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Nicola Comincioli, Paolo M. Panteghini, Sergio Vergalli

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On the Main Determinants of Start-Up Investment in Developing Countries

Abstract

In this article we study start-up investments in developing countries. Using a representative firm, we wonder how relevant are the effects of taxation and risk on new business activities. It is worth noting that developing countries are usually characterized by three main characteristics. Firstly, a firm's Earnings Before Interest and Taxes (EBIT) is likely to be more volatile than in developed jurisdictions. Secondly, firms in developing countries can be affected by a higher risk of expropriation. In particular, this may happen when early-stage businesses are supported by multinational companies. Thirdly, financial market show higher inefficiencies, compared to countries. Using a real-option approach, we study start-up investment decisions. We find that, although tax rates are usually higher than the developed countries' ones, taxation has an almost negligible effect. If however a policy-maker aims at boosting new business activities it must decrease both EBIT volatility and the expropriation risk, as well as improving financial market efficiency.

JEL-Codes: H250, G330, G380.

Keywords: real options, business taxation, default risk, developing countries, numerical simulations.

Nicola Comincioli
Department of Economics and Management
University of Brescia / Italy
nicola.comincioli@unibs.it

Paolo M. Panteghini
Department of Economics and Management
University of Brescia / Italy
panteghi@eco.unibs.it

Sergio Vergalli
Department of Economics and Management
University of Brescia / Italy
sergio.vergalli@unibs.it

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1. Introduction

The relationship between business taxation and financial stability, and how they affect the start-up decision, has been extensively studied in the literature. However, most studies focus on investment decisions by firms in developed countries, where the market structure is clearly different from that of developing countries, which have often been disregarded. As pointed out by the World Bank, "*entrepreneurs in developing countries face many challenges in their journey to launch high-growth companies. Yet when they succeed, entrepreneurs can act as powerful agents of change - reducing inefficiencies, creating jobs, and boosting economic development*".[1]

Although start-up firms are powerful economic agents, Singh and Mungila Hillemane (2023) show the lack of highly innovative tech ones in developing countries. Despite this aspect, Kowalewski and Pisany (2023) argue that even in developing countries fintech start-ups are beginning to emerge.[2] If compared to developed countries start-up ones, new firms in developing countries may face some financing problems, even severe ones. For instance, Mazorodze (2023) uses a sample of 40 developing countries, over the 2010-2018 period, and finds that the access to finance is a decisive factor in fostering the emergence of start-ups. Quite interestingly, Munemo (2017) uses a panel of 92 developing countries and studies the effects of financial market efficiency on the relationship between foreign direct investment (FDI) and business start-up. The author shows that, above a certain cut-off level, FDI stimulates new business activities in developing countries. In that case, many start-ups can exploit the support of their controlling multinational companies. Moreover, Brixiová et al. (2020) use firm-level data regarding 42 African countries and show that small and medium-sized enterprises (SMEs) create more jobs if they benefit from formal financing.[3] This impact looks stronger for manufacturing firms than for service providers.

To sum up, developing countries share at least three feature that justify an *ad hoc* analysis. Firstly, the economic environment is typically riskier. Secondly, governments are more likely to expropriate private companies. Thirdly, and crucially, access to financial markets may be more difficult or costly with respect to developed countries. In order to deal with these characteristics, we use a real-option model that accounts for the high riskiness of starting a business in a developing country. Of course, we compare these results with those obtained by using parameter values characterizing developed countries: this enables us to see which features have a larger impact on the start-ups under study. As will be shown, the tax rate, whose average value is higher in developing countries, is not a relevant determinant of new investment activities. Rather, risk (in terms of both volatility and expropriation) have substantial impact. Similarly, financial market imperfection have a very important impact on early-stage activities.[4]

The structure of the article is the following; Section 2 introduces a real-option model that describes a representative start-up business activity. Section 3 provides a numerical analysis in which the behavior of start-ups in

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[1] Available at: https://www.worldbank.org/en/topic/innovation-entrepreneurship/brief/about-infodev-a-world-bank-group-program-to-promote-entrepreneurship-innovation. On the World Bank website, there are many interesting examples.

[2] Kowalewski and Pisany (2023) have also found that the establishment of fintech companies is more likely in developed countries because they benefit from the support provided by an older and wealthier population. See also the articles quoted therein.

[3] See also the articles quoted in Brixiová et al. (2020), such as Asiedu et al. (2013) and Blancher et al. (2019).

[4] In order to evaluate the distorsion caused by financial market imperfections, we follow both Sørensen (2017) and Comincioli et al. (2021). These studies are different as they focus on mature firms operating in developed countries. Moreover, Sørensen (2017) applies a deterministic framework.

developed and developing countries is compared. Finally, Section 4 summarizes our results and discusses their policy implications.

