Promotion, Turnover and Compensation in the Executive Market

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Introduction

What are executives paid for?

- CEOs are paid more than executives in lower ranks.
- Average tenure of a CEO is five years.
- They are mainly promoted internally.
- Is promotion to CEO a reward for excellent service at lower ranks?
- The income volatility of CEOs is also much higher.
- Rent from human capital or risk premium?
- Are there non pecuniary benefits?

Introduction

What we do: develop and estimate structural model

- Formulate a dynamic model where there is:
  1. Moral hazard and incentive concerns
  2. Human capital, firm specific and general
  3. Job turnover stimulated by demand from firms for a mix of executive talent and idiosyncratic (private) shocks to executives.
- Identify non pecuniary benefits of jobs, human capital, risk premium, span of control.
- Estimate model and compute importance of factors above.

Introduction

Background literature

- There is a growing literature on estimating structural models of contracting.
- See Ferral and Shearer (99), Margiotta and Miller (00), Dubois and Vukina (05), Bajari and Khwaja (06), D'Haultfoeviller and Fevrier (07), Einav, Finkelstein and Schrimpf (07), Nekipelov (07), Gayle and Miller (08a,b,c).
- In related work Gibbons and Murphy (92) test implications of optimal contract with career concerns, and Frydman (05) presents evidence on turnover and general human capital.
- There is little empirical work relating career hierarchies to human capital, promotion and job turnover.
- See Baker Gibbs and Holmstrom (94) for a case study of one firm.

- Briefly describe the data.
- Develop a structural model.
- Discuss identification and estimation.
- Present preliminary results from structural model.

Data

Sources

- S&P ExecuComp database.
- Compensation and title on top 5 paid executives (1992-2006).
- 30,614 executives with at least one year of data.
- 2818 firms S&P 500, midcap, smallcap.
- Matched sample with background data from "Who's Who".
- Matched 16,300 executives in 2100 firms.
- Compensation data:
  - Direct compensation (cost to shareholders): salary, bonus, value of restricted stocks and options granted, retirement and long-term compensation schemes
  - Total compensation (relevant for manager): also include wealth changes from holding firm options and stocks

Data

Ranks and transitions

- We constructed a life-cycle based hierarchy of 7 ranks:
  - Rank 1 includes Chairman
  - Rank 2 includes CEO
  - Rank 4 includes COO
  - Rank 5 includes Senior VP
- See Gayle, Golan and Miller (2008) for details.
- Most executives do not move in any given period.
- Internal promotion by one rank is the most common job transition.
- 99% of Rank 2 executives are not demoted.They occur more frequently at lower levels, 5% in Rank 3, 7% in Rank 4.
- There is more exit than entry in lower ranks.
- There is more entry than exit at higher ranks.
- A small percentage of transition involves turnover.
- Movers are more likely to change ranks than stayers, with promotion more likely than not below Rank 2.

Data

Job mobility within the firm

Table 2a: Internal Transitions

	RANK 1	RANK 2	RANK 3	RANK 4	RANK 5	RANK 6	RANK 7	Size	exit	%exit
RANK 1	88	6	3	1	1	0	0	3995	487	12
RANK 2	4	95	0	0	0	0	0	20150	929	5
RANK 3	3	14	78	3	1	1	0	6272	1370	22
RANK 4	1	2	3	86	4	2	1	19359	2624	14
RANK 5	1	1	2	7	85	2	1	15781	2356	15
RANK 6	0	0	1	6	6	85	2	14646	2248	15
RANK 7	0	1	1	6	3	7	81	5581	1035	19
entries	1303	1872	1447	2634	1981	1086	726			
%entries	33	9	23	14	13	7	12			

Data

Job mobility between firms

Table 2b: Turnover

	RANK 1	RANK 2	RANK 3	RANK 4	RANK 5	RANK 6	RANK 7	Size	Size	Trans
								Moves	Rank	Rate
RANK 1	52	36	8	4	1	0	0	165	3995	4.1%
RANK 2	19	58	9	5	7	1	0	389	20150	1.9%
RANK 3	10	40	26	14	9	1	1	140	6272	2.2%
RANK 4	3	21	7	40	12	11	5	281	19359	1.5%
RANK 5	2	36	10	14	34	3	1	211	15781	1.3%
RANK 6	0	9	8	30	8	34	10	130	14646	0.9%
RANK 7	2	13	4	30	6	19	26	53	5581	0.9%
Total	188	496	141	244	160	96	44	1369	85748	1.6%

