

The Evans and Jovanovic Equivalence Theorem and Credit Rationing: Another Look

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ABSTRACT. In their well-known paper on liquidity constraints, Evans and Jovanovic (1989), argue that under certain assumptions an equivalence relation exists between the probability of switching from wage- into self-employment and assets of the entrepreneur. That is, *if and only if* there are liquidity constraints is the probability of switching a function of the individual's assets. The present paper amends this proposition by showing in a simple diagram that *if* the probability of switching depends on assets *then* capital constraints are implied in their model; *but not vice versa*. This apparently trivial correction is shown to have important implications for empirical work. Under some circumstances alternative tests need to be employed to establish the existence or otherwise of credit rationing. One such test is discussed.

1. Introduction

In their well-known paper on liquidity constraints, Evans and Jovanovic (1989), (henceforth "EJ") argue that under certain assumptions an equivalence relation exists between the probability of switching from wage- into self-employment and assets of the entrepreneur. That is, *if and only if* there are liquidity constraints is the probability of switching a function of the individual's assets. This paper amends this proposition: we show in a simple diagram that *if* the probability of switching depends on assets *then* capital constraints are implied in their model; *but not vice versa*. This apparently trivial correction is shown to have important implications for empirical work, especially in view of the fact that some recent empirical studies have found *no* relation between

switching and assets. Under these circumstances alternative tests need to be employed to establish the existence or otherwise of credit rationing. One such test is discussed.

2. The EJ model

An entrepreneur has the choice of either remaining in wage employment or switching into self-employment, choosing the state with the highest expected return. His profits from entrepreneurship *net* of the opportunity cost of wage employment are

$$\pi = \theta f(k) - rk - w \quad (1)$$

where θ is (unobservable) entrepreneurial ability, k capital used in the business, w the wage rate, r the rate of interest on borrowing, and $f(\cdot)$ a concave production function. k is chosen to maximise π , yielding an interior solution for unconstrained capital inputs

$$k = k^*(\theta; r) \quad (2)$$

and an unconstrained indirect profit function

$$\pi = \pi^*(\theta; r, w) \quad (3)$$

If π^* is negative, the individual stays in wage employment; else he switches to self-employment.¹

In Figure 1 the entrepreneur's demand for capital, $k^*(\theta)$,² is increasing in entrepreneurial ability, θ . The maximum capital he can obtain from the bank with assets z is, however, bz ($b \geq 0$). The unconstrained maximum net profit function, $\pi^*(\theta)$, and the constrained profit functions $\pi_i(\theta)$, which fall below $\pi^*(\theta)$ in the constrained region ($k^*(\theta) \geq bz$), are also increasing in ability. The

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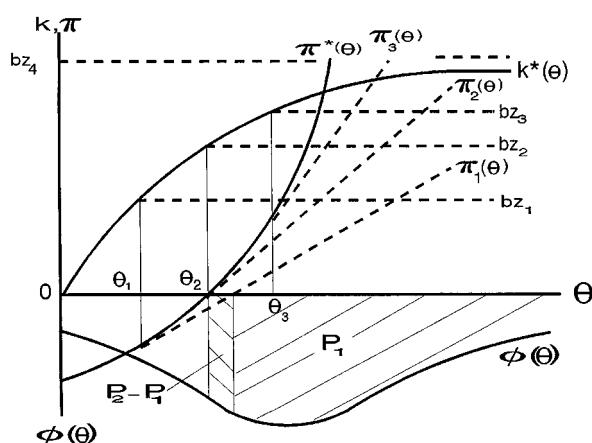


Figure 1. Switching in the EJ model.

probability of switching, namely, the probability that maximum net profits are positive, is given by the area under the pdf of θ , $\phi(\theta)$, to the right of the intersection of the relevant profit function (unconstrained or constrained) and the θ -axis.