2. The model

Let us consider a representative economic agent who can invest in a start-up business. By paying a sunk cost I, a company is established and starts generating Earnings Before Interest and Taxes (EBIT).[5] Following Goldstein et al. (2001), we let EBIT, denoted by Π, follow a Geometric Brownian Motion (GBM):

$$d\Pi = \mu\Pi dt + \sigma\Pi dz, \quad (1)$$

where $\Pi_0 > 0$ is its initial value, μ and σ are its drift and diffusion coefficients: they accounting, respectively, for the deterministic growth and the volatility of the process. Moreover, dz is the increment of a Wiener process. According to Dixit and Pindyck (1994), we let the so-called dividend yield $\delta \equiv i - \mu$ be positive, where i is the risk-free interest rate.[6] Moreover, we introduce the following assumptions:

Assumption 1. The start-up can borrow financial resources, thereby paying a non-renegotiable coupon C.

Assumption 2. Default occurs if EBIT falls to a trigger level $\overline{\Pi}$, which is optimally chosen by shareholders. If Π hits $\overline{\Pi}$, the lender becomes the firm's owner.

Assumption 3. The cost of default is borne by the lender and is proportional to EBIT. Hence, given the size parameter of the default cost $\alpha \in [0,1]$, the lender will manage a firm whose value is $(1-\alpha)$ times the before-default one .

Assumption 4. The access to financial markets is costly. Such a cost is proportional to the coupon: namely, it is equal to ωC, where the scale parameter is $\omega \geq 0$.[7]

Assumption 5. There exists some expropriation risk. Such a risk is modeled as a Poisson process. Hence the expropriation probability at each time is then λdt, where λ is the so-called mean arrival rate (Dixit and Pindyck, 1994).

The non-renegotiable coupon C introduced by Assumption 1 is optimally chosen by the firm under a non-arbitrage condition. Assumption 2 introduces default risk and the ownership change: as already pointed out, after default, the lender becomes the firm's owner. Assumption 3 introduces the default cost, that is borne by lender after default. Assumptions 4 and 5 then allow to focus on a start-up in developing countries: on the one hand, Assumption 4 introduces imperfections in the financial market which may be due, for example, to lack of good financial regulation as well as to usury and bribery. The parameter ω multiplied by coupon C accounts for all of these market imperfections. On the other

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[5] For simplicity, we focus on a single business activity and disregard the positive externalities ensured by successful businesses.

[6] The choice of the GBM rules out negative EBIT. This is not an issue in this framework as default occurs before EBIT falls to zero. In addition, it is worth noting that, as the expected growth rate is $\delta - i$, the environment is risk neutral. Indeed, according to Shackleton and Sødal (2005), by replacing the actual cash flows growth rate with a certainty-equivalent growth rate, we can evaluate any contingent claim on an asset. According to Bolton et al. (2019), this condition is necessary to allow the early exercise of a start-up option.

[7] It is worth noting that the lower (higher) the parameter ω, the higher (lower) the level of efficiency of financial markets.

hand, Assumption 5 introduces the risk of expropriation: this kind of risk typically regards nationalization risk and has is likely to be higher for developing countries.

In order to study a start-up decision, whose attractiveness depends on expected future EBIT, we first define the Net Present Value $NPV(\Pi)$ of the investment project at the time of exercise T. This value is the sum of equity $E(\Pi)$ and debt $D(\Pi)$, namely the value function, net of investment sunk cost I:

$$NPV(\Pi) = E(\Pi) + D(\Pi) - I. \quad (2)$$

As shown in the Appendix, the value of equity $E(\Pi)$ before default (b.d.) and after default (a.d.) is:

$$E(\Pi) = \begin{cases} \frac{1-\tau}{\delta}\Pi - \frac{(1-\tau+\omega)}{r}C - \left[\frac{1-\tau}{\delta}\overline{\Pi} - \frac{1-\tau+\omega}{r}C\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2} & \text{b.d.} \\ 0 & \text{a.d.} \end{cases}, \quad (3)$$

where τ is the relevant tax rate and the discount rate $r = \lambda + i$. Equity holders maximize (3) by setting the optimal default trigger EBIT:

$$\overline{\Pi}^* = \frac{\delta}{r}\frac{\beta_2}{\beta_2 - 1}\frac{1-\tau+\omega}{1-\tau}C < \mathrm{C}. \quad (4)$$

It is worth noting that if $\Pi < C$, equity holders can decide whether to default or issue new equity and let their firm operate. Obviously, if EBIT is too low, default is preferable. As shown in the Appendix, the value of debt D is:

$$D(\Pi) = \begin{cases} \frac{C}{r} + \left[\frac{(1-\alpha)(1-\tau)}{\delta}\overline{\Pi} - \frac{C}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2} & \text{b.d.} \\ \frac{(1-\alpha)(1-\tau)}{\delta}\overline{\Pi} & \text{a.d.} \end{cases}. \quad (5)$$

