

Why Micro-Funding? Why Small Businesses Are Important?

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Formulation of the problem. In economics, there is a known phenomenon of *economy of scale*, when a merger of two small companies helps lower the costs. The same phenomenon is known in all kinds of activities: when researchers collaborate, they can usually achieve much more than when they work on their own or in small groups. Based on this logic, one would expect that this effectiveness leads to the dominance of big companies in economics and big well-funded projects in science.

In practice, however, there is a stable and significant proportion of small businesses – which shows that there is economic benefit in having small businesses in addition to big companies. Along the same lines, it has been empirically shown that the best way to stimulate economy is to provide funding both to big and small businesses, i.e., to combine macro-funding and micro-funding. Similar, when supporting science, the best effect is achieved when usual-size grants are supplemented by micro-funding, i.e., by smaller-size grants; see, e.g., [1, 2]. How can we explain this phenomenon?

In economics, in science sponsorship, and in other similar areas there are good explanations for this phenomenon. However, the current explanations are specific to each area, while the phenomenon is the same in all these areas. It is therefore desirable to look for a general explanation for this phenomenon. In this talk, we provide such an explanation.

Our explanation. In all such situations, we have a fixed amount of money, and we want to find the best way to distribute this amount. Each distribution can be naturally described by a density function $f(m)$ for which the number of grants of sizes between m and Δm is equal to $f(m) \cdot \Delta m$. What is the optimal function $f(m)$?

We do not know the exact form of the objective function, all we know is that some distributions are more effective: we will denote it by $f(m) \succ g(m)$ – and some are of the same effectiveness ($f(m) \sim g(m)$). It is reasonable to require that there is only one optimal function – otherwise, if there were two functions of equal quality, we could use this non-uniqueness to optimize something else. It is also reasonable to require that the relation $f(m) \succ g(m)$ should not depend on what units we choose for counting money, be it dollars, euros, or Mexican pesos. When you change a unit of money, then the original amount m becomes $\lambda \cdot m$ for some constant λ . So, we require that $f(m) \succ g(m)$ imply $f(\lambda \cdot m) \succ g(\lambda \cdot m)$.

It turns out that under these requirements, the optimal function is the power law $f(m) = C \cdot m^\alpha$ for some C and α . This function is everywhere positive, so in the optimal arrangement, we should always have some grants with small m . This explains the ubiquity and effectiveness of micro-funding.

References

- [1] R. M. Flowers and J. R. Arrowsmith, “AGeS³: microfunding an inclusive community grassroots efforts to better understand the Earth system”, *GSA Today*, December 2022, Vol. 32, pp. 52–53, doi 10.1130/GSATG549GW.1.
- [2] R. Flowers, J. R. Arrowsmith, V. McConnell, J. Metcalf, T. Rittenour, and B. Schoene, “The AGeS2 (Awards for Geochronology Student research 2) program: supporting community geochronology needs and interdisciplinary science”, *GSA Today*, 2019, Vol. 29, No. 3, doi 10.1130/GSATG392GW.1.