The Daughter Effect and Rational Choice: A Neuroeconomic Perspective on Executive Decision-Making

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Abstract

This paper investigates how fathering a daughter can endogenously shift male corporate board members' preferences toward gender-inclusive executive appointments, a phenomenon known as the "daughter effect." While previous research has empirically documented this effect, its implications for rational choice theory remain underexplored. This study develops a theoretical framework that integrates behavioral and neuroeconomic insights into classical decision theory to show that such emotionally driven shifts in preference can remain consistent with rational choice – so long as completeness and transitivity are preserved. The analysis leverages Swedish register data on CEO appointments and proposes a neuroeconomic model in which personal experiences modify salience weights within utility functions. These evolving, context-sensitive preferences are framed not as departures from rationality but as adaptive responses within an intertemporal utility-maximizing structure. By bridging empirical data, formal economic modeling, and insights from neuroscience, this paper advances our understanding of how identity and emotion can reshape economic behavior without violating foundational theoretical axioms. Implications span corporate governance, gender equity, and the evolution of rational agency.

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Keywords: Rational Choice, Neuroeconomics, Behavioral Economics, Corporate Governance, Gender Preferences, Board Composition, Social Preferences, Decision-Making

JEL classification: D01 D87 G34 J16 M14

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1 Introduction

Standard economic theory posits that individuals make decisions based on stable, rational preferences aimed at maximizing utility, as initially outlined by classical economists and later formalized by (Von Neumann & Morgenstern 1944) and encapsulated in neoclassical economic theory (Friedman 1953, Becker 1976). Yet, over the past decades, behavioral economics and neuroeconomics have significantly challenged these axioms (Camerer et al. 2005), demonstrating that psychological and risk factors can reshape preferences and decision-making (Malmendier & Nagel 2011, Kahneman & Tversky 1979, Elder 1998).

Recent studies suggest that personal experiences, such as fathering daughters, may shift male leaders' attitudes and behaviors in meaningful ways – a phenomenon referred to as the "daughter effect." Research has linked this effect to increased support for corporate social responsibility (Cronqvist & Yu 2017), a greater likelihood of promoting women to top leadership (Dasgupta & Hauser 2018, Bennedsen et al. 2019), and broader endorsement of gender-inclusive policies (Warner 1991, Washington 2008, Dahl et al. 2012). While these behavioral patterns are increasingly well-documented, less is known about how such preference shifts relate to the core assumptions of economic rationality.

This paper addresses that theoretical gap by developing a framework that integrates classical utility theory with insights from behavioral economics and neuroeconomics. Specifically, it investigates whether preference changes induced by personal life events – such as fatherhood – can be reconciled with rational choice models, provided foundational axioms such as completeness and transitivity are preserved. I argue that such emotionally salient experiences may lead to a re-weighting of decision criteria, resulting in updated but still internally consistent utility functions.

In this account, male board members who become fathers to daughters may revise their preferences regarding gender diversity in leadership – not necessarily out of altruism or ideology, but as part of a rational response to new personal circumstances and future expectations. This aligns with Becker's model of family-based altruism and human capital investment (Becker 1976, 1981, 1993), while also extending it to incorporate emotional salience and intertemporal optimization across generations. The paper thus contributes to ongoing efforts to refine the concept of Homo economicus without abandoning its logical structure.

To illustrate these mechanisms, I present a simple two-period model in which a board director's utility-maximizing preferences evolve after fathering a daughter. Drawing on findings from neuroeconomics, the model suggests that emotionally salient life events can shift the salience of social outcomes, such as gender equity without violating rational choice theory. This challenges the binary distinction between emotion and reason and allows for a richer account of how identity and experience shape decision-making at the top of organizations.

The theoretical framework is grounded in empirical observations from Paper I (Liljegren 2025), which uses matched employer-employee data from Swedish SMEs to show that a higher share of daughter-having male board members significantly increases the likelihood of appointing a female CEO, an effect comparable in size to adding an additional female director. While this organizational-level result is consistent with the daughter effect, it does not reveal the underlying cognitive or motivational mechanisms.

To explore these microfoundations further, I propose an experimental extension using choice lotteries to test whether men with daughters exhibit systematically different preferences in hypothetical CEO appointments. Such an experiment could help determine whether these shifts reflect stable, rational adaptations consistent with expected utility theory (Von Neumann & Morgenstern 1944), or whether they align with systematic behavioral deviations as described by prospect theory (Kahneman & Tversky 1979). I also outline future research avenues using longitudinal designs and neuroeconomic methods to track how preferences evolve before and after the birth of a daughter. Because the sex of a child is randomly assigned, fatherhood offers a natural experiment that strengthens 'causal inference' and supports interdisciplinary study of preference formation.

Studying this phenomenon is compelling not only from a theoretical perspective but also in light of practical realities that perpetuate gender inequality. In 2023, women earned the majority of bachelor's degrees, yet held only 32% of board seats and 8.2% of CEO positions in S&P 500 firms (Catalyst 2024), with similar disparities in Europe (Commission 2024). Women also comprise only 27% of the world's wealthiest individuals. These gaps have been further exacerbated by the rollback of Diversity, Equity, and Inclusion (DEI) policies in the U.S. in 2025 – following executive orders from President Trump – which led many corporations to scale back diversity initiatives (House 2025).

Finally, the paper reflects on how neuroeconomics may help bridge utility theory with biological decision processes, illuminating how social preferences are encoded and updated in the brain. This perspective extends beyond the corporate domain, raising broader questions about how economic theory can accommodate evolving, context-sensitive preferences. Of particular relevance is the way neuroeconomics connects traditional utility theory to neural computations at the micro- and even nano-scale – such as valuation processes in the ventromedial prefrontal cortex or dopaminergic reward pathways (Rangel et al. 2008, Glimcher & Fehr 2014, Levy & Glimcher 2012). This perspective enhances classical models of decision-making by accounting for the role of identity, emotion, and context – without compromising internal consistency or predictive value.

By combining empirical, theoretical, and biological insights, this paper contributes to a broader understanding of how rational preferences can evolve in response to personal life experiences. It also suggests practical implications for leadership development, policy design, and institutional strategies aimed at promoting gender equity in corporate governance.

The paper proceeds as follows: Section 2 reviews the empirical literature on the daughter effect. Section 3 presents findings from Swedish register data and introduces an analytical model of preference change. Section 4 discusses the intersection of rational choice, behavioral economics, and neuroeconomics. Section 5 builds the formal theoretical framework. Section 6 explores implications and limitations. Section 7 concludes.

2 Literature Review: Fathers with Daughters and Changing Preferences

A growing body of research shows that fathering daughters can significantly influence men's preferences and behaviors across political, economic, and organizational domains. Early work by Warner (1991) found that parents – especially mothers – of daughters were more likely to endorse feminist ideals. This line of inquiry later extended into political behavior: Washington (2008) showed that U.S. congresspersons with daughters were more likely to vote liberally, particularly on gender-related issues, introducing the idea of 'offspring effects'. Similar results were found in judicial behavior (Glynn & Sen 2015) and in voting patterns among the general public in the U.S. and U.K. (Oswald & Powdthavee 2010, Conley & Rauscher 2013). Notably, several studies find that the effect is strongest when the firstborn child is a daughter (Sharrow et al. 2018, Green & Homroy 2018).

