Personnel Economics

Recruitment: Screening & Signaling

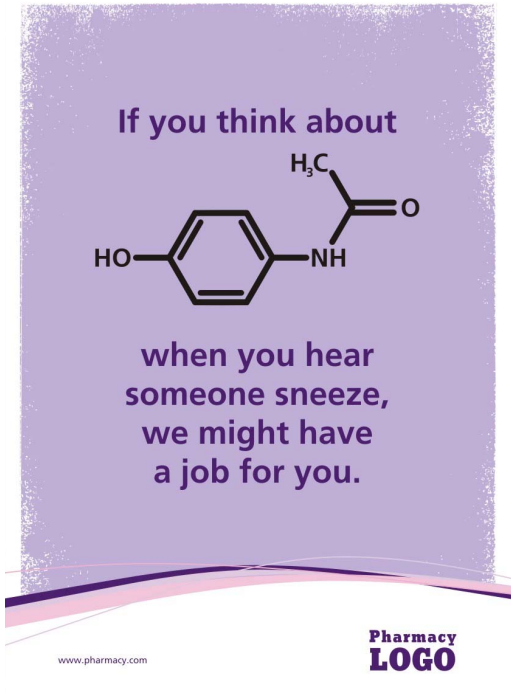
(Chapter 2)

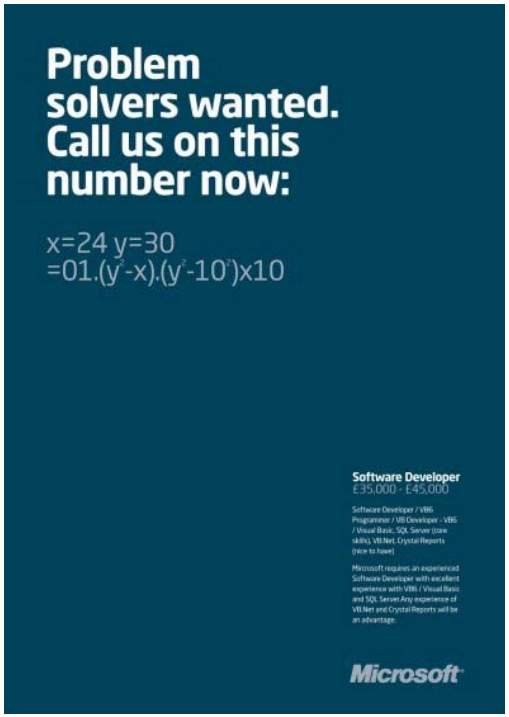
Recruitment of workers

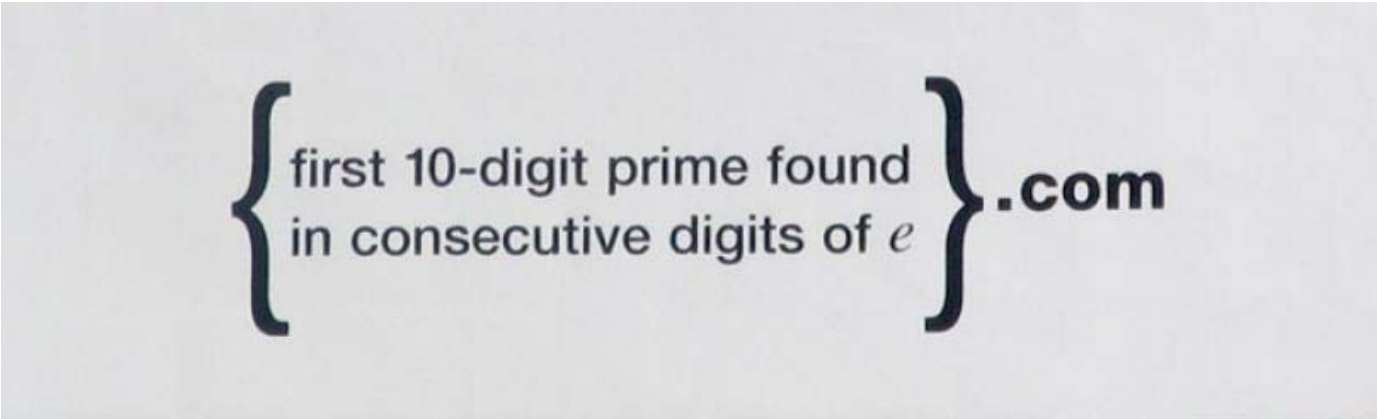
- A: "If we want to recruit highly qualified workers, we should promote the job with a high wage to attract the best workers."
- B: "Good idea, but this costs a lot. Instead, we should offer low entry wages and pay higher wages later for those who turn out to be very productive."
- A: "Offering low entry wages will lead to a negative selection of job applicants. The best will not apply."
- B: "But if we offer very high wages, the whole world will apply."
- ...

