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Optimal fiscal policy under learning

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ABSTRACT

This paper characterizes optimal fiscal policy when agents learn about future taxation. A benevolent and fully rational government chooses taxes on labor income and state-contingent bonds to finance public spending, considering that private agents form their expectations through a learning algorithm. Facing a trade-off between distortionary taxes and distorted expectations, the Ramsey planner chooses the policy that minimizes the total cost of distortions. The analysis produces two main results. First, the government will use fiscal variables to manipulate expectations, reducing taxes and issuing debt at times of pessimism and doing the opposite at times of optimism. This speeds up learning. Second, the expectation-dependent fiscal plan is also history-dependent, and it prescribes taxes that are not as smooth and more persistent than under rational expectations. These findings are robust to alternative learning algorithms.

1. Introduction

One important issue in macroeconomics is how to collect revenues to pay for government expenditures. When lump-sum transfers are not available, the government must resort to taxes that distort agents' choices concerning consumption and leisure and push the economy away from the first-best equilibrium. The literature on optimal taxation seeks to determine the tax profile that minimizes distortionary costs. The key insight of this literature is that taxes should be smooth.[1]

This conclusion has been derived under the assumption of rational expectations (RE) (Lucas and Stokey, 1983). While useful as a benchmark in macroeconomics, this assumption is quite restrictive as regards the amount of information given to market participants, who are supposed to know the exact market outcomes for every possible future contingency. Indeed, the assumption of rational expectations has been challenged by a growing empirical literature that finds potential non-rationalities in expectations.[2] In the light of this evidence, learning models have been developed to explain some stylized facts[3] and to check the robustness of the policy implications derived under RE. The impact of learning on monetary policy

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[1] The optimal taxation literature is immense and offering a comprehensive survey goes beyond the scope of this paper. See Barro (1979), Barro (1989), Bohn (1990), Kydland and Prescott (1980), Lucas and Stokey (1983), Chari et al. (1994), Chari and Kehoe (1999), Aiyagari et al. (2002) among many others.

[2] For example, Adam and Padula (2011), Forsells and Kenny (2003), Robert (1997) conclude that inflation expectations, measured by survey data, are less than perfectly rational.

[3] For asset prices behavior, Adam et al. (2012), Adam and Marcet (2011), Carceles-Poveda and Giannitsarou (2008), and Cogley and Sargent (2008); for hyperinflationary episodes, Marcet and Nicolini (2003)and Adam et al. (2006); for inflation, Sargent (1999) and Cho et al. (2002); for business cycle fluctuations, Eusepi and Preston (2011), Milani (2007a), Kurz et al. (2005), Beaudry and Portier (2006), and Beaudry and Portier (2007).

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design is a much-explored field, whether the central bank follows ad-hoc policy rules or implements the optimal rule,[4] but fiscal policy has been the object of much less study.

This paper characterizes optimal fiscal policy when private agents learn the level of future taxation. Agents are assumed to know their own objective function and constraints and to optimize given their beliefs about the future fiscal stance. But they do not know how macroeconomic variables outside their own control – namely taxes – are determined. This kind of uncertainty about future taxes, which has been intensifying in the US since the last decade, as is observed by new (see Fig. 1) can be justified by the empirical evidence on the complexity of the tax code. For example, 90% of the respondents to the 2003 Survey of Americans' Views on Taxes find the tax system very or at least somewhat complicated. Brown (1968) and Fujii and Hawley (1988) show that taxpayers are uninformed about the level of taxation; also Kotlikoff and Rapson (2007) claim that "thanks to the incredible complexity of the U.S. fiscal system, it is impossible for anyone to understand her incentive to work". The main contribution of this paper is to show how this distortion qualitatively changes the optimal policy design compared with the RE benchmark, in terms of both short-run dynamics and steady-state implications.

To address this issue I consider a closed production economy with a fiscal authority, infinitely-lived agents and no capital. The government has to finance an exogenous stream of public spending through a proportional tax on labor income and state-contingent bonds. It pursues optimal taxation: given the initial amount of debt, it chooses policy instruments so as to maximize consumers' welfare.

