Financiers vs. Engineers: Should the Financial Sector be Taxed or Subsidized?*

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Abstract

I study the optimal allocation of human capital in an economy with production externalities, financial constraints and career choices. Agents in the economy choose to become entrepreneurs, workers or financiers. Entrepreneurship has positive externalities, but innovators face borrowing constraints and require the services of financiers in order to invest efficiently. The constrained-efficient allocation can always be implemented with investment subsidies and the same income tax rate on workers and financiers. Without investment subsidies, it can be optimal to give a preferential tax treatment to the financial sector when externalities depend more on aggregate investment than on the number of entrepreneurs.

PRELIMINARY

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Technological progress requires innovative ideas and the means to implement these ideas. As a result, economic growth relies on both engineers and financiers. On the other hand, since individuals can only hold a finite number of jobs at any given time, the various industries end up competing for the same scarce supply of human capital. Without externalities, the competitive allocation of talent and resources would be efficient, but innovative activities are such that private and social returns do not often coincide. Is the competitive allocation inefficient? If so, are there too many or too few financiers? What kind of corrective taxes should be implemented?

I study these questions by combining insights from two well-known fields of economic research. External effects play an important role in the models of Romer (1986) and Lucas (1988). In most models of endogenous growth, the decentralization of the Pareto optimum requires subsidizing investment, production or R&D, as discussed in Aghion and Howitt (1998) and Barro and Sala-i-Martin (2004). This literature argues that social returns to innovation exceed private returns, and that too few individuals become innovators in the competitive equilibrium. Indeed, Baumol (1990) and Murphy, Shleifer, and Vishny (1991) argue that the flow of talented individuals into law and financial services might not be entirely desirable, because social returns might be higher in other occupations, even though private returns are not.

On the other hand, however, a large body of research has shown the importance of efficient financial markets for economic growth. Levine (2005), in his comprehensive survey, argues that "better functioning financial systems ease the external financing constraints that impede firm and industrial expansion, suggesting that this is one mechanism through which financial development matters for growth."

These issues are particularly important today. The financial sector in the United States has grown from 2.3% of private GDP in the 1950s to 7.7% of GDP in the early 21st century. Moreover, since the early 1980s, this growth has been strongly biased towards highly skilled individuals, who used to become engineers and now become financiers (Philippon and Resheff (2007)).[1] The decline in engineering has prompted a debate about the role of science and technology in U.S. economic performance. It is commonly argued that policy

[1] "Thirty to forty percent of Duke Masters of Engineering Management students were accepting jobs outside of the engineering profession. They chose to become investment bankers or management consultants rather than engineers." Vivek Wadhwa, *Testimony to the U.S. House of Representatives, May 16, 2006.*

interventions that promote science and technology are desirable because of externalities in knowledge and the diffusion of new technologies (National Academy of Sciences (2007)).[2]

This line of reasoning also appears in the debate about the tax treatment of hedge funds and private equity funds. Hedge funds and private equity funds have their fees taxed at the 15 percent capital gains rate rather than the 35 percent ordinary income rate. The properties of an optimal tax system are not *a priori* obvious. On the one hand, one could argue that finance diverts resources from entrepreneurship. To the extent that innovations have positive externalities, this suggests that entrepreneurship should be subsidized and that other activities should be discouraged. On the other hand, one could argue that financial services help innovation by relaxing entrepreneurs' constraints, and that finance should therefore be subsidized. Indeed, executives of investment funds argue that taxing their funds at a lower-rate promotes economic growth because they provide specific services to entrepreneurs and industrial companies. Critics argue that lower taxes for private equity firms and fund managers distort incentives for college students deciding what career to pursue.[3]

I propose a simple model where one can evaluate the relative merits of these seemingly contradictory arguments. In the model, agents choose to become workers, entrepreneurs or financiers. Like in the endogenous growth literature, entrepreneurs have the ability to innovate, and these innovations have positive externalities. Like in the financial development literature, innovators face binding borrowing constraints and may require the use of financial services in order to invest efficiently. I characterize the social planner's allocation and the competitive equilibrium, and I study a tax system that implements the constrained-efficient outcome.

I obtain the following results. First, the constrained efficient allocation can always be decentralized with an investment subsidy and the same tax rate on workers and financiers. The intuition for this result is the following. The optimal investment subsidy is chosen so as to make sure that the private and social marginal returns to investment are equalized.

[2] "Our goal should be to double the number of science, technology, and mathematics graduates in the United States by 2015. This will require both funding and innovative ideas." Bill Gates, *Testimony to the U.S. Senate, March 7, 2007*

[3] "Industry Groups Warn of Adverse Effects of Private Equity Tax Hike", Alan Zibel, Associated Press Business Writer, Tuesday July 31 2007. See in particualr the quotes of Joseph Bankman, law professor at Stanford University, and Bruce Rosenblum, managing director of the Carlyle Group.

Once this subsidy is in place, the private and social returns to moving an agent from the pool of workers to the pool of financiers are also equalized, and there is no reason to tax financiers more or less than workers. This is true even if there is a strong complementarity between finance and entrepreneurship, precisely because, when the complementarity is strong, subsidizing entrepreneurs indirectly benefits the financial sector as well.

Moreover, the constrained efficient allocation requires only an investment subsidy when the external effects depend exclusively on the aggregate resources given to entrepreneurs, as in Romer (1986). When the external effect depends also directly on the number of entrepreneurs, the second best requires positive subsidies to scientific education (equivalently, positive tax rates on workers and financiers). This distinction has not been emphasized in the endogenous growth literature so far.

Moving away from the second best, it is true that, starting from a competitive equilibrium without corrective taxation, a subsidy given to the financial sector can enhance welfare because this sector provides specific services to entrepreneurs. It is also true, however, that these subsidies may lure human capital away from entrepreneurship to the point of reducing welfare. In fact, which effect dominates depends on the precise nature of the externalities. Subsidizing the financial sector is generally useful if one seeks to generate more investment in the aggregate. If one is only interested in increasing the number of entrepreneurs, on the other hand, it might be optimal to tax the financial sector.