Some ads . . .


If you can figure this out, you may have a future with Google.
8 M L D Q 6 T U I
6 T F M L R H A A
N R A 6 Q 8 E F L
D M Q 8 6 I I 2 O 3
2 S 5 J 1 3 J X O J
Google Job


If you think about
H_3C
O
HO
NH
when you hear someone sneeze, we might have a job for you.
www.pharmacy.com
Pharmacy LOGO


Problem solvers wanted. Call us on this number now:
x=24 y=30
=01.(y²-x).(y²-10⁰)x10
Software Developer
£35,000 - £45,000
Microsoft


{ first 10-digit prime found in consecutive digits of e }.com

Staff at ACME Incorporated

TABLE 2.1
CAREER PATTERNS AT ACME INCORPORATED

			Number of years in		*Percent who stay at Acme*			
Hierarchical Level	*Percent of total employees*	*Percent hired at this level*	*Current position*	*Acme*	*Only 1 year*	*Only 2 years*	*5–10 years*	*More than 10 years*
1	25.4	99.0	2.3	2.4	10.7	10.4	25.5	39.8
2	26.2	31.0	2.5	4.5	15.2	10.2	19.7	38.5
3	25.4	31.0	3.0	6.0	10.7	10.1	25.5	35.6
4	20.5	27.0	4.1	7.9	15.3	7.9	24.9	30.7
5–8	2.5	19.0	4.0	9.7	7.1	14.3	42.9	28.6

Problem: **Asymmetric information and adverse selection**

- **Asymmetric information**
  - Two parties to a contract do not posses the same information
  - eg. Job applicants have more information about their productivity than firms
  - Nobelprize 2001: George Akerlof, Michael Spence und Joseph Stiglitz
- **Adverse selection**
  - The informed party uses the information advantage in his/her favor
  - The uninformed party knows that and acts accordingly
  - Result is not optimal
  - Examples
    - Insurance market
    - All-you-can . . .
    - Market for used cars (Market for lemons)

George Akerlof (QJE, 1970): **Adverse Selection in "Markets for Lemons"**

- Sellers know about the quality of the cars, buyers do not
- Buyers inform themselves about the average quality on the market (eg. reading test reports)
- Negotiation about the price
  - Buyers don't want to pay a lot, they know about the average quality
  - Since buyers don't want to pay above average, sellers don't want to sell above average quality
  - Average quality on the market should fall
  - Willingness to pay declines ...
- The market might break down

Screening & Signaling

- Strategies to handle the problem of asymmetric information
- How can the hidden information be revealed?
- **Screening**
  - Uninformed party takes the action
  - eg. What can firms do to learn about the hidden quality of job applicants?
- **Signaling**
  - Informed party takes the action
  - eg. What can the job applicants do to signal their hidden quality?

Credentials as signals and screening device

- What information can a firm use to assess the quality of the job applicant? **or** What can a job applicant do to signal his/her quality?
- **Credentials**
  - Education: final apprenticeship examination, Matura, university degree, quality of school, extracurricular activities, . . .
  - Work experience: previous jobs, promotions, gaps in your CV, . . .
- **What makes credentials useful?**
  - Informativeness
  - Cost of obtaining
  - Return on investment

Credentials as signals and screening device

- **Informativeness**
  - Work productivity should be **positively related** to the ability to obtain the credential
  - Directly, eg. final apprenticeship examination $\Longrightarrow$ occupation specific knowledge and skills
  - Indirectly, eg. school grade in Latin, merit scholarship $\Longrightarrow$ general ability and willingness to make effort
- **Cost of obtaining**
  - Costs of obtaining should be **inversely related** to productivity,
    it should be easier for high ability candidates to obtain the credential
    eg. accountant exam $\Longrightarrow$ not too difficult for a qualified accountant to pass the exam but impossible for others
  - The cost of obtaining should not be too high.
    Effective credentials: most of qualified candidates have it, most unqualified do not (credential should **discriminate** between types)