Given (3) and (5) it is now possible to focus on the investment decision problem, that consists in the maximization of $NPV(\Pi)$ with respect to investment timing T and coupon C. In other words, we can write the objective function as follows: $\mathbb{E}[e^{-rT}NPV(\Pi)]$. As shown by Harrison (1985), the optimal choice of T is equivalent to the choice of the threshold level of EBIT, $\widehat{\Pi}$, above which investment is profitable. We can therefore write the problem as follows:

$$\max_{\widehat{\Pi}\geq 0, C\geq 0} \left(\frac{\Pi}{\widehat{\Pi}}\right)^{\beta_1}\left[\frac{1-\tau}{\delta}\widehat{\Pi} + \frac{\tau-\omega}{r}C - \xi C\left(\frac{\widehat{\Pi}}{C}\right)^{\beta_2} - I\right], \quad (6)$$

where $\xi \equiv \left[(1-\tau+\omega)\frac{\alpha}{r}\frac{\beta_2}{\beta_2-1} + \frac{\tau-\omega}{r}\right]\left(\frac{r}{\delta}\frac{\beta_2-1}{\beta_2}\frac{1-\tau}{1-\tau+\omega}\right)^{\beta_2}$ to lighten the notation. It is worth noting that term $\left(\frac{\Pi}{\widehat{\Pi}}\right)^{\beta_1}$ is the contingent value of one dollar. Hence, $\left(\frac{\Pi}{\widehat{\Pi}}\right)^{\beta_1}\left[\frac{1-\tau}{\delta}\widehat{\Pi} + \frac{\tau-\omega}{r}C - \xi C\left(\frac{\widehat{\Pi}}{C}\right)^{\beta_2} - I\right]$ is the contingent value of the *NPV*. As shown in the Appendix, problem (6) gives both the optimal coupon, i.e.,

$$C^{*}(\Pi) = \frac{r}{\delta}\frac{\beta_2 - 1}{\beta_2}\frac{1-\tau}{1-\tau+\omega}\left[\frac{\tau-\omega}{\left[(1-\tau+\omega)\alpha\frac{\beta_2}{\beta_2-1}+\tau-\omega\right](1-\beta_2)}\right]^{-\frac{1}{\beta_2}}\Pi, \quad (7)$$

and the optimal threshold level of EBIT, above which investment is profitable, i.e.,

$$\widehat{\Pi}^{*}(\Pi) = \frac{\delta}{1+m}\frac{\beta_1}{\beta_1-1}\frac{1}{1-\tau}I. \quad (8)$$

Term $m \equiv \frac{\tau-\omega}{1-\tau}\frac{\beta_2}{\beta_2-1}\frac{\delta}{r}\left(\frac{1}{1-\beta_2}\frac{\tau-\omega}{r\xi}\right)^{-\frac{1}{\beta_2}}$ eases the notation. Given these results, we can calculate the contingent value of tax revenue due to the start-up business:

$$R(\Pi) = \left(\frac{\Pi}{\widehat{\Pi}^{*}}\right)^{\beta_1}\left[\frac{\tau}{\delta}\widehat{\Pi}^{*} + \frac{\tau-\omega}{r}C^{*} - \xi C^{*}\left(\frac{\widehat{\Pi}^{*}}{C^{*}}\right)^{\beta_2}\right], \quad (9)$$

and the welfare function, which is given by the summation between $NPV(\Pi)$ and $R(\Pi)$, i.e.,

$$W(\Pi) = \left(\frac{\Pi}{\widehat{\Pi}^{*}}\right)^{\beta_1}\left[\frac{\widehat{\Pi}^{*}}{\delta} + 2\frac{\tau-\omega}{r}C^{*} - 2\xi C^{*}\left(\frac{\widehat{\Pi}^{*}}{C^{*}}\right)^{\beta_2} - I\right]. \quad (10)$$

In order to evaluate the welfare loss jointly caused by taxes, financial market imperfections and expropriation risk, we set $\tau = \omega = \lambda = 0$ and define $W(\Pi)|_{\tau=\omega=\lambda=0}$ as the first best welfare. Using (10) we can therefore find:

$$WL(\Pi) = W(\Pi)|_{\tau=\omega=\lambda=0} - W(\Pi). \quad (11)$$

Then, according to Sørensen (2017), the deadweight loss $DWL(\Pi)$ is defined as the ratio between welfare loss $WL(\Pi)$ and tax revenue $R(\Pi)$. Using (11) we therefore obtain:

$$DWL(\Pi) = \frac{WL(\Pi)}{R(\Pi)}. \quad (12)$$

Finally, from the government's perspective, it is crucial to measure the probability of a start-up investment within a given time. In line with Carini et al. (2020), we use the probability of investment within n periods:

$$P(t^{*} < 10) = \left(\frac{C}{\Pi_0}\right)^{\frac{2}{\sigma^2}\left(\mu-\frac{\sigma^2}{2}\right)}\Phi\left[\frac{ln\frac{\Pi}{\Pi_0} + \left(\mu-\frac{\sigma^2}{2}\right)n}{\sigma\sqrt{n}}\right] + \Phi\left[\frac{ln\frac{\Pi}{\Pi_0} - \left(\mu-\frac{\sigma^2}{2}\right)n}{\sigma\sqrt{n}}\right], \quad (13)$$

where $\Phi[x]$ is the cumulative distribution function of a standard normal distribution, given x: in this case, x is EBIT. As explained by Sarkar (2000), volatility has a twofold effect. On the one hand, it raises the investment trigger point (and the optimal coupon), thereby reducing the probability of a start-up business at a given time. On the other hand, a higher volatility makes investment more likely. For any given threshold point, the probability that EBIT hits $\widehat{\Pi}^*$ rises. The net effect is therefore ambiguous.

