Tax Policy and Entrepreneurship in the Presence of Asymmetric Information in Capital Markets

by

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Abstract

This paper considers the implications of asymmetric information in capital markets for entrepreneurial entry and tax policy. In many countries, governments subsidize the foundation of new firms. One possible justification for these subsidies is the observation that capital markets for the financing of new firms do not function properly. We analyse this issue in a model where entrepreneurs need outside financing for their projects and know more about the quality of their projects than outside investors. Entrepreneurs have the choice between carrying out their entrepreneurial projects or working as an employee. It turns out that asymmetric information in capital markets leads to too much rather than too little entrepreneurial entry. Therefore, the optimal tax policy in our model should discourage rather than subsidize entrepreneurial entry. Our policy conclusion is that subsidies for the foundation of firms must be based on other reasons than informational asymmetries in capital markets.

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1 Introduction

Start-up firms are commonly viewed to play an important role in fostering economic growth, innovation and employment. Therefore, governments in many countries frequently take measures at local and state levels to stimulate entrepreneurial activity. Although existing empirical studies suggest that public assistance programs improve the survival chances and enhance the employment growth rates of young firms, no efficiency argument about such public policy can be derived from this correlation. An efficiency-based argument for public policies supporting start-up firms requires that market signals are somehow distorted, i.e. market failure in the form of too little entrepreneurial entry exists. One argument to justify this policy are the alleged positive externalities of entrepreneurial activity. If start-up firms are the source of positive externalities, public policy intervention would be desirable. But it is an unresolved empirical issue whether the market produces too few or too many firms.

Another important problem faced by entrepreneurs is the existence of capital market imperfections. Since start-ups require investments that usually far exceed the entrepreneur's own wealth, one key aspect of the ability to start a new firm is to raise outside finance. Here, entrepreneurs face two key problems. Firstly, outside investors know much less about the prospects of a young firm than the entrepreneurs themselves. This informational asymmetry is particularly severe in the case of young and innovative start-ups. Entrepreneurs setting up a new firm usually do not have an own track record, their market potential is unproved and they often lack collateral as well as managerial and commercial experience. Therefore the investors´ money is put at a formidable risk. The second problem is that the relationship between the entrepreneur and the financier suffers from moral hazard problems. Due to these reasons it is often argued that bank loans or equity finance by independent investors are difficult to obtain and that venture capital is better adapted to solve the special problems of financing early stage business.

Much of the academic literature on public policy and capital market imperfections focuses on moral hazard problems in the agency relationship between venture capitalists and entrepreneurs. Keuschnigg and Nielsen (2000, 2002) place emphasis on the productive

contribution of venture capitalists to the survival and success of start-up firms. They find that the effort of the venture capitalists tends to be inefficiently low in market equilibrium. As a consequence, they argue that there is room for welfare enhancing tax policy interventions such as cutting the capital gains tax rates on small firms or subsidizing the revenues of the venture capitalists. Gompers and Lerner (1999) show empirically that changes in the capital gains tax rate significantly affect venture capital investment.

De Meza and Webb (1987) show that asymmetric information in capital markets may lead to overinvestment. The tax policy implications of this tendency towards overinvestment are explored in De Meza and Webb (1988). Fuest et al (2000) abstract from moral hazard issues and consider a model where the capital market suffers from adverse selection problems. They show that, if there is asymmetric information between entrepreneurs and outside investors, the capital structure of new firms will be distorted in favour of debt financing. In this situation, it is optimal to support equity financing through the tax system.

One important limitation of most of these contributions is that they do not consider the question of entrepreneurial entry by itself, i.e. the number of entrepreneurs is taken as given. One exception is Gordon (1998). He points out that the fiscal treatment of start-ups should depend on the motives of firm formation. If new firms are entrepreneurial he also recommends tax distortions favoring entrepreneurial activity to raise economic efficiency.

