CORPORATE GOVERNANCE, FIRM DYNAMICS & SECURITY DESIGN

KAIPICHIT RUENGSRICHAIYA*

30^{th} June 2023

PIER Research Workshop
Thailand

*DISCLAIMER & COPYRIGHTS : The opinions expressed in this document are those of the author and should not be attributed to author's affiliations.

Contents

Corporate Governance, Firm Dynamics and Security Design

1 OVERVIEW

MOTIVATION : How to price corporate governance (CG) **theoretically**?

METHOD

Corporate Governance	• mechanism to deal with agency conflict & protect investors • legally enforceable (*Law and Finance*)
Firm Dynamics	• conflict b/w ownership vs control e.g. shareholder vs manager, controlling vs minority shareholders • dynamics : investment - intertemporal incentive, while CG is static
Security Design	• implement dynamic contract by financial instruments (using mathematical finance & financial engineering methods) • exhibit CG as a part of security price

RESULT : More complete understanding of CG in firm dynamics & its price

2 MOTIVATION : GOVERNANCE MECHANISM IN AN ECONOMY & ISSUES

- Capitalism economy bases on private property rights : *people have the right to own private property and on its benefits*

- Capitalism trade-offs b/w gain from specialization and cost from agency problem[1]

- the prosperity of an economy depends very much on investor protection, as proven by literature of *Law and Finance*, originated by LLSV (1998)[2]

- governance mechanism provides investor protection, through laws, enforcement and internal governance of the firm

GOVERNANCE MECHANISM IS A GUARDIAN OF CAPITALISM

[1] Investors (owner of money invested and controlled by manager) need protections from expropriations to guarantee the benefit of their property, otherwise there is no future investment, and cost of capital increases in aggregate level

[2] La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998), Law and Finance, *Journal of Political Economy*

- despite its importance, our understanding of governance mechanism on firms, relationship between investors and agents, and the economy has been so far
  - lacking of theory *(unsynthesised-unsystematic)*,
  - understanding of CG on economy bases on basic intuition and collections of evidences

- current predominant idea of CG is **Free Cash-flow Theory (FCF)**; Jensen(1986)

Idea of FCF

manager abuses free cash-flow & expropriates investors for his private benefit $\Rightarrow$ both employment contract and governance mechanism (CG) limits the expropriation

when $CG \uparrow \Rightarrow$ investor protection $\uparrow$ & private benefit $\downarrow \Rightarrow$ profit $\uparrow$ & price $\uparrow$

- most studies on CG, both theoretical and empirical, base on FCF

- FCF inconsistent with current circumstances : widely used *dynamic incentives* and *empirical studies (puzzle) of governance and stock price*
  - **not answer** many fundamental questions
  - **static** and conceptual
  - **inconsistent** with practices and facts
    - dynamic executive compensation, conditional on performance
    - empirical puzzle of governance and stock price

- fundamental questions to be explained by **better understanding of CG**

  (i) VALUE of governance mechanism and share price

  (ii) INCENTIVE to use and improve good governance

  (iii) EFFECTS ON A FIRM, esp on share price, executive compensation, profit

3 MODEL & KEY RESULTS

3.1 CONTRIBUTIONS OF DYNAMIC PERSPECTIVE OF GOVERNANCE MECHANISM

1. More complete idea of consequences of governance mechanism (g) on elements of a firm (both static and dynamic context), answer all fundamental questions
2. Subsume the STATIC VIEW OF FCF as a case
3. Explain empirical puzzle of governance and security price (and suggest remedy)
4. Offer better understanding of on
   - firm dynamics (contract, profit, compensation)
   - time inconsistency in corporate governance $(g \uparrow$ at first $\Rightarrow g \downarrow$ later$)$
   - government intervention on firm's governance

3.2 MODEL : A BRIEF VIEW

- methodology : dynamic contract with hidden actions and investment in continuous time
- logical progression of the results
  - step 1 : characterise the optimal contract, the binding agreement on key variables
    - ⋆ governance level of the firm, two parties must agree and respect
    - ⋆ investment policy (process)
    - ⋆ executive compensation policy (process)
    - ⋆ optimal terminal time to terminate contract
  - step 2 : characterise the security price of the firm when optimal contract is implemented
  - step 3 : comparative static analysis of optimal contract, hence the security price

- MODEL COMPOSITION 1 : Governance Mechanism
  - it promotes investor rights on voting & information, hence induces investor protection against expropriation
  - composes of two contributions
    - ⋆ Legal Requirement (in laws)
    - ⋆ Internal Governance[3] (g) beyond the law
  - renegotiable b/w principal & agent
  - legally enforceable

[3] the agreement on the extend of investors' right and discretion of management such as investor's vote on structural change of the firm organisation, limitation on managerial power, executive compensation determination, financial & capital structure

- MODEL COMPOSITION 2 : Investment & Production Technology
  - Capital Dynamics

$$dK_t = (I_t - \delta K_t - b_t \zeta(g) K_t)\, dt$$

⋆ $b_t \in \{0, 1\}$ is stealing decision and unobservable

⋆ $\zeta(g)$ is rate of capital distortion

▷ $\zeta(0) > 0$: if firm follows law, high distortion

▷ $\zeta'(g) < 0$: if firm increase governance, distortion reduces

NOTE : hence governance *controls the damage, but cannot guarantee* the decision "no stealing" $(b_t = 0)$