The rest of the paper is organized as follows. Section 1 lays down the model and discusses how it relates to the literature. Section 2 characterizes the social planner's allocations. Section 3 derives the competitive equilibrium outcome and compares it to the social planner's outcome. Section 4 shows how the second best allocation can be decentralized, and then discusses optimal taxation in a third-best economy with limited tax instruments. Section 5 concludes and offers a perspective on the current debate regarding the taxation of hedge funds and private equity funds.

1 The model

1.1 Technology and preferences

Consider an economy with two periods and a continuum of ex-ante identical individuals, indexed by $i \in [0,1]$. Let c_t^i be the consumption of individual i at date $t = \{1,2\}$. The lifetime utility of the agent is:

$$u\left(c_1^i\right) + \beta u\left(c_2^i\right). \tag{1}$$

The function $u(.)$ is strictly increasing, strictly concave and satisfies the boundary conditions:

$$\lim_{c \to 0} u'(c) = \infty. \tag{2}$$

Career choice

Agents choose a career at the beginning of the first period. Let e be the number of agents who chose to become entrepreneurs, n the number of workers in the industrial sector, and b the number of financiers. Population size is normalized to one, so that one can think of e, b and n as shares of the labor force. I will abuse notation and use e to denote both the measure of entrepreneurs and the set of individuals who choose to become entrepreneurs.

First period production

The production technology is:

$$y_t = f(a_t n, k_t). \tag{3}$$

The function f is increasing and concave, has constant returns to scale and satisfies:

$$f(0,.) = f(.,0) = 0. \tag{4}$$

Saving and investment

The investment technology requires the human capital of entrepreneurs as well as physical capital. Let x^i be the amount of physical capital allocated to entrepreneur i at time $t = 1$. At time $t = 2$, this entrepreneur privately produces $g\left(a_1, x^i\right)$ new units of capital. For simplicity, I assume full depreciation of the existing capital at the end of the first period, so that:

$$k_2 = \int_{i \in e} g\left(a_1, x^i\right) di.$$

Enforcement constraint and monitoring technology

The enforcement of financial contracts is limited. More precisely, I assume that an entrepreneur can always steal and consume at time 2 some of the resources that she controls. Without monitoring, if individual i becomes an entrepreneur and commands the resources x^i, her consumption in the second period, c_2^i, cannot be less than zx^i. Financiers have access to a monitoring technology that makes it more difficult for entrepreneurs to divert resources. If m^i units of monitoring are allocated to a particular entrepreneur i, the enforcement constraint is relaxed and becomes:

$$c_2^i \geq zx^i - a_1 q\left(m^i\right). \tag{5}$$

The function $q(.)$ is increasing and concave. In an equilibrium with b bankers, the total amount of monitoring available in the economy is b. The resource constraint in the monitoring market therefore requires:

$$\int_{i \in e} m^i \leq b. \tag{6}$$

External effects

Following Romer (1986) and Lucas (1988), I assume that external effects determine the evolution of productivity. Productivity evolves according to:

$$a_2 = a_1 h\left(e, X\right), \tag{7}$$

where X is the aggregate level of investment in the economy:

$$X \equiv \int_{i \in e} x^i.$$

1.2 Discussion and relation to the literature

The two critical components of the model are the external effects from investment and entrepreneurship, captured by the function $h(e, X)$ in equation (7), and the monitoring services provided by the financial sector, described in equations (5) and (6).

The production technology in equation (7) allows for external effects, in the spirit of the endogenous growth literature. In Romer (1986), who builds on early contributions by Arrow (1962) and Sheshinski (1967), the output of a particular firm depends not only on its own capital, but also on the aggregate capital stock. Griliches (1979) distinguishes between firm specific and economy-wide knowledge. Lucas (1988), on the other hand, emphasizes human capital because "human capital accumulation is a social activity, involving groups of people in a way that has no counterpart in the accumulation of physical capital." Several types of external effects have therefore been studied in the literature. Some might plausibly be linked to the number of entrepreneurs, e, while others might depend more directly on aggregate investment, X. The function $h(e, X)$ captures these various possibilities. One should also keep in mind that I have normalized the population to one, so one can think of X as investment per capita, and e as the fraction of entrepreneurs. Barro and Sala-i-Martin (2004) discuss how these scale effects matter in the comparison of small and large economies, across countries and over time.

There are two approaches to modelling financial intermediation. The first is to assume exogenous transaction costs and study the organization of the industry. In this approach, financial institutions (FIs) are to financial products what retailers are to goods and services. However, as Freixas and Rochet (1997) argue, "the progress experienced recently in telecommunications and computers implies that FIs would be bound to disappear if another, more fundamental, form of transaction costs were not present". A second approach, which I follow here, focuses on moral hazard and information asymmetries, instead of mechanical transaction costs. This paper builds on the rich literature on financial intermediation, but it is more concerned with the macroeconomic outcome than with the microeconomic ones. I therefore abstract from the issues of delegated monitoring emphasized in Diamond (1984), from the supply of bank capital studied by Holmström and Tirole (1997), and from the formation of optimal coalitions as in Boyd and Prescott (1986). In the model, the cost of financial intermediation is an opportunity cost, because an agent cannot be a banker, an engineer or a worker at the same time. I assume that there is no asymmetric information between FIs and their creditors. As a result, even though there exists a well defined financial sector, the boundaries of FIs within the industry are inconsequential.

The paper is also related to the work of Bencivenga and Smith (1991), Greenwood and Jovanovic (1990), Levine (1991), King and Levine (1993), Khan (2001) and Greenwood, Sanchez, and Wang (2007) who study the links between financial intermediation and growth.[4] Compared to these papers, my contribution is to study the decentralization of the second-best allocation of talent in the presence of credit constraints and external effects.