This paper extends the existing literature by explicitly analysing the question of entrepreneurial entry in the presence of capital market imperfections. We consider a simple partial equilibrium model of occupational choice, where potential entrepreneurs can choose between carrying out an entrepreneurial project and the alternative of working as employees. If they become entrepreneurs, they have to finance their projects in a capital market which is plagued by informational asymmetries. We analyse the optimality of entrepreneurial entry and financing decisions under different assumptions on the financing instruments and the type of informational asymmteries. Our main result is that the existence of capital market imperfections does not constitute a reason for subsidizing entrepreneurial entry. In most of the cases we consider, the optimal tax policy should discourage rather than encourage entrepreneurial entry.

The structure of the paper is as follows. Section 2 gives an overview of the model and describes the first best entrepreneurial entry. Section 3 analyses entrepreneurial entry when debt financing without screening is the only source of finance and section 4 extends the analysis by the possibility of screening. The impact of equity financing is investigated in section 5. Section 6 considers the implications of the Stiglitz-Weiss argument for the optimality of entrepreneurial entry. Section 7 concludes.

2 The model

2.1 Overview

We consider an economy inhabited by a large number of risk neutral individuals who live for two periods and face the choice between becoming an entrepreneur or working as an employee. Each individual is endowed with one entrepreneurial project. The projects differ by their probability of success, which is denoted by ε. For the economy as a whole, ε is distributed in the interval $[0,1]$, with a continuous density function $g(\varepsilon)$ and a distribution function denoted by $G(\varepsilon)$. Each project requires a given investment which we denote by K. If a project is successful, it produces an output F(K). If a project is not successful, the output is zero. Individuals who decide not to carry out their entrepreneurial project work as employees and receive a given wage income w. The riskless interest rate is ρ. All types of income are subject to taxes which will be specified further below.

We assume that investment and financing decisions in this model are taken in three stages.

Stage 1: Each entrepreneur observes the specific productivity e_i of his/her project and decides whether or not to carry out the project.

Stage 2: Entrepreneurs who carry out the project decide on the financing of the project and invest. Outside investors know the distribution of ε for the economy as a whole but cannot observe the specific success probabilities of individual firms.

Stage 3: Firms produce their output and all agents receive their payoffs.

Stages 1 and 2 are assumed to take place in period 1, stage 3 in period 2.

2.2 First best entrepreneurial entry

As a point of reference, we start by describing the condition for first best entrepreneurial entry in this economy. Assume that potential entrepreneurs with a success probability of at least ε^* decide to carry out their project whereas individuals with a lower success probability decide to work as employees. Overall welfare is given by

$$W = \int_{\varepsilon^*}^{1} [\varepsilon F(K) - (1+\rho)K] g(\varepsilon) d\varepsilon + \int_{0}^{\varepsilon^*} w g(\varepsilon) d\varepsilon \quad . \tag{1}$$

The optimal level of entrepreneurial entry is given by

$$\frac{\partial W}{\partial \varepsilon^*} = -[\varepsilon^* F(K) - (1+\rho)K - w] g(\varepsilon^*) = 0$$

which implies

$$\varepsilon^* F(K) - (1+\rho)K = w \quad , \tag{2}$$

i.e. the expected profit of the marginal firm should be equal to the wage income the entrepreneur could earn as an employee. It is easy to show that a perfect capital market would lead to the implementation of a first best allocation. As the following analysis will

show, problems of asymmetric information in the capital market imply that the decision on entrepreneurial entry is typically distorted, so that a potential role for government intervention arises.

3 Debt Financing without Screening

In this section, we consider the case where debt is the only source of finance and no signal for firm specific project quality is available. We assume that debt financing is provided by a competitive banking sector. Banks cannot discriminate between projects and therefore offer a standard debt contract with a uniform interest rate which we denote by r^p. Entrepreneurs will carry out their project if the after tax profits are at least as high as the after tax income from working as an employee. If the project is successful, the entrepreneur earns F(K)-(1 $+r^p$)K. If the project fails, neither the entrepreneur nor the bank receive any positive return. There are no tax rebates in case of project failure.

