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FINANCIAL INNOVATIONS AND THE REAL ECONOMY

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Abstract: We show that financial innovations when investors greatly value certainty, by letting firms benefit from safe cash flows in new ways, potentially cause a misallocation of resources at the firm level with low net present value (NPV) projects (with larger amounts of safe cash flows) getting preference over high NPV projects. Even negative NPV projects may be accepted. Such financial innovations benefit large firms (with large cash flows) more than small firms; hence, they widen the value-gap between leader and follower firms. These results indicate that productivity slowdown and the rise of superstar firms are not independent phenomena, rather they share the same underlying cause: Financial innovations letting firms benefit from safe cash flows. We show that misallocation towards low NPV projects gets worse as interest rates approach zero. The value-gap between large and small firms also increases as interest rates approach zero. These results cast doubt on the effectiveness of monetary policy in a low interest rate environment.

Keywords: Financial Innovation, Interest Rate Swaps, Securitization, Credit Default Swaps, Productivity Slowdown, Disproportionate Safety Preference

JEL Classification: G00, G30, G10

Introduction

Many financial innovations in the last few decades are aimed at capturing the benefits from safe cash flows. Such innovations have been blamed for creating new systemic risks that led to the 2008 global financial meltdown (Gennaioli, Shleifer, and Vishny 2012, Caballero 2010). In this article, we consider the implications of such innovations for the production side of the economy. Our key findings are: Financial innovations, by letting firms benefit from safe cash flows in new ways, potentially cause a misallocation of resources at the firm level with low net present value (NPV) projects (with larger amounts of safe cash flows) getting preference over high NPV projects. Even negative NPV projects may be accepted. Such financial innovations benefit large firms (with large cash flows) more than small firms; hence, they widen the value-gap between leader and follower firms.

By encouraging such misallocation towards low or even negative NPV projects, recent financial innovations might have contributed to the productivity slowdown at the firm level. The current productivity slowdown afflicting core advanced economies predates the GFC-2008 and continues unabated even after the effects of the crisis have largely dissipated (Fernald 2014, Cete *et al* 2016, Syverson 2017). This suggests that structural rather than cyclical factors are behind the slowdown consistent with the approach here.

We show that a low interest rate environment makes such misallocation towards low NPV projects worse, which makes a sustained period of loose monetary policy structural damaging to the economy. Furthermore, as large firms generally benefit more due to higher amounts of safe cash flows, such financial innovations may have contributed to the rise of "superstar" firms by widening the value-gap between leader and follower firms. This gap due to financial innovations gets even wider in a low interest rate environment. Our analysis indicates that weak productivity growth (Fernald 2014, Syverson 2017) and the corporate world being dominated by a handful of "superstar" firms (Autor *et al* 2019) are not unrelated phenomena. Rather, they have the same underlying cause: Financial innovations aimed at capturing the benefits from safe cash flows. Such financial innovations hurt firm-level productivity by creating a preference for low NPV projects while widening the value gap between leader and follower firms that gets even wider as interest rates fall.

Despite the special status given to safe cash flows in recent financial innovations, there is no a priori reason for this importance. After all, splitting the payoffs from an asset into uncertain and safe components does not increase the overall value under standard expected utility maximization. However, Siddiqi (2017) shows that such financial innovations add value when a disproportionate preference for safety is allowed for in an otherwise standard framework.

There is a growing body of evidence consistent with decision-makers displaying a disproportionate preference for safety (see Serfilippi *et al* (2019)). Andreoni and Sprenger (2010) show that Allais paradoxes (common consequence, and common ratio), as well as other prominent decision-making anomalies, can be understood by incorporating a disproportionate preference for safety in the expected utility framework. In general, violations of standard expected utility maximization are substantially less prevalent when only uncertain payoffs are involved (Camerer 1992, Harless and Camerer 1994, Starmer 2000), indicating that behavior at or close to certainty is fundamentally different from behavior away from certainty. Andreoni and Sprenger (2012) present a discounted expected utility violation which is consistent with a disproportionate preference for safety with certain outcomes being assessed with a different utility function than uncertain outcomes. The results in Gneezy *et al* (2006) are also indicative of certain outcomes being assessed differently than uncertain outcomes. Simonsohn (2009) reports similar results showing that risky prospects are evaluated below their worst outcomes consistent with a disproportionate preference for safety.[2]

We add to the above literature by showing how financial innovations motivated by the disproportionate safety preference matter for the production side of the economy. Our results are largely in accord with the argument in Liu, Mian, and Sufi (2019) that low interest rates are associated with increase in market concentration, slow productivity growth, and widening gap between leader and follower firms. However, the underlying mechanism here is different and is driven by financial innovations with low interest rates making the misallocation incentive worse at the firm level, and further widening the value-gap between leader and follower firms.