- Productivity & Effort

$$dA_t = a_t dt + \sigma dZ_t$$

  - ⋆ $a_t \in \mathbb{R}_+$ is effort and unobservable
  - ⋆ Z_t is the standard Brownian Motion

- Cash Flow Dynamics (Performance)

$$dY_t = K_t \left(dA_t - L(i_t)dt \right)$$

  - ⋆ $L(\cdot)$ is convex adjustment cost depending on investment per capital

- MODEL COMPOSITION 3 : Agent's (CEO's) Preference and Decisions

$$\Big(\underbrace{U_t}_{\text{compensation}} - \underbrace{H(a_t;g)}_{\text{effort cost}} \Big) dt + \underbrace{b_t \zeta(g) K_t}_{\text{private benefit}} \; dt$$

⋆ ASSUMPTION : $\frac{\partial^2 H(a,g)}{\partial a \partial g} > 0$ complementarity in effo rt cost

- using *Revelation Principle* at any instance

1. Instantaneous Participation Constraint

$$U_t - H(a_t;g) \geqslant 0; \quad \forall t \in [0,\tau]$$

2. Instantaneous Incentive Constraint[4] (no stealing)

$$U_t^g \geqslant U_t + \zeta(g) K_t; \quad \forall t \in [0,\tau]$$

- both constraints together require

$$U_t^g - H(a_t;g) \geqslant \zeta(g) K_t; \quad \forall t \in [0,\tau]$$

[4]where τ is terminal time and U_t^g compensation process satisfying instantaneous IC

- MODEL COMPOSITION 4 : Principal's (Investor's) Preference and Decisions

$$dY_t - U_t^g dt; \qquad \forall t \in [0, \tau]$$

  - ⋆ His benefit is the cash flow net of compensation to CEO

- MODEL COMPOSITION 5 : Contract $\{I_t, U_t^g, \tau; g\}$, agree on g first, then characterise $\{ I_t, U_t^g, \tau \}$

  - Agent solves

$$\sup_{\{a_t, b_t; t\in[0,\tau]\}} \mathbb{E}^a \left[\int_0^\tau e^{-\gamma t} \left(U_t^g - H(a_t; g) + b_t \zeta(g) K_t \right) dt \right]$$

  - Principal solves, assuming $\gamma \geqslant r$

$$F(W_0, K_0) = \sup_{\{I_t, U_t^g; t\in[0,\tau]\}} \mathbb{E} \left[\int_0^\tau e^{-rt} dY_t - \int_0^\tau e^{-rt} U_t^g dt + e^{-r\tau} l K_\tau \right].$$

3.3 PREVIEW OF KEY RESULTS

- under following circumstance

  1. Profit depends dynamically on effort and corporate investment
  2. CEO's effort and stealing decisions are unobservable

- KEY RESULT 1 : incentive structure for agent (CEO) is a trade-off between Static Incentive (Private Benefit) against Dynamic Incentive (Incoming Profit & Executive Compensation)

  Static Incentive : Absence of Corporate Stealing

$$U_t^g = H(a_t; g) + \zeta(g)K_t; \quad \forall t \in [0, \tau].$$

  - the agent will be indifferent between stealing $(b_t = 1)$ and no stealing $(b_t = 0)$ at any time
  - *no-arbitrage* argument

- **Embed** static incentive compatible compensation into dynamic motivation

Dynamic Incentive : Optimal Intertemporal Effort Provision

Define *Continuation Value* of the agent

$$W_t = \mathbb{E}^a \left[\int_t^\tau e^{-\gamma(s-t)} \left(U_s^g - H(a_s; g) \right) ds \right]$$

- Optimal Incentive is characterized through continuation value : $\exists \lambda_t$

$$dW_t = \gamma W_t dt - \underbrace{(U_t^g - H(a_t; g))dt}_{=\zeta(g)K_t dt} + \lambda_t \underbrace{(\sigma K_t dZ_t)}_{=dY_t - K_t(a_t - L(i_t))dt}$$

  where $dY_t - K_t(a_t - L(i_t))dt$ induces dynamic alignment to principal's net cashflow and $\lambda_t = \frac{\partial H(a,g)}{\partial a}$ and instantaneous constraints hold with equality

- The expected evolution continuation value

$$\mathbb{E}\left[dW_t + \underbrace{\zeta(g)K_t dt}_{\text{Instantaneous Control Rent}} \right] = \gamma W_t dt$$

- KEY RESULT 2 : optimal dynamic contract induces

$$a_t \in argmax_{\{\tilde{a}\in[0,\infty)\}}\{\lambda_t \tilde{a}_t - H(\tilde{a}_t; g)\}; \quad \forall t \in [0, \tau]$$

$$b_t = 0; \quad \forall t \in [0, \tau]$$

$$\frac{I_t^*}{K_t} = i_t^* = \frac{q_t - 1}{\theta} = \left(\frac{f(w_t) - w_t f'(w_t) - 1}{\theta}\right); \quad \forall t \in [0, \tau]$$

$$\frac{U_t^g}{K_t} = u_t^g = \frac{H(a_t; g)}{K_t} + \zeta(g); \quad \forall t \in [0, \tau]$$

