Fostering Entrepreneurship: Promoting Founding or Funding?

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Abstract

Governments across the globe are eager to foster entrepreneurial ecosystems, yet there is no consensus on what policies to use. We develop a theory about the equilibrium consequences of two canonical types of entrepreneurship policies: policies that encourage entrepreneurs to found new ventures, and policies that encourage investors to fund new ventures. We distinguish between a short-term impact on current market activity, versus a long-term impact on future activity. Investing in entrepreneurial ventures requires tacit knowledge that is mainly acquired through prior entrepreneurial experience, implying that the supply of capital depends on successful entrepreneurs from prior generations. Recognizing this intergenerational linkage has a profound impact on the market equilibrium, and the effect of entrepreneurship policies. Our analysis identifies a rationale for using funding polices.

Keywords: Entrepreneurship, angel investors, start-ups, government policies, ecosystem, overlapping generations, steady state.

JEL classification: D53, D92, G28, L26.

1 Introduction

Policy makers across the globe want to foster their entrepreneurial ecosystems. Silicon Valley seems to be the envy of everyone, imitations abound: Silicon Forest (Oregon), Swamp (Florida), Gorge (UK), Glen (Scotland), Fjord (Norway), Wadi (Israel), Savannah (Kenya), and many more. The core reasons why policy makers want to promote entrepreneurship are fairly well understood, they relate mainly to economic growth, employment, and innovation (see Lerner (2008), Decker et al. (2014),Wilson (2015)). However, there are vast disparities in the approaches taken by governments to achieve these goals. The questions becomes *how* policy makers can foster entrepreneurship?

One common set of approaches focuses on expediting founding, facilitating entry into entrepreneurship, and promoting firm formation. Such policies come in a wide variety of forms, such as training, access to mentoring and expertise, or a reduction of bureaucratic red tape. In the US, the Small Business Administration (SBA) offers a large variety of training programs for entrepreneurs, and the I-Corps program of the National Science Foundation (NSF) provides entrepreneurship training for scientists and engineers.[1] The website of the UK government alone lists over 250 business support programs for entrepreneurs.[2] McKenzie and Woodruff (2014) summarize various studies on business support programs for entrepreneurs in developing countries.

A very different set of policies focuses on supporting the funding of entrepreneurial ventures. These policies use a variety of methods to encourage investors to channel more funding into start-ups. In the US, the SBIC program supports the funding of early-stage start-ups, and according to the Angel Capital Association, more than half of all US states have some tax credits for angel investing.[3] In the UK angel investors receive generous tax credits under the EIS/SEIS program.[4] New Zealand has a government fund that matches private angel investments.[5] Wilson and Silva (2013) provide a comprehensive discussion of government policies for early-stage funding across the OECD.

Applied policy analysis typically focuses on evaluating the effectiveness of specific programs in isolation, but there is limited emphasis on contrasting policies, and asking what type of policies would be most effective. We therefore raise the fundamental question of how differ-

[1] See https://www.sba.gov/starting-managing-business and https://www.nsf.gov/news/special_reports/i-corps/

[2] https://www.gov.uk/business-finance-support-finder/search?support_types%5B%5D=expertise-and-advice&postcode=&business_sizes=&sectors=&stages=

[3] See https://www.sba.gov/sbic and https://www.angelcapitalassociation.org/aca-public-policy-state-program-details/

[4] https://www.gov.uk/government/publications/the-enterprise-investment-scheme-introduction

[5] See http://www.nzvif.co.nz/what-we-offer/seed-co-investment-fund and

ent entrepreneurship policies compare in terms of their impact on entrepreneurial ecosystems. We tackle this question with a formal theory model that derives and contrasts the equilibrium impact of different government policies. Specifically we ask how different policies promote entrepreneurial activity, distinguishing between (i) founding policies that affect what is often called the 'demand-side', i.e., the number of entrepreneurs demanding capital, versus (ii) funding policies that affect the supply of funds to new ventures.

Based on a large prior entrepreneurial finance literature (see Da Rin et al. (2003)), we acknowledge that the financing of entrepreneurial ventures is different from standard financial investments and requires 'smart money'. Specifically it requires tacit knowledge about the entrepreneurial process that is mostly acquired by going through the entrepreneurial process itself. We view so-called 'angel' investing as the natural process by which experienced entrepreneurs pass on their knowledge to the next generation of entrepreneurs. In practice, the first check of successful start-ups often comes from angel investors who were successful entrepreneurs before: think of Andy Bechtolsheim, co-founder of Sun Microsytems, who wrote the first check for Google, or Peter Thiel, co-founder of PayPal, who wrote the first check for Facebook. We use an 'overlapping generations' model to account for the accumulation of expertise in an entrepreneurial ecosystem. Early in their career entrepreneurs start new ventures that may succeed or fail. Successful entrepreneurs accumulate both the expertise and the wealth to then fund the next generation of entrepreneurs. This creates dynamic interlinkages between generations of entrepreneurs, where the supply of angel capital is a function of the number of past entrepreneurs and the wealth they accumulated.

Promoting entrepreneurship is not a short term endeavor. Silicon Valley took decades to become what it is today; its imitators had to learn how long it takes to create an entrepreneurial ecosystem (Lerner (2008)). Our dynamic model allows us to examine both the short term and the long term impacts of entrepreneurial policies. We first build a simple Walrasian model of the demand and supply for capital to fund new ventures, without any intergenerational linkages. We establish several important benchmark results. Comparable levels of founding and funding subsidies generate the same increase in entrepreneurial activity. However, founding policies create a competitive dynamic where more entrepreneurs seek a limited supply of funds, resulting in less favorable investment terms for entrepreneurs, i.e., lower valuations. By contrast, funding policies create a more abundant supply of capital which results in more favorable investment terms for entrepreneurs, i.e. higher valuations. We then introduce intergenerational linkages and show that the differences in valuations have important dynamic implications. This is because the wealth created by one generation of entrepreneurs determines the supply of angel capital for the next generation of entrepreneurs. A central result is that for increasing entrepreneurial activity, funding subsidies are more effective than founding subsidies.

Our model also generates some interesting predictions about the dynamic path of entrepreneurial ecosystems. While there is always a unique equilibrium in every period, the model with intergenerational linkages can have multiple steady state equilibria (to which the period equilibria converge to). In the low (high) steady state equilibrium the lack (abundance) of entrepreneurial activity prevents (enables) the formation of angel capital for future generations, thus perpetuating the low (high) level of entrepreneurial activity. We show that even in the high steady state equilibrium there is too little entrepreneurial activity relative to the first best outcome. This is because future entrepreneurs benefit from the wealth of earlier generations, but this intergenerational externality is not taken into account by investors when striking a deal with entrepreneurs. In the low equilibrium there is an additional rationale for government support, namely to provide temporary subsidies to lift the economy above a critical threshold, beyond which there is a self-sustaining dynamic path toward the high equilibrium.

In our model funding subsidies are the optimal policy, but they can be implemented in several ways. One of them is to subsidize investments (such as an investment tax credit), another is to subsidize returns (such as a relief from capital gains taxation). We also show that if investors need to screen out good from bad projects, funding policies have the advantage of being applied only to those projects that have passed the investors' screen.

We extensively discuss the implications from our model for entrepreneurship policies, looking first at how policies affect a single ecosystem in isolation, and then looking at 'open economy' issues that allow for capital and labor mobility across ecosystems. We also provide an extensive discussion of how our analysis can guide future theoretical and empirical.

Our model suggests a societal benefit to having wealthy entrepreneurs, and a benefit of giving tax credits to 'already-rich' angel investors. At first sight this argument runs contrary to Piketty's (2014) argument about the harms of wealth inequality. However, our model does not suggest a blanket tax-exemption for the rich. Instead our argument is to create effective channels for rich entrepreneurs to reinvest their wealth (and their expertise) into the next generation of poor entrepreneurs. As such our argument focuses on creating a channel for social mobility. This argument is related to the recent work of Aghion et al. (2015) concerning the broader relationship between innovation and top income inequality.

Our paper relates to a diverse set of prior literatures. There is a large literature discussing the differences in entrepreneurship across ecosystems, starting with the seminal work by Saxenian (1994); Lerner and Schoar (2010) contains a more recent overview. In terms of theory, the closest work are formal entrepreneurship theories with multiple equilibria, such as Canidio and

Legros (2015) and Landier (2006). In terms of theories that examine how government policies affect entrepreneurs and investors, seminal contributions include Poterba (1989a, 1989b), and the work of Keuschnigg and Nielsen (2003, 2004). More recent contributions include Di Maio et al. (2016) and Egger and Keuschnigg (2015). None of this focuses on the comparison of founding versus funding policies.