In the corporate sphere, the daughter effect has been linked to shifts in organizational behavior and leadership decisions. Cronqvist & Yu (2017) found that male CEOs with daughters tend to improve their firms' corporate social responsibility (CSR) ratings. Dahl et al. (2012) reported that male CEOs reduce wages after becoming fathers, but less so when the firstborn is a daughter – particularly for female employees. Similar patterns have been observed in founder-driven ventures (Wu et al. 2023), among Chinese CEOs from patriarchal regions (Wang & Huang 2019), and in male-dominated industries (Bennedsen et al. 2019). These studies suggest that personal experiences with daughters increase leaders' sensitivity to gender inequality, with downstream effects on hiring and promotion practices.

The daughter effect also extends to broader behavioral traits. Empirical studies specifically targeting the neurobiology of fatherhood show that the experience of caring for a child leads to measurable hormonal and structural brain changes. Pogrebna (2018) showed that parents expecting daughters are more risk-averse, while Oswald & Powdthavee (2010) and Mascaro et al. (2017) found that fathers of daughters displayed more attentiveness and more elaborative speech when interacting with their child, as well as greater activation in brain areas associated with empathy and language processing. These findings suggest a durable cognitive and affective reconfiguration linked to the father-daughter relationship. Notably, fathers of daughters may show distinct neural activation patterns compared to fathers of sons, particularly in tasks involving fairness, moral reasoning, or gender-related judgments.

Even under patriarchal constraints, paternal mentorship could alter life trajectories – as exemplified by Hypatia of Alexandria, a renowned philosopher, mathematician, and astronomer of the 4th century CE, who received her education from her father and mentor, Theon of Alexandria. Her legacy demonstrates how familial support – especially from fathers – could transcend societal barriers and empower daughters to pursue knowledge and public life (Dzielska 1995).

However, the robustness of the daughter effect remains debated. A recent replication by Green et al. (2023), extending Washington (2008), found inconsistent results across cohorts and periods, underscoring the role of social context. Still, the literature suggests that father-daughter dynamics can shape male preferences in ways relevant to policy, governance, and social norms.

3 Exploring the Daughter Effect with Swedish Data: Empirical Findings and Analytical Approach

This section develops an analytical framework to explore how personal experiences – specifically, fatherhood – can shape decision-making in corporate governance. The model focuses on a male board member whose preferences evolve after becoming the father of a daughter, and examines how this shift may affect his likelihood of supporting a female CEO candidate.

A. Empirical Findings

The framework builds on the empirical results of Liljegren (2025), who use matched firm- and board-level register data from the Swedish Companies Registration Office and Statistics Sweden (SCB) to examine external CEO appointments in small and medium-sized enterprises (SMEs) with more than 10 employees. The study finds that a higher share of male board members with at least one daughter in the previous year is associated with a significantly greater likelihood of appointing a female CEO. Specifically, a one-unit increase in this share is linked to an approximately 4 percentage point increase in the probability.[1] The estimated effect is comparable in magnitude to the appointment of an additional female director. Results remain robust when controlling for the gender of children born after the director's appointment, strengthening the interpretation that personal life experience may causally influence governance decisions.

B. Analytical Framework

To formalize this intuition, consider a two-period setting. In period 1, a male board member without children evaluates CEO candidates based on a utility-maximizing function with stable preferences, including a latent valuation of gender equality. In period 2, following the birth of a daughter, his preferences may shift. The key question is whether this shift increases the likelihood of supporting a female CEO candidate – and whether the change reflects deliberate reasoning or unconscious salience effects. More fundamentally, does this shift represent a departure from rationality, or can it be reconciled within a consistent, axiomatic framework of choice?

We can model the decision process by letting Y represent the vector of CEO selection outcomes and X the set of observable predictors. Unobserved preference-relevant factors, denoted W, are embedded in the error term: $Y = X + \mathbb{E}(W)$. In this context, W may include changes in cognitive salience or valuation mechanisms triggered by becoming the father of a daughter. These mechanisms may be accessible through neuroeconomic inquiry – for example, by observing variation in neural activity when board members vote on female candidates before and after such life events.

While neuroeconomists posits that tracing such shifts to neural processes can improve explanatory depth, traditional economists remain skeptical (Gul & Pesendorfer 2008). For them, utility is not an emotional impulse, but an internally coherent ranking that guides consistent choices under axioms such as completeness and transitivity. From this perspective, utility functions are not states of feeling but structured representations of relative value (Bernheim 2009).

Before developing this distinction further, the next section outlines the theoretical foundations shared across classical, behavioral, and neuroeconomic perspectives. It also provides a brief intellectual history of neuroeconomics, charting its development and current direction.

[1] The pooled probit model is estimated as follows: For firm i in industry j and year t, the model is

$$\Pr(Y_{it} = 1) = \alpha_1 DDD_{it-1} + \alpha_2 + B'_{it-1}\beta + X'_{it-1}\gamma + \epsilon'_j\delta + \tau'_t\theta + e_i, \tag{1}$$

where Y_{it} indicates the appointment of a female CEO, DDD_{it-1} is the share of male directors with at least one daughter, B_{it-1} includes board characteristics (e.g., board size, gender diversity, outside director share), X_{it-1} includes firm-level controls (e.g., size), and ϵ_j, τ_t are industry and year fixed effects, respectively.

4 Theoretical Framework

4.1 A Brief Intellectual History: From Classical Theory to Neuroeconomics

A. From Philosophy to Marginalism
The history of economic thought reflects a gradual refinement of how human choice is understood – from normative and philosophical beginnings to formal utility models and, more recently, neurobiological perspectives. In antiquity, Aristotle (1995) introduced the idea of a "just price" and criticized usury, linking value to ethical reasoning. This ethical dimension was further developed by medieval scholars like Aquinas (1948).

Classical economics emerged in the 18th century, with Smith (1776)'s *Wealth of Nations* introducing foundational ideas such as the invisible hand, free markets, and division of labor. Ricardo (1817) and Malthus (1798) extended this foundation with theories of comparative advantage and population pressure. A major turning point came in the late 19th century with the marginalist revolution and replaced labor-based value theory with marginal utility, emphasizing subjective preferences and individual valuation . Walras (1874) introduced general equilibrium theory, Jevons (1871) the equimarginal principle, and Menger (1871) focused on ordinal valuation – together forming the basis of neoclassical economics. These theories resolved classical puzzles such as the diamond-water paradox and framed value in terms of scarcity and utility. The Austrian School, led by Menger (1871) and later developed by von Mises (1949) and Hayek (1945), emphasized subjective value, praxeological reasoning, and the importance of decentralized knowledge in guiding economic coordination.

B. Psychology and Bounded Rationality
In the early 20th century, figures like Edgeworth, Fisher, and Ramsey speculated on physically measurable utility – so-called hedonimeters – but lacked empirical tools (Colander 2007). Meanwhile, Keynes (1936) introduced psychological realism into macroeconomic theory, emphasizing uncertainty, expectations, and "animal spirits". His ideas dominated policy until monetarist critiques by Friedman & Schwartz (1963) refocused attention on rational expectations and monetary stability.