  - optimal effort provision[5]
  - No stealing
  - Marginal-q investment rule
  - g controls instantaneous rent and dynamic compensation of CEO

Notice : Agent still get control rent, but it can be changed by (re)negotiation on governance (g)

[5] marginal benefit is equal to marginal cost of effort

INVESTOR'S PROFIT : Investor's Profit Functional (in per capital unit), $f(\cdot) = \frac{F(\cdot)}{K_t}, w_t = \frac{W_t}{K_t}$

$$\underbrace{(r+\delta)f(w_t)}_{\text{rate of return}} = a_t - h(a_t; g) - \zeta(g) + \frac{(q_t-1)^2}{2\theta} \qquad \text{Level}$$

$$+ \left((\gamma+\delta)w_t - \zeta(g)\right) f'(w_t) \qquad \text{Slope}$$

$$+ \frac{1}{2}\lambda_t^2 \sigma f''(w_t) \qquad \text{Curvature}$$

⋆ Boundary Conditions, let l be the liquidation rate

1. Terminal Condition (Lower Boundary) : $f(0) = l$
2. Smooth Pasting Condition (Upper Boundary) : $f'(\bar{w}) = -1$
3. Supper Contact Condition (Upper Boundary) : $f''(\bar{w}) = 0$

⋆ Profit function is *strictly concave*.

- g affects level, slope and rate of change of profit of investor

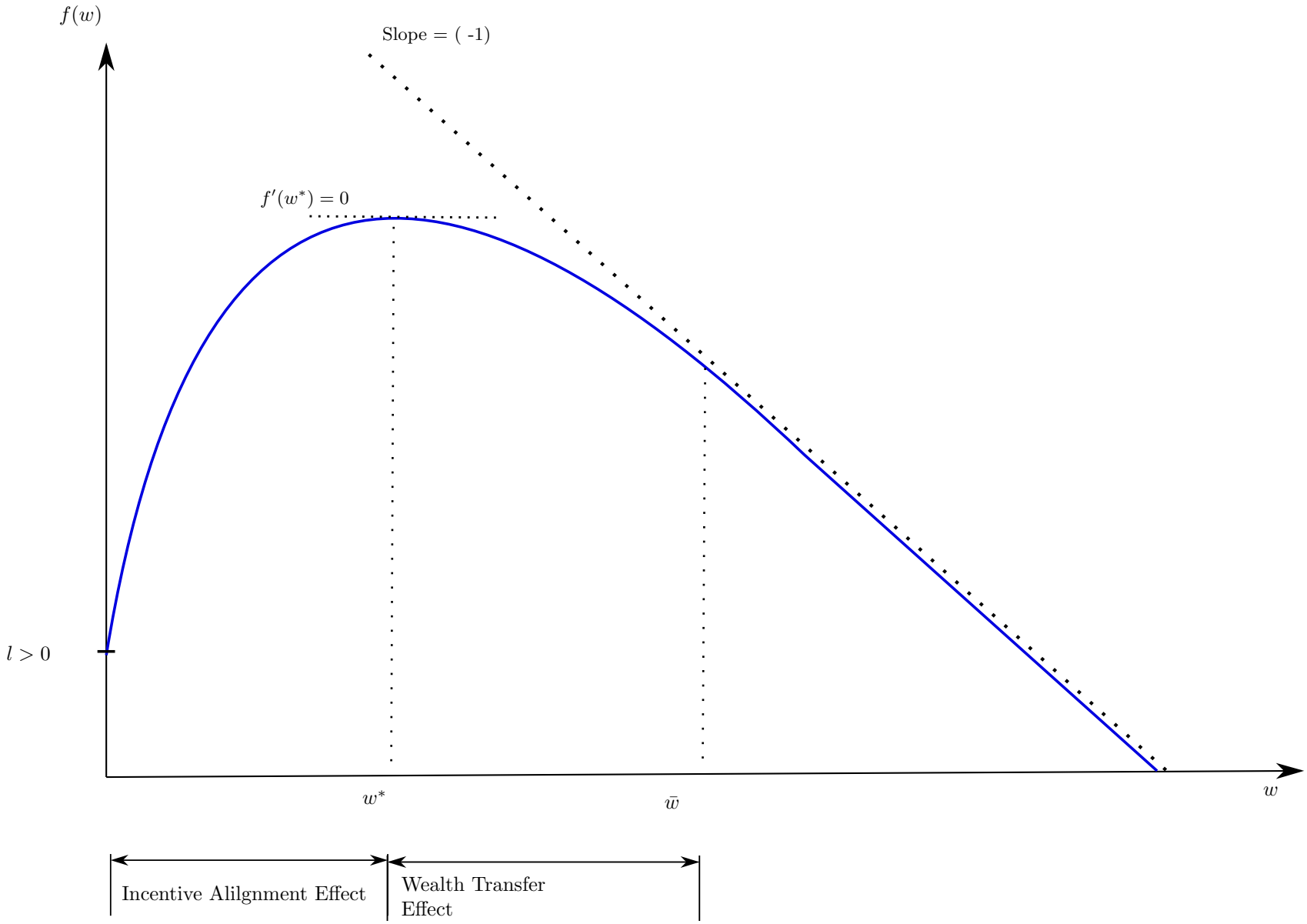

Figure 1: The shape of investor's profit function

- KEY RESULT 3 : when both parties agree to increase governance (renegotiation on CG), $g \uparrow$, *incentive alignment is intensified in which the profit function become more concave*, hence along the firm dynamics,
  - ⋆ In *initial* stage, compensation ↑ AND profit ↑ **(*similar* to static view)**
  - ⋆ In *mature* stage, compensation ↑ BUT profit ↓ **(*contrast* to static view)**

