( ) t-stats in [ ]

	Surplus/GDP	Liabilities/GDP	Discount factor
Surplus/GDP(-1)	-0.143236	-0.055835	-0.283277
	(0.12603)	(0.36483)	(0.20082)
	[-1.13655]	[-0.15304]	[-1.41063]
Liabilities/GDP(-1)	0.007410	0.848320	0.009950
	(0.02691)	(0.07790)	(0.04288)
	[0.27537]	[10.8902]	[0.23205]
Discount factor(-1)	0.041959	-0.768730	-0.172378
	(0.10818)	(0.31317)	(0.17238)
	[0.38787]	[-2.45470]	[-1.00001]
C	-0.066504	1.162098	1.171988
	(0.12014)	(0.34778)	(0.19143)
	[-0.55357]	[3.34148]	[6.12232]
POL	-0.032454	-0.078636	-0.048367
	(0.01168)	(0.03381)	(0.01861)
	[-2.77846]	[-2.32554]	[-2.59865]
HUN	0.009534	0.022942	-0.088622
	(0.01829)	(0.05294)	(0.02914)
	[0.52129]	[0.43333]	[-3.04102]

	Surplus/GDP	Liabilities/GDP	Discount factor
R-squared	0.425210	0.963886	0.452986
Adj. R-squared	0.349579	0.959135	0.381011
Sum sq. resids	0.019549	0.163831	0.049637
S.E. equation	0.022682	0.065661	0.036142
F-statistic	5.622213	202.8470	6.293615
Log likelihood	107.3848	60.61512	86.88548
Akaike AIC	-4.608401	-2.482506	-3.676613
Schwarz SC	-4.365102	-2.239207	-3.433314
Mean dependent	-0.012555	2.409477	0.984607
S.D. dependent	0.028124	0.324809	0.045938

Determinant resid cov. (dof adj.)	1.83E-09
Determinant resid cov.	1.18E-09
Log likelihood	264.9929
Akaike criterion	-11.22695
Schwarz criterion	-10.49705

B Data Appendix

Primary balance was computed from the Revenues (series 81) and Expenitures (series 82) series for Poland and the Czech Republic. For government debt I used the 'Total Debt' series (series 88) in these countries. The same variables for Hungary came from the National Bank of Hungary's database. For nominal GDP I used IFS series 99b for all countries. Real GDP figures are series 99b.pyf for Poland and the Czech Republic, while series 99b.pvf was used for Hungary again from the IFS. To construct the discount factor I have also used the 'GDP Deflator' series (IFS series 99bip) for all countries, while the interest rate variable is the 'Treasury Bill Rate' series for Hungary and the Czech Republic (IFS series 60c) and the 'Money Market Rate' series for Poland (IFS series 60b). The money stock is the 'Monetary Base' series for Hungary (IFS series 19ma) the 'Money' series for the Czech Republic (IFS series 34) and the 'M0' series of the National Bank of Poland. The graphs below offer a quick overview of the series that were used in the estimations. Note that both the surplus and the liabilities series are divided by the quarterly GDP figures, this is the reason for the surprisingly high values of Liabilities/GDP series. All series are seasonally adjusted using X12.

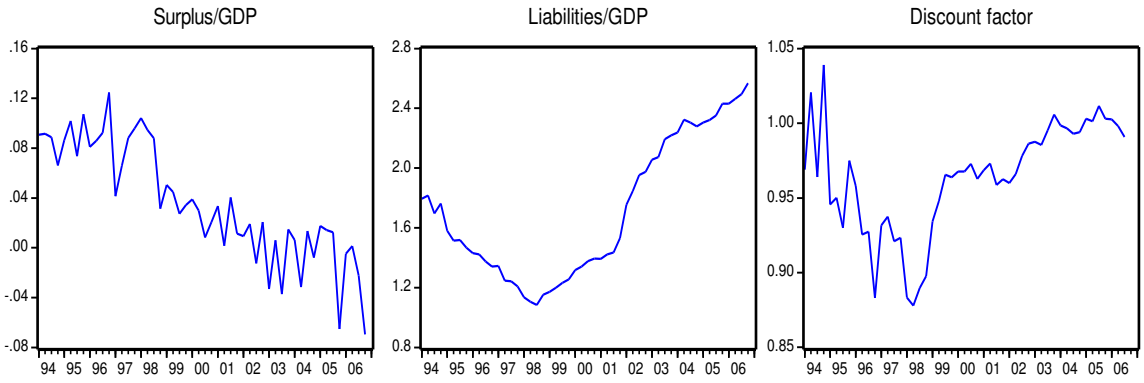

Figure 7: Graphs of the variables for the Czech Republic

Figure 8: Graphs of the variables for Hungary

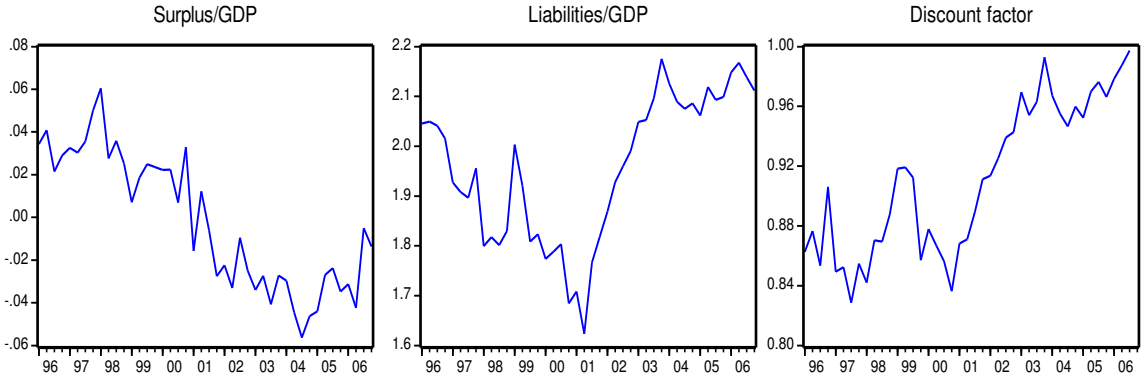

Figure 9: Graphs of the variables for Poland