Credentials as signals and screening device

- **Return on investment**
  - The investment in a credential (eg. university degree) is made only by persons for whom it is profitable (returns are higher than costs)
  - *Returns are low*: only those for whom it is easiest to obtain the credential will do so (those with the lowest costs, the most able)
  - *Returns are high*: many invest in the credential (credential does not discriminate)

Screening

- How much should a firm invest in screening job candidates?
- Screening is expensive
  - check applications
  - conduct tests (IQ, psychological tests)
  - job interviews (at different hierarchical levels)
  - assessment center
- Exercise Screening Bankers
  - Investment bank and commercial bank
  - 5 types of job applicants
  - Wage: GBP 100,000
  - Should the bank screen if it costs GBP 2,000 per Person?
  - Differences? Why?

Screening Bankers

Table 2.2
Screening Investment Banking Job Applicants

		Type				
		A	*B*	*C*	*D*	*E*
Percent of Job Applicants		10%	20%	40%	20%	10%
Productivity	*Investment Bank*	–£250	0	125	200	450
(£ thousands)	*Commercial Bank*	£95	100	110	120	125

Table 2.3
Profitability of Screening at an Investment Bank and a Commercial Bank

	Screen?	*Productivity*	*Salary*	*Screening Cost*	*Profit*
Investment Bank	No	£110	£100	£0.0	£10.0
	Yes	193	100	2.9	90.1
Commercial Bank	No	110	100	0.0	10.0
	Yes	112	100	2.2	9.8

Screening Bankers

- Expected Productivity without screening
  - $E(Q|IB) = \sum_{i=A}^{E} Q_{i|IB} \cdot p_i = \mathbf{110}$
  - $E(Q|CB) = \sum_{i=A}^{E} Q_{i|CB} \cdot p_i = \mathbf{110}$
- Expected productivity with screening (sorting out $Q_i < W$)
  - Investment bank sorts out A and B: $E(Q|IB_S) = \sum_{i=C}^{E} Q_{i|IB} \cdot p_{i|i\neg A,B}$
    $125 \cdot \frac{0.4}{0.7} + 200 \cdot \frac{0.2}{0.7} + 450 \cdot \frac{0.1}{0.7} = \mathbf{193}$
  - Commercial bank sorts out A: $E(Q|CB_S) = \sum_{i=B}^{E} Q_{i|CB} \cdot p_{i|i\neg A}$
    $100 \cdot \frac{0.2}{0.9} + 110 \cdot \frac{0.4}{0.9} + 120 \cdot \frac{0.2}{0.9} + 125 \cdot \frac{0.1}{0.9} = \mathbf{112}$
- Expected screening costs: 2k per person
  - Investment bank: If the probability for a good candidate is 0.7, it takes 1/0.7 interviews to find one on average. $1/0.7 \cdot 2 = 2.9$
  - Commercial bank: $1/0.9 \cdot 2 = 2.2$

Screening Model

- The model
  - Two types of applicants: High-ability H and low-ability L
  - Productivities: $Q_H > Q_L$
  - Wage: $Q_H > W > Q_L$
  - Distribution: Type H with probability p_H and L with $(1 - p_H)$
  - Screening costs s and is successful with probability q
- Expected profits π
  - Random hire: $\pi_r = p_H(Q_H - W) + (1 - p_H)(Q_L - W)$
  - Screening: $\pi_s = qp_H(Q_H - W) + (1 - q)(1 - p_H)(Q_L - W) - s$
- Gain from screening $G = \pi_s - \pi_r$

$$G = -p_H(1 - q)(Q_H - W) - (1 - p_H)q(Q_L - W) - s$$

  - negative: good candidate (p_H) + screening fails $(1 - q)$
  - positive: bad candidate $(1 - p_H)$ + screening works (q)

Screening Profitability

- Results

  $\frac{\partial G}{\partial q} > 0$, $\frac{\partial G}{\partial s} < 0$, $\frac{\partial G}{\partial p_H} < 0$

- Screening ist more profitable ...
  - the better the test is in discriminating between types (high q)
  - the cheaper the test is (low s)
  - the smaller the fraction of high quality types (low p_H)

- The profitability also depends on the unobserved productivities. Screening is more profitable, the higher the potential of finding the right type (high Q_H) and the more negative the loss from hiring the wrong type (low Q_L).