The rest of the article is organized as follows. Section 2 presents the main results, and section 3 concludes with a discussion on the effectiveness of monetary policy in a low interest rate environment given our results.

2. Recent Financial Innovations and Benefits from Safe Cash flows

The clearest example of a financial innovation in which safe cash flows are explicitly carved-out from uncertain payoffs via a seniority structure is securitization. The primary motive of this type of financial innovation is the creation of AAA-rated securities (Gennaioli *et al* 2012, Caballero 2010), which are in high demand from investors and pension funds. Securitization accomplishes this by pooling cash flows and creating a seniority structure that effectively carves-out the safest bits, which are then re-packaged and sold separately as AAA securities. However, a financial innovation does not have to explicitly carve-out safe cash flows to capture their benefits as there are many indirect ways of doing so. Consider a plain vanilla interest rate swap (IRS). IRS contracts constitute about 60% of the global OTC derivatives trade, which, at 10 times the world GDP, is arguably the most significant market for any financial instrument in the world (Bank for International Settlement 2017). A typical IRS contract is between a firm and a bank in which the firm pays a fixed-rate to the bank in exchange for the bank paying a variable-rate (Fontana *et al* 2019). This arrangement effectively transforms a short-term variable-rate loan that the firm owes the bank to a long-term fixed-rate loan. To fix ideas, suppose a firm already has a short-term loan at LIBOR + Spread. It then enters into a long-term IRS contract with the bank in which it pays FIXED and receives LIBOR on a notional amount equal to the size of the loan. Effectively, the loan now costs a fixed rate, which is, FIXED + LIBOR + Spread - LIBOR = FIXED + Spread. If the firm has plenty of safe cash flows and continues to generate them then it would have lower counterparty risk, with the bank not only charging a lower FIXED now but also lower Spread in the future when the short-term variable rate loan is rolled over. In this manner, conservatism is dynamically rewarded in the investment choices of the firm, with safe cash flows benefiting the firm without any explicit carving-out (Kuprianov 1994, Wall and Pringle 1989).

Another example of a financial innovation that lets firms capture the benefits from safe cash flows without any explicit carving-out is a credit default swap (CDS). A CDS seller insures the CDS buyer against default by a firm on its corporate bonds. A spread, known as CDS spread, is charged for providing this protection. One can see the same trend towards dynamically rewarding conservatism as introduction of the CDS market has been shown to make firms more liquidity conscious (Subrahmanyam *et al* 2017) as firms desire to keep the CDS spreads on their corporate bonds low.

In what follows, it does not matter whether the safe cash flows are explicitly carved-out and sold separately as AAA bonds, or the benefits are implicitly captured as in the case of IRS and CDS contracts. The only requirement is that safe cash flows are considered separately from risky ones.

Suppose there is a firm considering two mutually exclusive projects: A and B. For simplicity and without any loss of generality, assume that they both require the same initial investment of C, and have a life of one period at the end of which, they generate uncertain payoffs of $\tilde{X}_A$ and $\tilde{X}_B$ respectively. There are no other expenses or inflows. The decision to choose between the projects depends on their NPVs:

$$NPV_A = PV\left(\tilde{X}_A\right) - C \tag{2.1}$$

$$NPV_B = PV\left(\tilde{X}_B\right) - C \tag{2.2}$$

There is a representative agent whose behavior determines discount rates. The agent is assumed to have a disproportionate preference for safety as in Andreoni and Sprenger (2010) and Siddiqi (2017). That is, certain and uncertain utility functions are related as follows:

$$u^s(c_t) = (1+\alpha)u^R(c_t) \tag{2.3}$$

where $\alpha \geq 0$

Risky or uncertain outcomes are evaluated with the utility function, $u^R(c_t)$, and certain outcomes are evaluated with the utility function, $u^s(c_t)$. Otherwise, these utility functions obey the standard properties (see Andreoni and Sprenger (2010)). The parameter, α, captures the strength of disproportionate preference for safety when its value is larger than 0. We revert to the classical case without a disproportionate preference for safety when $\alpha = 0$. Proposition 1 shows the relationship between discount rates with and without a disproportionate preference for safety.