3. Numerical results

Let us next calibrate our model. Table 1 contains the benchmark values of the parameter of the model.

Table 1. Benchmark values of parameters used in the numerical simulations.

Parameter		**Value(s)**
Effective tax rate	τ	$0.20; 0.30$
EBIT's drift	μ	0.01
EBIT's volatility	σ	$0.20; 0.30$
Interest rate	i	0.05
Cost of default	α	0.20
Investment sunk cost	I	100
Initial EBIT	Π_0	6
Expropriation risk	λ	$0.00; 0.10$

If we look at corporate tax rates (CITs) in developing countries, the statutory ones are on average higher than those levied in developed countries. For instance, China has a standard tax rate is 25% (although, under certain conditions, the tax rate can be reduced to 15%); the Brazilian CIT is 34%; India's CIT stands at 34.94%. Other examples are then represented by South African and Kenyan CITs, equal to 27% and 30%, respectively. For this reason, we use $\tau = 30\%$ as a benchmark value. We also evaluate the numerical findings when the tax rate is closer to the average one applied by developed countries ($\tau = 20\%$). The risk-free interest rate is equal to $i = 0.05$. The drift $\mu = 0.01$ is a realistic parametrization as the start-up's EBIT is expected to grow over time.[8] Then, following Dixit and Pindyck (1994) and Comincioli et al. (2021), we set $\alpha = 0.20$ and $\sigma = 0.20$. As pointed out by Comincioli et al. (2021), estimated default costs range from about 10% to 40%. We prefer to follow Branch (2002) and set $\alpha = 0.20$. Moreover, we consider an additional scenario where $\sigma = 0.30$, to reflect the possible higher volatility of EBIT in developing countries. Then we normalize the initial EBIT by setting $\Pi_0 = 6$ with $I = 100$, which coincides with the value of the tax-free perpetual rent $\Pi_0/(i-\mu) = 25$. According to Comincioli et al. (2024), the average value of EBIT is about 0.08. Using a lower starting value, we can therefore study start-up's investment timing. If a firm's EBIT were high enough, investment would be made at time 0. This case fits well with mature firms. However, it is less likely for a start-up. Therefore, we focus only on the opportunity to invest in the future when current EBIT is not high enough. Finally, in developing countries we must consider political risk. In particular, this is due to the likelihood of expropriation. Hence, we run our numerical simulations with λ equal to either 0 or 0.1. Since this parameter has a monotonic effect, we only focus on these two values (although we have also used other parameter values: robustness checks are available upon request).

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[8] We have run some robustness checks by using different parameter values. The effects are quite similar to the ones discussed in this paper. Of course, all numerical calculations are available upon request.

Table 2 shows the results of our numerical simulations with $\tau = 0.30$. As can be seen, an increase in both EBIT volatility and expropriation risk leads to an increase in the default trigger point $\overline{\Pi}^*$. However, financial market imperfections ω slightly reduce $\overline{\Pi}^*$. This means that, ceteris paribus, financial market imperfections raise the default risk. Let us next focus on the investment trigger point $\widehat{\Pi}^*$ and the probability of exercise of the start-up option within the arbitrary interval of 10 periods, namely $P(t^* < 10)$. As can be seen, both EBIT volatility and expropriation risk increase with $\widehat{\Pi}^*$. However, a change in parameter values has an ambiguous effect on probability $P(t^* < 10)$. For instance, if λ is low enough, an increase in both ω and σ reduces the investment probability. In other words, a higher EBIT volatility discourages the investment decisions, and therefore its probability decreases. As pointed out (see Sarkar, 2000), volatility causes two offsetting effects. On the one hand, volatility raises the investment threshold level of EBIT, thereby making investment less likely. On the other hand, a more volatile EBIT leads to an increase in the probability that it hits $\widehat{\Pi}^*$ sooner. If λ is low enough, the latter effect dominates the former one. The opposite is true when λ is high enough: in this case (i.e., when the former effect dominates the latter one), the investment probability is dramatically discouraged by the expropriation risk.

Let us next focus on the optimal coupon. As can be seen, C^* approximately doubles when the expropriation risk λ grows. This means that, when λ is high enough, a start-up may expect a shorter lifespan (due to either default or expropriation) and hence decides to exploit more borrowing. Of course, the higher the degree of financial market imperfections ω the lower the coupon is. This is due to the fact that financial market imperfections cause an additional borrowing cost.