Table 4: Executives Characteristics
Age, Gender, Education and Experience

Variable	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7
Age	59.6	55.7	52.4	52.0	52.8	52.4	52.2
	(9.8)	(7.6)	(8.0)	(8.8)	(10)	(10.3)	(11.2)
Female	0.02	0.02	0.03	0.05	0.06	0.06	0.05
No Degree	0.25	0.21	0.25	0.21	0.21	0.17	0.21
MBA	0.24	0.26	0.23	0.27	0.19	0.18	0.22
MS/MA	0.16	0.17	0.17	0.19	0.21	0.21	0.21
Ph.D.	0.15	0.15	0.14	0.13	0.21	0.27	0.17
Prof. Certification	0.15	0.14	0.15	0.22	0.24	0.37	0.30
Executive Experience	22.3	19.8	16.1	15.9	16.6	16.5	16.9
	(13.0)	(10.5)	(10.7)	(11.0)	(12)	(11.7)	(11.7)
Tenure	17.1	15.1	13.7	13.8	14.1	13.7	14.2
	(13.5)	(11.7)	(11.4)	(11.2)	(12)	(11.0)	(10.8)

Data

Executive movement and compensation

Table 4: Executives Characteristics (continued)
Compensation and Salary are Measured in Thousands of 2006 US$

Variable	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7
# of past moves	1.9	1.9	1.7	1.9	2.2	2.3	2.3
	(2.0)	(1.9)	(1.9)	(1.9)	(2.0)	(2.1)	(2.1
# of Executive	0.9	0.93	0.73	0.76	0.77	0.80	0.84
Moves	(1.4)	(1.38)	(1.3)	(0.13)	(1.32)	(1.3)	(1.4
Salary	640	767	591	438	408	323	340
	(375)	(398)	(320)	(197)	(190)	(141)	(217
Total	2682	4199	4055	2587	2311	1598	186
Compensation	(18229)	(20198)	(14892)	(8536)	(7319)	(5539)	(663

Model
Overview

Labor Demand:

- Firms have demand for effort level and skills for jobs in each rank.
- Jobs yield match specific non-pecuniary benefits and experience.
- Firms offer contracts to achieve target hiring levels.

Labor Supply:

- Managers are heterogenous with respect to tastes, productivity and endogenously determined experience.
- Risk averse managers choose their job, firm, and effort level.

Equilibrium

- Markets clear in rank transitions and firm turnover to balance supply with demand in probability.
- This determines firm specific and general skills investment, plus career trajectory and lifecycle compensation.
- At the aggregate level, equilibrium induces a distribution of firm size and rank composition, plus distribution of management experience

Model

Job choice and human capital

- Manager chooses job k in firm j be setting indicator variable $d_{jkt} = 1$, and chooses an effort level $l_t \in \{0, 1\}$. Retirement is also possible, by setting $d_{0kt} = 1$.

$$\sum_{j=0}^{J} \sum_{k=1}^{K} d_{jkt} = 1$$

- Human Capital:
  - EITHER Private information on firm specific human capital:

$$h_{jt} = \sum_{k=1}^{K} \sum_{s=1}^{t} d_{j,k,t-s} l_{t-s}$$

  - OR Public information on firm specific human capital:

$$h_{jt} = \sum_{k=1}^{K} \sum_{s=1}^{t} d_{j,k,t-s}$$

  - General human capital:

$$h_{0t} = \sum_{j=1}^{J} h_{jt}$$

- Managers get utility from current consumption c_t.
- Managers have absolute risk aversion parameter ρ.
- Utility also depends on age, education, gender, stock of human capital, all captured in z_t.
- Jobs, firms, and effort level give nonpecuniary utility though the functions α_{0jmkt} (shirking) and α_{1jmkt} (working):

$$\alpha_{0jmkt} \equiv \alpha_{0jk}(z_t) < \alpha_{1jk}(z_t) \equiv \alpha_{1jmkt}$$

- An i.i.d. firm-job privately observed taste shock ε_{jkt} also affects utility.
- Lifetime utility is parameterized as:

$$-\sum_{t=1}^{\infty}\sum_{k,j}\beta^t d_{jkt}\left[\alpha_{0jkt}\left(1-l_t\right)+\alpha_{1jkt}l_t\right]\exp\left(-\rho c_t-\varepsilon_{jkt}\right)$$

- Managers face life-time budget constraint for goods and services.