Proposition 1 Risky cash flows are discounted at a higher rate, R_U^D, when there is a disproportionate preference for safety when compared with the discount rate, R_U, without such preference. The discount rates are related as: $R_U^D = R_U(1+\alpha)$. The risk-free discount rate, R_F remains the same regardless of the safety preference.

Proof

The discount rate for risky cash flows without a disproportionate safety preference, R_U, can be inferred from the following:

$$\frac{E[\tilde{X}]}{R_U} = \beta E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)} \cdot \tilde{X}\right] = \beta\left\{E[\tilde{X}]E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)}\right] + cov\left(\tilde{X}, \frac{u'^R(c_{t+1})}{u'^R(c_t)}\right)\right\} \tag{2.4}$$

where B<1 is time-discount.

Also,

$$\beta E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)}\right] = \frac{1}{R_F}$$

where R_F is the risk-free discount rate.

It follows that:

$$R_U = \frac{R_F \cdot E[\tilde{X}]}{E[\tilde{X}] + cov\left(\tilde{X}, \frac{\frac{u'^R(c_{t+1})}{u'^R(c_t)}}{E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)}\right]}\right)} \tag{2.5}$$

The market value of risky cash flows with a disproportionate preference for safety can be inferred from:

$$P_t \cdot u'^s(c_t) = \beta E[u'^R(c_{t+1}) \cdot \tilde{X}_{t+1}] \tag{2.6}$$

Note, that paying the price for an asset is a certain expense, hence, evaluated with the utility function, $u^s(c_t)$, whereas receiving payoffs from the asset is an uncertain or risky gain, hence, evaluated with the utility function, $u^R(c_t)$. Hence, the discount rate for risky cash flows with a disproportionate safety preference, R_U^D, can be inferred from:

$$\begin{aligned} P_t = \frac{E[\tilde{X}]}{R_U^D} &= \frac{\beta}{(1+\alpha)} E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)} \cdot \tilde{X}\right] \\ &= \frac{\beta}{(1+\alpha)}\left\{E[\tilde{X}]E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)}\right] + cov\left(\tilde{X}, \frac{u'^R(c_{t+1})}{u'^R(c_t)}\right)\right\} \end{aligned} \tag{2.7}$$

which simplifies to:

$$R_U^D = \frac{(1+\alpha) \cdot R_F \cdot E[\tilde{X}]}{E[\tilde{X}] + cov\left(\tilde{X}, \frac{\frac{u'^R(c_{t+1})}{u'^R(c_t)}}{E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)}\right]}\right)} = (1+\alpha)R_U \tag{2.8}$$

The risk-free rate with disproportionate preference for safety is the same as the risk-free rate without such preference as:

$$\beta E\left[\frac{u'^s(c_{t+1})}{u'^s(c_t)}\right] = \beta E\left[\frac{(1+\alpha)u'^R(c_{t+1})}{(1+\alpha)u'^R(c_t)}\right] = \beta E\left[\frac{u'^R(c_{t+1})}{u'^R(c_t)}\right] = \frac{1}{R_F}$$

It makes intuitive sense that risky cash flows are more heavily discounted when there is a disproportionate preference for safety. As safe cash flows are discounted at the same rate, with and without safety preference, splitting payoffs into risky and safe components adds value. Without the safety preference, that is, when α = 0, it does not really matter how a given cash flow is split between risky and safe components. However, with safety preference, that is, when α > 0, risky cash flows are more heavily discounted, so considering safe and risky cash flows separately adds value.