Households, in order to satisfy their optimality conditions, have to forecast one-step-ahead marginal utilities of consumption. Like econometricians, they compute these by estimating a statistical model that has the same functional form as the equilibrium under RE, updating their estimates through an adaptive algorithm that is common in the literature. However, as routinely assumed in the learning literature in macroeconomics, agents ignore this updating process and treat their estimates in each period as if they were true.

As households' expectations are distorted, so are their saving decisions; compared to the RE benchmark, pessimistic agents – those who expect future taxes to be higher than their RE values - would inefficiently save too much, and optimistic agents too little. In choosing the optimal fiscal plan, the benevolent and fully rational[5] government incorporates this distortion, in addition to the households' optimality conditions and the feasibility constraint.

The analysis delivers two main results. First, the government will actively use fiscal variables to manipulate expectations and speed up learning by agents. The example of constant public expenditure offers an intuitive explanation for this result. Under rational expectations, the only distortion is taxes, and to smooth them the government follows a balanced-budget rule. Thus households enjoy a constant stream of consumption and leisure. With learning, by contrast, when agents are pessimistic not only taxes but also expectations are distorted, because they result in precautionary saving that is inefficient given the fundamentals of the economy. To minimize the overall distortion, the government initially stimulates the economy with low tax rates, so that vis-a-vis the RE benchmark, households both consume and work more and, facing a lower-than-expected tax rate, revise their expectations downward. This belief-updating process continues until, at the limit, expectations are consistent with government policy.

This policy depends on agents' initial beliefs: the more pessimistic they are, the lower the tax rate is initially and the higher it will be in the long run, because of interest payments on a higher public debt. In this way the expectation distortion has steady-state implications and the model is not ergodic.[6]

The example of a temporary increase in public spending (to finance war, say) also highlights the tension between tax smoothing and manipulation of beliefs. Under RE the tax rate is constant in all periods before and after the war, because the government accumulates assets beforehand and then sells them to finance at least part of the extra expenditure. But when agents are pessimistic the government sets low tax rates in order to mitigate the pessimism. It also accumulates fewer assets before the war and therefore finances wartime outlays by issuing more debt, and the postwar tax rate is higher than the prewar rate.

The second result is that taxes and government debt are history-dependent even when shocks are Markovian, a feature of the data that the model of Lucas and Stokey (1983) cannot capture, as it depends only on the current realization of government expenditure. The mechanism for obtaining history-dependence, namely the incentive for the government to manipulate expectations, is similar to that found by Molnar and Santoro (2014), and alternative to the mechanisms proposed by Aiyagari et al. (2002), Battaglini and Coate (2008) and Karantounias (2013), which introduce, respectively, market incompleteness, political-economic bargaining considerations and fear of misspecification by agents.

Evans et al. (2009) and Hollmayr and Matthes (2013) show that under learning a future fiscal policy change (namely an increase in public consumption) generates higher volatility than the RE framework and that economic dynamics differ from

[4] For the first case, see Orphanides and Williams (2006), Preston (2005), Preston and Eusepi (2011), and Preston and Eusepi (2010); for the second, see Evans and Honkapohja (2003), Evans and Honkapohja (2006), and Molnar and Santoro (2014).

[5] The assumption that the government can identify agents' expectations perfectly would be hard to justify in a framework of dispersed information like that pioneered by Angeletos and Pavan (2009), where neither private agents nor the government can perfectly observe aggregate shocks. In our setup instead, by observing bond prices and private consumption and knowing the discount factor, the government immediately learns agents' state-contingent expectations.

[6] The government's incentive to accelerate the correction of distorted expectations is related to the manipulation of its bond prices. In a pessimistic environment, *ceteris paribus*, the interest rate on government bonds is lower than under RE; by stimulating private consumption through low taxes, the government actually reinforces this depressive effect on the interest rate, which falls still further.