A large prior literature looks at the dynamics of entrepreneurship. One important strand looks at the origin of entrepreneurial activities in terms of spin-offs from established companies. Relevant theories include Cassiman and Ueda (2006), Hellmann and Perotti (2011), and Rauch (2015). Important empirical works include Agarwal et al. (2004), Gompers et al. (2005), and Klepper and Sleeper (2005). Another strand looks at the role of serial entrepreneurs, including Hsu (2007), Gompers et al. (2010), and Lafontaine and Shaw (2016). Our specific interest here is a slightly different dynamic transition that has received less attention, namely the transition from entrepreneur to angel investor. The recent empirical explorations of Guiso et al. (2015) and Cumming et al. (2016) are a useful step in that direction. As a background, the work of Van Osnabrugge and Robinson (2000) and Wilson (2011) provide useful overviews of angel investing.

There is a growing policy literature on the merits of entrepreneurship policies. Lerner (2008) and Audretsch et al. (2007) provide an extensive coverage of this topic, including a discussion of the pitfalls of misguided policies. Wilson and Silva (2013) and Wilson (2015) summarize a large body of research about the experience of OECD countries with entrepreneurship policies. The work of Leleux and Surlemont (2003) and Brander et al. (2015) empirically evaluates one important class of funding programs, namely government-supported venture capital. Our paper is also related to the broader literature on innovation and agglomeration, see Delgado et al. (2010), Ellison et al. (2010), and Glaeser et al. (2010).

We explain our theory in Section 2, but relegate much of the formal analysis to the Online Appendix, which is available on the authors' websites. Section 3 provides an extensive discussion of the implications of the model. It is followed by a brief conclusion.

2 Main Model

2.1 Base Assumptions

Consider an overlapping generations model where all parties are risk-neutral and share the discount factor $\delta \in (0, 1)$. In each period t there is a continuous unit mass of potential entrepreneurs that are considering starting a new venture. Entrepreneurs have no initial wealth and face a non-monetary entry cost denoted by l (see Jovanovic (1982)). For simplicity assume that l has a uniform distribution with support $[0, \mu_E]$; the cumulative distribution function is denoted by $\Gamma_E(l)$. The number of entrepreneurs actually starting a venture in period t is a continuous measure denoted by $n_{E,t}$; whenever possible we simply write n_E.

Each entrepreneur lives for three periods. In period 1, she starts a new ventures; we describe the main properties below. If the venture is successful, the entrepreneur has some wealth that she can invest in period 2. In period 3 she consumes the returns of all her investments.[6]

In period 1 the entrepreneur requires a financial investment $\phi > 0$. This is provided by a set of investors (described below) in exchange for an equity stake α. The venture succeeds with probability ρ, generating a payoff $y > 0$. With probability $1 - \rho$ the venture fails, generating a zero payoff. In case of failure the entrepreneur has no more wealth, and plays no further role in the model.

We call the market for funding entrepreneurs the 'angel market' and assume for simplicity that it is characterized by symmetric information and competitive pricing. Moreover, investors can freely combine their investments to ensure that total capital demand equals total capital supply. However, we assume that only a limited set of investors have the required skills to invest in the angel market. Specifically we consider two types of angel investors. First there are 'entrepreneurial angels' who are formerly successful entrepreneurs (period 1), and have therefore acquired the necessary skills for angel investing. Second, there are 'external angels' who are wealthy individuals, and who also have the required skills for angel investing. In Section 3.2 we argue that such external angels can be successful entrepreneurs from other entrepreneurial ecosystems (such as Silicon Valley), wealthy senior executives from established corporations or financial institutions, or other professionals. The key distinction is that the number of entrepreneurial angels arises endogenously within our model, whereas external angels appear exogenously in every period. Specifically, the number of entrepreneurial angels is determined by the number of entrepreneurs that succeeded in the previous period, so that $n_{A,t} = \rho n_{E,t-1}$. Their individual wealth is endogenously determined by their ownership in their prior entrepreneurial ventures, so that $w_t = (1 - \alpha_{t-1})y$. The number of external angels is exogenously given by $\widetilde{n}$ and their individual wealth is denoted by $\widetilde{w}$.

In period 2 a formerly successful entrepreneur can invest her wealth w_t. First, we assume there is a safe asset that generates a safe return $1+r$. We use the standard assumption that $1+r =$

[6]In our base model we assume that each entrepreneur has only one period for starting a venture, and only one period for investing her wealth. In the Online Appendix we consider a model extension where entrepreneurs can start multiple ventures over multiple periods (serial entrepreneurs) and can invest over multiple periods (serial investors). We show that the main insights of the base model remain intact.

$1/\delta$. Second, there is the possibility of investing in the next generation of period 1 entrepreneurs (angel investing). We denote the amount of angel investing by k so that an entrepreneurial angel invests $k \in [0, w_t]$ in new ventures, and invests the remaining $w_t - k$ in the safe asset. We assume that angel investing involves some private costs. These can be thought of as legal and due diligence costs, as well as the opportunity cost of time and the personal preferences for engaging in angel investing. Specifically we assume that each successful entrepreneur has a monetary cost θk of making angel investments, where θ is drawn from a uniform distribution with support $[0, \mu_I]$; the cumulative distribution function is denoted by $\Gamma_I(\theta)$. For the external angels we use parallel assumptions: They invest $\widetilde{k}$ in new ventures, and the remaining amount $\widetilde{w} - \widetilde{k}$ in the safe asset. The aggregate amount of wealth potentially available for angel investing in period t is therefore given by $n_{A,t}w_t + \widetilde{n}\widetilde{w}$; however, aggregate amount actually invested in entrepreneurial ventures will depend on the expected returns to angel investing, which will be derived as part of the market equilibrium.

Central to our argument is that angel investing requires unique skills that cannot be taken for granted in an ecosystem. The most natural source for acquiring such skills is to go through the entrepreneurial experience itself, and then use the experience, as well as the acquired wealth, to fund the next generation of entrepreneurs. Note that it is the combination of entrepreneurial experience and wealth that creates the entrepreneurial angels. Unsuccessful entrepreneurs may or may not have useful skills, but they lack the wealth to become angel investors. To avoid making our model over-restrictive we allow for the possibility that others also possess the necessary skills for angel investing, hence the external angels. For some parts of the model we set $\widetilde{n} = 0$, in order to focus on the endogenous determination of angel markets. For other parts we allow for $\widetilde{n} > 0$, to consider the more general setting where there is also an autonomous supply of angel capital.

We formally derive all proofs in the Online Appendix. For the main paper we provide more intuitive explanations of the different equilibrium outcomes using traditional demand and supply graphs.

2.2 Benchmark Model Without Intergenerational Dynamics

As a building block it is useful to consider a model where there are no entrepreneurial angels (e.g., all successful entrepreneurs invest in the safe asset). We can think of this benchmark model as a repeated static Walrasian equilibrium model with no intergenerational effects.

Consider the optimal investment decision of external angels. In exchange for investing the amount ϕ, investors receive an ownership stake α, which generates the expected return

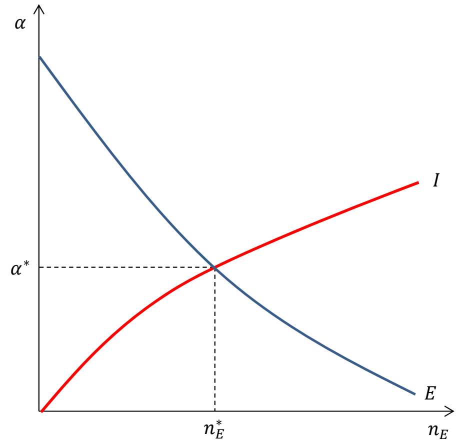

Figure 1: Benchmark Model – Market Equilibrium

$\rho\alpha y$. From the perspective of an individual angel this means that investing an amount k in entrepreneurial ventures generates an expected return of $\frac{k}{\phi}\alpha\rho y$. The expected utility of an external angel is thus given by

$$U_I(k) = \delta\frac{k}{\phi}\alpha\rho y - \theta k + \delta(1+r)(\widetilde{w} - k).$$

In the Online Appendix we show that there exists a critical level $\widehat{\theta}$, such that for $\theta \leq \widehat{\theta}$ it is optimal for external angels to invest their entire wealth in new ventures ($k^* = \widetilde{w}$), and for $\theta > \widehat{\theta}$ it is optimal to invest their entire wealth in the safe asset ($k^* = 0$). The threshold is given by $\widehat{\theta} = \alpha\frac{\delta\rho y}{\phi} - 1$, which is an increasing function of the ownership share α, and the venture's net economic return $\frac{\delta\rho y}{\phi}$. The aggregate supply of angel capital is thus given by $\widetilde{n}\widetilde{w}\Gamma_I(\widehat{\theta})$.