The survival probability of the marginal project ε^p is thus given by

$$\varepsilon^p\left[F(K)-(1+r^p)K\right](1-\tau)=w(1-t), \tag{3}$$

where τ is the corporate income tax rate and t is the tax rate on labour income. Since banks make zero profits in equilibrium, r^p must satisfy:

$$\varepsilon^{p+}(1+r^p)-(1+\rho)=0, \tag{4}$$

where

$$\varepsilon^{p+}=\frac{1}{(1-G(\varepsilon^p))}\int_{\varepsilon^p}^{1}\varepsilon g(\varepsilon)d\varepsilon \tag{5}$$

is the mean of the survival probability of all firms issuing debt. Note that $\varepsilon^{p+} > \varepsilon^{p}$.

Substituting (4) into (3) yields

$$\varepsilon^{p} F(K) - \frac{\varepsilon^{p}}{\varepsilon^{p+}}(1+\rho)K = w\frac{(1-t)}{(1-\tau)}. \qquad (6)$$

In the following analysis, we assume that the left hand side of (6) is increasing in ε^{p}. Under this assumption, an increase in the alternative wage w reduces entrepreneurial entry. Comparing equations (2) and (6) immediately shows that, for $t = \tau$, we have $\varepsilon^{p} < \varepsilon^{*}$, i.e. the number of entrepreneurial projects which are carried out is inefficiently high. The reason is that the marginal firm pays a risk premium on its debt based on the average success probability, which is higher than the marginal firm´s success probability. The government may influence the entrepreneurial entry decision by taxing labour and profit income differently. For the following analysis, we define

$$\beta \equiv \frac{(1-t)}{(1-\tau)}.$$

If the labour income tax rate is lower than the corporate income tax rate, we have $\beta > 1$ and vice versa. What is the optimal tax policy in this framework?

Proposition 1:

If debt financing without screening is the only source of finance, the optimal labour income tax rate is lower than the corporate income tax rate.

Proof: See the appendix.

Given that too many entrepreneurs carry out their projects relative to the first best allocation, the result in proposition 1 is intuitive. By reducing the labour income tax below the corporate income tax, the government induces entrepreneurs with low quality projects to choose the option of working as an employee. Entrepreneurs with better success probabilities will carry out their projects despite the tax disadvantage.

4 Debt financing with screening

We now extend the analysis by assuming that, next to debt financing as described in the preceding section, entrepreneurs have the possibility to have their project screened by banks. Screening has the advantage that it allows outside investors to observe the specific survival probability of a project. This implies that they will offer debt contracts where the interest rate reflects the project specific success probability. However, this advantage comes at a cost. The screening of projects is a complicated and time consuming task. We therefore assume that there is a screening cost c per unit of capital invested. Entrepreneurs who decide to carry out their projects may now choose between debt financing with or without screening. Screening is an interesting option for entrepreneurs with higher than average success probabilities. If screening was costless, the market for unscreened debt would eventually disappear as the more productive firms leave the market. The existence of a positive screening cost implies that both debt markets may coexist. Denote the success probability of an entrepreneur who is indifferent between screened and unscreened debt financing by ε^s. All entrepreneurs with $\varepsilon_i \geq \varepsilon^s$ will finance their investment with screened debt. ε^s is given by

$$\varepsilon^s\left[F(K)-(1+r(\varepsilon^s))K\right](1-\tau)=\varepsilon^s\left[F(K)-(1+r^{ps})K\right](1-\tau),$$

(7)

where $r(\varepsilon^s)$ denotes the interest rate for screened debt of the marginal firm and r^{ps} is the interest rate in the "pooling market". Entrepreneurs with $\varepsilon_i < \varepsilon^s$ will either use unscreened debt or not carry out the project at all. Denote the success probability of an entrepreneur who is indifferent between using unscreened debt to finance his project and working as an employee by ε^{ps}. ε^{ps} is given by

$$\varepsilon^{ps}\left[F(K) - (1 + r^{ps})K\right] = w\beta .$$

(8)