Holding the level of profit unchanged : $g \uparrow \Rightarrow \zeta(g) \downarrow$ & $\lambda \uparrow$,

• Better intensify CEO's incentive to firm's growth and profit b/c

1. $\zeta(g) \downarrow$ (lower instantaneous control rent)
2. $\lambda \uparrow$ (higher dynamic incentive alignment)

Shifting relative weight : $dW_t = \gamma W_t - (\zeta(g) \downarrow) K_t dt + (\lambda_t \uparrow) \sigma K_t dZ_t$

• Investor's profit is more concave (see figure 2 next page) : assuming effect of $(g \uparrow)$ of profit's level is canceled out

1. magnitude of slope ↑ : $((\gamma + \delta) w_t - (\zeta(g) \downarrow)) f'(w_t)$
   where $f'(w) > 0$ when $w \in (0, w^*)$ and $f'(w) < 0$ when $w \in (w^*, \bar{w})$
2. maximal point ↓ : $w^* \downarrow$
   Overall

$$\frac{\partial f(w)}{\partial g} \begin{cases} > 0; & \text{if } w \in (0, w^*) \quad \text{profit} \uparrow \text{ at initial stage} \\ < 0; & \text{if } w \in (w^*, \bar{w}) \quad \text{profit} \downarrow \text{ at mature stage} \end{cases}$$

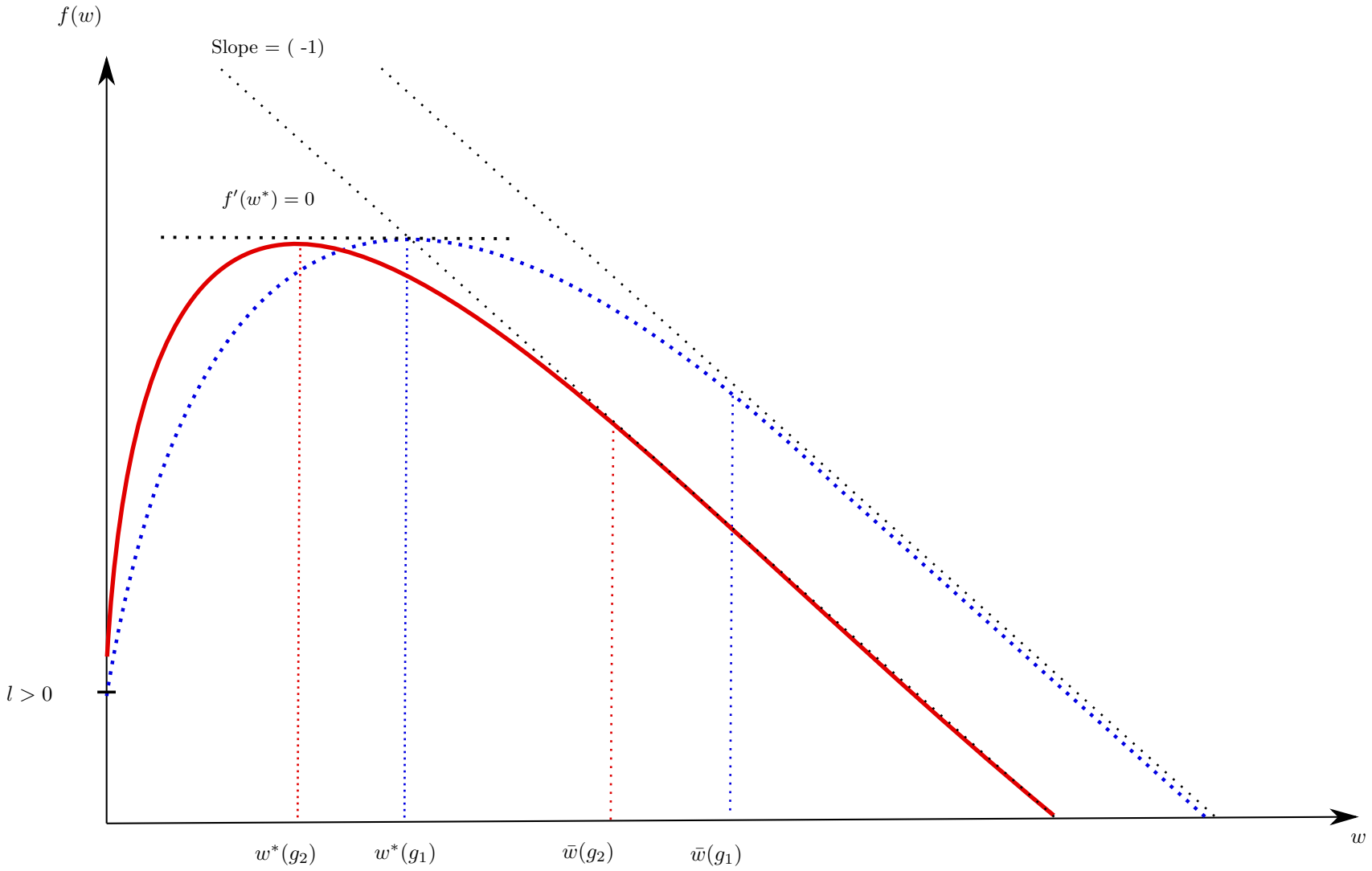

Figure 2: The shape of investor's profit function with better governance ($g_2 > g_1$) with neutralization on the level effect

