Intangible Capital and the Decline of Corporate Leverage in the EU

CompNet Annual Conference 2025

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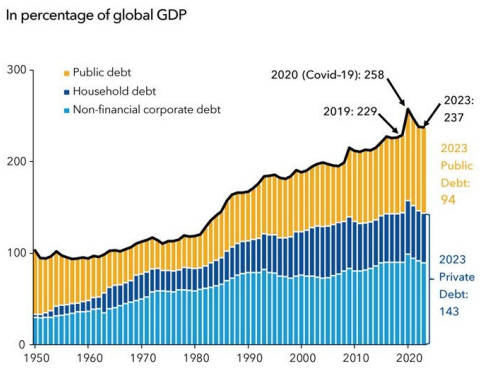
Motivation

- There is growing concern around increasing levels of **global debt**:
  - The level of public debt can prove critical for industrial policy and resilience to shocks.
  - Household debt is taking a rising share of private debt.
  - What about **firms**?



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1. Present evidence of a puzzling trend of **declining corporate leverage** between 2000 and 2020 in the EU.
   - parallel to rising cash holdings.
2. Construct a **model of firm behavior** to account for different driving factors.
   - Both supply vs demand side forces.
3. Provide an explanation based on **growing productivity of intangible capital** vs tangible capital.

Existing Literature

- Standard theory: low interest rates and abundant liquidity $\Rightarrow$ corporate demand for credit $\uparrow$.

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Existing Literature

- Standard theory: low interest rates and abundant liquidity $\Rightarrow$ corporate demand for credit $\uparrow$.
- Evidence of declining leverage in the US (Bellon et al. 2024) and in other advanced economies (Khoo and Durand 2017; Dao and Maggi 2018; Beck et al. 2023).
- Possible explanations:
  - **Bank credit tightening** (e.g. Basel III) (Whited and Wu 2006; Almeida and Campello 2007; Kaplan 2019; Corbisiero and Faccia 2020; Kalemli-Özcan, Laeven, and Moreno 2022).
  - **Secular stagnation** and declining business dynamism (Gordon 2012; Eichengreen 2015; Jones and Philippon 2016; Eggertsson, Mehrotra, and Robbins 2019).
  - **Changing nature of firm assets** (Corrado and Hulten 2010; Döttling and Perotti 2017; Sun and Xiaolan 2019; Dell'Ariccia et al. 2021; Crouzet and Eberly 2023).
  - **Declining corporate tax** (Dallari et al. 2018).

Data

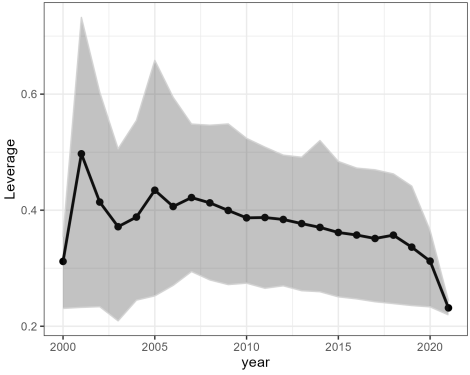
- We rely on the **CompNet dataset**[1]:
  - Micro-aggregated moments from underlying population of firms with at least 20 empl.
  - Reweighted moments to improve representativeness.
  - 19 EU countries (incl. DE, FR, IT, ES, NL).
  - Unbalanced panel between 2000 and 2021.
  - More than 350.000 firms
  - Manuf. firms are between 35% in 2006 and 30% in 2018.
- Variables from income statement, balance sheet, investment survey.
- unit in our data: moment (mean, p50, ...) of variable X in year Y, country C and industry I.