The late 20th century brought behavioral economics to prominence. Simon (1955) concept of bounded rationality challenged the optimization assumption and argued that individuals operate under cognitive and informational constraints, and therefore do not fully optimize but instead "satisfice" by selecting options that are good enough given limited processing capacity. Kahneman & Tversky (1979) prospect theory formalized systematic deviations from expected utility, including loss aversion and reference dependence. Building on this, Thaler & Sunstein (2008) introduced mental accounting, nudging, and the endowment effect. Loewenstein (1996) and Mullainathan & Shafir (2013) extended these insights to include emotions, self-control, and decision context.

C. Toward a Neurobiological Understanding of Choice

Neuroeconomics extends this behavioral turn by embedding decision-making within the brain's architecture. Using fMRI and related tools, researchers link value computation to activity in regions like the vmPFC and ventral striatum (Kable & Glimcher 2009, Camerer 2004). These studies suggest that preferences are not fixed but shaped by emotion, identity, and neurobiology – challenging the idea of stable, exogenous utility functions.

Critics such as Gul & Pesendorfer (2008) argue that economics should remain rooted in observable choices. Yet proponents contend that neuroeconomics enhances explanatory power, especially under uncertainty, emotion, or social salience. Hormonal and emotional influences on risk-taking (e.g., Coates 2008, Zak 2005) support this view. Recent advances in AI and machine learning have expanded the neuroeconomic toolkit, allowing more precise modeling of complex behavioral data (Duncan 2020). Research on hormones like testosterone, cortisol, and oxytocin shows how biology influences trust, risk-taking, and financial behavior (Coates 2008, Zak 2005, Knutson 2007). Emotional responses to macroeconomic shocks, such as fear, can lead to herd behavior and suboptimal decisions (Callen 2014, Cohn 2015). The Adaptive Markets Hypothesis (AMH) by Lo (2017) synthesizes these insights, proposing that markets evolve as boundedly rational agents adapt to changing environments. Recent work by Lo & Zhang (2024) incorporates neural and evolutionary mechanisms, offering a biologically informed alternative to the Efficient Market Hypothesis (EMH) (Fama 1970) [2].

In sum, the shift from classical rationality to neuroeconomic modeling reflects an integrative progression – where internal consistency is supplemented with psychological realism and biological plausibility. This trajectory supports richer accounts of decision-making in contexts like the daughter effect, where social and emotional experiences reshape economic preferences. Taken together, these insights represent a substantial theoretical shift.

Dimension	**Neoclassical Economics**	**Neuroeconomics**
View of the Decision-Maker	Rational agent ("Homo economicus") with stable, context-independent preferences	Boundedly rational, neurally constrained agent with dynamic, context-sensitive preferences

[2] While EMH assumes static rationality and complete information, AMH views efficiency as context-dependent, fluctuating with stress, learning, and institutional constraints.

Core Assumptions	Full information, utility maximisation, internal consistency (e.g., transitivity, independence)	Limited cognitive capacity, emotional/hormonal influence, adaptive behaviour
Data Basis	Observable choices (e.g., prices, consumption patterns)	Behavioural data combined with neural measures (e.g., fMRI, EEG, hormones)
Methodological Foundations	Deductive reasoning, mathematical optimization, axiomatic models	Empirical experimentation, computational modeling, integration with biology
Axiomatic Structure	Central; models are defined by formal axioms such as revealed preference, transitivity	Explores whether neural processes satisfy or violate economic axioms; tests axioms biologically
Utility Concept	Abstract utility functions (ordinal or cardinal), derived from observable choice	Subjective value represented in neural signals, e.g., dopaminergic reward pathways
Treatment of Emotions	Typically excluded or treated as external noise	Emotions are integral; affect value computations and behavioral outcomes
Time and Risk Preferences	Exponential discounting and expected utility under uncertainty	Hyperbolic discounting, loss aversion, probability weighting, supported by neural data
Social Preferences	Focus on individual self-interest; social effects external to utility	Includes fairness, reciprocity, norm compliance; social value encoded in brain regions
Market Behavior	Tends toward equilibrium; rational expectations prevail	Markets are adaptive; efficiency varies with learning, stress, and context
Relation to Psychology	Historically separate; minimized role for psychological variables	Deeply integrated with behavioral, cognitive, and social psychology

Table 1: Comparison of Neoclassical Economics and Neuroeconomics

4.2 The Classical Microeconomic View of Individual Decision-Making

The formalization of utility theory during the marginalist revolution marked a turning point in economic thought, introducing the utility function to relate satisfaction and price to quantity. Yet, the idea of using utility to evaluate outcomes under uncertainty can be traced back to Bernoulli (1738), who argued that decisions involving risk should be based on expected utility rather than expected monetary value. This foundational insight was later rigorously formalized by Von Neumann & Morgenstern (1944), embedding stochastic elements into rational choice theory through their axiomatic framework.

Mathematical formalism has since shaped microeconomic theory, modeling individual agents as utility-maximizing entities whose interactions determine broader outcomes (Mas-Colell et al. 1995). Rooted in the work of Walras (1874). and Pareto (1906). and extended by Arrow & Debreu (1954), this approach relies on abstraction and internal consistency to derive economic predictions.

Preference - vs. Choice-Based Models

A decision problem involves a set of alternatives X. Two core modeling approaches exist: the **preference-based** and the **choice-based**. The preference-based approach assumes a complete and transitive binary relation $\succsim$ over X. If a utility function $u : X \to \mathbb{R}$ exists such that $x \succsim y \iff u(x) \geq u(y)$, then preferences can be represented numerically. This forms the foundation of consumer theory (Kreps 1990, Mas-Colell et al. 1995).[3]

In contrast, the choice-based approach, most notably formalized by Samuelson (1938) in his theory of revealed preference, avoids reference to unobservable mental states by focusing exclusively on observed choice behavior. A choice function $C(\cdot)$ maps any feasible set $B \subseteq X$ to a non-empty subset $C(B) \subseteq B$. If choices satisfy the **Weak Axiom of Revealed Preference (WARP)**, underlying preferences can be inferred.

[3]This formalism relies on stable and mathematically well-defined preferences, often abstractly specified in axiomatic terms. Gary Becker adopts a different stance: while he maintains the rational choice assumption, he broadens the scope of utility to include non-market goods such as family dynamics, discrimination, or social prestige. In Becker's framework, preferences are assumed to be stable, but the set of arguments entering the utility function is expanded to reflect psychological and social motivations (Becker 1976). This contrasts with standard consumer theory, which typically assumes preferences over tangible goods or outcomes.

Though preferences are unobservable, they may be inferred when consistent choices imply a latent ordering. Under assumptions like completeness and transitivity, these can be rationalized as utility-maximizing behavior – core to **rational choice theory**.

Illustration: Preference Evolution in CEO Selection

Consider a male board member choosing among CEO candidates $ceo_1, ceo_2, ceo_3 \in X$. In period 1, before parenthood, his evaluation is based on conventional metrics. He satisfies:

Completeness: All pairs can be compared.
Transitivity: If $ceo_1 \succ ceo_2$ and $ceo_2 \succ ceo_3$, then $ceo_1 \succ ceo_3$.