Now consider the demand for capital from entrepreneurs that are entering the market. An entrepreneur's expected utility of starting a venture is given by $U_E = \delta\rho(1-\alpha)y$. This has to be traded off against the cost of entry l. Clearly, entry is optimal as long as $U_E \geq l$, so that the number of entrepreneurs (which is a continuous measure) is given by $n_E = \Gamma_E(U_E)$ – we call this the entry condition.

The total amount of capital that all entrepreneurs demand is given by ϕn_E. In equilibrium this must equal to the total capital supply, resulting in the following market clearing condition: $\phi n_E = \widetilde{n}\widetilde{w}\Gamma_I(\widehat{\theta})$.

Consider Figure 1. On the vertical axis we put α, a measure of investor ownership and the effective price of capital. On the horizontal axis we put n_E, the relevant quantity variable, namely the number of funded entrepreneurs. The demand curve is downward sloping, because fewer entrepreneurs want to enter with a higher price of capital, as reflected by a higher investor ownership stake α. The supply curve is upward sloping, because more investors want to invest in the angel market when the net returns are higher.

We can also interpret Figure 1 using the concept of valuation. The so-called post-money valuation of a venture investment is defined as ϕ/α, so that a higher α corresponds to a lower valuation. Entrepreneurs prefer higher valuations, investors prefer lower valuations. As α increases, entrepreneurs' utilities decrease and the demand slopes downwards, but investor's utilities increase and the supply slopes upwards.

The comparative statics of the market equilibrium are very intuitive. The equilibrium level of entrepreneurial activity n_E^* is increasing in the probability of success ρ, the success value y, the number of external angels $\widetilde{n}$, and their levels of wealth $\widetilde{w}$; it is decreasing in the required amount of capital ϕ, the average entry cost of entrepreneurs $\mu_E/2$, and the average entry cost of investors $\mu_I/2$. The investor's ownership stake α^* is increasing in ϕ and $\mu_I/2$, and it is decreasing in $\widetilde{n}$, $\widetilde{w}$, $\mu_E/2$, ρ, and y.

To examine whether the market equilibrium is efficient, we compare it with the first best equilibrium that maximizes the sum of all utilities. In addition, we are interested in the effects of two alternative types of government subsidies. The first subsidy targets the demand side by subsidizing founding, the second subsidy targets the supply side by subsidizing funding. We discuss the interpretation of these policies in Section 3.

We define a founding subsidy as an in-kind support to potential entrepreneurs that want to start a venture. The subsidy specifically reduces the non-monetary cost of entry by S_E, which implies that entry is now optimal as long as $U_E \geq l - S_E$. The entry condition becomes $n_E = \Gamma_E(U_E + S_E)$, so that founding subsidies increase entry, and therefore increase the demand for capital. We assume that the government cannot discriminate among entrepreneurs with different values of l, so that all entrepreneurs that want to enter can take advantage of the subsidy.[7]

We define a funding subsidy as a financial support to potential investors that want to invest in new ventures. For now we consider a simple tax-credit of s_I for every unit of investment; Section 2.7 then looks at alternative funding policies. When investing k, an investor therefore receives a total tax credit of ks_I. This changes the cost of angel investing to $(\theta - s_I)k$. The market clearing condition then becomes $\phi n_E = \widetilde{n}\widetilde{w}\Gamma_I(\widehat{\theta}+s_I)$, so that funding subsidies increase the supply of angel capital. Again we assume that the government cannot discriminate among investors with different values of θ, so that all investors take advantage of the subsidy. It is useful to define $S_I \equiv \phi s_I$ as the absolute subsidy amount per firm.

[7] In the case of $l < S_E$ we simply assume that the entrants' cost of entry remains zero, but that the government still pays the full cost.

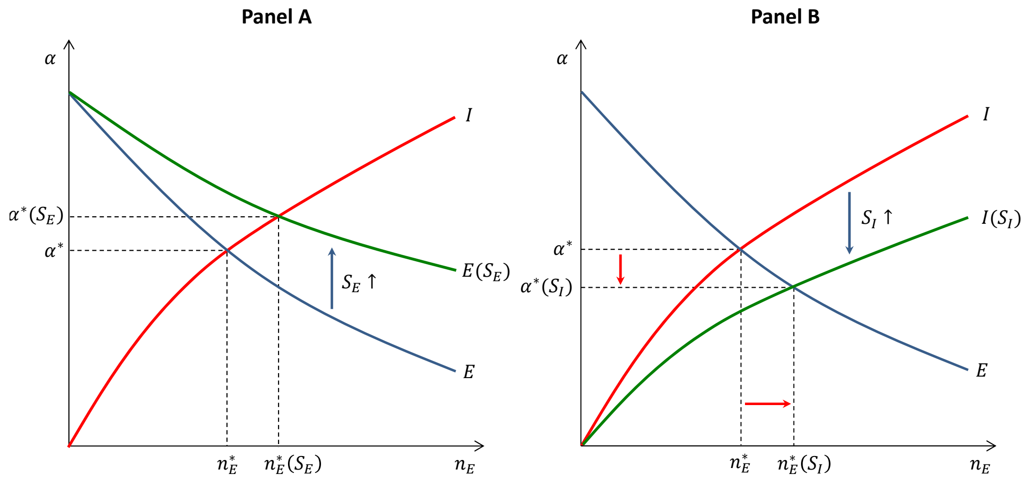

Figure 2: Benchmark Model – Effect of Subsidies

We now state useful benchmark results concerning the efficiency of the market equilibrium, as well as the effects of demand-side versus supply-side polices.

Proposition 1 *Consider the benchmark model without intergenerational dynamics.*

(i) *The competitive equilibrium is socially efficient.*

(ii) *The effect of a demand-side founding subsidy (S_E) is to increase the equilibrium number of entrepreneurs (n_E^*), and to increase the investor's ownership stake (α^*).*

(iii) *The effect of a supply-side funding subsidy (S_I) is to increase the equilibrium number of entrepreneurs (n_E^*), and to decrease the investor's ownership stake (α^*).*

(iv) *Equivalent levels of founding and funding subsidies ($S_E = S_I$) result in equivalent equilibrium numbers of entrepreneurs ($n_E^*(S_E) = n_E^*(S_I)$), but in different ownership stakes ($\alpha^*(S_E) > \alpha^*(S_I)$).*

Figure 2 accompanies Proposition 1, showing in Panel A the effect of a founding policies (S_E), and in Panel B the effect of funding policy (S_I). Our first result is that the competitive equilibrium is efficient. This is not surprising, because the benchmark model is a standard competitive Walrasian equilibrium model with no externalities. While there is no rationale for government intervention, it is still instructive to look at the effects of the various subsidies. We find that both policies are effective in raising the equilibrium level of entrepreneurial activity: founding subsidies by shifting the demand curve, and funding subsidies by shifting the supply curve.

An important finding is that the two policies create different equilibrium investment terms. Founding policies create relatively more favorable terms for investors, as they lead to relatively higher ownership stakes α^* (i.e., lower valuations). At first glance one might have expected that funding policies would be more favorable for investors, because investors receive a subsidy. However, our equilibrium analysis suggests an interesting alternative mechanism. With a founding subsidy, more entrepreneurs enter the market and seek funding. A founding subsidy therefore creates a competitive dynamic where entrepreneurs bid up the stakes they are willing to give to investors in exchange for funding, thus resulting in lower valuations. By contrast, a funding subsidy brings more investors into the market, creating a competitive dynamic where investors bid up valuations, and therefore end up with lower equity stakes.

The last part of Proposition 1 states that comparable subsidy levels ($S_E = S_I$) generate identical levels of entrepreneurial activity ($n_E^*(S_E) = n_E^*(S_I)$). However, the mechanisms behind founding and funding subsidies are fundamentally different, as the former affect the non-monetary cost of entering the market for entrepreneurs, whereas the latter affect the investment terms obtained after entering the market. More importantly, this 'equivalence result' only applies to the benchmark model, and will not be true in our main model with intergenerational dynamics.

It is worth pointing out that the equivalence result in Proposition 1 is fundamentally different from the well-known 'tax incidence equivalence' result that says that the burden of a tax (or subsidy) on buyers and sellers is independent of who nominally pays the tax (or receives the subsidy). In the Online Appendix we show how the usual 'tax incidence equivalence' result applies in our context. In particular, it does not matter whether the funding subsidy S_I is given to the investor or the entrepreneur. This is because the nominal 'price' α readjusts to generate the same real price, irrespective of who nominally receives the subsidy. We discuss this further in Section 2.7. The above equivalence result of founding and funding policies is different from the tax incidence equivalence result because the founding subsidy pertains to an entry decision that happens at an earlier point in time than the funding subsidy.