- KEY RESULT 4 : contract implementation yields security price (S_t)

Define $\zeta(g) = \Omega - \psi(g)$

Ω : a constant reflecting *distortion due to law* (good country has low Ω)

$\psi(g)$: investor protection due to firm's internal governance $(\psi'(g) > 0)$

Implementing Optimal Dynamic Contract by [6]

- Pure equity-financed firm with the required dividend D_t

$$dD_t = K_t \left(a_t - L(i_t)\right) dt - (\gamma - r) M_t dt.$$

- Define financial flexibility[7] or liquidity M_t

$$dM_t = rM_t dt + dY_t - dD_t - dX_t$$

[6] This is not unique. Other financial structure can also implement the optimal contract

[7] to keep track on continuation value

The security price under optimal contract

$$S_t = F(W_t, K_t) + \frac{W_t}{\lambda_t} - \mathbb{E}\left[\int_t^\tau e^{-r(s-t)}\Omega K_s ds\right] + \mathbb{E}\left[\int_t^\tau e^{-r(s-t)}(\psi(g))K_s ds\right].$$

$$S_t = \underbrace{F_t}_{\text{profit}} + \underbrace{\frac{W_t}{\lambda_t}}_{\text{compensation}} - \text{country's discount}_t + \text{firm's premium}_t$$

IMPORTANT IMPLICATIONS

- Effects of country's law and firm's governance are separated from operation profit and executive compensation (e.g control premium)
- The governance elements in security price exists in both public and private corporations[8]
- Static nature of corporate governance, including country's law and firm's internal governance, has dynamic context

[8] This result is general to all types of firms

- From key results, we can extend the analysis to
  - explain empirical puzzle and suggest the remedy
  - explain time inconsistency in corporate governance
  - with information about liquidation rate, explore the benevolence of government intervention in governance

NOTE : the details are in Appendix C

4 KEY TAKE-AWAYS

- we model firm dynamics with governance mechanism using continuous-time contract; then implement the optimal dynamic contract using tools and ideas from financial engineering, including non-arbitrage argument, martingale representation theorem , Feynman-Kac theorem $\Rightarrow$ Linkage among Law and Economics and Finance

- corporate governance in firm dynamics and security design broadens the perspective on the effects of governance mechanism on a firm

- some important implications

  1. if renegotiate for $g \uparrow$, do it at the beginning (initial stage); it is *rational* to renegotiate for $g \downarrow$ later (in mature stage)
  2. value of governance in security price depends on how long you use it
  3. in some cases, enhanced governance hurts profit

APPENDICES

A PROOF OF OPTIMAL INCENTIVE STRUCTURE (KEY RESULT 1)

Idea : Embedding Static Incentive into Dynamic Incentive & Create the Multiplier (λ_t) inducing a martingale of the investor's value (profit).

Benefit : Explicit Trade-Off between Instantaneous (Static) and Intertemporal (Dynamic) Incentive

Given U_t^g, agent's dynamic incentive is captured by the dynamic continuation value. From

$$V_t = \mathbb{E}^a \left[\int_0^t e^{-\gamma s}(U_s^g - H(a_s; g))ds + e^{-\gamma t} W_t \right]$$

We have

$$dV_t = e^{-\gamma t} \left[(U_t^g - H(a_t; g))dt + dW_t - \gamma W_t dt \right] \tag{1}$$

Similarly, the value of total expected benefit in another form.
By martingale representation theorem, there exists λ_t that makes the total ex-

pected benefit a martingale.

$$V_t = V_0 + \int_0^t e^{-\gamma s} \lambda_s \left(dY_s - K_s(a_s - L(i_s))ds \right)$$

We also have

$$dV_t = e^{-\gamma t} \lambda_t \sigma K_t dZ_t \tag{2}$$

From the equality of (1) and (2),

$$e^{-\gamma t} \left[(U_t^g - H(a_t; g))dt + dW_t - \gamma W_t dt \right] = e^{-\gamma t} \lambda_t \sigma K_t dZ_t,$$

We hence have *Dynamic Continuation Value* (dW_t)

B PROOF OF CHANGE IN GOVERNANCE (KEY RESULT 3)

From Profit Function

$$
\begin{aligned}
(r+\delta)f(w_t) = a_t \underbrace{-h(a_t;g)-\zeta(g)}_{=-u_t^g} + \frac{(q_t-1)^2}{2\theta} && \text{Level} \\
+ \left((\gamma+\delta)w_t - \zeta(g)\right) f'(w_t) && \text{Slope} \\
+ \frac{1}{2}\lambda_t^2 \sigma f''(w_t) && \text{Curvature}
\end{aligned}
$$