As regards the contingent value of tax revenue we can say that it is due to two offsetting effects. On the one hand, the contingent value of one euro, namely, $\left(\Pi/\widehat{\Pi}^*\right)^{\beta_1}$, is decreasing in $\widehat{\Pi}^*$. This means that the higher the threshold level of EBIT the lower the contingent value of one euro. On the other hand, given $\left(\Pi/\widehat{\Pi}^*\right)^{\beta_1}$, the higher the parameter ω the greater the amount of resources will be. This result, which seems somehow surprising, is due to the fact that C^* is decreasing in ω. Hence, higher market imperfections lead to a decrease in the deductible coupon. Moreover, Table 2 shows that an increase in expropriation risk causes a dramatic decrease in tax revenue: unless the government is more efficient than the private sector, expropriation may cause a dramatic decrease in the contingent value of welfare.[9] Looking at the welfare function $W(\Pi)$, we see that it is increasing in volatility and decreasing in the expropriation risk. In this latter case, expropriation has a quite negative effect.

Table 3 shows the results of the same numerical simulation with the exception of a lower tax rate (20%). As can be seen, a start-up's investment is made earlier. This is not surprising since a lower tax rate raises the contingent value of net profitability. However, we see that such a tax rate cut has no dramatic effect. The same result holds for the contingent value of the welfare loss and tax revenues. The most relevant effect regards $DWL(\Pi)$. As shown in Figure 1, there is a positive relationship between $DWL(\Pi)$ and ω (already shown in the Tables). Moreover, the curves of Figure 1 are concave, which implies that, if the starting value of ω is low, an increase in financial market imperfections has a relevant effect on $DWL(\Pi)$ (and vice versa).

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[9] Of course, expropriation well fits with start-ups supported by multinational companies.

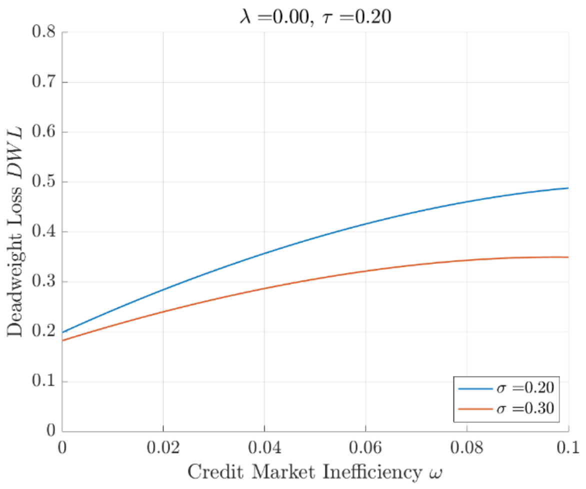
Table 2. Results of numerical simulations for different levels of credit market inefficiency (ω), expropriation risk (λ) and volatility (σ) with $\tau = 0.30$.

Credit access inefficiency	**Variable**	**Scenario**			
		$\boldsymbol{\lambda = 0.00}$		$\boldsymbol{\lambda = 0.10}$	
		$\boldsymbol{\sigma = 0.20}$	$\boldsymbol{\sigma = 0.30}$	$\boldsymbol{\sigma = 0.20}$	$\boldsymbol{\sigma = 0.30}$
$\boldsymbol{\omega = 0.00}$	$\bar{\Pi}$	4.65	5.38	13.16	13.76
	$\hat{\Pi}^*$	10.44	14.56	24.36	30.03
	C^*	10.11	15.88	19.73	24.73
	$P(t^* < 10)$	0.65	0.67	0.16	0.37
	R	14.46	16.65	0.33	0.86
	W	56.64	67.72	1.08	2.96
	WL	2.43	2.39	0.08	0.18
	DWL	0.17	0.14	0.25	0.21
$\boldsymbol{\omega = 0.05}$	$\bar{\Pi}$	4.64	5.25	13.41	13.79
	$\hat{\Pi}^*$	10.88	15.12	25.53	31.33
	C^*	9.43	14.46	18.78	23.12
	$P(t^* < 10)$	0.65	0.67	0.16	0.37
	R	15.00	17.34	0.34	0.88
	W	54.05	65.58	0.98	2.79
	WL	5.03	4.53	0.18	0.35
	DWL	0.34	0.26	0.54	0.40
$\boldsymbol{\omega = 0.10}$	$\bar{\Pi}$	4.53	4.96	13.47	13.53
	$\hat{\Pi}^*$	11.30	15.62	26.63	32.55
	C^*	8.63	12.82	17.68	21.26
	$P(t^* < 10)$	0.65	0.67	0.16	0.37
	R	15.50	18.01	0.33	0.89
	W	51.94	63.90	0.91	2.65
	WL	7.13	6.21	0.26	0.49
	DWL	0.46	0.34	0.78	0.55

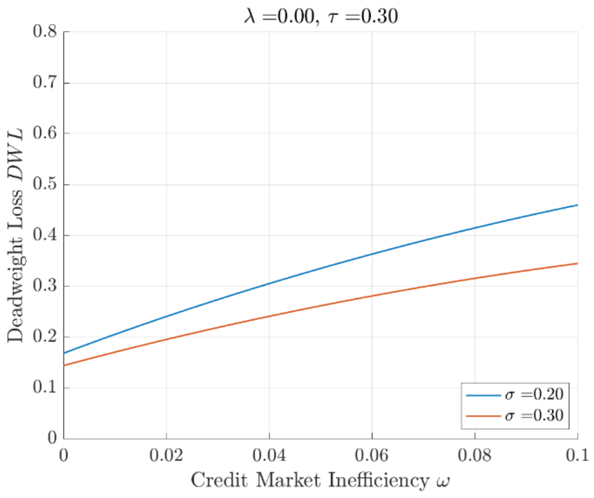
Table 3. Results of numerical simulations for different levels of credit market inefficiency (ω), expropriation risk (λ) and volatility (σ) with $\tau = 0.20$.

