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Tax policy and the financing of innovation☆

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ABSTRACT

We study tax policy in a Schumpeterian growth model with asymmetric information in the financing of innovation. Investors cannot a priori distinguish between more or less talented entrepreneurs. Net-worth allows talented entrepreneurs to self-invest and avoid being pooled with less talented entrepreneurs in the credit market. Increasing net-worth boosts innovation even when financed through higher profit taxes. Taxing consumption effectively raises net-worth and subsidizes profits simultaneously. Sufficiently taxing consumption implements the social optimum free of adverse selection. If forced to tax consumption less, the government implements a second best allocation with adverse selection when boosting net-worth enough to avoid adverse selection requires taxing profits excessively.

1. Introduction

The private and social gains from technological research diverge in the presence of externalities in the production and dissemination of innovation. The policy prescription of the endogenous growth literature is simple: subsidize innovation activity sufficiently to eliminate that wedge. However, there is substantial evidence that firms face constraints in financing the pursuit, adoption, or acquisition of innovations.[1] In the presence of asymmetric information, providing incentives to innovators does not necessarily lead to more innovation activity; the government must also take into account the response of financial markets, and prevent the adverse selection problem from constraining innovators.

In our model, some entrepreneurs are more talented than others, but their talent is private information. When the market cannot separate these two types, the demand for credit of untalented entrepreneurs raises the cost of capital of talented entrepreneurs as creditors require compensation for the risk of lending to the untalented. In other words, talented entrepreneurs must pay an adverse selection premium. Indeed, even when the market can separate the two types, the investment decisions of the high types are distorted by their need to avoid being confused with the low types.

To study fiscal policy in this environment, we assume the government can tax labor income, profit, and consumption. Our results about the effects of tax policy reforms on economic growth depend crucially on whether financial markets are in a pooling or separating equilibrium, and the design of optimal policy hinges on which of those equilibria is most conducive to growth when the first best allocation is not implementable.

We show that increasing the after-tax labor income of entrepreneurs is often necessary to increase technological research while at the same time avoiding a pooling equilibrium. The reason is that investable net-worth equals after-tax labor income. With more resources at hand, talented entrepreneurs can pursue more research without facing adverse selection. Thus, boosting net-worth provides a rationale for taxing profits in order to subsidize labor income. In our model, moreover, taxing profits may lead to an overall increase in

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[1] Fagerberg et al. (2010) and Hall and Lerner (2010) recently reviewed this evidence.

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research, because it may make it easier for high-talent entrepreneurs to differentiate themselves from the low-talent ones. This starkly contrasts the benchmark Schumpeterian growth model, wherein taxing profits could only result in a decrease in research. Nonetheless, substituting labor income taxes with profit taxes is not wholly effective, because eventually entrepreneurs become unconstrained by their relatively high net-worth and poor incentives. At that point, the benchmark and our asymmetric information model behave identically, and further increases in the profit tax are growth-reducing. In other words, there is an inverted-U relationship between after-tax profit and innovation.[2]

Substituting labor income and profit taxes for consumption taxes, i.e. fundamental tax reform, more decidedly boosts technological research. Consumption taxes do not hurt the incentive to innovate, as profit taxes do, nor do they constrain the entrepreneur's effort choice, as labor income taxes do. In fact, when the government can freely tax consumption, it is able to implement the first best level of technological research. Otherwise, the government must tax profit and labor income more and implement a second best equilibrium at a lower level of research.

Surprisingly, if the government is unable to tax consumption sufficiently,[3] the second best equilibrium exhibits adverse selection. This happens because implementing a separating equilibrium requires a low tax on labor income, which given a low tax on consumption requires an excessively high tax on profits to balance the government's budget.

Our paper is related to several strands of literature. The *financial development and economic growth* literature (reviewed by Levine, 1997), has incorporated financial frictions into endogenous growth models to understand, on the one hand, how the frictions affect economic growth and welfare, and on the other hand, how financial institutions reduce these imperfections by providing risk-sharing, screening, and monitoring services. For example, King and Levine (1993) incorporate asymmetric information about entrepreneurial quality into a Schumpeterian growth model. However, they preclude adverse selection by introducing financial intermediaries that pay a fee to screen entrepreneurs. The policy focus of this literature has been to estimate the effects of government policies that induce financial institutions to provide more of their services, and how these policies can have long-lasting effects as they allow the economy to develop. Instead, we ask how well the government can pursue policy despite the persistence of financial frictions.