For capital constraint bz_1 , entrepreneurs with ability $\theta \geq \theta_1$ are constrained; similarly for bz_2 and θ_2 , and for bz_3 and θ_3 . Note, however, that the curve $k^*(\theta)$ will never intersect constraint bz_4 , so this constraint is never binding: small variations in the constraint cannot influence the probability of switching, which remains fixed at the area $P_2 = (P_2 - P_1) + P_1$. However, the probability of switching is a function of z for sufficiently tight capital constraints. Consider the marginal entrepreneur, θ_2 , whose profits are zero in the unconstrained situation. He will find that if capital constraint bz_1 is applied by the bank his potential profits will become negative (at $\pi_1(\theta_2)$), thus forcing him to remain in wage employment. The probability of switching then decreases from the area P_2 to the area P_1 . A testable prediction of the EJ model is therefore that, for “marginal” (or unprofitable) businesses, if the probability of switching depends on assets, then capital constraints exist.

Contrary to EJ, however, the probability of switching can be independent of assets *and yet capital constraints may still exist*. To see this, note that tightening (loosening) of the constraint at bz_3 lowers (raises) the profits of constrained entrepreneurs $\theta \geq \theta_3$ but has no effect on the probability of switching (which remains at P_2). For infra-

marginal entrepreneurs, profits are reduced, but for marginal entrepreneurs they are unaffected. Since under this constraint profits are more than the minimum for survival both for inframarginal and marginal entrepreneurs, survival chances are therefore *unaffected* by a small change in the constraint.

This means that in order to generate the equivalence relation between credit rationing and the dependence of switching on assets we must assume that assets (or the borrowing-to-assets ratio) fall below certain well-defined values, namely those at which the marginal entrepreneur ($\pi^*(\theta) = 0$) is *just* constrained.

More formally, define the levels of ability and capital solving the equation $\pi^*(\theta) = 0$ as $\theta = \theta_2(r, w)$, and $k = k^*(\theta_2, r) \equiv k^{**}(w, r)$, say. Define z_2 by $k^*(\theta_2, r) = bz_2$ or $z_2 = k^*(\theta_2, r)/b \equiv z_2(r, w, b)$, say. Then capital constraints affect switching if and only if $z < z_2$, for fixed r, w and b . If we solve for b instead of z in $k^* = b_2 z$ (say), constraints affect switching iff $b \leq b_2$. EJ unfortunately ignore this possibility, and implicitly argue that the relationship between assets and the probability of switching is independent of the level of the constraint. This is the main theoretical result of the present paper.³

The empirical research and policy implications of this result are not trivial. For example, most studies testing the EJ theory have found that there are indeed credit constraints: the probability of switching/survival⁴ depends on assets (see EJ and Holtz-Eakin et al. (1994a, b)). Capital constraints are therefore correctly inferred to exist.⁵ However, there are exceptions to this rule. For example, a recent study of U.K. startups finds no evidence of a relationship when a sufficiently wide range of human capital variables are held constant (Cressy, 1996). From the above analysis, we cannot conclude that credit rationing does *not* exist. A separate and additional test needs to be performed, which in the quoted study is a direct one of the dependence of bank finance probability on assets, given human capital. What emerges is that whilst assets are correlated with bank finance, once human capital, *also correlated with finance*, is accounted for, assets add nothing to the explanation of finance provision.⁶ Moreover, since this study relies on a large random sample of small business startups with a significant average failure

rate (50% in three and a half years) it is clear that it contains marginal businesses as defined above.⁷

Nonetheless, the finance variable employed in this study can be interpreted as conveying *either* demand *or* supply information so that additional data has then to be appealed to in order to conclude the result is in fact demand-driven.⁸ The study illustrates that one needs to have demand-specific variables to be able to state conclusively whether credit rationing exists, even on a direct test.

3. Conclusions

This paper implies that the Evans and Jovanovic (1989) reliance on the attractively simple equivalence of the switching-assets relation and credit rationing will not always be adequate to test for rationing. This is because the EJ model implies, contrary to the authors' claim, that *if* switching is a function of assets *then* credit rationing exists, *but not vice versa*. Recognising this, we showed that if the assets-switching relation failed empirically, alternative tests might be performed to check for its existence. One such test was discussed.