Detail on Country Coverage Detail on Industry Coverage

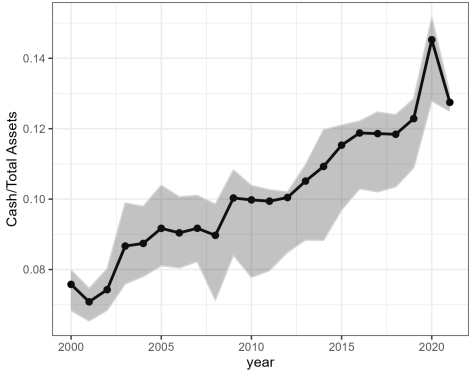
[1] https://www.comp-net.org/

Main Trends

(A)



(B)



Leverage (A) is defined as total debt over total assets; cash holdings (B) are cash and cash equivalen over total assets. All figures report a weighted average in the solid line and p75-p25 values in the shaded area. Filtered Trend

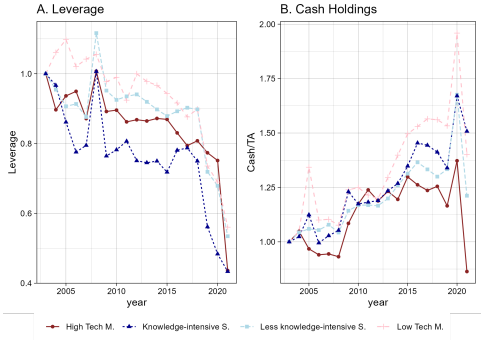
Demand vs Supply

- Leverage decline may be caused by two broad categories of factors:
  1. **"Supply side"**: Credit tightening and/or declining corporate tax rate.
  2. **"Demand side"**: Secular stagnation and/or changing demand for credit.

- An explanation based on credit tightening would imply that firms should be **increasingly constrained**, but we find:
  - Stable or declining share of liquidity or credit constrained firms (European Central Bank 2025). See Graph
  - Declining interest burden. See Graph
  - Moderately increasing dividends. See Graph

Changing Investment Needs

- **Intangible capital** is associated with lower demand for debt. (Sun and Xiaolan 2019; Dell'Ariccia et al. 2021).
  - Poor collateral theory vs low demand for cash in advance.
- Notoriously hard to measure, especially when it is firm specific and developed in house.
  1. proxy with knowledge intensity (Eurostat 2025).



Panel A. Weighted average of leverage as total debt over total assets by industry level knowledge intensity. Panel B. Weighted average of cash holdings as share of total assets by industry level knowledge intensity. Breakdown of Manufacturing and Services in differ classes based on knowledge intensity is available at Eurostat 20 Total Assets used as weights.

Taking Stock

In this study, we focus on the demand side:

- Firms have abundant liquidity $\Rightarrow$ bank credit tightening seems to be insufficient to explain the decline in leverage.
- Focus on **intangible capital**, but allow for other mechanisms to play a role.
- Market power and business dynamism are endogenous.
- There is probably no unique smoking gun.

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- From the utility maximization equilibrium demand for variety i of good j is:

$$y_{it} = \left(\frac{p_{it}}{p_t(j)}\right)^{-\eta} \left(\frac{p_t(j)}{P_t}\right)^{-\theta} Y_t$$

- $p_t(j)$ and P_t are price indexes and Y_t is total production.

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  - K_t and H_t are tangible and intangible capital.
  - l_t and h_t standard and skilled labour.
  - set p_{it} and production inputs $X_{it} = \{H_t, K_t, h_t, l_t\}$ to maximize profits.

Production Factors

Labour is remunerated with wages $w = 1$ and q.

Capital is **built in-house**.

- Convex investment cost $c_K(K)$ and $c_H(H)/\phi_i$
- $\phi_i \sim G()$ heterogeneous ability to deploy intangible capital.

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  - **H** is **embedded in key skilled workers**, who can take part of the asset with them, should they depart from the firm.
  - At Poisson rate $\lambda(H)$ a new potential entrant tries to poach h.
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- The firm needs to build **cash reserves**.

Role for Finance and Timing

- Firms face a liquidity problem when managing their investments:
  1. Start period t with liquidity from $t-1$: Q_{t-1}.
  2. Can finance total investment with Q_{t-1} or debt D_t at interest r.
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  3. Capital fully depreciates.
- Each period:
  1. Firm starts with Q_{t-1} and set up equilibrium investment in $\{K_t, H_t\}$, covering the cost with Q_{t-1} and/or D_t.
  2. Shocks occur to capital. $\Rightarrow$ **Investment is sunk**
  3. Bankruptcy or move on to production and pricing decisions.
  4. Profits π_t are collected, interest and wages are paid out.
  5. Leftover cash Q_t can be distributed or saved for next period. $\Rightarrow$ **$\mathbf{Q_t}$ is the only state variable**