Finally, I would like to discuss an important assumption that I maintain throughout the paper. I assume that all the externalities from innovation are in the industrial sector, and I neglect financial innovations. Yet innovations also happen in the finance industry, and the private returns to financial innovations may also be lower than their social returns (Allen and Gale (1994), Duffie and Rahi (1995), Tufano (2004)). I make this modelling choice for two reasons. First, because it is interesting to understand when and why the financial sector should be subsidized even though it does not create direct externalities. Second, in the current debate on the taxation of hedge funds and private equity funds, even the advocates of these funds do not seem to argue that externalities from financial innovations justify the preferred tax treatment that they receive. Rather, they argue along the lines of this paper, that the funds provide important services by promoting growth in the industrial sector. This view is also consistent with the fact that, in most advanced countries, direct subsidies to scientific education are much more common that direct subsidies to business education.

2 Social planner's solution (SP)

In the rest of the paper, I normalize $a_1 = 1$ and I abuse notations by writing $g\left(x^i\right)$ instead of $g\left(a_1, x^i\right)$. For each individual $i \in [0,1]$, the social planner chooses a job (entrepreneur, worker or financier), two levels of consumption $\left\{c_1^i, c_2^i\right\}$, and, if the individual is an entrepreneur, an amount of investment x^i and a level of monitoring m^i. The planner faces the constraints (5) and (6), as well as the usual resource constraints in the first and second periods. The planner seeks to maximize the lifetime utility (1) for a particular agent subject to delivering a given level of utility to all the other agents. In order to be able to compare the social planner's allocation to the decentralized equilibrium where all agents are free to choose their jobs, I look for Pareto-optima where all the agents have the same ex-ante utility: $u\left(c_1^i\right) + \beta u\left(c_2^i\right) = \bar{U}$ for all $i \in [0,1]$.[5]

[4] It is impossible to cite all the relevant contributions here. See Levine (2005) for an excellent survey and extensive references.

[5] It might appear objectionable to assume that workers, entrepreneurs and investment bankers all receive the same expected utility. However, one can simply restate the model in terms of efficiency units of human

Lemma 1 *In any solution to the planner's problem, all entrepreneurs receive the same allocation* $\left\{x, m, \{c_t^e\}_{t=1,2}\right\}$.

Proof. See appendix. ■

The first thing to notice is that the planner can always adjust the relative consumptions in the first period without affecting any of the technological or incentive constraints. Therefore, starting from any Pareto-efficient allocation, it is possible to construct another Pareto-efficient allocation where (11) holds. The planner could choose different allocations for different entrepreneurs, since this would relax some enforcement constraints. It is not optimal to do so, however, mainly because the production and utility functions are concave, and the monitoring technology is (weakly) concave.

Since financiers and workers do not face enforcement constraints, it is never optimal to give them different allocations. When the enforcement constraint binds, however, the planner chooses to distort the consumption pattern of entrepreneurs relative to workers and financiers. Lemma (1) allows me to restate the planner's problem in a simpler form:

$$(\text{SP}) : \max u(c_1) + \beta u(c_2)$$

subject to the resource constraint in the first period:

$$ec_1^e + (1-e)\,c_1 + ex \leq f(n, k_1)\,, \tag{8}$$

and in the second period:

$$ec_2^e + (1-e)\,c_2 \leq f(h(e, X)\,n, eg(x))\,. \tag{9}$$

The enforcement constraint can be written as:

$$zx - q\left(\frac{1-n}{e} - 1\right) \leq c_2^e \tag{10}$$

The indifference constraint becomes:

$$u(c_1^e) + \beta u(c_2^e) = u(c_1) + \beta u(c_2)\,. \tag{11}$$

capital, and assume that different agents are endowed with different efficiency units. The analysis would be essentially the same, except that the comparison of expected utilities among ex-ante heterogenous agents would be more cumbersome.

The population constraint for this simplified program is:

$$e + n \leq 1. \tag{12}$$

The control variables are $\{e, n\}$ chosen in $[0, 1]$, x in $[0, \infty)$ and $\{c_1, c_2, c_1^e, c_2^e\}$ in $(0, \infty)$.

A few properties of this program are worth pointing out at the outset. First, the solution is always interior. For consumption, it follows from the assumptions about the behavior of the marginal utility in equation (2). For investment, it follows from the assumptions in equation (4) about the production function. For n, it follows from the first period resource constraint, and for e, it follows from the second period resource constraint. Therefore, beyond characterizing the first order conditions, we only need to study three cases: the first best with a slack enforcement constraint (10), the second best with no bankers and a tight constraint (12), and the second best with an active monitoring market and a slack constraint (12).

2.1 First best

The first best is obtained when $z = 0$. Financiers are not needed and all agents are either workers or entrepreneurs. The marginal utilities are equalized between all agents, and, given the indifference constraint (11), the levels of consumption are also equalized. The first order condition for optimal investment per-entrepreneur, x, is simply:

$$\frac{u'(c_1)}{\beta u'(c_2)} = g'(x) \frac{\partial f_2}{\partial k} + (1 - e) \frac{\partial h}{\partial X} \frac{\partial f_2}{\partial n}. \tag{13}$$

The allocation of workers and entrepreneurs is optimal when:

$$\frac{u'(c_1)}{\beta u'(c_2)} \left(x + \frac{\partial f_1}{\partial n} \right) + h \frac{\partial f_2}{\partial n} = g(x) \frac{\partial f_2}{\partial k} + (1 - e) \left(\frac{\partial h}{\partial e} + x \frac{\partial h}{\partial X} \right) \frac{\partial f_2}{\partial n}. \tag{14}$$

The left hand side of this equation is the cost of adding one entrepreneur and removing one worker in the first period. The right hand side is the return to entrepreneurship in the second period, properly discounted. Finally, clearing the goods market requires that (8) and (9) hold with equality. There is a unique solution $\left(x^{FB}, e^{FB}\right)$ solving the system of equations (13) and (14).