Model

Firms and Output

- Excess return x_{jt} of j^{th} firm attributed to all its executive management:
  - This residual is not priced by (purged of) its aggregate factors
  - It is the relevant measure for compensation and incentives
- p.d.f. of excess return depends on each executive's effort and human capital:
  - $f_j(x|z_{jt})$ high effort by all managers
  - $f_{jk}(x|z_{jt})$ only executive in rank k shirks
  - $g_{jk}(x,z) \equiv f_{jk}(x|z_{jt})/f_j(x|z_{jt})$ likelihood ratio
- Firms maximize expected value, by minimizing expected cost of achieving HR goals.

Model

Timing, Information, and Overview

- Executives know their z and privately observe realizations of ε_{jkt}.
- Demand for positions $P_{jkt}(z)$ and effort level L_{jkt} revealed to firms.
- Firms offer contracts, w_{jkt+1}.
- Executives choose contracts, d_{jkt}.
- Executives choose effort, l_t.
- Hence the positions are filled with probability $p_{jkt}(z)$.
- Expectations by firms and managers are rational, meaning $(p_{jkt}(z), l_t) = (P_{jkt}(z), L_{jkt})$.

Optimization by executives

Other assets held in smoothing over uncertain income sequences

- Executives smooth their consumption over the winnings from playing a sequence of lotteries.
- Let e_t denote the value of assets in t.
- Let b_t denote the bond price in t.
- Let a_t denote the price of a security which pays a dividend of $(\lambda_s \ln \lambda_s - s \ln \beta)$ each period where λ_s is the price of a consumption unit in period s.
- Those two assets are sufficient to achieve the optimal portfolio when markets are complete.
- See Rubinstein (1981) on aggregation.

Optimization by executives

Value function for executives

- Define the "indirect utility from compensation" by:

$$\upsilon_{jk,t+1}(z,x) \equiv \exp\left[-\rho w_{jk,t+1}(z,x)/b_{t+1}\right]$$

- Set $A_0(z_t) \equiv 1$ and recursively define $A_s(z_t)$ as:

$$\sum_{(j,k,l)} p_{jkl}(z_t)\,\alpha_{jklt}^{1/b_t} E[e^{-\frac{\varepsilon^*_{jkt}}{b_t}}|z_t]\left[A_{s-1}\left(z_{t+1}^{(j,k,l)}\right) E[\upsilon_{jk,t+1}|z_t, l_t]\right]^{1-\frac{1}{b_t}}$$

- The value function, indirect utility at the beginning of period t, is:

$$V(z_t) = A_s(z_t)\, b_t \exp\left(-\frac{a_t + \rho e_t}{b_t}\right)$$

- $A_s(z_t)$ is a normalized value function for the consumption smoothing problem reflecting wealth from future lotteries.

Optimization by executives

Job, firm and effort choice

- The conditional value function is:

$$V_{jklt}\left(z_t, \varepsilon^*_{jkt}\right) = -\left\{ \begin{array}{r} \alpha_{jklt}^{1/b_t}\left[A_{s-1}\left(z_{t+1}^{(j,k,l_t)}\right) E\left[v_{jk,t+1} \middle| z_t, l_t\right]\right]^{1-\frac{1}{b_t}} \\ \times \exp\left(\frac{-\varepsilon^*_{jkt}}{b_t}\right) b_t \exp\left(-\frac{a_t+\rho e_t}{b_t}\right) \end{array} \right\}$$

- If ε_{jkt} is standard Type 1 extreme value, the choice probability is:

$$p_{jklt}\left(z_t\right) = \frac{\alpha_{jklt}\left[A_{s-1}\left(z_{t+1}^{(j,k,l_t)}\right)\right]^{(b_t-1)}\left\{E\left[v_{jk,t+1}|z_t,l_t\right]\right\}^{(b_t-1)}}{1+\sum_{j',k'}\alpha_{j'k'l't}\left[A_{s-1}\left(z_{t+1}^{(j',k',l')}\right)\right]^{(b_t-1)}\left\{E\left[v_{j'k',t+1}|z_t,l'\right]\right\}^{(b_t-1)}}$$