Static Optimization

In each period the firm solves:

$$
\begin{aligned}
\underset{X_{it}, D_{it}, p_{it}}{max} \quad & \pi_{it} = p_{it} y_{it} - (1 + r_t) D_{it} - q_t h_{it} - w_t l_{it} - \mathcal{C}(H, K, \phi_i) \\
\text{s.t.} \quad & A_t F(H_{it}, K_{it}, h_{it}, l_{it}) = y_{it} \\
& \mathcal{C}(H, K, \phi_i) \leq D_{it} + Q_{it-1} \\
& \mathcal{C}(H, K, \phi_i) = \sum_{s \in \{H,K\}} c_s(S_{it}) + Q_S(S_{it}) \\
& D_{it} \geq 0 \ , \ Q_{it-1} \geq 0
\end{aligned}
\tag{1}
$$

which delivers an equilibrium solution $\Theta(\phi, Q_{t-1}) = [X, D, p](\phi, Q_{t-1})$.

Details on Solution

Dynamic Optimization

Each period the firm faces a **tradeoff** between using Q to **finance investment** or keep it as **savings** to reduce probability of exit $\varphi(Q) = e^{-\delta-\lambda(H^*(Q))}$:

$$V(Q) = max_{Q' \leq \Pi(Q)}\{\Pi(Q) - Q' + \beta\varphi(Q)V(Q')\}$$

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Implicitly defines a **target buffer**:

- $\Pi(Q) \leq Q^*$: firm is cash constrained and retains all available cash: $Q' = \Pi(Q)$.
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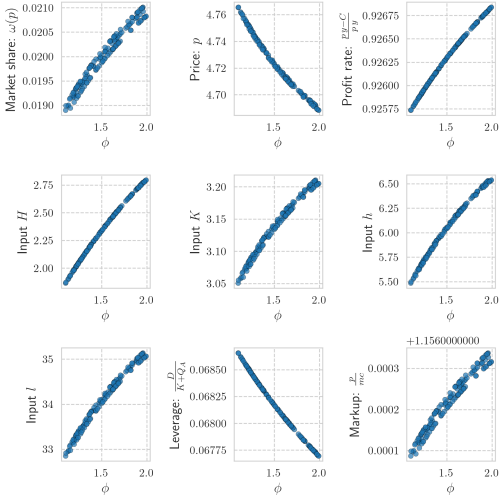
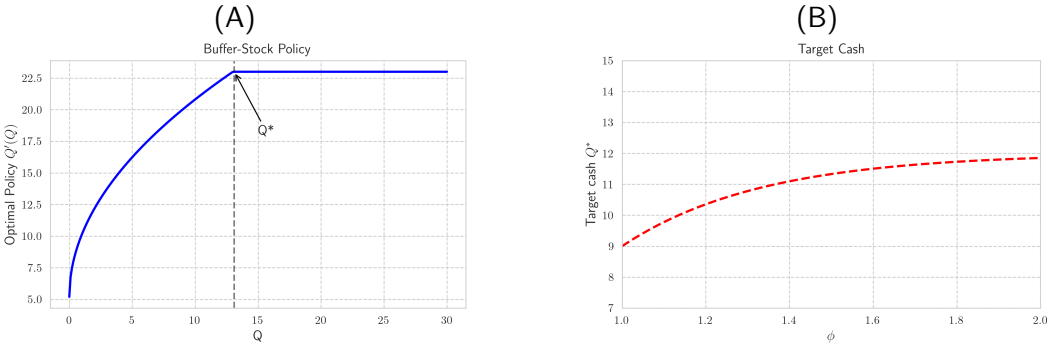
Optimal policy ('Buffer-stock'): $\mathbf{Q'} = \mathbf{min}\{\mathbf{\Pi(Q)}, \mathbf{Q^*}\}$

Solution Details

Firm level ϕ_i drives within firm economies of scale:



Optimal Policy



(A) Optimal policy $Q'(Q)$ for a given firm. (B) Equilibrium distribution of Q^*.