Credit access inefficiency	**Variable**	**Scenario**			
		$\boldsymbol{\lambda = 0.00}$		$\boldsymbol{\lambda = 0.10}$	
		$\boldsymbol{\sigma = 0.20}$	$\boldsymbol{\sigma = 0.30}$	$\boldsymbol{\sigma = 0.20}$	$\boldsymbol{\sigma = 0.30}$
$\boldsymbol{\omega = 0.00}$	$\overline{\Pi}$	4.65	5.38	13.16	13.76
	$\widehat{\Pi}^*$	10.44	14.56	24.36	30.03
	C^*	10.11	15.88	19.73	24.73
	$P(t^* < 10)$	0.70	0.71	0.19	0.40
	R	14.46	16.65	0.33	0.86
	W	56.64	67.72	1.08	2.96
	WL	2.43	2.39	0.08	0.18
	DWL	0.17	0.14	0.25	0.21
$\boldsymbol{\omega = 0.05}$	$\overline{\Pi}$	4.64	5.25	13.41	13.79
	$\widehat{\Pi}^*$	10.88	15.12	25.53	31.33
	C^*	9.43	14.46	18.78	23.12
	$P(t^* < 10)$	0.70	0.71	0.19	0.40
	R	15.00	17.34	0.34	0.88
	W	54.05	65.58	0.98	2.79
	WL	5.03	4.53	0.18	0.35
	DWL	0.34	0.26	0.54	0.40
$\boldsymbol{\omega = 0.10}$	$\overline{\Pi}$	4.53	4.96	13.47	13.53
	$\widehat{\Pi}^*$	11.30	15.62	26.63	32.55
	C^*	8.63	12.82	17.68	21.26
	$P(t^* < 10)$	0.70	0.71	0.19	0.40
	R	15.50	18.01	0.33	0.89
	W	51.94	63.90	0.91	2.65
	WL	7.13	6.21	0.26	0.49
	DWL	0.46	0.34	0.78	0.55

Moreover, an increase in volatility (from $\sigma = 0.2$ to $\sigma = 0.3$) reduces $DWL(\Pi)$. In other words, the effect of the denominator of (12), namely $R(\Pi)$, dominates that on the numerator, $WL(\Pi)$. Policy uncertainty exacerbates this effect: the gap between the blue and the red line dramatically increases when expropriation is possible. Moreover, financial inefficiency has a tremendous impact on the magnitude of $DWL(\Pi)$. Since we cannot exclude the existence of tax competition, we therefore analyze the effects of a tax-rate decrease. In Figure 1, we also compare the effect of a tax-rate decrease from 0.20 (left panels) to 0.30 (right panels). This allows us to say that taxation has a minor impact on $DWL(\Pi)$.



(a)



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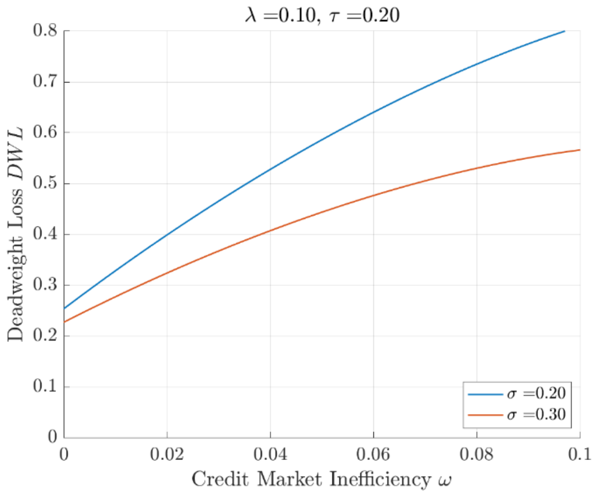

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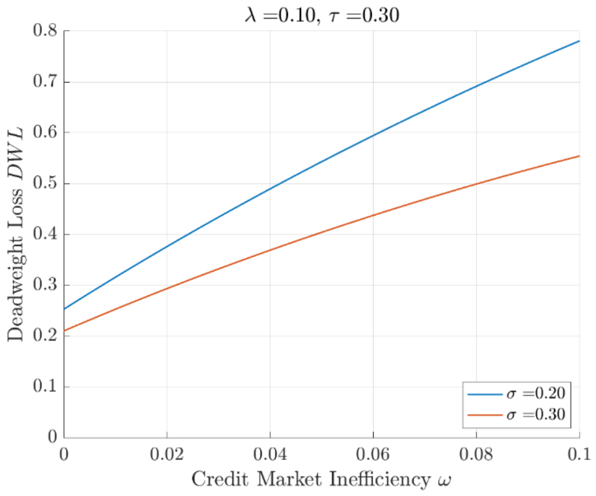