2.2 Second best

We now turn to the case where the enforcement constraint binds. Let μ be the Lagrange multiplier on (10), and let λ_1 and λ_2 be the multipliers on (8) and (9). The marginal rates of substitutions are not equalized when $\mu > 0$. The intratemporal condition for the allocation of consumption between workers and entrepreneurs is also affected. Suppose that the social planner decides to provide one extra unit of utility to all agents at time 1. For an agent with consumption c, this costs $1/u'(c)$ units of output. For the population of agents, it becomes a weighted average of inverse marginal utilities. At the optimum, this costs must be equal to the relative price of consumption, i.e. $1/\lambda_1$:

$$\frac{1}{\lambda_1} = \frac{e}{u'(c_1^e)} + \frac{1-e}{u'(c_1)} \ . \tag{15}$$

This does not reduce to the usual condition $u'(c_1) = \lambda_1$ because $u'(c_1^e) > u'(c_1)$ due to the enforcement constraint. In what follows, and especially in the comparison with the decentralized economy, it is more efficient to describe the solution to (SP) using two new multipliers:

$$R^* \equiv \frac{\lambda_1}{\lambda_2} \text{ and } \phi^* \equiv \frac{\mu}{\lambda_2}$$

The two consumption smoothing conditions become

$$\frac{u'(c_1)}{\beta u'(c_2)} = R^* \tag{16}$$

and

$$\frac{u'(c_1^e)}{\beta u'(c_2^e)} = \frac{R^*}{1-\phi^*} \tag{17}$$

The optimality condition for investment equates the marginal cost to the marginal return. The marginal cost includes both physical and monitoring costs:

$$R^* + \phi z = g' \frac{\partial f_2}{\partial k} + n \frac{\partial h}{\partial X} \frac{\partial f_2}{\partial n}. \tag{18}$$

Two conditions ensure that the allocation of human capital is optimal. First, the net return to adding an entrepreneur equals the net return to adding a worker. Workers produce output in both periods. Entrepreneurs deliver output in the second period, but require investment x and monitoring m. Taking into account that their consumptions are also different, we obtain:

$$R^* \left(x + c_1^e - c_1 + \frac{\partial f_1}{\partial n} \right) + c_2^e - c_2 + \frac{h \partial f_2}{\partial n} = g \frac{\partial f_2}{\partial k} + n \left(\frac{\partial h}{\partial e} + x \frac{\partial h}{\partial X} \right) \frac{\partial f_2}{\partial n} - \phi^* \frac{b}{e} q'. \tag{19}$$

The second condition for the optimal allocation of agents depends on whether the population constraint (12) binds or not. If it binds, implying that there are no financial intermediaries in equilibrium, we can simply close (SP) by imposing:

$$n = 1 - e. \tag{20}$$

If (12) does not bind, we have an optimality condition for the allocation of financiers and workers. Since these agents have the same consumptions, the planner simply chooses to equalize their marginal productivities:

$$R^* \frac{\partial f_1}{\partial n} + h \frac{\partial f_2}{\partial n} = \phi^* q'. \tag{21}$$

The social planner allocation (SP) is described by the indifference condition (11), the three market clearing conditions (8), (9), and (10), and the five first order conditions (16), (17), (18), (19) and either (20) or (21). The nine unknowns are seven quantities $\{e, n, x, c_1, c_2, c_1^e, c_2^e\}$ and two multipliers $\{R^*, \phi^*\}$.[6] For the remaining of the paper, I focus on the (relevant) case where active financial intermediaries exist in equilibrium.

3 Decentralized equilibrium (DE)

In this section, I study the decentralized competitive equilibrium (DE), and I compare it to the social planner outcome (SP). I assume that the ownership of capital in the first period is equally shared among the agents.

3.1 Workers and financiers

In (DE), workers earn the competitive wages at dates 1 and 2, and save at rate R. The program of a worker is to maximize $u(c_1) + \beta u(c_2)$, subject to the budget constraint

$$c_1 + \frac{c_2}{R} \leq k_1 \frac{\partial f_1}{\partial k_1} + \frac{\partial f_1}{\partial n} + \frac{h}{R} \frac{\partial f_2}{\partial n}$$

The bankers receive a fee φ for each unit of monitoring that they provide. I use the convention that bankers are paid in the second period, once the projects are realized, but this is without loss of generality. Their budget constraint is

$$c_1 + \frac{c_2}{R} \leq k_1 \frac{\partial f_1}{\partial k_1} + \frac{\varphi}{R}$$

[6] Note that condition (15) is now redundant, and one can think of it simply as defining λ_1.

Whenever there are both workers and financiers, the following indifference condition for career choice must hold:

$$R\frac{\partial f_1}{\partial n} + h\frac{\partial f_2}{\partial n} = \varphi. \tag{22}$$

Finally, we have the usual consumption smoothing condition:

$$\frac{u'(c_1)}{\beta u'(c_2)} = R. \tag{23}$$

3.2 Entrepreneurs

Each entrepreneur faces an enforcement constraint because she cannot commit to repay her debts. She can purchase m units of monitoring from the banking sector to mitigate this constraint, at a price of φ units of second period output for one unit of monitoring. Her program is therefore

$$\begin{aligned} V^e &= \max_{\{c_t^e\},x,m} u(c_1^e) + \beta u(c_2^e), \\ \text{subject to } zx - q(m) &\leq c_2^e, \\ \text{and } Rc_1^e + c_2^e &\leq Rk_1\frac{\partial f_1}{\partial k_1} + g(x)\frac{\partial f_2}{\partial k} - \varphi m - Rx. \end{aligned}$$

Define ϕ such that the first order condition for the intertemporal choice of consumption by the entrepreneur is:

$$\frac{u'(c_1^e)}{\beta u'(c_2^e)} = \frac{R}{1-\phi}. \tag{24}$$

Comparing equations (23) and (24), we see that the entrepreneur chooses a steeper consumption profile than workers or financiers. The entrepreneur takes into account that it is optimal to delay consumption in order to relax the credit constraints.

The optimal choice of monitoring leads to

$$\varphi = \phi q'(m)$$

The optimal choice of investment leads to:

$$\phi z + R = g'(x)\frac{\partial f_2}{\partial k}. \tag{25}$$

The entrepreneur equates the private marginal return and marginal cost of investment, but does not take into account the external effects of her activities on future labor productivity.