Scenarios

We simulate different scenarios to test multiple alternative and concurring explanations of the general trends we observe:

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To be able to account for all mechanisms, we introduce two new features in the model:

- Endogenous interest rates allowing for preferential access to tangible intensive firms:
  $r(K) = \bar{r}(1 + K^{\kappa})^{-1}$, $\kappa > 1$
- Endogenous taxes allowing for interest rate deductibility:
  $\tau(D) = \bar{\tau}(1 + D^{\psi})^{-1}$, $\psi > 1$

The terms enter into the profit maximization of each firm.

Updated Profit maximization

Simulations

Different scenarios:

- An increase in relative productivity of intangible capital: $\alpha : 0.5 \rightarrow 0.4$.
- A credit tightening: $\kappa : 2.3 \rightarrow 1.7$.
- Secular stagnation: $A : 1.5 \rightarrow 1.1$.
- Reduction in corporate taxation $\bar{\tau} : 0.4 \rightarrow 0.34$.

Try them one-by-one and jointly.

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	Data			**Model**				
	2001	2020	% ch.	Intang. prod.	Credit tight.	Sec. stag.	Tax cut	All
Leverage	0.40	0.32	–0.23	–0.12	–0.06	–0.04	–0.01	–0.19
Cash holdings	0.08	0.13	0.51	0.63	0.01	0.30	0.30	0.45
Profitability	0.03	0.05	0.62	0.40	-0.05	0.15	0.23	0.80

Conclusions

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  - More work needed in exact calibration of our framework
- Understanding the forces behind these changes has implications for monetary policy, macroprudential policy and growth.

Thank You for Your Attention

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APPENDIX

Country Coverage

Country	Years	Number of Firms (CompNet) First Year	Number of Firms (CompNet) Last Year	Number of Firms (Population) First Year	Number of Firms (Population) Last Year
Belgium	2000-2020	6915	11197	15200	16054
Croatia	2002-2021	3872	6070	6462	6834
Czech Republic	2008-2020	15375	9808	21216	21586
Denmark	2001-2020	10288	9755	15198	12670
Finland	1999-2020	6044	9471	8473	10611
France	2003-2020	79801	86442	107491	97193
Germany	2001-2018	-	-	36607	186987
Hungary	2003-2020	11957	11936	16267	15347
Italy	2006-2020	53001	51432	94578	75769
Latvia	2007-2019	4155	4271	5765	4466
Lithuania	2000-2020	4409	6183	5788	7067
Netherlands	2007-2019	19506	23399	28977	27022
Poland	2002-2020	27733	31747	38656	48972
Portugal	2010-2020	18231	19261	18598	20982
Romania	2005-2020	23654	21788	25172	25447
Slovakia	2004-2019	3987	13160	5521	14877
Slovenia	2006-2021	2717	3380	3209	4418
Spain	2008-2020	20187	23846	77145	70137
Sweden	2003-2020	12635	15669	16999	19370

Note: The table presents the number of firms in the sample by country and year. The "CompNet" columns represent firms from the Competitiveness Network dataset, while "Population" columns refer to the full population of firms in the country. Missing values in Germany are indicated by a dash (-) and are due to confidentiality requirements.

Back to Main Presentation

Macro-Sector Coverage

Macrosector	Number of Firms (CompNet) First Year	Number of Firms (CompNet) Last Year	Number of Firms (Population) First Year	Number of Firms (Population) Last Year
Manufacturing	92618	110545	197383	175831
Construction	33890	41176	53560	71740
Wholesale & Retail Trade	60685	84292	95686	144618
Transportation	18147	29701	32974	52765
Accommodation & Food Serv.	12619	28290	25958	66096
ICT	10096	17844	17763	29820
Real Estate	3933	4708	6488	8530
Professional Services	14060	26133	41614	50530
Admin & Support Services	15125	30847	32595	60398

Note: The table presents the number of firms in the sample by macrosector (1-digit level of NACE Rev. 2 classification) and year. The "CompNet" columns represent firms from the Competitiveness Network dataset, while "Population" columns refer to the full population of firms in the country. Back to Main Presentation

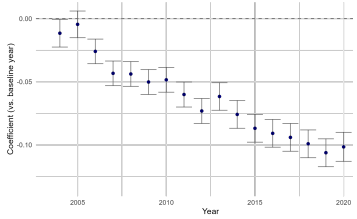
Controlling for Firm Characteristics

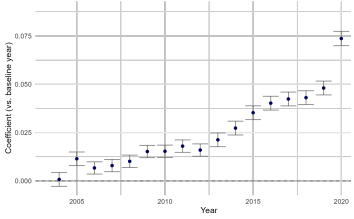
Trends in leverage and cash are independent from firm characteristics:

- Fit regression:

$$lev_{cjt} = \alpha_j + \alpha_c + \gamma_t + \delta' \cdot X_{cjt} + \varepsilon_{cjt}$$

- and plot $\hat{\gamma}_t$.
- c, j, t stand for country, industry, year.
- X_{cjt} controls for age, size, profitability, share of tangible asset, interest payment over sales.