After becoming a father to a daughter (period 2), his evaluative criteria may shift, emphasizing inclusivity or diversity. If his new ranking prefers $ceo_2 \succ ceo_1$ (e.g., female candidate with inclusive leadership), but still maintains transitivity and completeness, then the updated preferences remain rational. Thus, by Debreu (1954) Representation Theorem, there exists a real-valued utility function $u : X \to \mathbb{R}$ such that:

$$ceo_i \succsim ceo_j \iff u(ceo_i) \geq u(ceo_j), \quad \forall ceo_i, ceo_j \in X.$$ [4]

Hence, even if the board member's evaluative criteria change – such as placing increased emphasis on inclusivity after becoming a parent – the evolving preferences can still be represented

[4] *Note:* For a utility function $u : X \to \mathbb{R}$ to represent a preference relation $\succsim$, the relation must satisfy the axioms of *completeness* and *transitivity*. In the context of the CEO selection example, the utility function u assigns numerical values to candidates such that:

$$ceo_i \succsim ceo_j \iff u(ceo_i) \geq u(ceo_j), \quad \forall ceo_i, ceo_j \in X.$$

Proof.
(1) u represents $\succsim \implies$ Completeness:
Assume that a utility function u exists and represents the preference relation $\succsim$. For any $ceo_i, ceo_j \in X$, since real numbers are totally ordered, it must be that either $u(ceo_i) \geq u(ceo_j)$ or $u(ceo_j) \geq u(ceo_i)$. Hence, by definition of representation, either $ceo_i \succsim ceo_j$ or $ceo_j \succsim ceo_i$. Therefore, $\succsim$ is complete.
(2) u represents $\succsim \implies$ Transitivity:
Suppose $u(ceo_1) \geq u(ceo_2)$ and $u(ceo_2) \geq u(ceo_3)$. By the transitivity of the real numbers, it follows that $u(ceo_1) \geq u(ceo_3)$, and thus $ceo_1 \succsim ceo_3$. Therefore, the relation $\succsim$ is transitive.
(3) Completeness and Transitivity $\implies$ Existence of u:
Assume the preference relation $\succsim$ is complete and transitive. Then, by Debreu's Representation Theorem there exists a real-valued utility function $u : X \to \mathbb{R}$ such that:

$$ceo_i \succsim ceo_j \iff u(ceo_i) \geq u(ceo_j), \quad \forall ceo_i, ceo_j \in X.$$

numerically, provided the axioms of rational choice are maintained. This ensures theoretical consistency and interpretability within the preference-based framework. Thus, personal experiences can reshape the utility function without violating rational choice axioms.

Example: Intransitive Preference and Gender Bias

Suppose instead that the board member's updated preferences introduce inconsistency.

$$\begin{aligned} ceo_2 &\succ ceo_1 \quad \text{(based on gender)} \\ ceo_1 &\succ ceo_3 \quad \text{(based on merit)} \\ ceo_3 &\succ ceo_2 \quad \text{(previous ranking)} \end{aligned}$$

This creates a preference cycle, violating transitivity. The resulting inconsistency undermines utility representation and reveals a departure from classical rationality – often highlighted by behavioral economists.

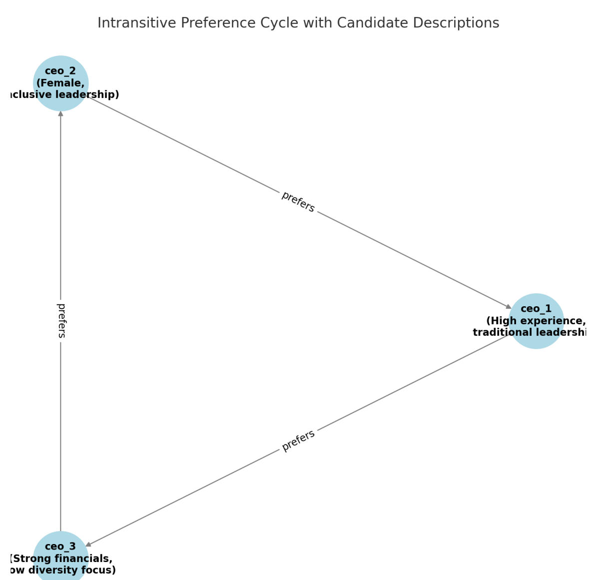

Figure 1: Intransitive preference cycle: ceo2 $\succ$ ceo1 $\succ$ ceo3 $\succ$ ceo2.

Conclusion and Transition

While classical models assume stable preferences, real-world decision-making may involve evolving criteria driven by personal identity and emotional context. As illustrated in Figure 1, the board member's evolving preferences result in a cycle that violates transitivity. This example illustrates a departure from the purely theoretical conception of rational decision-making. As the next section shows, behavioral and neuroeconomic perspectives offer theoretical tools for interpreting such shifts, while still accounting for internal consistency or bounded rationality.

4.3 Behavioral Economics and Violations of Rational Choice Axioms

Behavioral economics, grounded in cognitive psychology, challenges the axioms of classical rationality by demonstrating systematic deviations in real-world decision-making. Rather than assuming agents possess perfect information and unbounded cognitive capacity, behavioral models emphasize *bounded rationality* (Simon 1955), *heuristics and biases* (Kahneman & Tversky 1979), and social preferences. Individuals tend to overweight losses relative to equivalent gains (*loss aversion*), discount future benefits inconsistently (*present bias*), and value fairness even at personal cost.

These empirical findings have been formalized in models such as *prospect theory*, which replaces the classical expected utility framework with a reference-dependent value function and a probability weighting function that captures perceived distortions in likelihoods (Kahneman & Tversky 1979). Thus, behavioral economics preserves the analytical structure of microeconomic theory while relaxing foundational assumptions like exogenous, stable preferences.

Expected Utility Theory and its Limits

The von Neumann-Morgenstern (vNM) framework[5] defines rational choice under risk through a set of axioms: completeness, transitivity, continuity, and independence (Von Neumann & Morgenstern 1944). These allow for a utility function $u : X \to \mathbb{R}$ representing preferences over lotteries $L \in \mathcal{L}$, such that:

$$L \succsim M \iff \mathbb{E}[u(L)] \geq \mathbb{E}[u(M)].$$

While foundational, this model assumes stable cognitive processing, something that empirical data often contradicts. Laboratory experiments reveal frequent violations of transitivity, intransitive cycles, and framing effects – all of which call into question the descriptive validity of vNM (Tversky 1969, Kahneman & Tversky 1979).

[5]The expected utility framework proposed by Von Neumann & Morgenstern (1944) (vNM) rests on a set of axioms that define rational behavior under risk. Let $\mathcal{L}$ denote the set of all lotteries over a finite set of outcomes $X = \{x_1, x_2, \ldots, x_n\}$, where a lottery $L \in \mathcal{L}$ is represented as a probability distribution $[p_1, x_1; \ldots; p_n, x_n]$ with $\sum_{i=1}^n p_i = 1$. Let $\succsim$ denote a binary preference relation over $\mathcal{L}$. The axioms are as follows:

1. **Completeness:** For any $L, M \in \mathcal{L}$, either $L \succsim M$, $M \succsim L$, or both.
   The decision-maker is able to compare any two lotteries and form a preference or declare indifference.
2. **Transitivity:** For any $L, M, N \in \mathcal{L}$, if $L \succsim M$ and $M \succsim N$, then $L \succsim N$.
   Preferences are logically consistent.
3. **Continuity:** For any $L, M, N \in \mathcal{L}$ such that $L \succ M \succ N$, there exists a probability $p \in (0, 1)$ such that:
   $$M \sim [p, L; (1-p), N].$$
   The decision-maker is indifferent between an intermediate lottery and a probabilistic combination of a more and a less preferred outcome.
4. **Independence (Substitution):** For any $L, M, N \in \mathcal{L}$ and $p \in (0, 1)$,
   $$L \succsim M \iff [p, L; (1-p), N] \succsim [p, M; (1-p), N].$$
   Preference between two lotteries should not change when both are mixed with a common third lottery in the same proportions.