3.3 Comparison with the social planner's allocation

The indifference condition (11) and the three market clearing conditions (8), (9), and (10), are the same in (SP) and in (DE). The consumption smoothing equations (16, 23, 17, 24), and the worker/banker career choice (21, 22) are also equivalent.

The first discrepancy appears between the investment equations (18) and (25) when $h_X \neq 0$. The second discrepancy concerns the career choice between entrepreneurs and workers/bankers. Using the budget constraints of workers and entrepreneurs, we see that in (DE):

$$R\left(x + c_1^e - c_1 + \frac{\partial f_1}{\partial n}\right) + c_2^e - c_2 + h\frac{\partial f_2}{\partial n} = g\frac{\partial f_2}{\partial k} - \phi\frac{b}{e}q' \tag{26}$$

The corresponding condition in SP is (19). Once again, a discrepancy appears when $h_X \neq 0$ or $h_e \neq 0$. It is clear that the decentralized outcome is constrained efficient when there are no externalities in production. Credit constraint by themselves do not create scope for policy intervention in this model. When external effects are present, however, the perceived returns to investment and the value of becoming an entrepreneur are both too low.

4 Optimal taxation

4.1 Implementation of the second best

In this section, I study how the constrained efficient equilibrium can be decentralized using an investment subsidy and income taxes. Let τ^x, τ^w and τ^ϕ denote the investment subsidy, the tax rate of labor income in the industrial sector, and the tax rate of income in the financial sector, respectively. I assume that capital income is not taxed, and that all entrepreneurial income is treated as capital income.[7] I also allow for lump sum transfers T to balance the budget of the government.

[7] In practice, there is much confusion in the Law as to what distinguishes capital gains from ordinary income, and why they should be treated differently. Weisbach (2007) argues that "At best, we can try to observe where the tax law draws the lines [..] There appears to be two key factors. First, the more entrepreneurial the activity, the more likely the treatment will be capital. Second, the more that labor and capital are combined into a single return, the more likely it will be treated as capital [...] Entrepreneurs such as founders of companies get capital gains when they sell their shares even if the gains are attributable to labor income. For example, most or possibly all of Bill Gates's fortune comes from his performance of services for Microsoft, but the overwhelming majority of his earnings from Microsoft will be taxed as capital gain."

Proposition 1 *The second best outcome can be decentralized with an investment subsidy and the same income tax rate in the industrial and financial sectors. The optimal tax rates, expressed as functions of the second best allocations, are:*

$$\tau^x = \frac{n}{R}\frac{\partial h}{\partial X}\frac{\partial f_2}{\partial n},$$

and

$$\tau^\phi = \tau^w = n\frac{\partial h}{\partial e}\frac{\partial f_2}{\partial n} / \left(R\frac{\partial f_1}{\partial n} + h\frac{\partial f_2}{\partial n}\right).$$

Proof. See appendix. ■

The nature of the external effect determines the characteristics of the optimal tax system. If the external effects depend only on aggregate investment, and not on the number of entrepreneurs for a given volume of investment, then the optimal tax rate on labor income is zero, and lump sum taxes are levied only to finance the investment subsidy. The partial derivative h_X appears in the first order condition for socially optimal investment, and in the condition for the optimal allocation of agents among jobs. How come, then, that only one instrument is enough to implement the second best? To understand this result, notice first that the subsidy gives incentives to entrepreneurs to invest more, but also that it increases the value of becoming an entrepreneur. When $h(.)$ is only a function of X, we know that $\partial h/\partial e = xh_X$. Since $R\tau^x = h_X$, the marginal external return of one extra entrepreneur h_e/R is therefore equal to the effective subsidy receive by an entrepreneur, $x\tau^x$, and the subsidy solves both problems at once.

The polar opposite happens when the external effects does not depend on aggregate investment for a given number of entrepreneur. A simple example is when investment has a fixed scale $\bar{x}$ and the only effective choice variable is e.[8] In this case, the investment subsidy is zero, and the optimal transfer is to tax the labor income of workers and financiers, and redistribute lump-sum transfers to all agents. Alternatively, one could interpret such a scheme as a subsidy to education in those fields that are complement with innovation and entrepreneurship, financed by a uniform labor income tax.

Finally, it is remarkable that in all cases, the second best is obtained with the same tax rate on income in the industrial and financial sectors.[9] The reason is the following. Suppose

[8] This can be achieved by making the function $g(x)$ extremely concave, until it looks like a step function.

[9] Allowing the entrepreneurs to produce some output in the first period, as though they were partly workers, does not change this result.

that one has found a tax system that implements the second best, without taxing capital income. This tax system does not affect the Euler equations (23) and (24). Therefore, it must be the case that $R = R^*$ and $\phi = \phi^*$. Consider now the programs of the workers and bankers. The indifference condition for career choice becomes $(1 - \tau^w)(Rf_{1,n} + hf_{2,n}) = (1 - \tau^\phi)\, \phi q'(m)$. Since R and ϕ are the same as in the planner's allocation, if one want to replicate the allocation, it must be the case that $\tau^w = \tau^\phi$. In other words, because the externalities do not enter directly the career choice between workers and bankers, a tax system that manages to deal with these externalities should treat workers and financiers in the same way. It is important to realize, of course, that this is only true in a tax system that actually implements the second best outcome. I now turn to the case where the second best outcome cannot be implemented.

4.2 Taxation in a third best economy

What happens if we restrict the menu of tax instruments available to the government? More precisely, suppose that investment subsidies are not available. Starting from an economy without any policy intervention, would it then be optimal to tax or to subsidize the financial sector alone?