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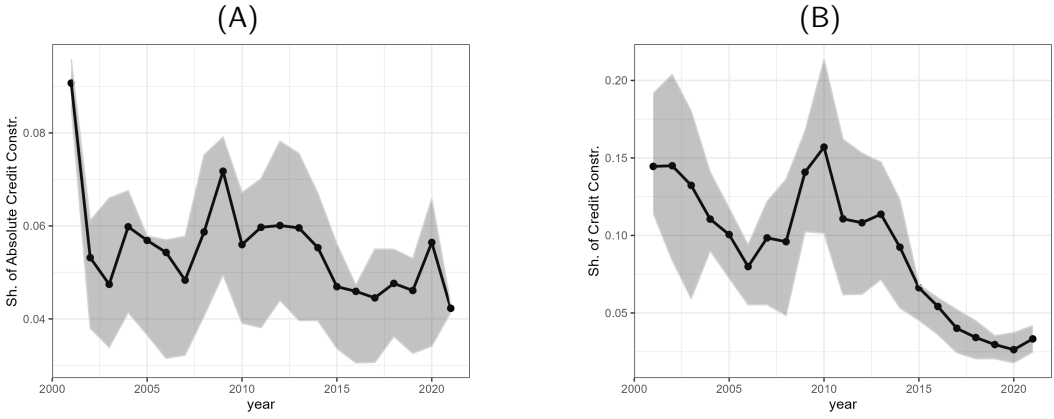
Declining Share of Constrained Firms



(A) Share of credit constrained firms. A firm is considered credit constrained if it has positive investment and total investment higher than the current cash flow as well as a concurrent reduction of debt and capital. Alternatively, a firm is considered constrained if, although disinvesting, ha positive financing gap. (B) Share of credit constrained firms according to the ECB SAFE survey definition (Ferrando and Ruggieri 2018). All figu report a weighted average in the solid line and p75-p25 values in the shaded area.

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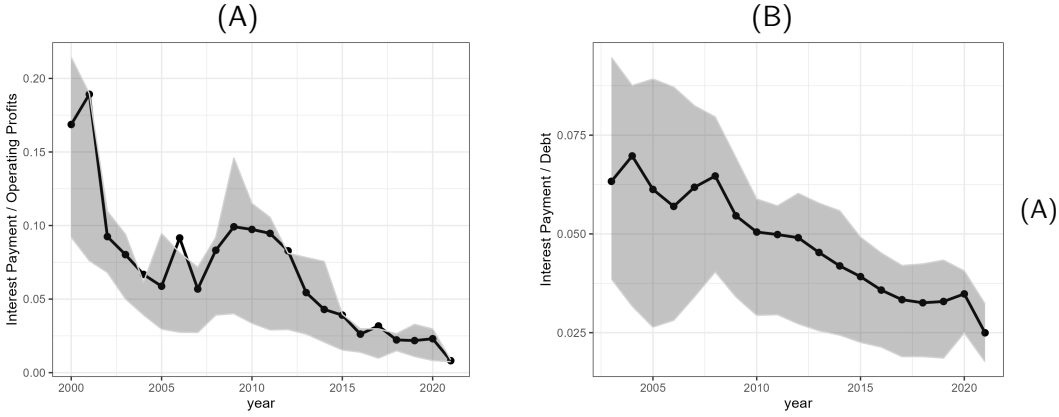
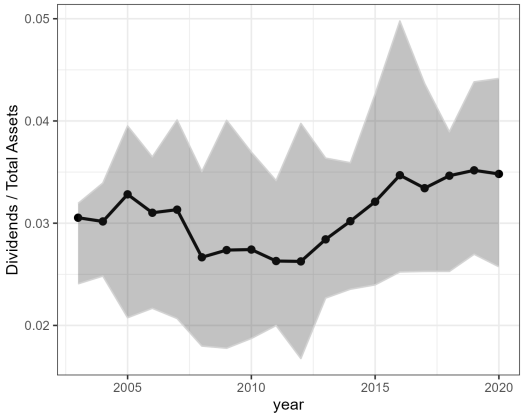
Declining interest burden