2.3 Model With Intergenerational Dynamics

In this section we bring in intergenerational dynamics by introducing entrepreneurial angels. Specifically, we now allow successful entrepreneurs to invest their wealth into the next generation of entrepreneurs. To identify the main effects of intergenerational dynamics, we temporarily assume that there are no external angels, i.e., $\widetilde{n} = 0$. In Section 2.5 we will bring them back in.

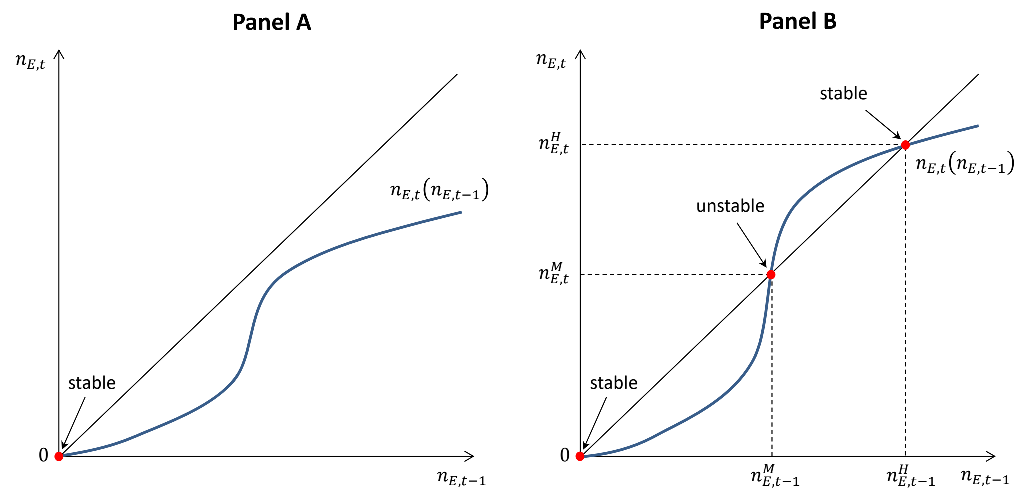

Figure 3: Dynamic Model – Equilibria

The optimal investment decision of entrepreneurial angels is the same as for external angels (obvious differences in notation apart). The important difference is that now the number of angels is no longer exogenously given by $\widetilde{n}$, but instead depends on the number of successful entrepreneurs from the previous period. Formally, the number of entrepreneurial angels actually investing in new ventures in period t is given by $n_{A,t} = \Gamma_I(\widehat{\theta})\rho n_{E,t-1}$. The market clearing condition is then given by $n_{E,t}\phi = n_{A,t}(1-\alpha_{t-1})y$.

Another important change in the model with entrepreneurial angels concerns the expected utility of becoming an entrepreneur, which now includes not only the returns from the entrepreneurial activity itself, but also the returns from future angel investing. Specifically the expected utility is now given by

$$U_{E,t} = \delta\rho\left(1-\alpha_t\right)y\left[\int_0^{\widehat{\theta}_{t+1}}\left(\alpha_{t+1}\frac{\delta\rho y}{\phi}-\theta\right)d\Gamma_I(\theta)+\int_{\widehat{\theta}_{t+1}}^{\mu_I}d\Gamma_I(\theta)\right],$$

with $\widehat{\theta}_{t+1} = \alpha_{t+1}\frac{\delta\rho y}{\phi} - 1$. This expression is then used in the entry condition $n_{E,t} = \Gamma_E(U_{E,t})$.

The intergenerational model has a unique equilibrium in each period, and also converges to some steady state equilibrium over time. However, there can be more than one steady state equilibrium. In the Online Appendix we fully characterize the equilibrium for each period, $\{n^*_{E,t}(n_{E,t-1}); \alpha^*_t(n_{E,t-1})\}$, and its dynamic properties. In the main text we refer to Figure 3, which illustrates the dynamic evolution of the key state variable $n^*_{E,t}(n_{E,t-1})$. The S-shaped curve in Figure 3 starts at the origin, and has a strictly positive slope. Intuitively, more entrepreneurial activity in the previous period creates a larger pool of potential angels, which

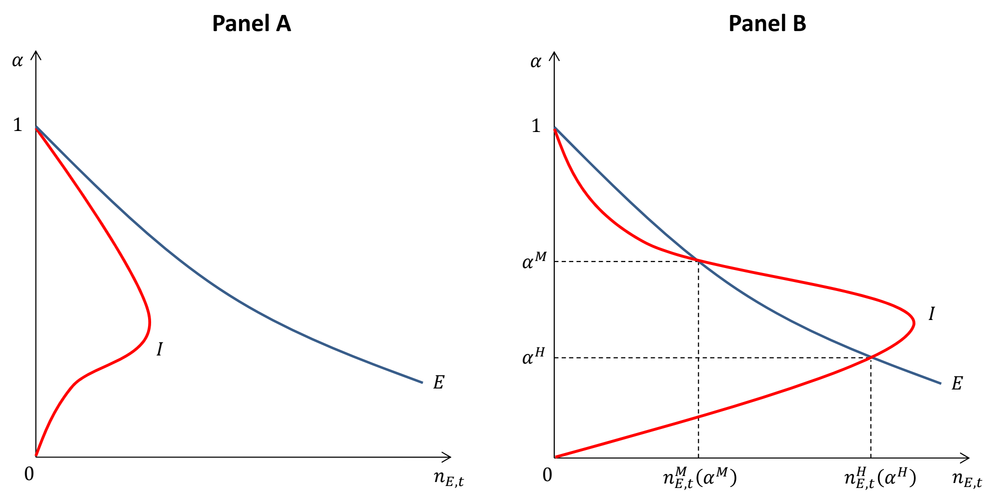

Figure 4: Dynamic Model – Capital Supply and Demand

results in a higher level of entrepreneurial activity in the current period. However, the slope of the curve varies and may be less than 1, suggesting that a unit increase in the past activity may result in less than a unit increase in the current period.

In a steady state we have $n^*_{E,t} = n^*_{E,t-1}$; this is where the S-curve intersects the 45 degree line, as shown in Figure 3. Clearly, this always happens at the origin where $n^*_{E,t} = n^*_{E,t-1} = 0$. The question is whether there are further intersections so that $n^*_{E,t} = n^*_{E,t-1} > 0$? This happens in Panel B of Figure 3, but not in Panel A. In the Online Appendix we formally show that there exists a critical investment level $\widehat{\phi} \in (0, \delta\rho y)$ such that for $\phi > \widehat{\phi}$ only the low steady state equilibrium $n^*_{E,t} = n^*_{E,t-1} = 0$ exists (as shown in Panel A), but for $\phi < \widehat{\phi}$ three steady state equilibria exist (as shown in Panel B). Moreover, standard dynamic analysis reveals that the lowest and the highest equilibria are stable, but the middle one is unstable. We can therefore limit our focus on the low and high equilibrium.[8]

To better understand the structure of these equilibria, consider Figure 4 which illustrates the demand and supply functions. The demand curve (E) looks similar to the one for the benchmark model as shown in Figure 1. Even though the entrepreneur's utility function $U_{E,t}$ is now more complicated, as it includes the returns to angel investing, we show in the Online Appendix that the demand function continues to be downward sloping. The supply function (I), however, becomes non-monotonic. Initially it is upward sloping for the same reason that it is upward sloping in Figure 1, namely that higher returns induce angels to invest more. However, there is an important countervailing effect that becomes dominant for larger values of α. Giving

[8] For $\phi = \widehat{\phi}$ two equilibria exist, the low one is stable, the high one unstable. In the Online Appendix we further show that given uniform distributions for l and θ, the maximum number of equilibria is three.

investors a higher equity share also means leaving entrepreneurs with a lower share. This has no effect on the total wealth available for investments in a model without intergenerational linkages. With such linkages, however, it means that entrepreneurial angels have less wealth to invest. That is, a higher share for investors means better returns to current angel investors, but also less wealth for future angel investors. The second effect can dominate, thus causing the supply curve to bend backwards. Indeed, as α approaches 1, the supply curve falls back to zero. This is for the simple reason that at $\alpha = 1$, successful entrepreneurs generate no wealth, and therefore have nothing to invest.

Panel A of Figure 4 shows the case of $\phi > \widehat{\phi}$, and Panel B the case of $\phi < \widehat{\phi}$. The difference between Panel A and Panel B is that in Panel A the supply curve begins to slope backwards relatively early, before ever intersecting with the demand curve. In this case the only equilibrium is the low equilibrium, as depicted in Panel A of Figure 3. In Panel B the supply curve intersects the demand curve before sloping down again. This is what creates the three equilibria depicted in Panel B of Figure 3. The intuition for why the existence of a high equilibrium requires lower capital needs can be obtained from Figure 3. For a given number of old entrepreneurs $(n_{E,t-1})$, lower values of ϕ permit a greater number of new entrepreneurs $(n_{E,t})$ to be funded. This means that in Figure 3 lower values of ϕ lift the S-curve up. In Figure 4, this gets translated into a leftward shift of the supply curve, again representing a greater number of new entrepreneurs $(n_{E,t})$. It follows that multiple equilibria can only exist for sufficiently low values of ϕ, as shown in Panel B of Figures 3 and 4.