The answer, it turns out, depends on the type of externality one considers. One can show that, starting from any decentralized equilibrium, the welfare gains are given by

$$dW = \frac{\lambda_1}{R}\left(\frac{\partial h}{\partial e}de + \frac{\partial h}{\partial X}dX\right) h\frac{\partial f_2}{\partial n} \tag{27}$$

where λ_1 is defined in equation (15). In the case where $h_e = 0$, welfare is enhanced if and only if the new tax system increases aggregate investment. In the case where $h_X = 0$, welfare is enhanced if and only if the new tax system increases the number of entrepreneurs. In practice, of course, it is difficult to achieve both goals. To make the discussion more precise, I consider a simple calibration of the model.

Calibration

I assume that the utility function $u(c)$ has a constant coefficient of relative risk aversion of 2 (since the model is non-stochastic, it is really the elasticity of intertemporal substitution that matters). The length of on period is set to 20 years. The production function is

Cobb-Douglas:

$$y_t = k_t^{1-\alpha} (a_t n_t)^{\alpha}$$

with $\alpha = 0.6$. The investment function is:

$$g(x) = \gamma x^{\theta}$$

with $\gamma > 0$ and $\theta \in (0, 1)$. The monitoring function is also assumed to be linear

$$q(m) = qm$$

I then chose the parameters of the model to match a size of 7% for the financial sector, an equilibrium return on physical capital of 4% per year, a per-capita consumption growth of 1% per year, and a ratio of investment to GDP of $X/y_1 = 0.1$ in the first period. At this stage, I still need one restriction to pin down the parameters of the model. Unfortunately, I do not have direct estimates for credit constraints and external effects. I choose the next two restrictions to make sure that the competitive equilibrium has significant credit constraints and significant externalities. The tightness of credit constraints is measured by ϕ. The smallest value is zero, when the constraints do not bind, and ϕ cannot be more than one: I set $\phi = 0.5$ as my benchmark. This implies that the consumption profile of entrepreneurs is 30% steeper than the consumption profile of unconstrained agents.

β	γ	θ	q	$zx/(g(x) f_{2,k})$
$(0.9809)^{20}$	1.0543	0.8889	0.8537	0.7916

The implied share of entrepreneurs is 3.1%, which means that 89.9% of the agents in the economy are workers. The degree of moral hazard is measured by the ratio $zx/(g(x) f_{2,k})$. The numerator is the consumption of the entrepreneur if she decided to misbehave without monitoring. The numerator is the value of the project she controls at time 2, in units of consumption.

I assume that the external effects are linear in e and X:

$$h(e, X) = 1 + h_e \cdot e + h_X \cdot X,$$

where h_e and h_X are constant. This calibration does not pin down the elasticicities h_e and h_X independently. It is clear from (27) that the welfare properties of various tax systems depend on these elasticities. I will therefore consider two cases, one where h_e is small and most of the externalities come from aggregate investment, and another case where h_e plays a more significant role.

I study two types of tax systems. Both include lump-sum taxes and transfers to balance the budget of the fiscal authority, but they exclude all investment subsidies. The first system imposes a tax on labor income in the industrial sector, at a rate τ^w. This tax system alters the career choice of agents by making it relatively more attractive to become either a financier or an entrepreneur. The tax revenues are rebated as lump-sum payments to all agents. The second tax system imposes a subsidy or a tax on income in the financial sector, at rate τ^ϕ. The after-tax revenue (discounted to period one) of financiers becomes $\left(1-\tau^\phi\right) q\phi/R$, and the budget is balanced with with lump-sum transfers, or lump-sum taxes if τ^ϕ is negative.

Taxes and Welfare

Figure 1 depicts the welfare consequences of these tax systems. Welfare is measured in consumption equivalent, that is, a welfare gain of 0.2% corresponds to a permanent increase in consumption by 0.2%. In each case, I consider first two parameterization of the external effects. The first case is when $h_e = 0$, which is consistent with Romer (1986). The second set of parameters is such that in the benchmark equilibrium, 30% of the externalities come from the number of entrepreneurs: $eh_e = 0.3\,(h-1)$.

The top panel of Figure 1 focuses on labor income taxes in industrial sector. Two fundamental forces explain the results. It is clear that an increase in τ^w leads to a drop in the number of workers, and to an increase in the number of entrepreneurs. The drop in the number of workers decreases output in the first period and increases the interest rate. With fewer resources an more entrepreneurs, investment per entrepreneur falls. When the external effects come from aggregate investment, the two forces mostly cancel out as long as the tax rate remains moderate. The optimal rate in figure 1a is positive, but the welfare gains are minuscule relative to competitive equilibrium, and relative to the welfare losses from excessive taxation. When a significant fraction of the external effects come from the number of entrepreneurs, on the other hand, significant welfare gains can be obtained by taxing labor income.

The bottom panel of figure 1 studies the consequences of subsidizing or taxing the financial sector. The magnitudes in panels 1a and 1b are not comparable because the financial sector is much smaller than the industrial sector, so that a tax rate τ^w of 1% involves transfers equivalent to a tax rate τ^ϕ of more than 10%. When τ^ϕ decreases, more agents become financiers. This decreases the number of workers and entrepreneurs, and increases the interest rate. While the number of entrepreneurs falls, investment per entrepreneur increases because the financial constraints are relaxed. The effect on aggregate investment is theoretically ambiguous, but in practice, for reasonable parameter values, aggregate investment increases. When $h_e = 0$, it is optimal to subsidize the financial sector. When $eh_e = 0.3\,(h-1)$, the fall in e and the increase in X mostly cancel out. Of course, if we were to consider the extreme case where $eh_e = h - 1$, it would be optimal to tax the financial sector. However, in this case, the top panel suggests that it would be even more efficient to tax labor income in the industrial sector.

The influence of the nature of the external effects on the optimal tax system sheds light on the current debate regarding the taxation of private equity funds. During his Senate Finance Committee hearing, Bruce Rosenblum, managing director of the Carlyle Group, a Washington-based private equity fund, argued that, if the tax rate is increased, some deals will not be done, "there will be entrepreneurs that won't get funded and turnarounds that won't get undertaken."[10] On the other hand, Robert H. Frank argues that "No one denies that the talented people who guide capital to its most highly valued uses perform a vital service for society. But at any given moment, there are only so many deals to be struck. Sending ever larger numbers of our most talented graduates out to prospect for them has a high opportunity cost, yet adds little economic value. By making the after-tax rewards in the investment industry a little less spectacular, the proposed legislation would raise the attractiveness of other career paths, ones in which extra talent would yield substantial gains."[11] In essence, one argues that aggregate investment is elastic and is the variable of interest, while the other argues that it is not very elastic and that the number of entrepreneurs is the variable of interest. The model makes is clear why they reach opposite conclusions regarding the optimal taxation of the financial sector.