If a preference relation $\succsim$ satisfies Axioms 1–4, then there exists a utility function $u : X \to \mathbb{R}$ such that for all lotteries $L, M \in \mathcal{L}$,

$$L \succsim M \iff \mathbb{E}[u(L)] \geq \mathbb{E}[u(M)],$$

where $\mathbb{E}[u(L)] = \sum_{i=1}^n p_i u(x_i)$. The utility function u is unique up to positive affine transformations. This permits a unique representation via an expected utility function $u : X \to \mathbb{R}$ such that:

$$L_1 \succsim L_2 \iff \mathbb{E}[u(L_1)] \geq \mathbb{E}[u(L_2)].$$

However, bounded rationality challenges the empirical validity of some of these axioms. Alternative models introduce weaker or modified axioms to account for cognitive limitations and context effects.

Bounded Rationality and Adaptive Models

Simon (1955) introduced bounded rationality as a formal relaxation of full optimization[6]. Instead of maximizing utility over all options, decision-makers select satisfactory alternatives that meet an aspiration level τ, often determined via heuristics[7]:

$$x^\dagger = h(\mathcal{I}) \quad \text{such that} \quad u(x^\dagger, s) \geq \tau.$$

This approach has been extended by models such as Gul & Pesendorfer (2008)'s menu preferences and McFadden (2005)'s theory of rational inattention, which incorporates information costs:

$$\mathbb{E}[u(x)] - \lambda \cdot \mathcal{I}(x; X),$$

where $\mathcal{I}$ denotes mutual information and λ reflects attentional constraints. These models retain a rational structure but incorporate psychological realism.

Experimental Test: Preference Shifts in CEO Selection

To test whether personal experiences – such as fathering a daughter – alter decision-making, I propose an experiment based on vNM-style lotteries. The core hypothesis is:

H0: No difference in preference for female CEO between men with and without daughters.

H1: Men with daughters assign higher utility to female CEO candidates.

Respondents choose between probabilistic and certain outcomes involving two identically qualified candidates, one male and one female. For example:

[6] Formally, let the agent face a decision problem defined by a choice set X, a set of possible states of the world S, and a utility function $u : X \times S \to \mathbb{R}$. In the fully rational model, the agent chooses $x^* \in X$ such that:

$$x^* \in \arg\max_{x \in X} \mathbb{E}_\mu[u(x, s)],$$

where μ is the agent's subjective belief over S. Under bounded rationality, this optimization is subject to constraints on information processing, memory, and time. The agent instead chooses a satisfactory option $x^\dagger \in X$ such that:

$$u(x^\dagger, s) \geq \tau, \quad \text{for some aspiration level } \tau \in \mathbb{R},$$

and where $x^\dagger$ is derived through a heuristic or simplified procedure $h : \mathcal{I} \to X$, mapping limited information $\mathcal{I} \subset X \times S$ into a feasible action. Thus, bounded rationality can be defined as decision-making that satisfies:

$$x^\dagger = h(\mathcal{I}) \quad \text{such that} \quad u(x^\dagger, s) \geq \tau,$$

where h is non-exhaustive and cognitively tractable.

[7] Heuristics refer to cognitive shortcuts or rules of thumb that simplify decision-making processes under uncertainty or limited cognitive resources. While often efficient, they can lead to systematic biases and deviations from rational choice predictions

Option A: 70% chance of appointing a female CEO, 30% male CEO.
Option B: A sure appointment of the male CEO.

Switching behavior across different probability levels is used to infer utility weights. If fatherhood increases utility for female candidate $u(C_F)$, this should be observable as a lower indifference point.

Theoretical Interpretation and Causal Design

Formally, under the vNM framework, the lottery is chosen if:

$$p \cdot u(C_F) + (1 - p) \cdot u(C_M) > u(C_M),$$

implying that higher utility is assigned to the female candidate. Crucially, since the gender of a child is randomly assigned at birth, fathering a daughter constitutes a natural experiment. This enhances the internal validity of the design and supports causal inference regarding identity-induced preference shifts.

Behavioral Implications

A consistent difference in behavior between men with and without daughters would imply that personal experience reshapes evaluative frameworks in predictable ways. These are not arbitrary deviations but structured shifts in salience, potentially induced by empathy, fairness concerns, or identity priming. As such, they challenge the assumption of time-invariant, context-independent preferences central to classical theory.

From a behavioral perspective, these shifts are not necessarily irrational – if preferences remain transitive and complete, they may still be modeled within a refined utility framework. However, they underscore the influence of emotion and identity in shaping high-stakes economic decisions, even at elite levels of corporate governance.

Toward a Neuroeconomic Interpretation

These insights raise further questions: How are such preference shifts instantiated in the brain? Can the salience of fairness or gender equity be traced to specific neural processes? Neuroeconomics offers tools to explore these questions, providing a biologically grounded framework for understanding how personal identity, emotion, and rationality interact during decision-making.

4.4 Neuroeconomics: Bridging Neuroscience and Economic Theory

Neuroeconomics extends classical utility theory by embedding valuation within the brain's architecture. Rather than treating preferences as fixed and exogenous, it models them as dynamic and context-sensitive – shaped by emotion, identity, and neural computation.

Neuroimaging studies show that regions like the ventromedial prefrontal cortex (vmPFC) and ventral striatum encode subjective value across diverse decision contexts, supporting the idea of a neural "common currency" for comparing costs and benefits (Peters & Buchel 2009, Levy et al. 2010, Delgado et al. 2012, Knutson et al. 2008). This biologically grounded mechanism forms the core of neuroeconomic models of decision-making under uncertainty and trade-offs. For a visual overview of how single neurons support information encoding relevant to valuation, see Figure 6, Appendix.

Interactive Utility and Axiomatic Violations

A key contribution comes from Talmi & Pine (2009), who propose an interactive model of utility that accounts for nonlinear integration between costs and benefits. Unlike additive models, this formulation captures how attributes interact in shaping decisions:

$$U = x(p_C) \cdot u(C) + x(p_B) \cdot u(B) + x(p_{C \cdot B}) \cdot u(C) \cdot u(B), \tag{2}$$

Here, $u(C)$ and $u(B)$ are the utilities from cost and benefit, respectively; $x(p_C)$, $x(p_B)$ their respective weights; and $x(p_{C \cdot B})$ captures synergistic or antagonistic effects. This structure reflects how neural systems integrate competing signals, modulated by emotional or contextual salience (Glimcher 2012, Levy 2012). For a comparative illustration of additive versus interactive utility models, see Figure 6, Appendix.

From the standpoint of revealed preference theory, the interactive model may satisfy WARP if the weights and utility functions remain stable across contexts. However, if neural processes dynamically reweight inputs due to affective priming, stress, or identity, then preference reversals may occur, violating WARP or even the *Generalized Axiom of Revealed Preference (GARP)*[8].