(d)

Not surprisingly, the existence of some expropriation risk increases $DWL(\Pi)$ in a dramatic way, as opposed to the almost negligible effect of taxation. If we focus on volatility, we see that $DWL(\Pi)$ is decreasing in σ**.** This seems counterintuitive. However, as shown in (12), $DWL(\Pi)$ is the ratio between the welfare loss and revenue. Figure 1 therefore shows that the effect of σ on the denominator (revenue) dominates that on the numerator (welfare loss). Moreover, an increase in ω widens the gap between the blue and red curves. To sum up, while taxation has a minor impact on $DWL(\Pi)$, the converse is true for both financial market inefficiencies and the expropriation risk.

4. Conclusion

As we have shown, start-up firms are deeply affected by financial market inefficiencies. This result is in line with the existing literature (see, e.g., Mazorodze, 2023, and Munemo, 2017). Given these findings, financial market inefficiency should be dramatically reduced by the policy-makers that aim at boosting start-ups. Similarly, the expropriation risk has a dramatic impact on absolute values: if, for instance, the tax rate and volatility σ are 30% and 20%, respectively, the contingent value of the welfare loss and revenues sharply decrease.

On the other hand, the existence of relatively high tax rates (i.e., higher than the ones applied by developed countries) is not a serious problem. Rather, these rates could help the Government to raise resources when firms are closer to maturity.

In conclusion, if a developing country wishes to increase its number of start-ups, a decrease in riskiness and a more reliable financial market are crucial targets, although the distortions measured by $DWL(\Pi)$ may increase. On the contrary, a decrease in τ is less relevant.

A. Appendix

Following Comincioli et al. (2021) and using dynamic programming, at any time t the value of equity is:

$$E(\Pi) = \begin{cases} [(1-\tau)(\Pi - C) - \omega C]dt + e^{-idt}e^{-\lambda dt}\mathbb{E}[E(\Pi + d\Pi)] & \text{b. d.} \\ 0 & \text{a. d.} \end{cases}, \quad \text{(A.1)}$$

where the discount factor due to the risk-free interest rate appears together with the factor related to expropriation risk. Following Panteghini (2007), the b.d. value of equity can be rewritten as:

$$E(\Pi) = \frac{1-\tau}{\delta}\Pi - \frac{1-\tau+\omega}{r}C + \sum_{i=1}^{2} A_i \Pi^{\beta_i}, \quad \text{(A.2)}$$

where $\beta_{1,2} = \frac{1}{2} - \frac{\mu}{\sigma^2} \pm \sqrt{\left(\frac{\mu}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}}$, with $\beta_1 > 1$ and $\beta_2 < 0$. According to Dixit and Pindyck (1994), without financial bubbles, we set $A_1 = 0$. To find A_2 we exploit the value matching condition in correspondence of the default trigger point:

$$E(\overline{\Pi}) = \frac{1-\tau}{\delta}\overline{\Pi} - \frac{1-\tau+\omega}{r}C + A_2\overline{\Pi}^{\beta_1} = 0, \quad \text{(A.3)}$$

that immediately gives (3). Similarly, at any time t the value of debt is:

$$D(\Pi) = \begin{cases} Cdt + e^{-rdt}\mathbb{E}[D(\Pi + d\Pi)] & \text{b. d.} \\ (1-\alpha)(1-\tau)\Pi dt + e^{-rdt}\mathbb{E}[D(\Pi + d\Pi)] & \text{a. d.} \end{cases}, \quad \text{(A.4)}$$

from which, proceeding in the same way as in the previous case, it follows that:

$$D(\Pi) = \begin{cases} \dfrac{C}{r} + \displaystyle\sum_{i=1}^{2} B_i \Pi^{\beta_i} & \text{b. d.} \\ \dfrac{(1-\alpha)(1-\tau)}{\delta}\Pi + \displaystyle\sum_{i=1}^{2} F_i \Pi^{\beta_i} & \text{a. d.} \end{cases} . \quad \text{(A.5)}$$

Since no financial bubbles exist, the equality $B_1 = F_1 = 0$ holds. In addition, if the profit falls to zero, so does the lender's claim a.d., namely, $D(0) = 0$, hence $F_2 = 0$. To derive the value of B_2, the value of debt b.d. and a.d. must be set equal in correspondence at point $\overline{\Pi}$:

$$B_2 \overline{\Pi}^{\beta_2} = \frac{(1-\alpha)(1-\tau)}{\delta}\overline{\Pi}, \quad \text{(A.6)}$$

from which (5) easily follows. As far as the investor's problem (6) is concerned, the first order condition with respect to C is:

$$\left(\frac{\Pi}{\widehat{\Pi}}\right)^{\beta_1} \left[\frac{\tau-\omega}{r}C - \xi(1-\beta_2)\left(\frac{\widehat{\Pi}}{C}\right)^{\beta_2}\right] = 0, \quad \text{(A.7)}$$

from which it follows the optimal ratio between C and $\widehat{\Pi}$ follows:

$$\frac{C}{\widehat{\Pi}} = \left[\frac{\tau-\omega}{r\xi(1-\beta_2)}\right]^{-\frac{1}{\beta_2}}. \quad \text{(A.8)}$$