Using comparative statics (both direct & indirect derivatives) & Feynman-Kac with respect g

$$
\frac{\partial f(w_t)}{\partial g} = \mathbb{E}^{w_0=w}\left[\int_0^\tau e^{-(r+\delta)t}\left(-\frac{\partial u_t^g}{\partial g} - f'(w)\frac{\partial \zeta(g)}{\partial g}\right)dt\right]
$$

- Level Effect : $\frac{\partial u_t^g}{\partial g} = \underbrace{\frac{\partial h(a_t;g)}{\partial g}}_{\text{cost}} + \underbrace{\frac{d\zeta(g)}{dg}}_{\text{benefit}}$
- Slope Effect : $-f'(w)\frac{\partial \zeta(g)}{\partial g}$

where

- $\frac{\partial h(a_t;g)}{\partial g} > 0$, $\frac{d\zeta(g)}{dg} < 0$
- By concavity : $f'(w) > 0$ for $w \in (0, w^*)$ and $f'(w) < 0$ for $w \in (w^*, \bar{w})$

- To highlight the effect of $g \uparrow$ on *incentive structure* (*shape* of profit function) $\Rightarrow$ level of expected value of manager does not change by g
- **Neutralize** the level effect by assuming $|\frac{\partial h(a_t;g)}{\partial g}| = |\frac{d\zeta(g)}{dg}|$

$$\frac{\partial f(w)}{\partial g} = \mathbb{E}^{w_0=w}\left[\int_0^\tau e^{-(r+\delta)t}(-f'(w_t))\zeta'(g)dt\right]$$

Then

$$\frac{\partial f(w)}{\partial g}\begin{cases} > 0; & \text{for } w \in (0, w^*), \text{ due to } f'(w) > 0 \\ < 0; & \text{for } w \in (w^*, \bar{w}), \text{ due to } f'(w) < 0 \end{cases}$$

- Turning point : $\frac{\partial w^*}{\partial g} < 0$

CONSEQUENCE : When $g \uparrow$, the scaled profit function become more concave and reaches maximum & upper boundary sooner

NOTE : If we do NOT neutralize the level effect, we will see a shift of the curve

Assuming $\underbrace{|\frac{\partial h(a_t;g)}{\partial g}|}_{\text{size of cost}} < \underbrace{|\frac{d\zeta(g)}{dg}|}_{\text{size of benefit}}$