[8] **Formal Definition: Generalized Axiom of Revealed Preference (GARP)**
Let $x^t \in \mathbb{R}^L_+$ be the bundle chosen in period t, and let the budget set be $B^t = \{x \in \mathbb{R}^L_+ : p^t \cdot x \leq p^t \cdot x^t\}$, where $p^t \in \mathbb{R}^L_{++}$ is the price vector. Define the direct revealed preference relation $x^t \succeq^D x^s$ if $p^t \cdot x^s \leq p^t \cdot x^t$. The transitive closure of $\succeq^D$ is the revealed preference relation $\succeq^R$. Then:

[GARP] A dataset $\{(p^t, x^t)\}_{t=1}^T$ satisfies the **Generalized Axiom of Revealed Preference (GARP)** if for any $x^t \succeq^R x^s$, it is not the case that $p^s \cdot x^t < p^s \cdot x^s$.

In words, if bundle x^t is revealed (directly or indirectly) preferred to x^s, then x^t must not be strictly more expensive than x^s at the prices faced in s. A violation implies that no monotonic, locally non-satiated utility function can rationalize the data (Varian 1982).

Neuroeconomic Example: Parental Identity and GARP Violations

Consider a male board member tasked with repeated CEO selection decisions. Before becoming a parent, his choices reflect consistent preferences for male candidates based on financial performance:

$$B_1 = \{A, B\}, \text{ choose } A \quad (A \succ B)$$
$$B_2 = \{B, C\}, \text{ choose } B \quad (B \succ C)$$
$$B_3 = \{C, A\}, \text{ choose } C \quad (C \succ A)$$

This cycle $A \succ B \succ C \succ A$ violates transitivity and GARP. Now assume the board member becomes a father to a daughter. His evaluative weighting shifts toward diversity, and he now consistently favors the female candidate. While each decision may be internally coherent, the aggregate pattern reveals a structural inconsistency when viewed across time.

This illustrates how affective and identity-driven shifts – plausibly encoded in brain systems involved in empathy and value salience – can lead to endogenous transformations in preferences. From a neuroeconomic view, such reversals are not irrational per se, but reflect a biologically grounded, dynamically constructed form of rationality inconsistent with axiomatic models.

Social Neuroeconomics: The Neural Circuitry of Social Preferences

Neuroimaging research reveals that social preferences – such as trust, fairness, and altruism – are underpinned by specific neural circuits. Activity in the dorsal striatum has been linked to fair and cooperative behavior, suggesting that such outcomes are intrinsically rewarding (Fehr & Camerer 2007). Likewise, the prefrontal cortex (PFC) is engaged when individuals resolve conflicts between self-interest and social norms, as in punishment or trust-based decisions (Fehr & Gächter 2002, Sanfey et al. 2003).

Social norm enforcement, such as altruistic punishment, also activates reward-related areas like the striatum, indicating that upholding fairness can be gratifying even at personal cost (Fehr & Rockenbach 2004, de Quervain et al. 2004). The amygdala and PFC together support the interplay between emotional reactivity and rational evaluation in socially sensitive decisions. These findings challenge models based on pure self-interest and support a dual-process view, where economic behavior reflects the integration of affective responses and cognitive control within the brain's decision circuitry.

Neuroeconomic Application: Interaction of Cost and Benefit

Take another example: a board member evaluating two CEO candidates. One offers high financial return (B) but also carries ethical or reputational costs (C). Rather than summing these linearly, the decision-maker's brain may process them interactively. A moderate cost may become disproportionately aversive when coupled with a high-stakes benefit, due to emotional amplification in the insula or amygdala.

The interactive utility model (Equation 2) captures this. If the interaction term is negative and large, it may dominate the additive components and lead to rejecting the high-return candidate in favor of a safer, lower-return alternative. This behavior deviates from standard rational choice, yet aligns with biologically plausible mechanisms of affect-laden value integration.

In both examples, neuroeconomics reveals that internal consistency cannot be assumed – even when decision-makers are introspectively coherent. Instead, the brain's valuation architecture allows for dynamic, experience-sensitive adaptation that challenges static assumptions embedded in WARP and GARP.

Unconscious Preferences and Rationality

The neuroeconomic perspective suggests that even preferences shaped by affective cues or social identity – such as the increased salience of gender equity after becoming a father to a daughter – may remain internally consistent. In contrast to classical models that assume fixed, introspectively accessible utility functions, neuroeconomics posits that preferences can emerge from unconscious or emotionally charged processes while still conforming to rational choice theory.

Although such preference shifts may not be deliberate, they can still satisfy the core axioms of rationality – completeness and transitivity – so long as they yield coherent and stable rankings across repeated choices. Moreover, continuity suggests that gradual changes in preferences over time are consistent with coherent valuation. If the father's unconscious preference for female candidates increases gradually – say, through increased exposure or awareness – the change aligns with the continuity axiom. Conversely, abrupt and inconsistent preference shifts would challenge this axiom:

$$\forall A, B, C, \quad A \succ B \succ C \implies \exists p \in (0,1) \text{ such that } B \sim pA + (1-p)C.$$

Finally, independence requires that preferences between two options remain unaffected by the presence of a third. If the father's unconscious preferences are structurally consistent, they satisfy this axiom, meaning that preference comparisons are preserved under probabilistic mixtures:

$$\forall A, B, C, \quad (A \sim B) \implies (pA + (1-p)C \sim pB + (1-p)C).$$

Rational behavior, in this broader interpretation, does not require conscious awareness of one's preferences, only that those preferences manifest in a consistent and non-circular decision structure.

For instance, if a board member repeatedly chooses female CEO candidates after becoming a father to a daughter, and this pattern reflects a structured internal valuation process (even if shaped by identity and emotion), his choices may remain rational. What changes is not the logic of choice, but the weighting of attributes – such as fairness or inclusivity – within the utility function. In this way, neuroeconomics reconciles dynamic, experience-sensitive preferences with the formal structure of rational decision-making.

5 Theoretical Model: Decision-Making in Appointing a Female CEO with a Daughter

In this section, I introduce a theoretical model to explain why board members who are fathers of daughters may be more likely to appoint a female CEO. I integrate *Becker's model of children as an investment* and the *axioms of rationality* to explore how this behavior, even if unconsciously influenced, remains consistent with rational decision-making.

The classical framework of rational decision-making, as established in Section 4, is based on the axioms of rationality:. These axioms suggest that even if a board member's preferences are influenced by personal experiences, such as fathering a daughter, the decisions can still be rational if the preferences maintain structure and consistency. The *neuroeconomic perspective* adds a layer of understanding by incorporating the brain's emotional and social processes. A father who has a daughter may unconsciously develop preferences that align with gender equality, but these preferences still follow the traditional rational choice model.

Model of CEO Selection: Including Becker's Human Capital Theory

To analyze how the appointment of a female CEO might be influenced by a board member's experience of having a daughter, I use a utility-maximizing framework. The decision-maker (the board member) has a utility function U, which is a function of both the firm's financial performance and the board member's personal, family-related preferences.