Then, the first order condition of (6) with respect to $\widehat{\Pi}$ is:

$$\frac{(1-\beta_1)(1-\tau)}{\delta} + \frac{C}{\widehat{\Pi}}\left[(\beta_1-\beta_2)\xi\left(\frac{\widehat{\Pi}}{C}\right)^{\beta_2} - \frac{\tau-\omega}{r}\beta_1\right] + I\frac{\beta_1}{\widehat{\Pi}} = 0, \quad \text{(A.9)}$$

that, using (A.8) and after some rearrangements, leads to (7) and (8).

References

Asiedu, E., Kalonda-Kanyama, I., Ndikumana, L., & Nti-Addae, A. (2013). Access to credit by firms in Sub-Saharan Africa: How relevant is gender?. *American Economic Review*, 103(3), 293-297. doi: 10.1257/aer.103.3.293.

Blancher, M. N. R., Appendino, M., Bibolov, A., Fouejieu, M. A., Li, M. J., Ndoye, A., ... & Sydorenko, T. (2019). *Financial inclusion of small and medium-sized enterprises in the Middle East and Central Asia*. International Monetary Fund.

Bolton, P., Wang, N., & Yang, J. (2019). Investment under uncertainty with financial constraints. *Journal of Economic Theory*, 184, 104912. doi: 10.1016/j.jet.2019.06.008.

Branch, B. (2002). The costs of bankruptcy: A review. *International Review of Financial Analysis*, 11(1), 39-57. doi: 10.1016/S1057-5219(01)00068-0.

Brixiová, Z., Kangoye, T., & Yogo, T. U. (2020). Access to finance among small and medium-sized enterprises and job creation in Africa. Structural Change and Economic Dynamics, 55, 177-189. doi: 10.1016/j.strueco.2020.08.008.

Carini, C., Moretto, M., Panteghini, P. M., & Vergalli, S. (2020). Deferred taxation under default risk. *Journal of Economics*, 129, 33-48. doi: 10.1007/s00712-019-00671-x.

Comincioli, N., Panteghini, P. M., & Vergalli, S. (2021). Welfare effects of business taxation under default risk. *International Tax and Public Finance*, 28(6), 1412-1429. doi: 10.1007/s10797-020-09650-1.

Carini, C., Comincioli, N., Gufler, I., Menoncin, F., Panteghini, P. M., & Vergalli, S. (2024). Brown firms and their optimal transition path. *Mimeo*.

Dixit, A. K., & Pindyck, R. S. (1994). *Investment under uncertainty*. Princeton university press.

Goldstein, R., Ju, N., & Leland, H. (2001). An EBIT-based model of dynamic capital structure. *The Journal of Business*, 74(4), 483-512. doi: 10.1086/322893.

Harrison, J. M. (1985). *Brownian motion and stochastic flow systems*. John Wiley & Sons Inc.

Kowalewski, O., & Pisany, P. (2023). The rise of fintech: a cross-country perspective. *Technovation*, 122, 102642. doi: 10.1016/j.technovation.2022.102642.

Mazorodze, B. T. (2023). Undervaluation And New Business Formation In Developing Countries. *Journal of Developmental Entrepreneurship*, 28(02), 2350011. doi: 10.1142/S1084946723500115.

Munemo, J. (2017). Foreign direct investment and business start-up in developing countries: The role of financial market development. *The Quarterly Review of Economics and Finance*, 65, 97-106. doi: https://doi.org/10.1016/j.qref.2016.08.010.

Panteghini, P. M. (2007). *Corporate taxation in a dynamic world*. Springer.

Sarkar, S. (2000). On the investment–uncertainty relationship in a real options model. *Journal of Economic Dynamics and Control*, 24(2), 219-225. doi: 10.1016/S0165-1889(99)00005-6.

Shackleton, M. B., & Sødal, S. (2005). Smooth pasting as rate of return equalization. *Economics Letters*, 89(2), 200-206. doi: 10.1016/j.econlet.2005.05.028.

Singh, S., & Mungila Hillemane, B. S. (2023). Sources of finance for tech startups over its lifecycle: what determines their approach of sources and its success?. *International Journal of Emerging Markets*, 18(8), 1766-1787. doi: 10.1108/IJOEM-06-2020-0705.

Sørensen, P. B. (2017). Taxation and the optimal constraint on corporate debt finance: Why a comprehensive business income tax is suboptimal. *International Tax and Public Finance*, 24, 731-753. doi: 10.1007/s10797-016-9432-1.