Cost Minimizing Contract

Incentive compatible contracts to correct moral hazard

- If human capital is private information then the incentive compatibility constraint is:

$$E\left[v_{jk,t+1}(x)\, g_{jk}(x, z_t)\,|z_t\right] \leq \left[\frac{\alpha_{1jkt}}{\alpha_{0jk0t}}\right]^{\frac{1}{b_t-1}} \frac{A_{s-1,t+1}^{(j,k,1)}}{A_{s-1,t+1}^{(j,k,0)}} E\left[v_{jk,t+1}(x)\,|z_t\right]$$

- If human capital is public information, then the incentive compatibility reduces to the standard moral hazard formulation:

$$E\left[v_{jk,t+1}(x)\, g(x, z_t)\,|z_t\right] \leq \left[\frac{\alpha_{1jkt}}{\alpha_{0jk0t}}\right]^{\frac{1}{b_t-1}} E\left[v_{jk,t+1}(x)\,|z_t\right]$$

- In the private information case, career concerns (may) help to offset current benefits from shirking because human capital accumulation depends on effort, not just on participation.

Cost Minimizing Contract

Demand for Executives and participation constraint

- Firm j is required to recruit at rate $P_{jk}(z_t)$ for an executive with characteristics z to fill position k.
- Let $U_{jk}(z)$ denote log odds ratio of the demand for the job multiplied by the continuation value for an outside option:

$$\left[\frac{P_{jkt}(z)}{1-P_{jkt}(z)}\right]\left\{1+\sum_{\substack{j'=1\\ j'\neq j}}^{J}\sum_{\substack{k'=1,\\ k'\neq k}}^{K}\alpha_{j'k'l't}\left[A_{s-1,t+1}^{(j',k',l')}E[v_{j'k',t+1}|z_t,l']\right]^{(b_t-1)}\right\}$$

- Exponential utility is negative. Thus to meet its recruiting objectives firm j picks a compensation contract $v^*_{j,k,t+1}$ satisfying

$$U_{jk}(z)\geq\alpha_{jklt}\left\{A_{s-1,t+1}^{(j,k,l_t)}E[v^*_{jk,t+1}|z_t,l_t]\right\}^{b_t-1}$$

Cost Minimizing Contract

Optimal contract

- Let η denote the Lagrange multiplier for the incentive compatitibility constraint, which is satisfied with equality.
- The optimal contract for $w_{j,k,t+1}(x,z)$ is:

$$\frac{b_{t+1}}{\rho}\left\{\begin{array}{l}(b_t-1)^{-1}\left[\log U_{jk}(z)-\log(\alpha_{jk1t})\right] \\ +\log\left[1-\eta g_{jk}(x,z_t)+\eta\frac{A_{s-1,t+1}^{(j,k,1)}}{A_{s-1,t+1}^{(j,k,0)}}\left(\frac{\alpha_{1jkt}}{\alpha_{0jkt}}\right)^{\frac{1}{b_t-1}}\right]\end{array}\right\}$$

- If firm specific human capital is public, it only affects the $U_{jk}(z)$ term (the level of compensation), not the second expression, and not η (the dependence of compesation on excess returns).

Rational Expectations and Competitive Selection

Matching supply with demand

- A competitive selection exists if there are contracts satisfying:

$$P_{jkt}(z) = p_{jkt}(z)$$

- A competitive selection exists.
- In this definition executives and shareholders have rational expectations. We also assume that shareholders do not believe executives deviate from the equilibrium path when human capital is private, and consequently act as if their employees behave optimally.
- If human capital is observed from employment records, the contract is optimal.
- If human capital is private information, the contract is sequentially optimal.
- In this case the (long term) optimal contract requires commitment.

Identification and Estimation

Data requirements

- Our analysis applies to longitudinal panels of executives.
- Each executive is sampled at least two consecutive periods.
- The asymptotics we derive apply as the product of the number of time periods and the number of firms increases.
- Each observation contains his employer firm j, his rank k, the firm's abnormal return x, his compensation w, plus all the background variables relevant to the contract, namely z.
- Included in z are firm characteristics such as size and sector.
- Also included in z are the manager's characteristics, such as educational attainment and employment history.
- We do not, however, assume that effort level l is observed.