- Level effect is positive
- Profit function is more concave

See Figure 3 next page

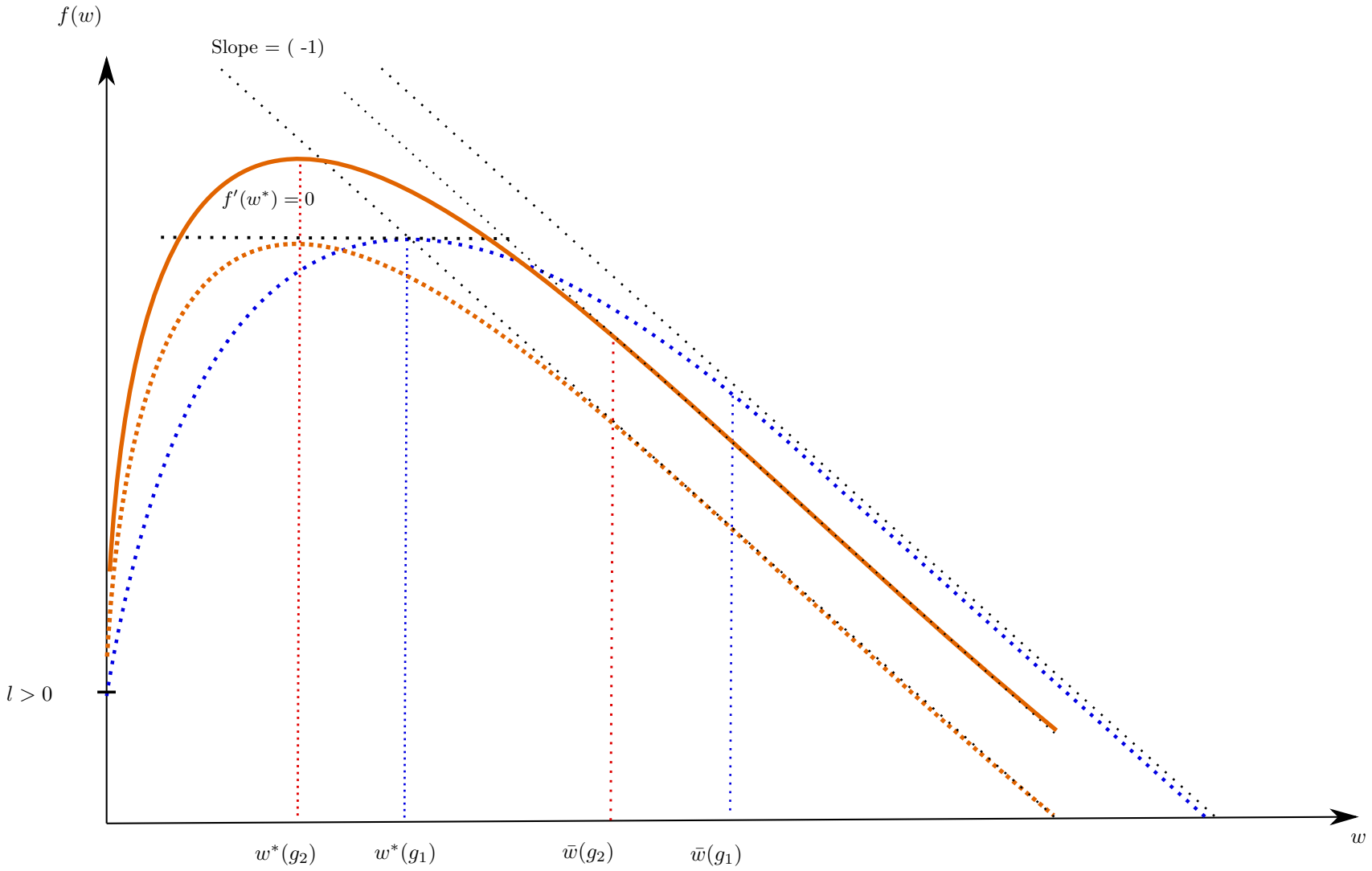

Figure 3: The shape of investor's profit function with better governance ($g_2 > g_1$) with positive net level effect

C FUTHER ANALYSES AND RESULTS

Explaining Empirical Puzzle : Empirical studies show unclear contributions of corporate governance on security price

In per-capital form, security price per unit of capital (s_t)

$$s_t = \underbrace{f_t}_{\text{profit}} + \underbrace{\frac{w_t}{\lambda_t}}_{\text{compensation}} \quad \text{- country's discount}_t \text{ + firm's premium}_t$$

Cross-sectionally, $g \uparrow \Longrightarrow$ firm's premium $\uparrow$, however

$$\frac{\partial f(w)}{\partial g} \begin{cases} > 0; & \text{if } w \in (0, w^*) \quad \text{profit } \uparrow \text{ at initial stage} \\ < 0; & \text{if } w \in (w^*, \bar{w}) \quad \text{profit } \downarrow \text{ at mature stage} \end{cases}$$

$\star$ Mixing samples in both stages could create empirical puzzle

REMEDY

1. Control the stage of the firm (eg. growth stocks VS value stocks)
2. Separate samples according to CEO's potential contribution (eg. hi-tech firm VS fund management firm)

Some Further Results

When liquidation rate (l) is high enough

- Incentive alignment effect disappears (figure 4)
- No investor's benefit from $g \uparrow$ (figure 5)
- Government intervention for $g \uparrow$ hurts investor's profit (consistent with Larker-Ormazabal-Taylor (2011, JFE))

For examples,
(1) Low contribution of CEO to firm's growth
(2) Mild agency problem