This is the first paper to consider the effect of adverse selection on tax policy in a model of growth. Plehn-Dujowich (2009) develops a model of endogenous growth with adverse selection to measure the negative impact of adverse selection on economic growth, but does not consider policy. However, there are studies of the impact of other financial frictions on growth policy. Aghion and Bolton (1997) assume that entrepreneurs that pursue capital accumulation projects face a moral hazard problem: outside creditors are unable to claim more than the entrepreneur's wealth at the time the project is completed as payment. Taxing profits of rich entrepreneurs to subsidize the net-worth of poor entrepreneurs increases growth because the disincentive effect of the profit tax to the rich is secondary to the benefit of alleviating the financial constraints of the poor. To contrast, our paper rationalizes a policy of taxing profits to subside net-worth without relying on a financial constraint that heterogeneously affects entrepreneurs. García-Peñalosa and Wen (2008) show that when risk-averse entrepreneurs face an un-diversifiable income stream stemming from their research, unconditional transfers to entrepreneurs raise the incentive to pursue research by lowering the marginal utility cost of failure. However, if entrepreneurs were able to insure against their income risk, unconditional transfers would have no effect on research effort. Instead, in our model an unconditional transfer would boost research effort even if entrepreneurs were risk-averse and able to insure against income risk as long as adverse selection constrained the entrepreneur's effort.

The paper is structured as follows. Section 2 describes the setup and analyzes the case of perfect information.Section 3 develops the model of asymmetric information, and analyzes the effects of small changes in policy. Section 4 studies the optimal policy problem, and Section 5 concludes. Furthermore, Appendix A completes the description of the model of Section 2, while Appendix B provides proofs to the lemmas and propositions within the paper.

2. A benchmark model of Schumpeterian growth

The basic structure of the economy imperfectly follows Chapter 4.3 in Aghion and Howitt (2009). In this section we intend only to explain the key ingredients of the innovation process necessary to develop and understand the results of this paper. For a complete description of the benchmark model, refer to Appendix A. Throughout the paper, we only consider equilibria with a risk-free interest rate equal to zero ($r = 0$) to simplify the analysis.

There are three types of tradable goods: consumption, a unit continuum of intermediate products, and a unit continuum of industry-specific labor inputs. The intermediate and consumption goods perish each period. There are two types of agents, entrepreneurs and consumers. All agents are completely informed about the model, themselves, and each other. Each agent that lives two periods, is able to provide a unit of industry-specific labor effort in his first period of life, and maximizes expected consumption. While any agent can start a business investing in, and producing, existing intermediate goods, only entrepreneurs are capable of pursuing technological research innovating on existing intermediate goods (Fig. 2.1).

At the beginning of period t, in each industry one entrepreneur and $L-1$ consumers are born. Also present are one entrepreneur and $L-1$ consumers born in period $t-1$. Each industry is monopolized by a single producer, who owns the blueprint of the technologically-superior intermediate good. When the industry has innovated in period $t-1$, the monopoly is held by the old entrepreneur, otherwise it is held by a random old consumer who inherited the blueprint from the previous owner.[4]

A perfectly competitive sector produces the consumption good, employing the entire spectrum of industry-specific labor and intermediate goods. From the consumption good producers, the young agents receive a wage and the intermediate good producers receive payments for their goods. In turn, old agents who invested at $t-1$ in the intermediate good producers receive the return on their investment.

At this point in the timeline, the only good trading in the economy is the consumption good. Young agents may either consume their entire net wage, or lend to young entrepreneurs investing in research or to young consumers investing in production of intermediate goods for period $t+1$. In sequence, young entrepreneurs choose

[2] Incidentally, this provides an entirely different explanation for the inverted-U relationship between competition and innovation found empirically by Aghion et al. (2005).

[3] There are important reasons to consider the effect of limits on consumption taxation. With some exceptions, governments in middle to high income countries do not rely heavily on consumption taxation. On average, taxes on goods and services make up only a third of total tax revenues in OECD countries. Despite the emergence of a large literature arguing in favor of fundamental tax reform, in some countries proposals to tilt the tax base towards consumption have faced serious political difficulties. In Japan, the protracted and conflicted efforts of several political parties to establish and raise consumption taxes provide a good example.

[4] Think of this consumer as the descendant of the last entrepreneur to innovate; he lacks entrepreneurial talent and behaves as a consumer.