Interest Burden is defined as interest payments over operating profits. (B) Interest payments as a share of total debt. All figures report a weighted average in the solid line and p75-p25 value in the shaded area. Back to Main Presentation

Dividends



Dividends as share of total assets. The figure reports a weighted average in the solid line and p75-p25 values in the shaded area.

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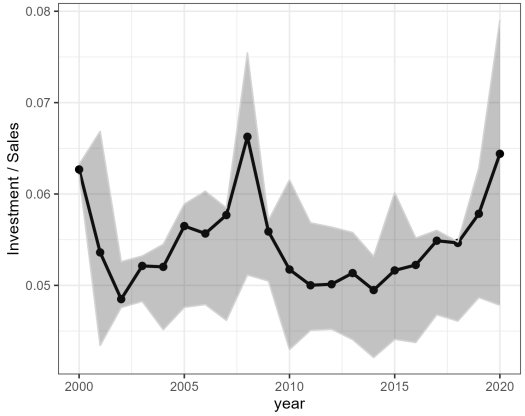
Coporate Investment



Total investment in tangible capital or externally acquired intangible assets as a share of tota assets. The figure reports a weighted average in the solid line and p75-p25 values in the shad area.

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Parameter Values

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Technology	
α	0.50
ρ	0.60
ζ	0.30
γ	0.30
A	1.50
Cost function	
c_K	1.50
c_H	1.50
ω_H	2.10
ω_K	2.10
w	1.00
Household	
θ	4.50
η	7.50
L	6000.00
v	0.15
τ	0.40
ψ	2.30
Spillover	
λ_0	0.05
λ_1	1.06
δ	0.50
Interest rate	
r	0.03

Static Solution Strategy

We proceed by breaking down the problem in two parts:

- First, solve cost minimization given demand y_{it} and prices $\{p_{it}\}_{\forall i \in j, \forall j \in \mathcal{J}}$. Retrieve equilibrium $X_{it}(\phi, p, Y, q, Q_{t-1})$ and required $D_{it} = max\{0, \mathcal{C}_{it} - Q_{i,t-1}\}$.
- Second, solve outer fixed point loop for the price distribution using the markup rule due to CES demand:

$$p_{it}(Y, q, Q_{t-1}) = \frac{\varepsilon_{it}}{\varepsilon_{it} - 1} mc_{it}(p_{it}; Y, q, Q_{t-1}) \tag{3}$$

- Finally derive aggregate variables Y and q as a function of initial cash distribution imposing free entry condition and labour market clearing:

$$\nu \bar{L} = \int_0^1 \sum_{i=1}^{n_j} h_{it}^*(Y, q, Q_{t-1}) dj$$

$$(1 - \nu) \bar{L} = \int_0^1 \sum_{i=1}^{n_j} l_{it}^*(Y, q, Q_{t-1}) dj$$

- End up with equilibrium Y,q,X,D,p as a function of Q.

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Updated Firm Static Problem

$$
\begin{aligned}
\underset{X_{it},\, D_{it},\, p_{it}}{max} \quad & \pi_{it} = (1 - \tau(\mathbf{D_t}))\left[p_{it} y_{it} - \mathbf{r}(\mathbf{K_t}) D_{it} - q_t h_{it} - w_t l_{it} - \mathcal{C}(H, K, \phi_i)\right] \\
\text{s.t.} \quad & A_t F(H_{it}, K_{it}, h_{it}, l_{it}) = y_{it} \\
& \mathcal{C}(H, K, \phi_i) \leq D_{it} + Q_{it-1} \\
& \mathcal{C}(H, K, \phi_i) = \sum_{s \in \{H,K\}} c_s(S_{it}) + Q_S(S_{it}) \\
& D_{it} \geq 0 \ , \ Q_{it-1} \geq 0
\end{aligned}
\tag{4}
$$

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