Identification and Estimation

Overview

- Estimation proceeds sequentially in six steps. Estimate:
  1. $f_j(x|z)$ nonparametrically from data on abnormal returns
  2. $w^o_{jk}(x,z)$ nonparametrically from data on compensation and abnormal returns
  3. $P_{jk}(z)$ from data on executive choices
  4. ρ and $\alpha_{1jk}(z)$ from market participation equation
  5. $\alpha_{0jk}(z)$ from incentive compatibility condition
  6. $g_{jk}(x|z)$ from compensation equation
- See Gayle and Miller (08): "Identifying and Testing . . . ".

- Substitute estimates of $P_{jk}(z)$ into $U_{jk}(z)$ and $w^{o}_{jk}(x,z)$ into $v_{j,k,t+1}(x,z)$.
- Then estimate α_{1jk} and ρ from:

$$E_t\left[\frac{A^{(j,k,0)}_{s-1,t+1}}{A^{(j,k,1)}_{s-1,t+1}}\left(U_{jk}(z)/\alpha_{1jk}(z)\right)^{1/(b_t-1)}-v_{j,k,t+1}(x,z)|z\right]=0$$

- This equation holds at each age to retirement and each type (j,k,z).
- We can identify recursively working back from a common retirement age, say 70.
- To identify $\alpha_{1jk}(z)$ and ρ we require one restriction on an otherwise full set of interactions with (j,k,z).

Identification and Estimation

Fifth step

- We impose the regularity condition that there exists some $\overline{x} < \infty$ such that if $x \geq \overline{x}$ then
$$g_{jk}(x, \cdot) = 0$$
- From the incentive compatibility condition we now obtain $\alpha_{0jk}(z)$ from our estimates of $\alpha_{1jk}(z)$, $w^{o}_{jk}(x, z)$ and ρ (and hence A) using:

$$\frac{\alpha_{0jk}(z)}{\alpha_{1jk}(z)} = \left\{ \frac{A_{s-1}^{(1,j,k)}}{A_{s-1}^{(0,j,k)}} \left[\frac{v_{k,j,t+1}^{-1}(\overline{x}, z) - E\left[v_{j,k,t+1}(x, z) \mid I = 1\right]^{-1}}{v_{j,k,t+1}^{-1}(\overline{x}, z) - E_t\left[v_{k,j,t+1}^{-1}(x, z) \mid z\right]} \right] \right\}^{1-b_t}$$

Identification and Estimation

Sixth step

- Since $g_{jk}(x,z)$ is a likelihood ratio:

$$E\left[g_{jk}(x,z)|z\right] = 1$$

- Then $g_{jk}(x|z)$ is identified off the relative slope of compensation schedule using this equation and the regularity condition given in the last slide.
- Using ρ and and nonparametric estimates of $w^{o}_{1jk}(x,z)$ we estimate $g_{jk}(x|z)$ from:

$$g_{jk}(x|z) = \frac{\upsilon^{-1}_{k,j,t+1}(\overline{x},z) - \upsilon^{-1}_{k,j,t+1}(x,z)}{\upsilon^{-1}_{k,j,t+1}(\overline{x},z) - E_t[\upsilon^{-1}_{k,j,t+1}(x,z)|z]}$$

Preliminary Empirical Results

Estimated compensation schedule

- The most important explanatory factor is the firm's excess return.
- Compensation at higher ranks is more sensitive to excess returns.
- Compensation is quadratic in age.
- There is a sign-on bonus, with penalties for increased tenure.
- Larger firms pay more, but compensation is more closely calibrated to excess returns.

Preliminary Empirical Results

Span of control

- One measure of how important a position is to the firm is how much the firm's value would fall if its occupant shirked.
- The expected gross loss from executive k with characteristics z in firm j shirking is:

$$
\begin{aligned}
\tau_{1jk}(z) &\equiv E\left\{x\left[1-g_{jk}(x,z)\right]\right\} \\
&= E\left[x \mid diligent\right] - E\left[x \mid shirk\right] \\
&= -E\left[x g_{jk}(x,z)\right]
\end{aligned}
$$

Preliminary Empirical Results

Estimated span of control and dispersion across firms

τ_1 is measured in percentage per year

Measure	Rank	Estimates	Standard Deviation.
ρ		0.45	
τ_1	1	5.2	3.4
	2	10.9	14
	3	8.3	2.9
	4	4.2	2.7
	5	1.6	1.2

- The estimate of the risk aversion parameter implies a manager would pay up to $217,780 to insure himself against a fair bet of losing versus winning one million dollars.
- Span of control is highest at rank 2, 11 percent per year.