2.4 The Effect of Government Subsidies

We now consider the effects of founding and funding subsidies in the model with intergenerational dynamics. We focus first on the high steady state equilibrium; in Section 2.6 we also consider the low equilibrium.

As a first step we again ask whether there is indeed a role for the government to intervene in the market. For this we compare the high steady state equilibrium (denoted by $\{n_E^*; \alpha^*\}$) with the first best equilibrium (denoted by $\{n_E^{fb}; \alpha^{fb}\}$) that maximizes the steady state sum of all expected utilities (i.e., total welfare).

Proposition 2 *The high steady state equilibrium does not maximize welfare. It has too few entrepreneurial ventures (i.e., $n_E^* < n_E^{fb}$) and investors get too much equity (i.e., $\alpha^* > \alpha^{fb}$).*

This result stands in sharp contrast to the benchmark model where the competitive equilibrium is efficient. In the model with intergenerational dynamics, there is an intertemporal externality. Future entrepreneurs need experienced angel investors, and therefore rely on the wealth creation of past generations of entrepreneurs. We find that relative to the first best level, there is insufficient entrepreneurial wealth creation: Investors get too much equity, so that successful entrepreneurs have too little wealth that can be reinvested in the next generation of entrepreneurs. This result provides a rationale for directed government action, provided the cost of intervention is not too high (see Section 2.8).

Again we consider the effect of founding and funding subsidies, now allowing for intergenerational dynamics. In the Online Appendix we re-derive the entry and market clearing conditions with subsidies for the model with entrepreneurial angels. In the main text we directly state our findings.

Proposition 3 *The effect of a founding subsidy S_E is to increase the level of entrepreneurial activity (i.e., $dn_E^*(S_E)/dS_E > 0$). However, there is no effect on the equilibrium ownership stake (i.e., $d\alpha^*(S_E)/dS_E = 0$).*

The first part of Proposition 3 is intuitive: founding subsidies lower barriers to entry and therefore encourage more entrepreneurs to start new ventures. This corresponds to an upward shift of the demand curve. In the model with intergenerational linkages, more entry also increases the number of successful entrepreneurs that become angel investors. This causes the supply curve to shift upwards, which further increases the equilibrium level of entrepreneurial activity. In equilibrium the demand and supply effect reinforce each other and create a robust positive effect on the level of entrepreneurial activity.

The second part of Proposition 3 is more surprising, namely that founding subsidies have no price effect. This is in contrast with the findings from the model without intergenerational linkages, where founding subsidies were associated with higher ownership stakes (i.e., lower valuations). As in Proposition 1, the demand shift increases the ownership stake, but the new supply shift decreases the equilibrium stake. Moreover, we note that the ratio of entrepreneurs to angels always remains the same in the high steady state equilibrium, irrespective of the level of the founding subsidy S_E. This ratio ultimately defines the equilibrium shares by balancing total capital demand and supply. The demand and supply effect therefore exactly offset each other, so that ownership stakes remain constant in the dynamic model.[9]

[9]It is worth noting that this particular result depends on the assumption of $\widehat{n} = 0$. Once we allow for some external angels (see the discussion in Section 2.5), the ratio of entrepreneurs to angels changes with S_E, and we find again that ownership shares for investors increase with founding subsidies, i.e., $d\alpha^*(S_E)/dS_E > 0$.

Proposition 4 *The effect of a funding subsidy S_I is to increase the level of entrepreneurial activity (i.e., $dn_E^*(S_I)/dS_I > 0$). In addition, it decreases the equilibrium ownership stake (i.e., $d\alpha^*(S_I)/dS_I < 0$).*

Proposition 4 shows that funding policies also increase the level of entrepreneurial activity. They clearly shift the supply curve upwards as the subsidy increases the net return to angel investing. They also shift the demand curve. Entry becomes more attractive not only because of a lower α (which represents a movement along the demand curve), but also because the subsidy increases the rewards to being a successful entrepreneur, who can take advantage of the subsidies once becoming an angel investor. Again the demand and supply effect reinforce each other to increase the equilibrium level of entrepreneurial activity.

Unlike in Proposition 3, however, there is an equilibrium effect on ownership stakes, which are reduced by higher subsidies. This is in line with the findings from Proposition 1. Specifically, funding subsidies encourage more potential angel investors to actually invest in new ventures, as reflected by the threshold value $\widehat{\theta} + \frac{1}{\phi}S_I$. This increases the number of active angels relative to the number of entrepreneurs, and therefore results in lower equilibrium ownership stakes for angel investors.

We are finally in a position to address the key question of how the two policies compare.

Proposition 5 *Consider a founding and a funding subsidy at equivalent levels of subsidization, so that $S_I = S_E > 0$. In the steady state the funding subsidy generates a higher level of entrepreneurial activity than the founding subsidy, i.e., $n_E^*(S_I) > n_E^*(S_E)$. It also generates a lower level of investor ownership, i.e., $\alpha^*(S_I) < \alpha^*(S_E)$.*

Proposition 5 stands in sharp contrast to Proposition 1 where we found that the two policies did not generate different levels of entrepreneurial activities. This is no longer true in the presence of intergenerational linkages. Funding subsidies generate a higher level of entrepreneurial activity than founding subsidies, precisely because of their long-term intergenerational impact. Funding policies ultimately benefit entrepreneurs by increasing valuations (i.e., lowering α). Having entrepreneurs retaining larger ownership stakes increases the amount of wealth that they can invest in the next generation of entrepreneurs. This creates a virtuous cycle that permanently increases entrepreneurial activity.

2.5 Model With External and Entrepreneurial Angels

The analysis of Sections 2.3 and 2.4 assumed no external angels; we now bring them back, i.e., $\widetilde{n} > 0$. The only difference worth mentioning is that the result of $d\alpha^*(S_E)/dS_E = 0$ in

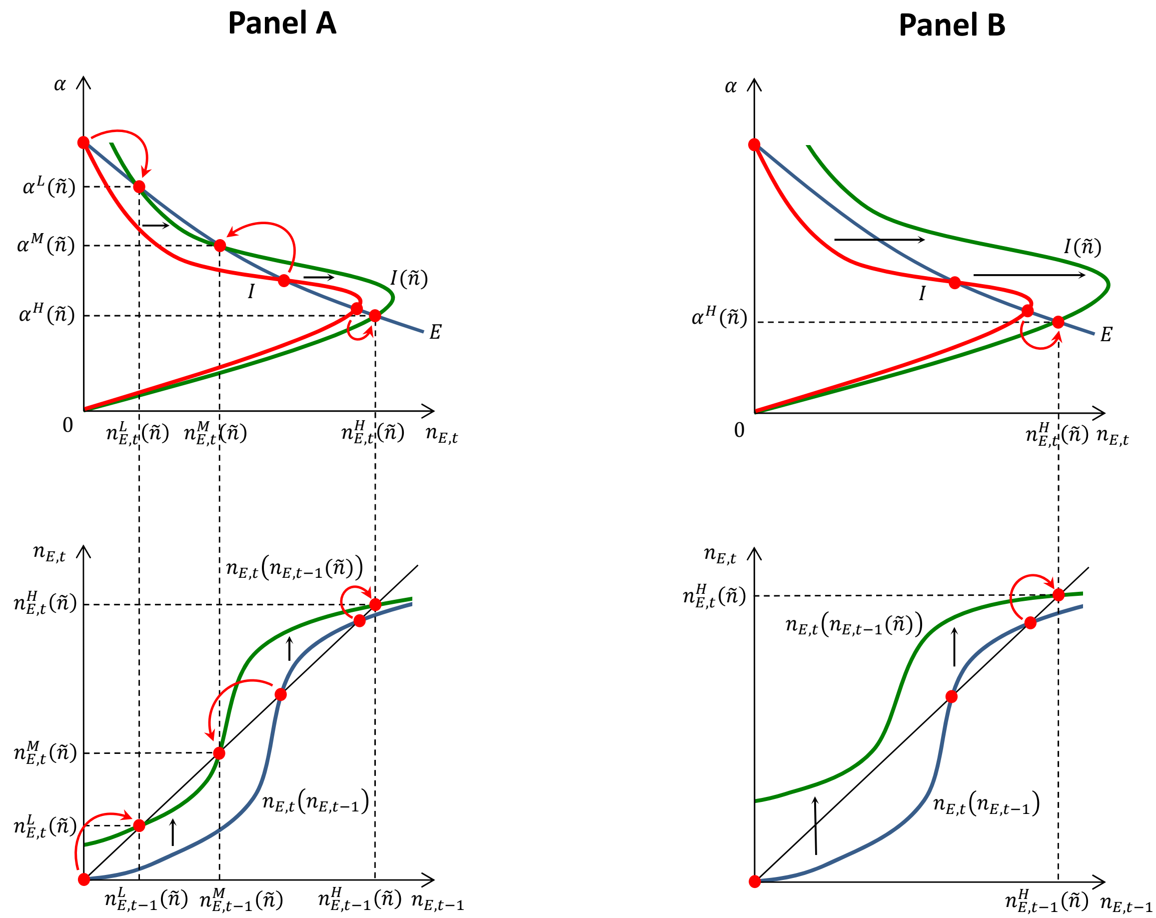

Figure 5: Dynamic Model – Equilibria with External Angels

Proposition 3 no longer applies. Once we allow for some external angels we find again that ownership increases with founding subsidies, i.e., $d\alpha^*(S_E)/dS_E > 0$.