Here I extend the utility function to reflect the personal and familial value associated with appointing a female CEO. Based on *Becker's theory of human capital*, a parent views their children as an investment, aiming to maximize the future well-being of their family (Becker

1964, 1981). When a board member has a daughter, they might perceive that promoting gender equality will improve their daughter's future economic opportunities (and his own). Let the utility function for the decision-maker be:

$$U = \alpha U_e + \beta U_f$$

Where U_e represents the *economic utility* derived from maximizing firm performance through the choice of CEO (financial return, productivity, etc.), and U_f represents the *family-related utility* associated with improving the daughter's future prospects by advancing gender equality in the workplace. The weights α and β indicate the importance placed on financial utility and family utility, respectively. Prior to having a daughter, the decision-maker places a higher weight on U_e, meaning the choice is primarily driven by economic considerations. However, after having a daughter, the weight on U_f increases, reflecting a shift in preferences toward promoting gender equality.

Thereafter I introduce a variable G, where $G = 1$ if the board member has a daughter, and $G = 0$ otherwise. The utility function now becomes:

$$U = \alpha U_e + \beta(1 + \gamma G)U_f$$

Here, γ is a positive parameter that reflects the change in preferences when the board member has a daughter. The term $(1+\gamma G)$ adjusts the weight on U_f to reflect the increased importance of family-related utility when $G = 1$ (i.e., after having a daughter).

Utility from Female CEO Appointment

Now, let's consider how the utility derived from the choice of a female CEO compares to that from a male CEO. If a female CEO_f is chosen, both U_e and U_f may be positively affected:

Economic impact: Studies have shown that firms with gender-diverse leadership often outperform those with homogeneous leadership Ahern & Dittmar (2012). Therefore, the choice of a female CEO could increase the firm's long-term financial prospects.

Family impact: Appointing a female CEO signals gender progressiveness, improving the prospects for the board member's daughter by reducing workplace gender barriers.

The overall utility from appointing a female CEO can be written as:

$$U(CEO_f) = \alpha U_e(CEO_f) + \beta(1 + \gamma G)U_f(CEO_f)$$

In contrast, the utility from appointing a male CEO would be:

$$U(CEO_m) = \alpha U_e(CEO_m) + \beta(1 + \gamma G)U_f(CEO_m)$$

Given that appointing a female CEO positively impacts both financial performance and family-related utility, a father with a daughter (i.e., $G = 1$) may rationally prefer CEO_f over CEO_m, as:

$$U(CEO_f) > U(CEO_m)$$

For readers interested in a more formal treatment of preference thresholds, majority voting outcomes, and comparative statics, an extended version of the model is presented in Appendix.

Becker's Investment in Children as an Explanation

Becker's model of children as an investment helps explain why a father's utility function changes after having a daughter. Just as parents invest in their children's education to maximize future returns, fathers may view promoting gender equality as a long-term investment in their daughters' careers. Appointing a female CEO can be seen as a step toward creating a more equal professional environment, which will ultimately benefit their daughters Becker (1981). Even if the board member's preferences change unconsciously after having a daughter, this shift is still rational according to the axioms of rationality. The decision-maker is maximizing a broader utility function that includes the well-being of future generations, consistent with Becker's theory of human capital investment.

6 Concluding Discussion

This paper has proposed a framework for understanding how personal experiences, specifically fatherhood can lead to preference shifts among male corporate board members without violating the foundational assumptions of rational choice theory. Drawing on insights from behavioral economics, neuroeconomics, and classical utility theory, I argue that such shifts may reflect a rational re-optimization of utility in response to new information and emotionally salient experiences, rather than irrational deviations.

Empirical studies documenting the "daughter effect" in corporate and political decision-making suggest that becoming the father of a daughter is associated with more gender-egalitarian behavior. While these findings are often interpreted through the lens of empathy or social identity, this paper has shown that such behaviors can also be understood as consistent with economic rationality. If new life circumstances affect how individuals value social outcomes, such as gender equity then updated preferences may still conform to the axioms of completeness and transitivity. In this view, board members may rationally revise their priorities not only for normative reasons, but also out of intertemporal utility considerations that include concern for their own and daughters' future prospects.

This interpretation aligns with dual-process models in behavioral science, where emotionally charged experiences can trigger both intuitive (System 1) and reflective (System 2) changes in decision-making. Fathers may become more attuned to structural barriers facing women through their daughters' experiences, and this awareness may, over time, be integrated into a revised utility function. Such adaptations may emerge from a combination of affective salience and deliberate reassessment, challenging the strict dichotomy between emotion and reason in economic models. Fathers may consciously or unconsciously reflect on these experiences, drawing from their roles as protectors or advocates for their daughters, and internalize a greater commitment to gender equality.

At the same time, the paper acknowledges that observed behavioral shifts – such as a greater likelihood of appointing female CEOs – are difficult to attribute solely to fatherhood. Without longitudinal or experimental evidence, distinguishing causal mechanisms remains a challenge. It is plausible that such decisions reflect not an inherent change in values but a reweighting of preferences to align more closely with perceived family interests. Moreover, concerns about selection bias, social desirability effects, and external validity complicate empirical interpretations.

To address these limitations, future research should prioritize randomized or longitudinal designs capable of isolating the effects of fatherhood from confounding institutional or contextual factors. Such studies could also examine whether the purported shifts in gender-egalitarian attitudes are stable or transient, thereby offering a more nuanced understanding of the phenomenon. It would also be valuable to investigate whether similar patterns emerge in less gender-normative societies and whether fathers of daughters exhibit increased altruism in game-theoretical contexts. Similarly, further scrutiny of mothers with sons could reveal complementary or contrasting dynamics worth exploring.

In addition to its contribution to theories of rational preference formation, this study also highlights a broader opportunity for integrating neuroeconomic methods into mainstream economic analysis. By linking neural processes of valuation, identity, and emotional salience to economic decision-making, neuroeconomics offers a biologically grounded extension of utility theory. These interdisciplinary insights may help explain how preferences evolve in response to experience and context, while maintaining coherence within rational choice frameworks.

Finally, the implications extend beyond corporate leadership. If emotionally significant experiences can shift preferences in predictable ways without undermining rationality, then policymakers, educators, and institutions may find new avenues for promoting inclusive behavior through experience-based interventions. Further research into the mechanisms and boundaries of such shifts – using both behavioral and neuroscientific tools – may provide a richer understanding of how economic agents adapt to a changing social world, and how those adaptations shape organizational and market outcomes.

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Table 2: Probit - New external Female CEO

	New external female CEO_{t-1}					
	(1)	(2)	(3)	(4)	(5)	(6)
DDD_{t-1}	0.108^{**}	0.106^{**}	0.109^{**}	0.111^{**}	0.110^{**}	0.115^{**}
	(0.042)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
DDS_{t-1}		-0.004	-0.001	0.002	0.002	0.006
		(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Board $size_{t-1}$			0.011			
			(0.009)			
Female $directors_{t-1}$				0.137^{***}	0.133^{***}	0.118^{***}
				(0.025)	(0.024)	(0.024)
Male $directors_{t-1}$				-0.019^{*}	-0.028^{**}	-0.035^{***}
				(0.011)	(0.011)	(0.011)
Out $director_{t-1}$					0.104^{**}	0.115^{***}
					(0.042)	(0.042)
Board HC_{t-1}						0.437^{***}
						(0.086)
Log(total $assets)_{t-1}$	-0.045^{***}	-0.045^{***}	-0.050^{***}	-0.044^{***}	-0.045^{***}	-0.050^{***}
	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)
Constant	1.134^{***}	1.136^{***}	1.194^{***}	1.116^{***}	1.126^{***}	1.189^{***}
	(0.264)	(0.264)	(0.269)	(0.270)	(0.270)	(0.269)
Observations	7913	7913	7913	7913	7913	7913