Financial innovations that aim to capture the benefits from safe cash flows induce a separate consideration of safe cash flows in project evaluation. So, cash flows from project A are viewed as $\tilde{X}_A = (\tilde{X}_A - K_A) + K_A$ and cash flows from project B are viewed as $\tilde{X}_B = (\tilde{X}_B - K_B) + K_B$ where K_A and K_B are safe cash flows generated by project A and project B respectively.

Without a disproportionate preference for safety, that is, when ?=0, the present value remains unchanged regardless of how the cash flows are split:

$$PV(\tilde{X}) = PV(\tilde{X} - K) + PV(K)$$
$$\Rightarrow \frac{E[\tilde{X}]}{R_U} = \frac{E[\tilde{X} - K]}{R'_U} + \frac{K}{R_F} \qquad (2.9)$$

where $R'_U > R_U$. When K is split-off, it gets discounted at a lower rate, however, the remaining risky cash flow component is then discounted at a higher rate, which keeps the total value the same.

With a disproportionate preference for safety, that is, when α > 0, the present value of unsplit cash flows is calculated as:

$$PV(\tilde{X}) = \frac{E[\tilde{X}]}{R_U^D} = \frac{E[\tilde{X}]}{(1+\alpha)R_U} = \frac{1}{(1+\alpha)}\left\{\frac{E[\tilde{X} - K]}{R'_U} + \frac{K}{R_F}\right\} \qquad (2.10)$$

where $R_U^D = (1+\alpha)R_U$ (proposition 1) is used above with a further substitution for $\frac{E[\tilde{X}]}{R_U}$ made from (2.9).

When safe and risky cash flows are considered separately, the present value is:

$$PV(\tilde{X} - K) + PV(K) = \frac{E[\tilde{X} - K]}{R_U^D} + \frac{K}{R_F} = \frac{E[\tilde{X} - K]}{(1+\alpha)R'_U} + \frac{K}{R_F} \qquad (2.11)$$

Subtracting (2.10) from (2.11) shows that considering safe and risky cash flows separately increases the overall present value by:

$$\Delta PV = PV(\tilde{X} - K) + PV(K) - PV(\tilde{X}) = \frac{\alpha K}{(1+\alpha)R_F} \qquad (2.12)$$

The above analysis indicates that framing of a project evaluation problem is of critical importance. If risky cash flows are considered as a whole and not split into risk-free and residual risky components, then the present value is smaller. However, if, one splits cash flows into risky and risk-free components before discounting then the overall present value is larger. By making it possible to capture benefits from safe cash flows, recent financial innovations have re-framed project evaluation as a decision-problem involving a separate consideration of safe cash flows from the rest.

Proposition 2 follows.

Proposition 2: ***Separating cash flows into safe and risky components increases the overall present value. The amount by which the value increases is given by*** $\frac{\alpha K}{(1+\alpha)R_F}$ ***making projects with higher amounts of safe cash flows more attractive.***

Empirically, one sees this re-framing in action when the introduction of CDS market on corporate bonds makes firms more liquidity conscious (Subrahmanyam *et al* 2017) or when the introduction of IRS market makes firms more conservative in their investment choices (Kuprianov 1994, Wall and Pringle 1989). Arguably, we witnessed the devastating result of this re-framing when the securitization of subprime mortgages made offering such mortgages more attractive for banks than marginally prime mortgages (Mian and Sufi 2009).

Relevant comparative statistics show that:

1) A cut in interest rates increases the benefit from such re-framing as:

$$\frac{\partial \Delta PV}{\partial R_F} = -\frac{\alpha K}{(1+\alpha)R_F^2} < 0$$

2) Interest rate cuts have more bite in a low rate environment as:

$$\frac{\partial^2 \Delta PV}{\partial {R_F}^2} = \frac{\alpha K}{(1+\alpha)R_F^3} > 0$$

3) Size of the safe cash flows increases the benefits from such re-framing as:

$$\frac{\partial \Delta PV}{\partial K} = \frac{\alpha}{(1+\alpha)R_F} > 0$$

4) Stronger preference for safety increases the benefits as well:

$$\frac{\partial \Delta PV}{\partial \alpha} = \frac{K}{(1+\alpha)^2 R_F} > 0$$

Such re-framing may alter the preference ranking of projects as well. Continuing with the case discussed in the beginning of this section, even when project A should be preferred over project B based on NPV analysis; if project B has larger amount of safe cash flows, then re-framing may cause project B to be accepted over project A. Proposition 3 follows.