Given that banks make zero profits, the interest rates $r(\varepsilon^s)$ and r^{ps} are given by

$$1 + r(\varepsilon^s) = \frac{1 + \rho + c}{\varepsilon^s}$$

(9)

and

$$1 + r^{ps} = \frac{1 + \rho}{\varepsilon^{ps+}},$$

(10)

where

$$\varepsilon^{ps+} = \frac{1}{(G(\varepsilon^{s}) - G(\varepsilon^{ps}))} \int_{\varepsilon^{ps}}^{\varepsilon^{s}} \varepsilon g(\varepsilon) d\varepsilon$$

(11)

is the mean of the survival probability of firms in the market for unscreened debt. Using (9) and (10), (7) can be written as

$$1 + \rho + c = \frac{\varepsilon^{s}}{\varepsilon^{ps+}} (1 + \rho)$$

(12)

and (8) becomes

$$\varepsilon^{ps} F(K) - \frac{\varepsilon^{ps}}{\varepsilon^{ps+}} (1 + \rho) K = w\beta \quad .$$

(13)

Equation (13) shows that, if profits and labour income are taxed at the same rate (β=1), there is too much entrepreneurial entry. The possibility of screening does not change this result. So the question arises whether it is again desirable to increase the corporate tax above the labour income tax. Here, we may state

Proposition 2

If entrepreneurs may choose between screened and unscreened debt to finance their projects, a reduction of the labour income tax rate below the corporate income tax rate reduces entrepreneurial entry, reduces screening and raises welfare.

Proof: See the appendix

Reducing the labor income tax below the corporate income tax rate now has two positive effects. Firstly, entrepreneurs with low success probabilities leave the market, which raises welfare for the reasons discussed in the preceding section. In addition, screening is reduced because the exit of low quality projects improves the average project quality in the market for unscreened debt. Given the number of entrepreneurial projects which are carried out, a reduction of screening is desirable because screening is costly. For the marginal screened firm, entering the pool of unscreened firms is not worthwhile because the benefit to the firm in the form of reduced screening cost would be offset by the fact the firm has to pay an interest rate based on the average success probability of unscreened firms. For the economy as a whole, however, no additional costs would arise if the marginal firm enters the market for unscreened debt. What the individual firm perceives as a cost is a redistributive effect. By entering the market for unscreend debt, the firm improves the average quality of the firms in this market and thus marginally reduces the interest rate. The problem is that, due to the existing informational asymmetry, the marginal firm cannot internalize this benefit as all firms pay the reduced interest rate.

5 The role of equity financing

We have assumed so far that entrepreneurs can only use debt financing. In this section, we extend the analysis by allowing firms to use equity financing. We consider the case where entrepreneurs sell a share s of the firm´s equity in order to finance the investment K. Equity investors are assumed to be holding companies which are endowed with capital which may either be invested in equity or in other financial assets which offer the riskless rate of return ρ. In order to exclude the problematic of incomplete loss offset from our analysis, we assume that the initial equity investment K may be deducted for tax purposes from the profits of the holding companies, so that there is no tax deduction at the level of the firm issuing the equity. The equity share required to finance K is given by

$$(1+\rho(1-\tau))K = s\varepsilon^{e+}F(K)(1-\tau)+\tau K, \tag{14}$$

where ε^{e+} is the mean of the survival probability of all firms issuing equity. The first term on the right hand side of (14) is the expected profit share the outside investor receives and the second term is the tax deduction for the equity investment. The profit of an entrepreneur issuing equity can thus be written as

$$(1-s)\left(\varepsilon_i F(K)(1-\tau)\right) = \left(\varepsilon_i F(K) - \frac{\varepsilon_i}{\varepsilon^{e+}}(1+\rho)K\right)(1-\tau). \tag{15}$$

Comparing (15) to the expected profit in the case of unscreened debt financing in equation (6) shows that the expected profits of entrepreneurs in the cases of unscreened debt financing and equity financing is the same. This implies that the result of too much entrepreneurial entry also holds for the case of equity financing:

Proposition 3

If entrepreneurs finance their investment through equity financing, a reduction of the labour income tax rate below the corporate income tax rate, departing from an equilibrium with $\tau = t$, reduces entrepreneurial entry, and increases welfare.