The most interesting analysis concerns the comparative statics of increasing the number of external angels ($\widetilde{n}$). The effects are illustrated in Figure 5. Panel A shows a small increase in external angels, and Panel B shows a large increase. An increase in $\widetilde{n}$ shifts up the entire supply curve but does not affect demand. For the high steady state equilibrium we find that this results in higher entry levels and lower ownership stakes. This is an intuitive finding, as the effect of external angels is to add capital into the market, thereby increasing quantities and lowering prices.

The low steady state equilibrium also becomes more interesting, as it is no longer fixed at the origin. The presence of external angels ensures that there is always some supply of capital. Moreover, it is easy to show that the low equilibrium has the same comparative statics as the high equilibrium. In the Online Appendix we explain how the results from Propositions 3, 4 and 5 can also be applied to a low equilibrium. Finally note that in Panel B the supply curve shifts sufficiently to eliminate the low steady state equilibrium entirely. We return to this case in Section 3.2, where we interpret the external angels as foreign investors.

2.6 Catalyst Government Policies

So far we examined how government policies locally affect the steady state equilibria. In the presence of multiple equilibria, there is also a question of whether and how government policies can help to switch equilibria. In this section we briefly show how subsidies can be used to move an economy from the low to the high steady state equilibrium.

Our steady state analysis naturally focuses on steady state subsidies, which are permanent policies. To study how government policies can help the economy to reach the high equilibrium, it is natural to consider temporary subsidies. Let us consider a situation where the economy is in the low steady state equilibrium as depicted in Panel A of Figure 5 – alternatively we can also start with the economy anywhere else below the middle steady state equilibrium n_E^M. Now suppose that the government is considering a temporary subsidy to push the economy towards the high equilibrium. Standard dynamic analysis reveals that an economy converges to the high (low) equilibrium whenever the current level of activity $n_{E,t}$ lies above (below) the critical threshold n_E^M, the unstable middle equilibrium.

What is the difference between using a temporary founding or funding subsidy? The key issue is their dynamic effect on future market outcomes. From Proposition 1 we know that a funding subsidy creates wealthier entrepreneurs that have more to invest in the next generation of entrepreneurs. It is therefore easy to see that a temporary funding policy advances the economy further towards the critical threshold than a founding policy. The key insight is that what matters is not only increasing the current level of entrepreneurial activity, but also increasing the amount of wealth available to entrepreneurial angels. Consequently we find that the same logic that made funding subsidies powerful in the high steady state equilibrium also applies to catalyst policies for pushing the economy towards the high equilibrium.

2.7 On the Optimality of Funding Subsidies

Our main model focuses on two prominent classes of entrepreneurship policies: policies targeted at encouraging entrepreneurial entry, and policies targeted at facilitating the financing of entrepreneurial ventures. This allows us to identify the key economic properties of demand-based versus supply-based policy approaches within a dynamic entrepreneurial ecosystem. Empirically, there many different types of entrepreneurship policies used by governments around the globe; we discuss this further in Section 3. From a theory perspective, the question here is whether funding policies are always optimal within the current model.

In the Online Appendix we show that a funding subsidy is an optimal subsidy within our model. To be specific, we assume that the government can only offer non-discriminatory policies that cannot offer differential subsidies to different entrepreneurs or angel investors. We first show that relative to a founding subsidy, a funding subsidy achieves not only higher activity levels, but also higher levels of social welfare (as measured by the sum of all utilities). We then show that within the constraints of our model, there are no other subsidies that can achieve higher social welfare levels for a given government budget. Obviously our model only allows for a limited set of potential government policies. In reality governments can naturally call upon a much richer set of policies. We discuss this further in Section 3.

There is one interesting twist to this argument. So far we have expressed funding subsidies in terms of investment subsidies. We now go one step further and show that we could also think of funding policies as return subsidies. That is, in our model funding subsidies are optimal, but they can be implemented equally as investment or return subsidies. Let us explain.

Return subsidies affect the payoff from a venture in case of success, given by y in the model. Capital gains reliefs are a prominent example for this class of subsidies: Many governments offer some kind of preferential treatment for capital gains from entrepreneurial ventures; the US Small Business Jobs Act of 2010 is a recent example. Similarly, corporate tax rates and other business taxes can also affect the returns to entrepreneurial ventures.

To model the effect of return subsidies, suppose the government can provide direct or indirect support that increases the returns of a venture from y to $y + \tau$. We note that entrepreneurs and investors only benefit from this subsidy when their ventures succeed. From an ex-ante perspective, the discounted expected value from the return subsidy is given by $S_R = \delta\rho\tau$. We can then compare return subsidies (S_R) with founding (S_E) and funding (S_I) subsidies.

In the Online Appendix we derive three main results about the properties of return subsidies. First, for the benchmark model without dynamic linkages, we find that larger return subsidies lead to more entry ($dn_E^*(S_R)/dS_R > 0$) and lower ownership stakes for investors ($d\alpha^*(S_R)/dS_R < 0$). Moreover, we extend the equivalence result from Proposition 1 by showing that return subsidies achieve the same level of entrepreneurial activity as comparable founding or funding subsidies (i.e., $n_E^*(S_R) = n_E^*(S_E) = n_E^*(S_I)$ for all $S_R = S_E = S_I$). Second, we show that larger return subsidies also increase entry and decrease ownership stakes in the dynamic model with intergenerational linkages. Finally we show that return and funding subsidies have in fact identical properties, in the sense that equivalent subsidy levels ($S_R = S_I$) generate the same equilibrium level of entrepreneurial activity ($n_E^*(S_R) = n_E^*(S_I)$), and even the same expected level of entrepreneurial wealth w^*. The reason for this last result is that both policies create the same expected net value for the entrepreneurial venture, as given by $\delta\rho y - \phi + S_R + S_I$. The equilibrium allocation of this net value between the entrepreneur and investor is then determined by the same underlying market forces, irrespective of whether funding or return subsidies are used.

We conclude that the key distinction in our model is between founding policies that affect the cost of entry, versus funding policies that affect the value of the entrepreneurial venture after entry. The optimal funding policies can be structured as either investment or return subsidies.

2.8 Comparing the Costs of Subsidies

Proposition 5 shows that funding policies create higher levels of entrepreneurship than founding policies. From the perspective of a government, however, there is also the question of which subsidies cost more to deliver. It is easy to see that funding policies are always optimal if they are less expensive to administer than founding policies, and continue to be optimal even if they are slightly more expensive. Beyond treating the costs as exogenous, however, we now ask if our model suggests any cost differences. For that we develop a simple model extension that identifies one powerful reason why funding policies are likely to be less expensive to the government.

Broadly speaking we can distinguish two types of costs. First there are administrative costs of running a subsidy program; our theory has nothing to say about that. Second there is the problem of appropriately targeting the program to the right recipients. Of particular interest here is the question of whether subsidies go to economic agents that do not deliver the desired outcomes.

In our base model we assume that every entrepreneur that enters obtains funding. In reality we would no expect all entrepreneurs to pass the various screening processes used by angel investors. Let us therefore consider a simple model extension where entrepreneurs first enter, and then get screened before obtaining funding. Assume that there are two types of ventures. A fraction γ are good ones that generate a return y with probability ρ, and a fraction $1 - \gamma$ are bad ones that never generate any returns. For simplicity we assume that entrepreneurs do not know their type when making the entry decision, but that 'smart' angel investors can tell them apart. We thus need to distinguish between the total number of entrepreneurs that enter (n_E), and the total number of entrepreneurs that are worthy of obtaining funding ($n_E^G = \gamma n_E$).