Proposition 3: ***(Misallocation of resources) When cash flows are split into safe and risky components then a low NPV project may be preferred over a high NPV project provided it generates a larger amount of safe cash flows.***

Proof

Suppose NPV of project A is larger than NPV of project B:

$$NPV_A = PV(\tilde{X}_A) - C > NPV_B = PV(\tilde{X}_B) - C$$

$$\Rightarrow PV(\tilde{X}_A) > PV(\tilde{X}_B)$$

Re-framing cash flows as safe and residual risky, if $K_A < K_B$, then it is possible:

$$PV(\tilde{X}_A) + \frac{\alpha K_A}{(1+\alpha)R_F} < PV(\tilde{X}_B) + \frac{\alpha K_B}{(1+\alpha)R_F}$$

Hence, a low NPV project may be accepted at the expense of higher NPV project

Corollary 3.1 Even a negative NPV project may be selected

Proof

Suppose the initial cost is larger than the present value of inflows, that is: $C > PV(\tilde{X})$. As this project has negative NPV, it should be rejected. However, in the presence of financial innovations inducing re-framing of cash flows into safe and risky components, the following may hold: $PV(\tilde{X}) + \frac{\alpha K}{(1+\alpha)R_F} > C$. Hence, a negative NPV project may be accepted.

Before the financial innovations aimed at capturing the benefits from safe cash flows started gaining importance (interest rate swaps and securitization in the 80s), there was no obvious reason for a firm to split cash flows into safe and risky components. For example, corporate bonds are never risk-free so funding a project through corporate bonds wouldn't lead to a separate consideration of risk-free and risky cash flows. However, with financial innovations aimed at capturing the benefits from safe cash flows, such as interest rate swaps, credit default swaps, and securitization, re-framing of cash flows into risk-free and residual risky components makes good sense. Projects with larger amounts of safe cash flows become more attractive, so project rankings without cash-flow splitting may differ from the ranking with such splitting. An otherwise low or even negative NPV project may be accepted due to such splitting.

Even though private sector debt is never risk-free, sectors that generate large amounts of safe cash flows s tend to rely more on debt, so one can use debt-reliance as a measure of safe cash flows in a sector. For example, housing and energy sectors carry more debt than the software sector as they have more safe cash flows. So, when the software sector is booming, one expects the misallocation of resources to be less severe as there aren't large safe cash flows in the sector. This is consistent with the empirical findings that from the mid 90's to early 21st century (booming software sector), productivity growth in the US was a decent 3% before collapsing to 1.2% after 2003 (booming housing sector) (Syverson 2017).

Financial innovations deliver asymmetric benefits with projects that have safe cash flows in bigger amounts benefitting more. Note, that the increase in value, $\frac{\alpha K}{(1+\alpha)R_F}$, depends on the amount of safe cash flows, K, and not on the fraction of cash flows that are safe. This means that, all else equal, simple scaling-up proportionately scales-up the benefit. Consider two firms that are exactly identical except that one firm has cash flows that are n times the other firm's cash flows, then the ratio of the benefits to the large firm and the benefits to the small firm is n. In other words, financial innovations widen the value gap between large and small firms.

Proposition 4: ***Financial innovations widen the value gap between large firms and small firms. Specifically, if a large firm has cash flows that are n times that of a small firm then their value gap widens by*** $\boldsymbol{\frac{\alpha(n-1)K}{(1+\alpha)R_F}}$

Proof

The increase in value delivered by financial innovation to a firm is: $\frac{\alpha K}{(1+\alpha)R_F}$. The increases in value to a larger firm with n times the cash flows is: $\frac{\alpha nK}{(1+\alpha)R_F}$. Subtracting the former from the latter shows the amount by which the value-gap is widened due to financial innovations.

By delivering bigger advantages to larger firms, such financial innovations contribute to the rise in industry concentration. The rise in industry concentration since the 80s is well-documented in the literature (Decker *et al* 2016), and it fits well the argument here.

It is straightforward to see that, in the presence of such financial innovations, an interest rate cut further widens the value-gap between large and small firms.