[10] "Industry Groups Warn of Adverse Effects of Private Equity Tax Hike", by Alan Zibel, Associated Press Business Writer, Tuesday July 31 2007.

[11] A Career in Hedge Funds and the Price of Overcrowding, The New York Times, July 5, 2007.

5 Conclusion

I have studied an economy with career choices, financial constraints and externalities from innovation and entrepreneurship. The model clarifies the relevance of two intuitions. On the one hand, subsidizing the financial sector increases the investments that entrepreneurs can undertake. On the other hand, it decreases the number of entrepreneurs by attracting more individuals to the financial sector. Starting from a competitive economy without any tax or subsidy, the introduction of a subsidy to the financial sector may increase or decrease welfare depending on the nature of the externalities involved. Generally in such a third-best economy, if one seeks to increase aggregate investment, then subsidizing the financial sector is likely to be welfare-improving.

The more surprising result, however, is that these considerations loose their relevance when one thinks about the implementation of the second best outcome. In the model, this implementation requires an investment subsidy to the extent that there are externalities linked to aggregate investment, and a subsidy to entrepreneurship or to scientific education to the extent that there are externalities linked to the number of entrepreneurs. Once these subsidies are in place, it is always optimal to set exactly the same tax rate on labor income in the industrial sector and in the financial sector, irrespective of the nature the external effects.

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A Proof of lemma 1

Fix the number of entrepreneurs e and the aggregate investment X. Let $i = 0$ denote a particular entrepreneur. Consider the following program, denoted SP^0:

$$\max u\left(c_1^0\right) + \beta u\left(c_2^0\right)$$

subject to the set of constraints

$$\begin{aligned}
\int_{i\in e} c_1^i &\leq \bar{C}_1 : \{\lambda_1\} \\
\int_{i\in e} c_2^i - f\left(h(e,X)\, n, \int_{i\in e} g(x_i)\, di\right) &\leq -\bar{C}_2 : \{\lambda_2\} \\
\int_{i\in e} m^i &\leq \bar{M} : \{\theta\} \\
\int_{i\in e} x^i di &\leq \bar{X} : \{\chi\} \\
z x_i - q(m_i) - c_2^i &\leq 0 : \left\{\mu^i\right\} \\
\bar{U} - u\left(c_1^i\right) + \beta u\left(c_2^i\right) &\leq 0 : \left\{\gamma^i\right\}
\end{aligned}$$

And, to be consistent with the constraint that all agents must receive the same utility in the original problem, $\bar{U}$ is chosen such that

$$\bar{U} = u\left(c_1^0\right) + \beta u\left(c_2^0\right)$$

For given values of e, b and X, the first two constraints keep the allocation of consumption to the other agents feasible. The other constraint are satisfied by the original program of the social planner. For the solution of the planner to be optimal, the allocation among entrepreneur must therefore solve (SP^0). Given our assumptions about the utility and production functions, the solutions for consumption and investment are always interior:

$$\begin{aligned}
\frac{u'\left(c_1^i\right)}{\beta u'\left(c_2^i\right)} &= \frac{\lambda_1}{\lambda_2 - \mu^i} \\
\lambda_2 g'(x_i) \frac{\partial f_2}{\partial k_2} &= \mu^i z + \chi \\
\theta &= \mu^i q'\left(m^i\right)
\end{aligned}$$

Let us show that μ^i must be the same for all i. Consider two entrepreneurs i and j and suppose that the enforcement constraint binds more for i and than for j: $\mu^i > \mu^j$. Therefore $u'\left(c_1^i\right)/u'\left(c_1^j\right) > u'\left(c_2^i\right)/u'\left(c_2^j\right)$. Since both i and j receive the same ex-ante utility, we must have $c_1^i < c_1^j$ and $c_2^i > c_2^j$. Since $\mu^i > \mu^j$ and $q(.)$ is concave, it must be the case that $m^i \geq m^j$. Therefore $zx^i = q\left(m^i\right) + c_2^i > c_2^j + q\left(m^j\right) \geq zx^j$ and $x^i > x^j$. The optimality condition for investment implies that $g'\left(x^i\right) > g'\left(x^j\right)$. Since g is concave, this implies that $x^i < x^j$, which contradicts the previous inequality. Therefore, μ^i must be the same for all $i \in e$. QED.

B Proof of proposition 1

For bankers and workers, the consumption/saving decision is unchanged and the career choice condition becomes:

$$(1-\tau^w)\left(R\frac{\partial f_1}{\partial n}+h\frac{\partial f_2}{\partial n}\right)=\left(1-\tau^\phi\right)\varphi.$$

The program of the entrepreneur changes because her budget constraint becomes:

$$Rc_1^e+c_2^e=Rk_1\frac{\partial f_1}{\partial k_1}+g\left(x\right)\frac{\partial f_2}{\partial k}-\varphi m-R\left(1-\tau^x\right)x.$$

The Euler equation of the entrepreneur does not change, but the first order condition for investment becomes

$$\phi z=g'\left(x\right)\frac{\partial f_2}{\partial k}-\left(1-\tau^x\right)R. \tag{28}$$