Our focus here is the effectiveness of the two policies. Suppose the government has a budget B that can be allocated between founding and funding subsidies. Assume that there is a common and constant cost ψ of administering subsidies. In the main model, the uptake on those subsidies is given by $n_E^* S_E$ and $n_E^* S_I$, so that $B = n_E^*(S_E + S_I)(1+\psi)$. We can now consider the effect of investor screening. The founding subsidy S_E is given to all projects n_E, irrespective of whether they are good or bad. The funding subsidy S_I, however, only applies to good projects n_E^G, because smart investors will never invest in bad projects. This suggests that funding subsidies are more targeted, because they only apply to those ventures that pass the investor screen. The government budget is then given by $B = (n_E^* S_E + \gamma n_E^* S_I)(1+\psi)$. We immediately recognize that founding policies are more expensive to the government than funding policies. This is because founding policies apply to an earlier stage of the entrepreneurial value creation process, where there is less selection. Consequently, large amounts of subsidies are spent on recipients that never generate the intended economic benefits. This simple model extension therefore provides an additional cost-based rationale for why funding policies may be preferable over founding policies.

3 Model Discussion

3.1 Implications for Entrepreneurship Policy

This paper aims to raise some fundamental questions about entrepreneurship policies. In this section we discuss some of the broader implications of our analysis. We start by looking at entrepreneurship policies within a single ecosystem.

Our analysis emphasizes the dynamic aspect of entrepreneurship policies, and the process by which ecosystems are built over time. This approach contrasts with parts of the ecosystems literature which emphasizes the interaction between a diverse set of players, focusing on 'cross-sectional' rather than 'longitudinal' aspects of ecosystem developments. The cross-sectional literature focuses on the interplay between entrepreneurs, different types of investors, universities and research labs, established corporations, stock markets, supply chains, service providers, and so on. Our goal here is to add a dynamic component to the analysis. Specifically we argue that some of the critical components of an entrepreneurial ecosystem can only be grown over time. The underlying premise is that one of the required inputs for building entrepreneurial ventures is a type of tacit knowledge that can only be acquired through direct experience of the entrepreneurial process. The key novelty of our analysis is the intergenerational linkage: the fact that younger generations of entrepreneurs benefit from the experience of previous generations, and the fact that over a career, individuals switch from being the key promoter (the entrepreneur), to being a key input provider (the investor).

Our dynamic perspective of looking at the accumulation of experiential expertise has immediate policy implications. First and foremost, any short-term evaluation of entrepreneurship policies is fundamentally incomplete and possibly misguided. An evaluation of entrepreneurship policies requires a long-term perspective, and needs to focus on the accumulation of expertise and experience as a key metric. While this becomes apparent in our model, we would argue that current practice is far away. Most entrepreneurship policies are measured either on the basis of how much entrepreneurial activity they encourage, or how successful that activity is. Concretely, most entrepreneurship programs are evaluated either in terms of direct inputs – how much money is invested in how many companies – or direct outputs – how many companies succeed, and how many jobs do they create. Our dynamic perspective challenges these approaches by arguing that a key metric for evaluating entrepreneurship policies is how much they add to the stock of accumulated experience that can be leveraged by the next generation of entrepreneurs. Admittedly this presents a significant measurement challenge, as it requires data about the career paths of the individuals in the supported ventures, and how they contribute to the ecosystem after exiting from these ventures.[10]

One interesting finding in our model is that even the simplest specification of intergenerational linkages immediately generates multiple equilibria. This paper is by no means the first to recognize the possibility of multiple equilibria in the market between entrepreneurs and investors (see Michelacci and Suarez (2004) and Landier (2006)). The novelty here is that the multiplicity of equilibria does not stem from a standard coordination problem where one side of the market needs the other side to do something; instead it comes from the dynamics of how expertise accumulates over time. To be precise, in our model there is actually a unique equilibrium in every period, and therefore no coordination problem. However, there can be multiple steady state equilibria to which the period equilibria converge to over time. The challenge here is not to bring together different players to coordinate; the challenge here is to dynamically build sufficient expertise for the ecosystem to become self-sustaining.

This dynamic perspective has important implications for entrepreneurship policy. Our model suggests different roles for governments in more versus less advanced ecosystems. In a high equilibrium there is a role for the government because of a fundamental intertemporal externality: future generations benefit from the entrepreneurial experiences of past generations. Pro-

[10]To give an example, the full economic impact of Paypal concerns not only the company itself, but also the so-called 'Paypal mafia' – the people that came out of Paypal, and became involved with companies as diverse as Facebook, SpaceX, Airbnb, Uber, and many others (see Forrest (2014)).

vided the costs to the government are not too high, the optimal government policy involves some permanent support of entrepreneurial activities. In a low equilibrium, there is an additional rationale for government support, namely to help the economy move from the low to the high equilibrium. In the model we show that this requires lifting the economy to a minimum threshold of entrepreneurial activity, to set it onto a self-sustaining dynamic upwards path. The most interesting implication is that this calls for a set of temporary government policies. That is, apart from the steady state logic of an intergenerational externality, there is a temporary catalytic logic for entrepreneurship policies. A practical implication is that policy makers are faced with the additional challenges of identifying where such critical threshold might lie, and how to implement temporary policies that are credibly phased out as the economy moves onto a self-sustaining dynamic path.

This paper looks at the trade-off between two canonical classes of entrepreneurship policies: founding and funding policies. We focus on these two policies because they represent two important and clearly distinct classes of entrepreneurship policies. Our model of founding subsidies is a stylized depiction of a large set of 'demand-side' policies, i.e., policies that encourage more entrepreneurial entry (and hence the 'demand' for capital). Across the globe there exist a large number of policies that encourage people to become entrepreneurs, consisting of a variety of skills training and mentoring services. Closely related, there are numerous policies for facilitating the initial steps of starting a business, such as business accelerators and incubation facilities. Another broad class of policies that fit our model of founding subsidies are commercialization grants that push technologies out of universities (and other research institutions) into the market.

We contrast these demand-side founding subsidies with funding policies that encourage the supply of capital to entrepreneurial ventures. We model this policy as an investment tax credit for investors. The fundamental 'tax incidence equivalence' theorem implies that our subsidy can also be interpreted as a tax credit to the entrepreneurial venture. R&D tax credits, for example, can thus also be interpreted as funding subsidies in our current model – a slightly richer model would be required to distinguish R&D versus investment tax credits. Finally, as discussed in Section 2.7, our funding subsidy can also be understood in terms of a return subsidy, which can be interpreted as capital gains holidays, or corporate income tax breaks. Despite its simplicity (or indeed because of it), our model therefore captures a large swath of entrepreneurship policies.

The finding that funding policies ultimately benefit entrepreneurs more than founding policies, is not immediately obvious. One might have expected that demand-side subsidies are more favorable to entrepreneurs than supply-side subsidies. This is where proper modeling of market dynamics is needed. Our analysis of equilibrium market valuations reveals a new but intuitive logic: founding policies generate more entrepreneurs chasing money, whereas funding policies generate more investors chasing deals (see Gompers and Lerner (2000), Hellmann and Thiele (2014), Inderst and Müller (2004)).

Another important insight is that policies for entrepreneurs do not behave in the same way as in more conventional markets. Our benchmark model represents a conventional 'Walrasian' market with well-behaved demand and supply functions. For this model we prove a fundamental equivalence result, namely that a unit of subsidy spent on the demand-side has the same effect as a unit of subsidy spent on the supply-side. Moving from the benchmark to the intergenerational model, we show that the long-term supply of capital to entrepreneurial ventures does not behave like a conventional supply function. This is because funding entrepreneurial ventures requires tacit knowledge that is acquired through experiencing the entrepreneurship process itself. In other words, the supply of capital depends on angel investors who are successful entrepreneurs from past generations. This insight fundamentally changes how we should think about long-term policies for promoting entrepreneurship. The equivalence of founding and funding policies is broken, because the two policies leave different legacies. Relative to founding policies, funding policies allow entrepreneurs to retain a larger ownership fraction, create more entrepreneurial wealth, and thereby increase the future supply of angel capital.

3.2 Some Open Economy Considerations

Our model naturally lends itself to discuss some open economy aspects of entrepreneurship policies. The main model considers a single economy, or ecosystem, in isolation; we can think of that as a country or a region within a country. We now discuss how one ecosystem may interact with other ecosystems. Of particularly interest is the question of how an economy, that is trapped in a relatively low equilibrium, might benefit from a high equilibrium economy. This gets at the heart of the 'Silicon envy' problem mentioned in the introduction. We consider both capital and labor mobility, looking at the role of foreign investors that might want to invest in a low equilibrium ecosystem, and looking at the threat of brain drain, where entrepreneurs from a low equilibrium economy relocate to a high equilibrium economy.