Proposition 5: ***An interest rate cut further widens the value gap between large and small firms in the presence of financial innovations separating cash flows into safe and risky components.***

Proof

If a firm has n times the cash flows of another firm, then the value-gap due to financial innovations is: $PVGap = \frac{\alpha(n-1)K}{(1+\alpha)R_F}$. This value-gap widens when interest rates fall.

When interest rates are low, the adverse impacts are larger as proposition 6 shows.

Proposition 6: ***The adverse impacts of financial innovations aimed at slitting cash flows into safe and risky components are larger when interest rates are low***

Proof

Follows from realizing that as interest rates fall $\frac{\alpha K}{(1+\alpha)R_F}$ gets larger, which makes the misallocation noted in proposition 3 and corollary 3.1 worse.

The results here indicate that the traditional channel of expansionary monetary policy that operates by increasing the NPV as the discount rate falls is not the only channel. There are detrimental impacts that operate by causing a misallocation of resources towards low NPV projects as well as by widening the value-gap between large and small firms.

3. Discussion and Conclusions

The traditional channel through which expansionary monetary policy affects the production side of the economy is as follows: An interest rate cut lowers the discount rates on projects; hence, pushing-up their NPVs. This leads to more projects being accepted; hence, more investments. In this manner, the production side of the economy is positively affected. This article adds two additional channels on the production side. Both channels affect the production side negatively. The first channel is that an interest rate cut makes the misallocation towards low NPV projects worse (proposition 6). The misallocation is driven by the term $\Delta PV = \frac{\alpha K}{(1+\alpha)R_F}$, which gets bigger when R_F falls. It is interesting to note that the first derivative of this term is negative whereas the second derivative is positive:

$$\frac{\partial \Delta PV}{\partial R_F} = -\frac{\alpha K}{(1+\alpha){R_F}^2} < 0 \text{ and } \frac{\partial^2 \Delta PV}{\partial {R_F}^2} = \frac{2\alpha K}{(1+\alpha){R_F}^3} > 0$$

It follows that an interest rate cut has more bite at low interest rates with the term getting bigger as interest rates approach zero. Hence, this first adverse channel is strongest at near zero interest rates and weakest at large interest rates. The second adverse channel is that an interest rate cut further widens the value-gap between large and small firms (proposition 5). Such widening makes it harder for small firms to catch-up; hence, may discourage them from investing in innovation. A wider gap may also make a dominant firm complacent as it does not feel a competitive threat from small firms that are left too far behind. The argument in Liu, Mian, and Sufi (2019) is similar except that the underlying mechanism generating the value-gap between large and small firms is different. In their approach, the overall investment response of the leader to a decline in interest rates is stronger than the response of the followers, which widens the value-gap. However, here, it is the asymmetric benefits of financial innovations, with an interest rate cut delivering a larger benefit to the leader (on account of the leader having more safe cash flows), that drives the result. This channel operates through the term: $PVGap = \frac{\alpha(n-1)K}{(1+\alpha)R_F}$. Just like with the first channel, the first derivative of this term w.r.t the interest rate is negative whereas the second derivative is positive:

$$\frac{\partial PVGap}{\partial R_F} = -\frac{\alpha(n-1)K}{(1+\alpha){R_F}^2} < 0 \text{ and } \frac{\partial^2 \Delta PVGap}{\partial {R_F}^2} = \frac{2\alpha(n-1)K}{(1+\alpha){R_F}^3} > 0$$

It follows that the second channel is also strongest at near zero interest rates, and weakest at large interest rates.

As the two adverse channels on the production side are strongest near zero interest rates, our approach suggests that a sustained period of low interest rates is structurally damaging to the economy. Interest rates in core advanced economies have been persistently low for about 11 years now. Such persistently low nominal rates are without precedence. At least since 1870, interest rates have never been this low for this long, not even during the great depression. The question of whether monetary policy has been less effective in such a low interest rate environment has been raised in the literature (Hoffman and Borio 2017). Our paper provides a new perspective to this debate.

Note

1. Such a preference for safety may arise in a resource-constrained rational brain that first optimizes on its own internal resources before optimizing on the resources available in the external world (Siddiqi and Murphy, 2021).

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