Preliminary Empirical Results

Compensating differential for diligent work versus shirking

- From the optimal contract, manager's reservation wage to shirk:

$$w^0_{0jk}(z) = \frac{b_{t+1}}{\rho}\log(A_{s-1}(z^{j,k,0}_{t+1})) + \frac{b_{t+1}}{\rho(b_t - 1)}\log(\alpha_{0jk} / U_{jk}(z))$$

- Manager's reservation certainty equivalent wage for diligent work:

$$w^0_{1jk}(z) = \frac{b_{t+1}}{\rho}\log(A_{s-1}(z^{j,k,1}_{t+1})) + \frac{b_{t+1}}{\rho(b_t - 1)}\log(\alpha_{1jk} / U_{jk}(z))$$

- Differential between shirking and working diligently:

$$\begin{aligned}\tau_{2jk}(z) &\equiv w^0_{1jk}(z) - w^0_{0jk}(z)\\ &= \frac{b_{t+1}}{\rho}\log\left[\frac{A_{s-1}(z^{j,k,1}_{t+1})}{A_{s-1}(z^{j,k,0}_{t+1})}\right] + \frac{b_{t+1}}{\rho(b_t - 1)}\log\left(\frac{\alpha_{1jk}}{\alpha_{0jk}}\right)\end{aligned}$$

- In a static moral hazard model the compensating differential is

$$\tau_{2jk}^{PM} \equiv \frac{b_{t+1}}{\rho(b_t - 1)} \log\left(\alpha_{1jk}/\alpha_{0jk}\right)$$

- Defining $\tau_{2jk}^{H}(z)$ as the amount which career concerns abate the moral hazard problem

$$\begin{aligned} \tau_{2jk}^{H}(z) &\equiv \tau_{2jk}(z) - \tau_{2jk}^{PM} \\ &= \frac{b_{t+1}}{\rho} \log\left[\frac{A_{s-1}\left(z_{t+1}^{j,k,1}\right)}{A_{s-1}\left(z_{t+1}^{j,k,0}\right)}\right] \end{aligned}$$

Preliminary Empirical Results

Estimates of the compensating differential

τ_2^H and τ_2^{PM} is measured in $US100,000

Measure	Rank	Estimates	Standard Deviation.
τ_2^H	1	4.0	0.2
	2	9.0	0.5
	3	11.8	0.9
	4	16.4	1.3
	5	18.8	2.2
τ_2^{PM}	1	18.6	34.7
	2	24.8	56.6
	3	8.3	14.2
	4	2.5	8.6
	5	.9	1.2

Preliminary Empirical Results

The welfare cost of moral hazard

- Firms pay the difference between expected compensation and its certainty equivalent to resolve moral hazard:

$$\begin{aligned}\tau_{3jk} &= E\left[w_{jk}\left(x\right)\left|z\right.\right] - w^{0}_{1jk}(z) \\ &= E\left[w_{jk}\left(x\right)\left|z\right.\right] - \frac{b_{t+1}}{\rho}\log(A_{s-1}(z^{j,k,1}_{t+1})) \\ &\quad -\frac{b_{t+1}}{\rho(b_t-1)}\log\left[\alpha_{1jk}/U_{jk}(z)\right]\end{aligned}$$

- If there were no career concerns, the additional cost of moral hazard to the firm would be

$$\tau_{4jk}(z) \equiv \frac{b_{t+1}}{\rho}\log(A_{s-1}(z^{j,k,1}_{t+1}))$$

Human Capital versus Moral Hazard

Estimating the welfare cost

τ_3 and τ_4 are measured in US100,000 of dollars

Measure	Rank	Estimates	Standard Deviation.
	1	17.3	34.0
	2	32.5	45.6
τ_3	3	16.03	24.8
	4	1.2	2.5
	5	0.8	1.3
	1	0.5	1.4
	2	2.6	3.9
τ_4	3	12.0	14.3
	4	14.0	18.9
	5	18.2	22.7