Proof: The proof is equivalent to the proof of proposition 1.

The explanation for the result in proposition 3 is equivalent to that of proposition 1, where firms used unscreened debt financing. The shares of firms with low success probabilities are overpriced in the equity market, so that there is a subsidy to entrepreneurs with low productivity projects. By reducing the labour income tax below the corporate income tax, the government may neutralize this subsidy and reduce the entry of low productivity firms.

6 The possibility of credit rationing

So far, the model has assumed that, despite asymmetric information in project quality all entrepreneurial projects do get funded if entrepreneurs are willing to pay high risk premia. But it is well known that informational asymmetries may also lead to credit rationing (Stiglitz and Weiss, 1981). In this section, we consider the implications of the Stiglitz-Weiss argument for entrepreneurial entry in a variant of the model developed above.

We now assume that projects differ not only by their probability of success but also in the productivity if they are successful. We now denote the success probability of project i by p_i, where p_i is assumed to be distributed in the interval [0,1]. The output of a successful project is now $\gamma F(K)$. We assume that $\gamma = \gamma(p_i)$ and $p_i\gamma(p_i) = 1$. These assumptions imply that projects which are very risky, i.e. projects with a low probability of success, also generate very high profits if they are successful. Ex ante, all projects have the same expected return. We also assume that $F(K) - (1+\rho)K > w$ so that first best entrepreneurial entry requires that all projects are carried out.

Consider first the case where unscreened debt is the only source of finance for entrepreneurs. In this case, the expected profit of a bank per project is given by

$$\Pi^B = \left(\bar{p}(1+r^n) - (1+\rho) \right) K, \tag{19}$$

where $\bar{p}$ is the average success probability of all projects financed by the bank and r^n is the interest rate charged by the bank. When the bank sets the interest rate r^n it charges for loans, it has to take into account that a change in the interest rate will also affect $\bar{p}$.

Denote the success probability of the entrepreneur who is indifferent between carrying out the project or working as an employee by p^n. p^n is given by

$$p^n\left[\gamma(p^n)F(K)-(1+r^n)K\right]=w\beta. \tag{20}$$

Note first that the left hand side of equation (20) declines if p^n increases. This implies that entrepreneurs with success probabilities $p > p^n$ will not carry out their projects. Moreover, an increase in r^n induces the projects with the lowest risks to leave the market. Differentiating (20) yields

$$\frac{dp^n}{dr^n}=-\frac{p^n}{1+r^n}<0. \tag{21}$$

This also implies that the average success probability of the project pool declines as r^n increases. This implies that the maximum interest rate which will be charged by banks is given by

$$\frac{\partial p^-}{\partial p^n}\frac{\partial p^n}{\partial r^n}(1+r^n)+p^-=0 \tag{22}$$

or

$$\frac{\partial \bar{p}}{\partial p^n}\frac{p^n}{\bar{p}} = 1 \quad .$$

(23)

Denote the interest rate determined by equation (22) as $r^{n\,max}$. There are two possible equilibria in the market for debt. If $\bar{p}(1+r^{n\,max}) < (1+\rho)$, banks would make losses and a situation with complete credit rationing would arise. No project would be financed. In this case, the government may raise welfare by creating tax incentives for more entrepreneurial entry. Differentiating equation (20) (with $dr^n=0$) yields

$$\frac{dp^n}{d\beta} = -\frac{w}{1+r^n} < 0$$

(24)

If the corporate tax rate is reduced below the labour income tax rate, more entrepreneurs are willing to enter the market at a given interest rate r^n, and the average success probability in the credit portfolio would improve, so that, at some value of β, credit rationing may vanish and some entrepreneurs enter the market.