Clustered standard errors in parentheses. Industry and year fixed effects included in all specifications

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Probit - New external Female CEO - The average marginal effects (AME)

	New external female CEO$_{t-1}$					
	(1)	(2)	(3)	(4)	(5)	(6)
DDD$_{t-1}$	0.035**	0.035**	0.036**	0.036**	0.036**	0.037**
	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
DDS$_{t-1}$		-0.001	-0.000	0.001	0.001	0.002
		(0.014)	(0.015)	(0.014)	(0.014)	(0.014)
Board size$_{t-1}$			0.003			
			(0.003)			
Female directors$_{t-1}$				0.045***	0.043***	0.038***
				(0.008)	(0.008)	(0.008)
Male directors$_{t-1}$				-0.006*	-0.009**	-0.011***
				(0.003)	(0.004)	(0.004)
Out directors$_{t-1}$					0.034**	0.037***
					(0.014)	(0.014)
Board HC$_{t-1}$						0.142***
						(0.028)
Log(total assets)$_{t-1}$	-0.015***	-0.015***	-0.017***	-0.014***	-0.015***	-0.016***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	7913	7913	7913	7913	7913	7913

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < t0.01$

Supplementary Figures

Neural Foundations of Economic Computation

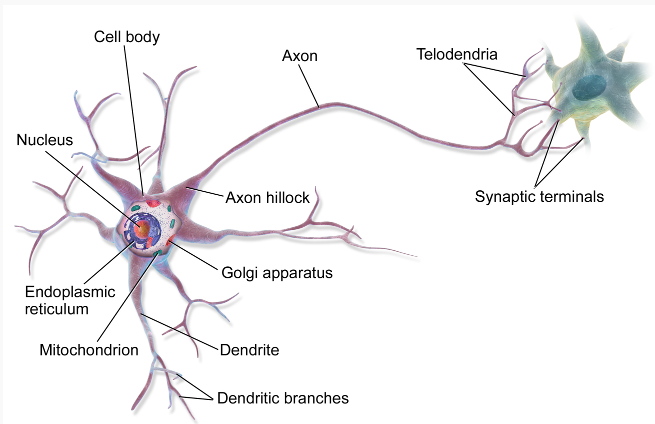

Figure A1: Illustration of a multipolar neuron.

A typical neuron consists of three main components: the cell body (soma), dendrites, and an axon. The soma houses the nucleus and supports vital metabolic activities, including the regulation of glucose and oxygen levels. Dendrites receive incoming signals, and the axon transmits outgoing electrical impulses, or action potentials. The brain's architecture reflects evolutionary constraints: maintaining long axons is metabolically costly, leading to optimized wiring (Van Essen 1997). This underpins neuroeconomics' use of functional Magnetic Resonance Imaging (fMRI), which relies on Blood-Oxygen-Level Dependent (BOLD) signals to localize cognitive computations. The BOLD signal reflects changes in blood oxygenation associated with neural activity, based on the principle that active brain regions require more oxygenated blood, thereby altering the local magnetic properties detectable by fMRI (Roy & Sherrington 1890). Despite the brain's vast complexity – around 100 billion neurons – single neurons can encode economic variables like reward magnitude or expected utility (Aidley 1998, Hodgkin & Huxley 1952). *Limitations:* The BOLD signal is delayed, spatially coarse, and weak. Careful averaging and artifact control are required in analysis.

Visualizing Utility Models: Additive vs Interactive

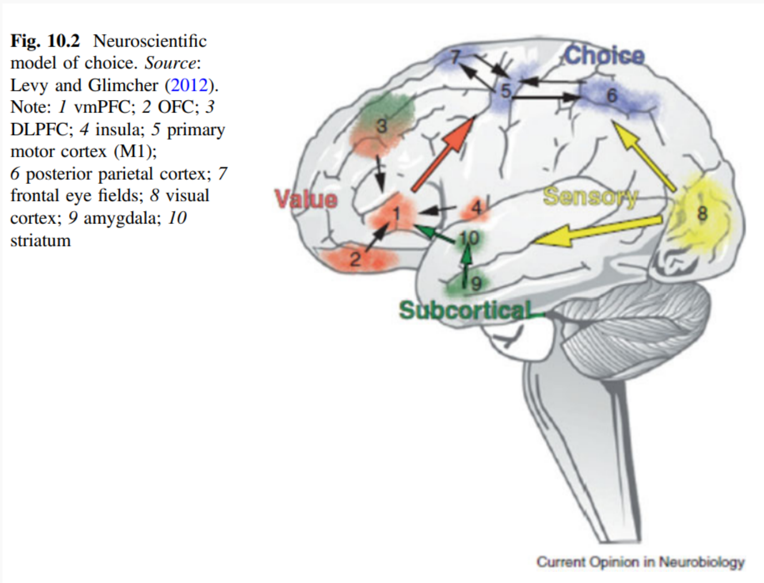

Figure A2: Comparison of additive and interactive utility models. Adapted from Talmi and Pine (2009).

This illustration compares two models of utility integration: the additive model assumes that costs and benefits contribute independently to overall value, whereas the interactive model captures how the perceived value of one attribute (e.g., benefit) depends on the magnitude of another (e.g., cost).
The interactive model better reflects findings from neuroeconomics showing that the brain integrates cost-benefit signals in a nonlinear, context-sensitive manner – often shaped by emotion, uncertainty, and social salience (Talmi & Pine 2009, Glimcher 2012, Levy 2012).

Extended Theoretical Model: Voting Behavior and Preference Thresholds

Let θ_i denote the relative weight that director i places on social utility, such that $\theta_i = \frac{\beta(1+\gamma G)}{\alpha+\beta(1+\gamma G)}$.

Consider the difference in utility between appointing a female and a male CEO:

$$\Delta U^i = U^i(CEO_f) - U^i(CEO_m) = (1-\theta_i)[U_e(CEO_f) - U_e(CEO_m)] + \theta_i[U_f(CEO_f) - U_f(CEO_m)]$$

Let $\Delta_e = U_e(CEO_f) - U_e(CEO_m)$ and $\Delta_f = U_f(CEO_f) - U_f(CEO_m)$. Then:

$$\Delta U^i = (1-\theta_i)\Delta_e + \theta_i \Delta_f$$

A director supports appointing a female CEO if $\Delta U^i > 0$. Solving for the threshold value θ_i^* at which the director is indifferent yields:

$$\theta_i^* = \frac{-\Delta_e}{\Delta_f - \Delta_e}$$

Hence, if $\theta_i > \theta_i^*$, the director prefers the female CEO. Since θ_i increases with G, directors with daughters are more likely to exceed the threshold and favor female candidates.

Board-Level Voting Outcome

Assume board decisions are made by simple majority rule. Let the board consist of N directors. The final CEO appointment depends on the number of directors for whom $\theta_i > \theta_i^*$. Define the board-level support for a female CEO as:

$$S = \sum_{i=1}^{N} \mathbb{I}\{\theta_i > \theta_i^*\}$$

A female CEO is appointed if $S > \frac{N}{2}$. Thus, the model predicts that the probability of appointing a female CEO increases monotonically with the share of directors who have daughters, provided this influences θ_i.