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Notes

¹ In EJ the entrepreneur compares the gross profit function $\pi^*_G = \pi^* + rz$ with the return to wage employment, $W = w + rz$, and switches if $\pi^*_G \geq W$, or equivalently if $\pi^* \geq 0$. Thus the difference is merely one of notation.

² Henceforth we ignore the dependence of capital and profits on w and r .

³ Whilst we do not enter into a formal proof of the following statement, it is intuitively clear that the EJ analysis is deficient in other respects also. For example, it ignores the role of risk aversion in the decision to enter or leave entrepreneurship. Thus, if we assume that risk aversion declines with wealth we will find that individuals will be more likely to switch into or less likely to switch out of self-employment the larger their assets. On this ground too, therefore, there is a questionmark over the role of assets in indicating financial constraints. I am indebted to a referee for this point.

⁴ Holtz-Eakin et al. (1994a, b) and Cressy (1994), examine the probability of survival of businesses, i.e., of staying in business rather than switching into wage-employment, rather

than the reverse switching which is the basis of the EJ paper. This, however, is legitimate in view of the symmetric spirit of the EJ model.

⁵ Two things need mentioning here. (i) In discussing these tests we assume that the range of human capital variables is sufficiently rich to ensure that the model is econometrically well-specified. It is not clear that this has always been the case – see below. (ii) Even if the probability of switching is found to depend on assets this does not strictly imply that constraints exist *at startup*, for example, it might only “kick in” at some *later* (e.g. expansionary) stage of the business lifecycle. Again, a direct test of the dependence of startup bank financing on assets (cet. par.) needs to be performed to confirm/disconfirm this.

⁶ The equation estimated is a probit of bank finance (used/not used to start the business) against proprietor age, team size, work experience, vocational qualifications, assets (housing equity) and startup mode (entirely new/purchase of an existing business). All variables were significant and of the “right” signs with the exception of vocational qualifications that had the “wrong” sign but remained significant. Also, the assets variable was found to be *insignificant*, despite being significant (and of positive sign) in the absence of human capital.

It should be mentioned that in another study of business loan demand (Ham and Melnik, 1987) assets was found to be a significant regressor. However, the sample was of much larger businesses than in Cressy (1994) and no attempt was made to control for human capital factors. The size of such businesses also makes it unlikely that they are marginal businesses in the abovementioned sense. Thus the test of the dependence of *survival* on assets used in the EJ theory would almost certainly fail. However, this test was not in fact performed, and so the outcome is speculative.

⁷ Thus, from Figure 1 we know that if capital constraints exist for marginal businesses they will exist also for infra-marginal businesses.

⁸ Two other tests were performed to shore up this claim. Firstly, it was shown that the proportion of loan requests not met was very small. Secondly, the difference between the two was then used as a regressor in the survival equation with and without human capital. The result was that the “excess demand” variable was not significant in explaining survival.

References

- Cressy, C., 1996, ‘Are Startups Debt-rationed?’, *The Economic Journal* **106**(438), September, 1253–1270.
- Evans, D. and B. Jovanovic, 1989, ‘An Estimated Model of Entrepreneurial Choice Under Liquidity Constraints’, *Journal of Political Economy* **97**(4), 808–827.
- Ham, J. C. and A. Melnik, 1987, ‘Loan Demand: An Empirical Analysis Using Micro Data’, *Review of Economics and Statistics* **69**, 704–709.
- Holtz-Eakin, D. Joulfaian and H. S. Rosen, 1994a, ‘Sticking it Out: Entrepreneurial Survival and Liquidity Constraints’, *Journal of Political Economy* **102**(11), 53–75.
- Holtz-Eakin, D. Joulfaian and H. S. Rosen, 1994b, ‘Entrepreneurial Decisions and Liquidity Constraints’, *Rand Journal of Economics* **25**(2) (Summer), 34–347.

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