In contrast, if $\bar{p}(1+r^{n\,max}) \geq (1+\rho)$, competition among banks would imply that $\bar{p}(1+r^n) = (1+\rho)$ and all entrepreneurs can finance their projects. Assume that this is the case with $\beta = 1$. In this case, the success probability of the marginal project is given by

$$p^n \gamma(p^n) F(K) - \frac{p^n}{\bar{p}}(1+\rho)K = w\beta \quad , \tag{25}$$

i.e. all entrepreneurs with a success probability below p^n carry out their projects. Since $p^n / \bar{p} > 1$, equation (25) shows that this equilibrium is characterized by too little entrepreneurial entry, i.e. some entrepreneurs with low risk projects prefer to become employees although this is inefficient for the economy as a whole. In this case, it is again welfare enhancing to reduce the corporate tax rate below the labour income tax rate in order to increase entrepreneurial entry.

The results derived so far in this section can be summarized as:

Proposition 4

If projects differ in risk but have the same expected returns, and if unscreened debt is the only source of finance for entrepreneurs, a reduction of the corporate income tax rate below the labour income tax rate increases entrepreneurial entry and raises welfare.

The market failure which explains the result in proposition 4 may again be explained by considering the entrepreneurial entry decision of the marginal firm. The marginal firm does not take into account that, by entering the credit market, it improves the average success probability in the pool of firms asking for credits. However, since all firms face the same credit contract, the benefit of this improvement is distributed to all firms, i.e. the marginal firm entering the market now exerts a positive externality for all other firms. This explains why, in the equilibrium without government intervention, there is too little entrepreneurial entry.

The result in proposition 4 contradicts our earlier findings in sections 3-5, according to

which there was a tendency of too much entrepreneurial entry. However, a limitation of the result in proposition 4 is that it does not hold any more if either project screening or equity financing is allowed for. In this sense, equity financing dominates debt financing in this setting.

Consider first the problem of equity financing. If entrepreneurs can sell their firm in the equity market, the problem of asymmetric information vanishes because all firms have the same expected return.

Consider next the possibility of screening. Assume as in the preceding sections that banks can screen projects at a cost c per unit of funds invested. The interest rate of a screened project (r^{ns}) with success probability p_j is given by $p_j(1+r^{ns}) = (1+ r + c)$. The expected profit of an entrepreneur with a screened project is simply $F(K) - (1+\rho+c)K$, i.e. it is independent of the project specific success probability.

If screening is possible, two equilibria may arise. Firstly, it is possible that some projects are financed via unscreened debt but no screening takes place. This equilibrium would arise if

$$F(K) - \frac{p^n}{\bar{p}}(1+\rho)K = w\beta > F(K) - (1+\rho+c)K \qquad (26)$$

The possibility of screening would then be irrelevant because screening is too costly. The second possible equilibrium is one where entrepreneurs with a success probability $p_j \geq p^{ns}$ would choose the screening option, where p^{ns} is given by

$$(1+\rho+c) = \frac{p^{ns}}{\bar{p}}(1+\rho) \tag{27}$$

In this case, all projects would be carried out and the case for subsidizing entrepreneurial entry vanishes. These results may be summarized as

Propositon 5:

If projects differ in risk but have the same expected returns, and if entrepreneurs may finance their projects either through screened debt or equity, tax incentives cannot improve the efficiency of entrepreneurial entry.