The optimal choice of monitoring is still

$$\varphi=\phi q'$$

We are looking for tax rates $\left(\tau^\phi,\tau^w,\tau^x\right)$ that decentralize the SP outcome. Because the Euler equations of workers and bankers have not changed, we must have $R=R^*$. Similarly, from the Euler equation of the entrepreneurs, we must have $\phi=\phi^*$. From the career choice of workers and financiers, it follows that:

$$\tau^\phi=\tau^w$$

The tax rate on labor income is the same inside or outside the financial services industry. From (18), we see that $R^*=g'\left(x\right)\frac{\partial f_2}{\partial k}+\frac{n}{e}\frac{\partial h}{\partial x}\frac{\partial f_2}{\partial n}-\phi z$. From (28), we see that $R=g'\left(x\right)\frac{\partial f_2}{\partial k}-\phi z+\tau^x R$. Therefore, with $R=R^*$, and $\phi=\phi^*$, we must have

$$\tau^x=\frac{n}{R}\frac{\partial h}{\partial X}\frac{\partial f_2}{\partial n}$$

Finally, to get the correct number of entrepreneurs, we must ensure that the career choice coincides with the choice of the social planner. With taxes, the career choice implies that:

$$R\left(x+c_1^e-c_1+\frac{\partial f_1}{\partial n}\right)+c_2^e-c_2+h\frac{\partial f_2}{\partial n}=g\frac{\partial f_2}{\partial k}-\phi\frac{b}{e}q'+R\tau^x x+\tau^w R\frac{\partial f_1}{\partial n}+\tau^w h\frac{\partial f_2}{\partial n}.$$

Comparing with (19), we see that the two equations are equivalent if and only if

$$R\tau^x x+\tau^w R\frac{\partial f_1}{\partial n}+\tau^w h\frac{\partial f_2}{\partial n}=n\left(\frac{\partial h}{\partial e}+x\frac{\partial h}{\partial X}\right)\frac{\partial f_2}{\partial n}.$$

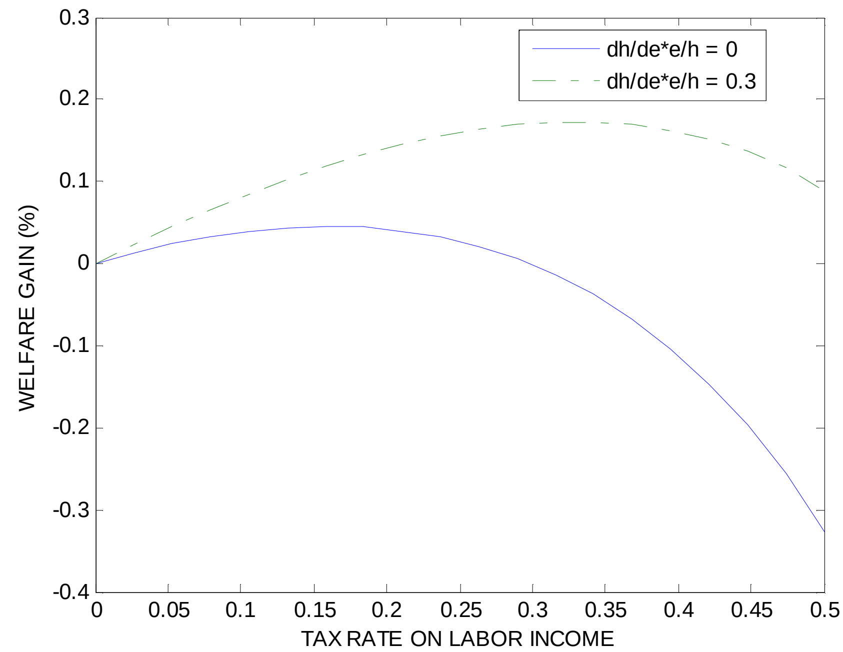
Using the optimal value of τ^x, this leads to:

$$\tau^w\left(R\frac{\partial f_1}{\partial n}+h\frac{\partial f_2}{\partial n}\right)=n\frac{\partial h}{\partial e}\frac{\partial f_2}{\partial n}.$$

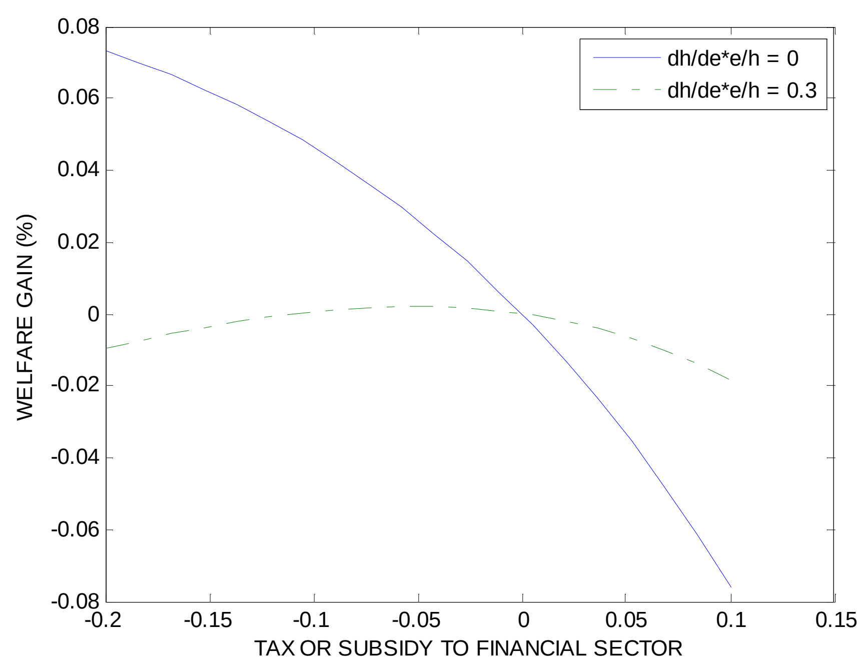
I have shown the necessary conditions for implementation. It is easy to check that they are sufficient as well, since all the other equilibrium conditions are also satisfied. QED.

Figure 1: Welfare and Taxes in the Third Best Economy

1a: Tax on Labor Income in Industrial Sector



1b: Tax on Income from Financial Sector



Notes: Welfare gains are expressed in consumption equivalent: a gain of 0.2% is equivalent to a permanent increase of consumption of 0.2%.