Relatively little is known about cross-border angel investing, but the empirical evidence on venture capital suggests that foreign investors play a considerable role in many less developed markets (see Aizenman and Kendall (2012)). An interesting case study is Israel (Avnimelech et al. (2005), Senor and Singer (2009)) which explicitly attracted foreign investors, mostly from the US, to jump-start its entrepreneurial ecosystem. Our model can be used to analyze the dynamic effects of attracting foreign investors. In fact, one natural interpretation of the external angels in our model is that they are foreign investors, who acquired their expertise by being successful entrepreneurs in a high equilibrium ecosystem.

Presumably there are costs to investing in a more distant and less familiar environment, so why would foreign investors even look at low equilibrium ecosystems? Our model captures a simple but important reason for foreign investors to consider making such investments. Figure 5 reveals that investors get a higher ownership stake in the low equilibrium economy than for comparable deals in a high equilibrium economy.[11]

Our model makes some interesting predictions about market dynamics when a low equilibrium ecosystem opens itself up to foreign investors. Consider an exogenous increase in external angels. Panel A of Figure 5 shows the effect of a small infusion of foreign capital, so that the low equilibrium continues to exist. Panel B shows the effect of a larger infusion where the low equilibrium disappears.

We are interested in the dynamics of how an ecosystem that starts in a low equilibrium changes over time. Let us focus on a large foreign investment shock, as depicted in Panel B of Figure 5. Initially the majority of deals is funded by foreign investors. These first-generation foreign-funded ventures create some successful domestic entrepreneurs who now begin to invest as entrepreneurial angels into the next generation of entrepreneurs. Over time the foreign investors are thus joined by more and more domestic entrepreneurial angels. As the economy moves towards the high equilibrium, the fraction of ventures funded by foreign angels decreases. This is because there are more domestic entrepreneurial angels, and because over time valuations increase, making the ecosystem less attractive to foreign investors. As the economy approaches the high equilibrium, foreign investors no longer play a large role, as the ecosystem is able to sustain itself on the basis of its home-grown entrepreneurial angels.

This simple dynamic theory has immediate policy implications, suggesting potential benefits of opening up a low equilibrium ecosystem to experienced foreign investors. Moreover, funding policies to promote entrepreneurship do not need to be restricted to domestic investors, but could also be made available to foreign investors. The main concern is that the economic activity of the underlying ventures remains in the domestic ecosystem.

This bring us to the second open economy issue: the problem of brain drain. So far we focused on the flow of capital from the high to the low equilibrium ecosystem, but there is also

[11] This is consistent with the empirical observation that valuations are higher in Silicon Valley than elsewhere, as reported by Angellist (2016). Obviously such descriptive evidence is indicative but not conclusive, as there are likely differences in the quality of ventures across ecosystems. In addition, there is some anecdotal evidence that companies, that move from elsewhere to Silicon Valley, obtain higher valuations there (see, for example, Burn-Callander (2015)).

the possibility of human capital moving from the low to the high equilibrium ecosystem. Our model adds some interesting insights to this debate. For one, it matters when people leave: prior to entry, past entry but before obtaining funding, or after funding? Our analysis suggests that in the early stages of the entrepreneurial process, entrepreneurs take more from the ecosystem than they give back to it. They require money and expertise that is in short supply, and they benefit from various government subsidies. Payback occurs when entrepreneurs succeed and reinvest their financial returns back into the ecosystem. Consequently, the worst type of brain drain is actually when entrepreneurs start their ventures domestically, take advantage of all the subsidies, then move abroad, and never come back. This insight has two important policy implications.

First, brain drain generates another difference between founding and funding policies, namely that founding policies are more exposed to brain drain. Specifically, if there is some probability of leaving at each stage of the entrepreneurial process, then founding subsidies are given to a larger number of entrepreneurs that subsequently leave the domestic ecosystem. This argument is very similar to the screening argument from Section 2.8. One possible remedy is to make (founding and funding) subsidies conditional on entrepreneurs keeping their economic activity in the domestic economy, at least for some length of time. That is, the government might want to retain the right to claw back subsidies in case of early departures.

Second, there is the issue of whether entrepreneurs that were successful abroad ever come back home? The natural inclination for many entrepreneurial angels is to invest in the ecosystem where they succeeded, because this is where their expertise and networks are fresh. However, there is also the possibility that successful entrepreneurs come back to their country of origin. Saxenian (2002, 2006) argues that some of the success of countries like Taiwan was partly based on the government's efforts to lure back Taiwanese-born entrepreneurs that had been successful in the US. There are also private sector initiatives to bringing back entrepreneurial talents. Universities, for example, can do this through their alumni network. Business networking organizations like C100, an association of Canadians in Silicon Valley, play a similar role.

3.3 Implications for Further Research

Our theory relates to existing empirical evidence, generates a host of new empirical predictions, and inspires interesting avenues for further empirical research. We group our discussion into three themes: (i) the behavior of entrepreneurial angels, (ii) the effect of entrepreneurship policies, and (iii) open economy issues.

Our model highlights the importance of entrepreneurial experience for angel investing. This suggests a more systematic empirical investigation of the behavior of these key individuals. There is the question of who becomes an angel investor. Consider the set of founders, managers, and key employees of successful ventures that experienced a successful exit, be it an acquisition or an IPO. The question is what do they do next? An empirical analysis could look at the incidence and determinants of these individuals becoming angel investors, as well as serial entrepreneurs (effectively investing in their own ventures). Also, our model looks at valuations and tax credits as determinants of the propensity to make angel investments; an empirical analysis might uncover further important determinants. The work of Cumming et al. (2016) is an interesting step in this direction.

A complementary approach is to consider a representative sample of angel investors, and look at the behaviors of different types of angels. Our model is based on the premise that prior entrepreneurial experience imbues angel investors with useful tacit knowledge. This opens up new avenues for empirically investigating how entrepreneurial angels differ from their non-entrepreneurial peers: Do they select different types of companies, at different stages? Do they become more actively involved in these companies, provide different advice, or make different decisions? And do they achieve better investment outcomes?

Our analysis calls for further empirical studies of entrepreneurship policies. At the core of our theory is a relative evaluation of alternative entrepreneurship policies. Currently the most common type of empirical analyses of entrepreneurship policies concerns program evaluations, which involve picking a single program in isolation and asking whether it achieves its objectives (see, for example, Gans and Stern (2003), Hellmann and Schure (2010), Lerner (1999), or Zhao and Ziedonis (2012)). However, our theory suggests a more ambitious empirical agenda. Beyond individual program evaluations, policy makers need to think about policy design. This involves a relative comparison of the effects of alternative policies. The analysis in Section 2.8 suggests that one of the challenges here is that different policies are applied to different populations of firms (or in fact individuals), at different stages of the entrepreneurial process. Another important challenge is that policies interact with each other, prompting questions to what extent different policies complement or substitute each other.

There is ample room for research on open economy aspects of entrepreneurship policies. A first set of questions relates to the role of foreign investors. Some prior literature explores when venture capitalists invest abroad and how (see Bottazzi et al. (2016), or Chemmanur et al. (2016)). The current model suggests going one step further and asking how these foreign investments affect domestic ecosystem development. A second set of empirical questions concerns brain drain. Surprisingly little is known about this: Which entrepreneurs leave? Under what circumstances, and at what stage? Where do they go? And what effect does government policy have on their decisions, directly and indirectly? A third issue concerns the return of departed entrepreneurs. While there is some empirical work on immigrant entrepreneurship (Kerr and Kerr, 2016), less is known about the flip side, i.e., the role of emigrant entrepreneurs (see, however, Agrawal et al. (2006) for some related work on patent citations). An empirical analysis of how successful emigrant entrepreneurs contribute to their home country, making angel investments and helping in other ways, could generate important insights into the long-term nature of the brain drain phenomenon.

Finally we briefly note that our model also opens up new avenues for further theoretical research. First, we believe that while our analysis identifies two important classes of entrepreneurship policies, future research could delve deeper into the details of these policies. Within each of our two policy categories there are interesting nuances between different policies; and beyond our two categories, there are many other entrepreneurship policies not considered here. Second, our analysis of intergenerational linkages focuses on one specific link, namely the transition of successful entrepreneurs to become angel investors. Future research might consider additional intergenerational linkages, such as the role of failed entrepreneurs. Third, a complete analysis of the open economy implications of entrepreneurship policies remains beyond the scope of this paper. Consequently we believe there is room for a more comprehensive analysis of the equilibrium flows of human and financial capital across ecosystems.

4 Conclusion

This paper builds a formal model of the market for financing entrepreneurial ventures, to examine the effects of two canonical entrepreneurship policies: founding policies that encourage entry by entrepreneurs, and funding policies that encourage financing by investors. The model recognizes the importance of tacit knowledge for investing in entrepreneurial ventures, and argues that this is mainly acquired through prior entrepreneurial experience. The supply of capital is therefore dependent on the wealth generated by prior generations of entrepreneurs. We show that this has a profound influence on the market equilibrium, and the impact of entrepreneurship policies.

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