7 Conclusions

Our analysis has focused on the distortions of entrepreneurial entry decisions in the presence of capital market imperfections and the role of tax policy as a corrective device. We have shown that, under different assumptions on the available sources of finance, adverse selection problems in capital markets lead to too much rather than too little entrepreneurial entry. The only exception is the case discussed in section 6, where credit rationing may occur or low risk projects leave the market. However, this result is not very robust. It has been shown that the case for subsidizing entrepreneurial entry vanishes in this case if equity financing or screening is taken into account. Our analysis thus suggests that arguments in favour of subsidizing entrepreneurial entry cannot easily be based on the observation that new firms which need outside finance face poorly informed outside investors. Of course, this result has to be evaluated in the light of the analytical framework used in this paper, which abstracts from several potentially important issues. For instance, we have assumed that the level of investment for each project is given. Moreover, we have abstracted from moral hazard problems.

The reader should also note that we do not claim that subsidies for entrepreneurial entry are generally undesirable. As mentioned in the introduction, the analysis of this paper focuses on problems of asymmetric information in the capital market for start-up firms and abstracts from other potential justifications of subsidies for entrepreneurs, such as general positive externalities of firm formation or the positive impact of entrepreneurship on labour market performance.

Appendix:

Proof of proposition 1:

Reducing t below τ implies an increase in β. Equation (6) implies $\frac{de^{p}}{db} > 0$. The marginal effect of an increase in ε^{p} on welfare, evaluated from $\beta = 1$, is

$$\frac{\partial W}{\partial e^{p}} = -\left[e^{p}F(K) - (1+r)K - w\right]g(e^{p}) \tag{A.1}$$

Substituting (6) into (A.1) yields

$$\frac{\partial W}{\partial e^{p}} = \left(1 - \frac{e^{p}}{e^{p+}}\right)(1+r)Kg(e^{p}) > 0 \tag{A.2}$$

.

Q.E.D.

Proof of proposition 2:

The equilibrium values of e^{s} and e^{ps} are now given by equations (12) and (13). These equations can be written as

$$\mathrm{A}(e^{ps}, e^{s}, b) \equiv e^{ps} F(K) - \frac{e^{ps}}{e^{ps+}}(1+r)K - wb = 0$$

(A.3)

and

$$\mathrm{B}(e^{ps}, e^{s}, b) \equiv \frac{e^{s}}{e^{ps+}}(1+r) - (1+r+c) = 0$$

(A.4)

Differentiating (A.3) and (A.4) and using Cramer´s rule yields

$$\frac{de^{ps}}{db} = -\frac{1}{\Xi}\frac{\partial \mathrm{A}}{\partial b}\frac{\partial \mathrm{B}}{\partial e^{s}} > 0$$

(A.5)

and

$$\frac{de^{s}}{db} = \frac{1}{\Xi}\frac{\partial \mathrm{A}}{\partial b}\frac{\partial \mathrm{B}}{\partial e^{ps}} > 0$$

(A.6)

where

$$\Xi = \frac{\partial \mathrm{A}}{\partial e^{ps}}\frac{\partial \mathrm{B}}{\partial e^{s}} - \frac{\partial \mathrm{A}}{\partial e^{s}}\frac{\partial \mathrm{B}}{\partial e^{ps}} > 0 \quad .$$

Overall welfare is now given by

$$W = n\int_{e^{s}}^{1}\left[eF(K) - (1+r+c)K\right]g(e)de + n\int_{e^{ps}}^{e^{s}}\left[eF(K) - (1+r)K\right]g(e)de + n\int_{0}^{e^{ps}} wg(e)de$$

(A.7)

Differentiating with respect to ε^{ps} and ε^{s} yields

$$\frac{\partial W}{\partial e^{ps}} = -n\left[e^{ps}F(K) - (1+r)K - w\right]g(e^{ps}) \tag{A.8}$$

and

$$\frac{\partial W}{\partial e^{s}} = ncKg(e^{s}) > 0 \tag{A.9}$$

Evaluating (A.8) at $\beta = 1$ and using (13) yields

$$\frac{\partial W}{\partial e^{ps}} = n\left(1 - \frac{e^{ps}}{e^{p+}}\right)(1+r)Kg(e^{ps}) > 0 \tag{A.10}$$

It follows that an increase in β, departing from $\beta = 1$, increases welfare. Q.E.D.

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