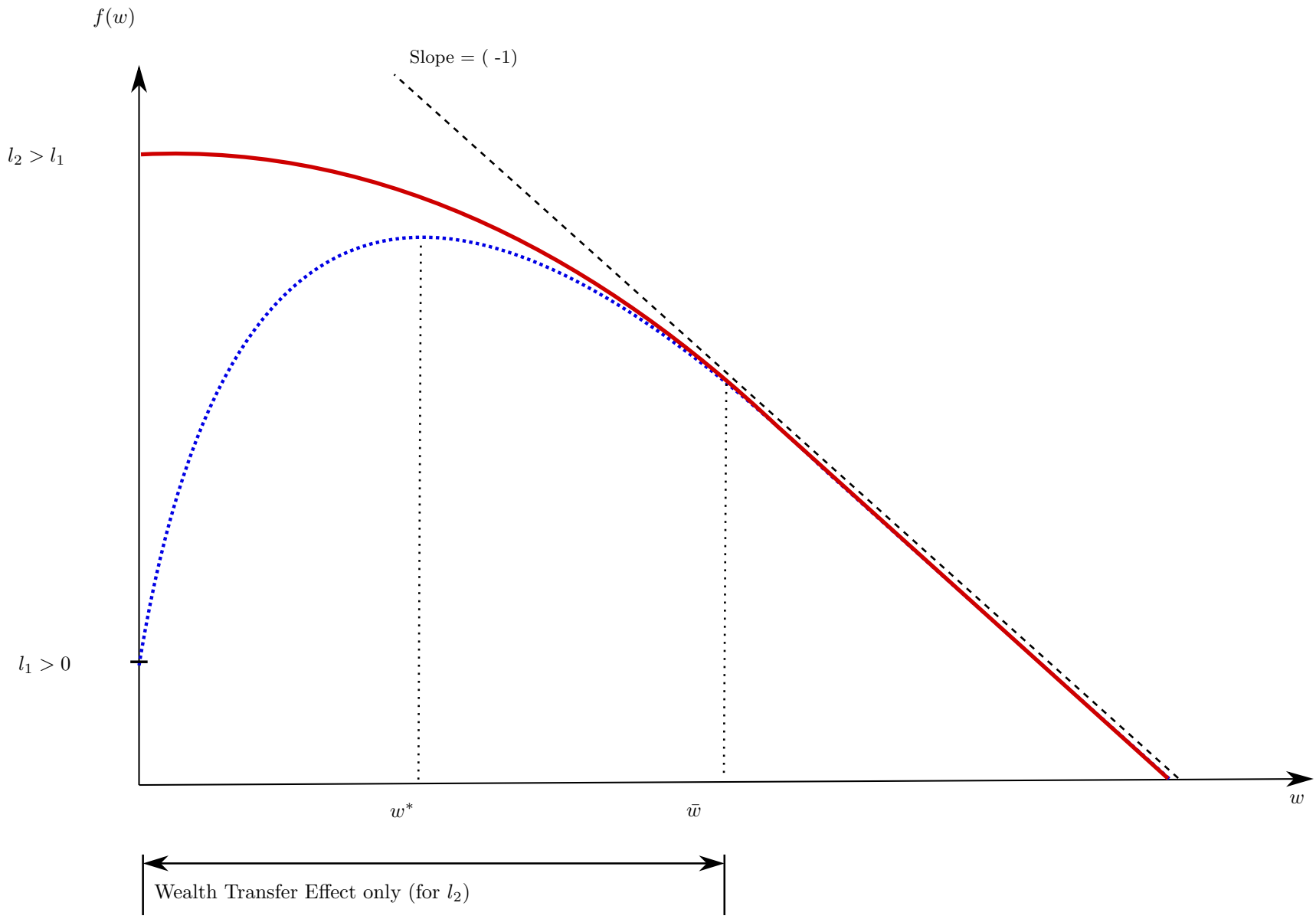

Figure 4: The shape of investor's profit function with higher liquidation rate ($l_2 > l_1$)

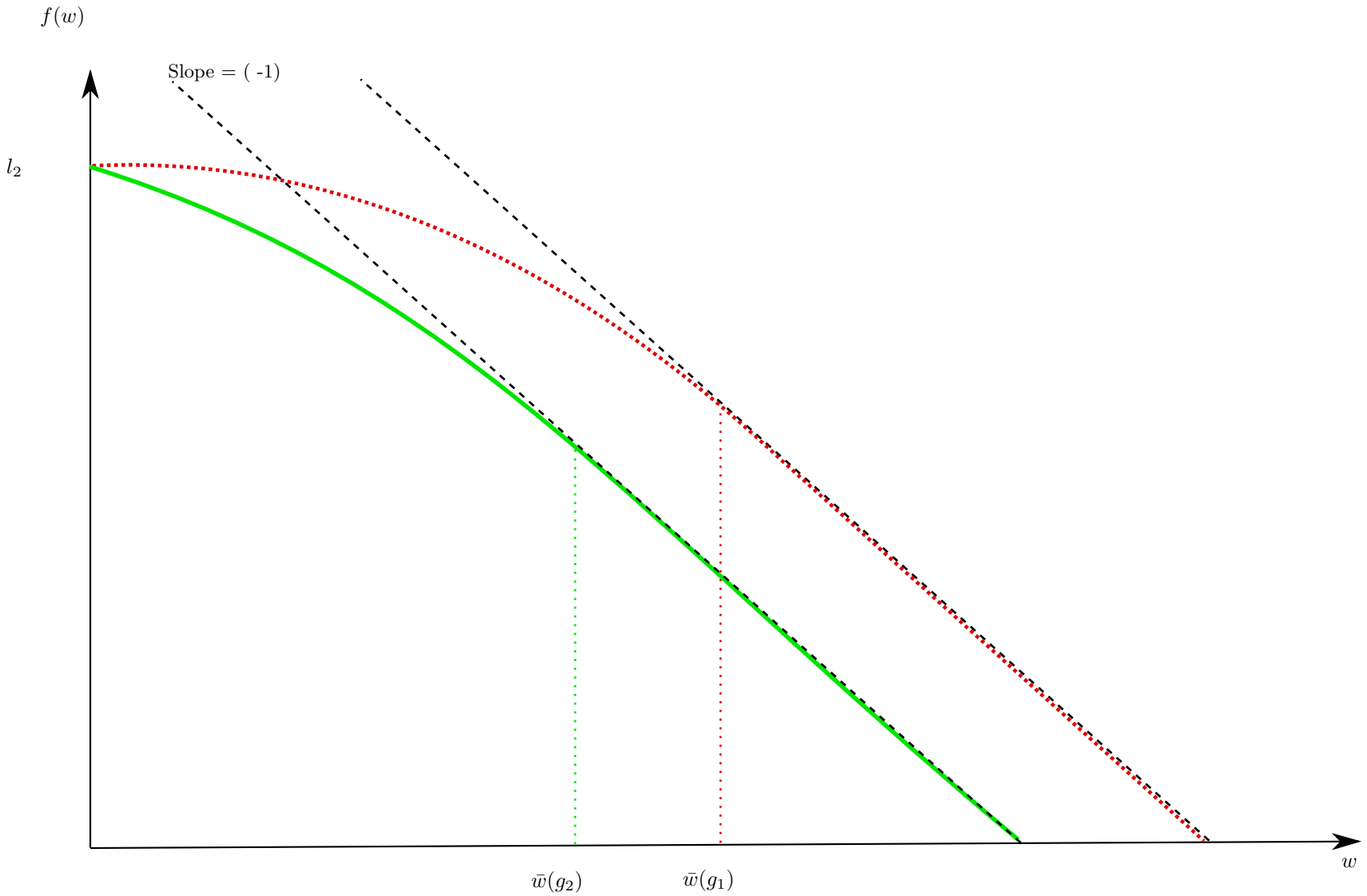

Figure 5: The shape of investor's profit function with high liquidation rate (l_2) and strengthen governance ($g_2 > g_1$)