Screening Example

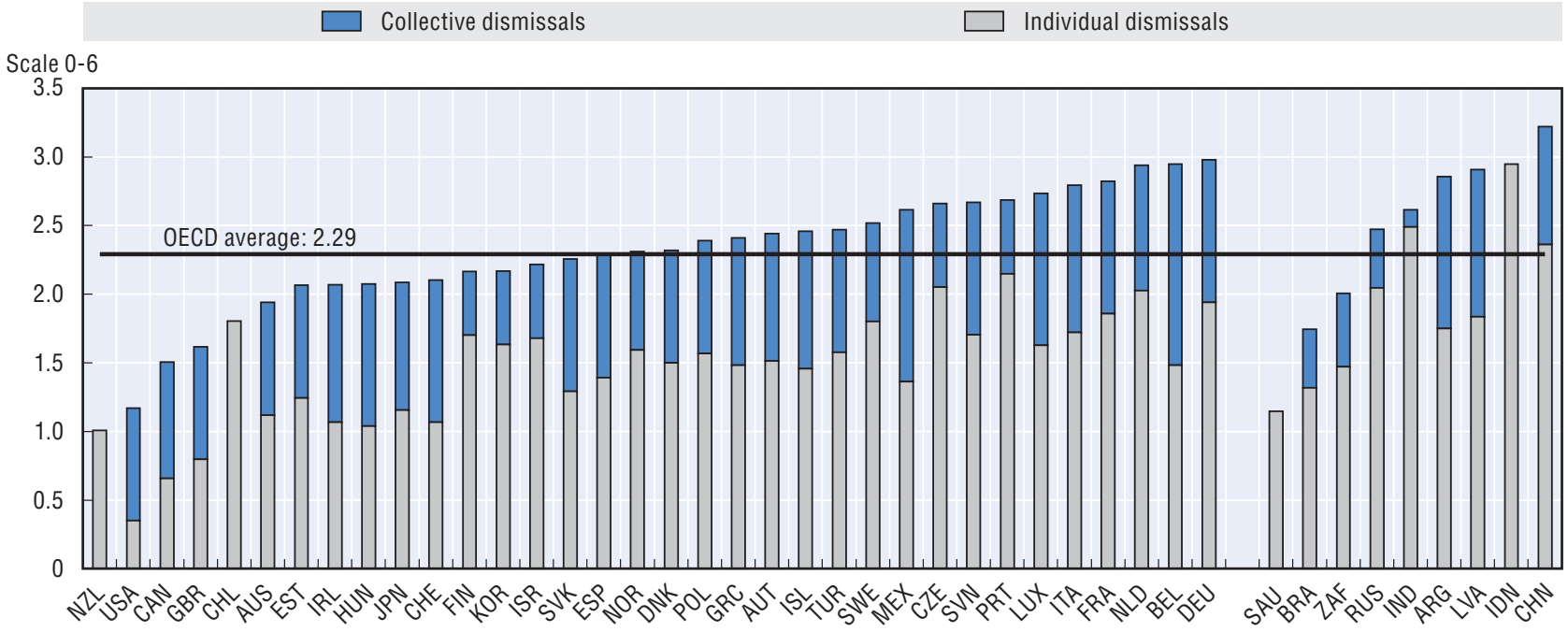
Exercise

- $Q_L = 20, Q_H = 200$
- $p_H = 0.6$
- $W = 100$
- Assessment Center works with $q = 0.8$
- What is the maximum price of the AC you would pay?

Screening Probation, temporary contracts & leased labor

- Approach to screening
- Workers are observed on the job and get a permanent contract later on if they do well
- Procedure determined by dismissal provisions
  - job protection
  - cancelation period
  - severance pay
- Employment protection and jobs in the OECD

Figure 2.6. **Protection of permanent workers against individual and collective dismissal**

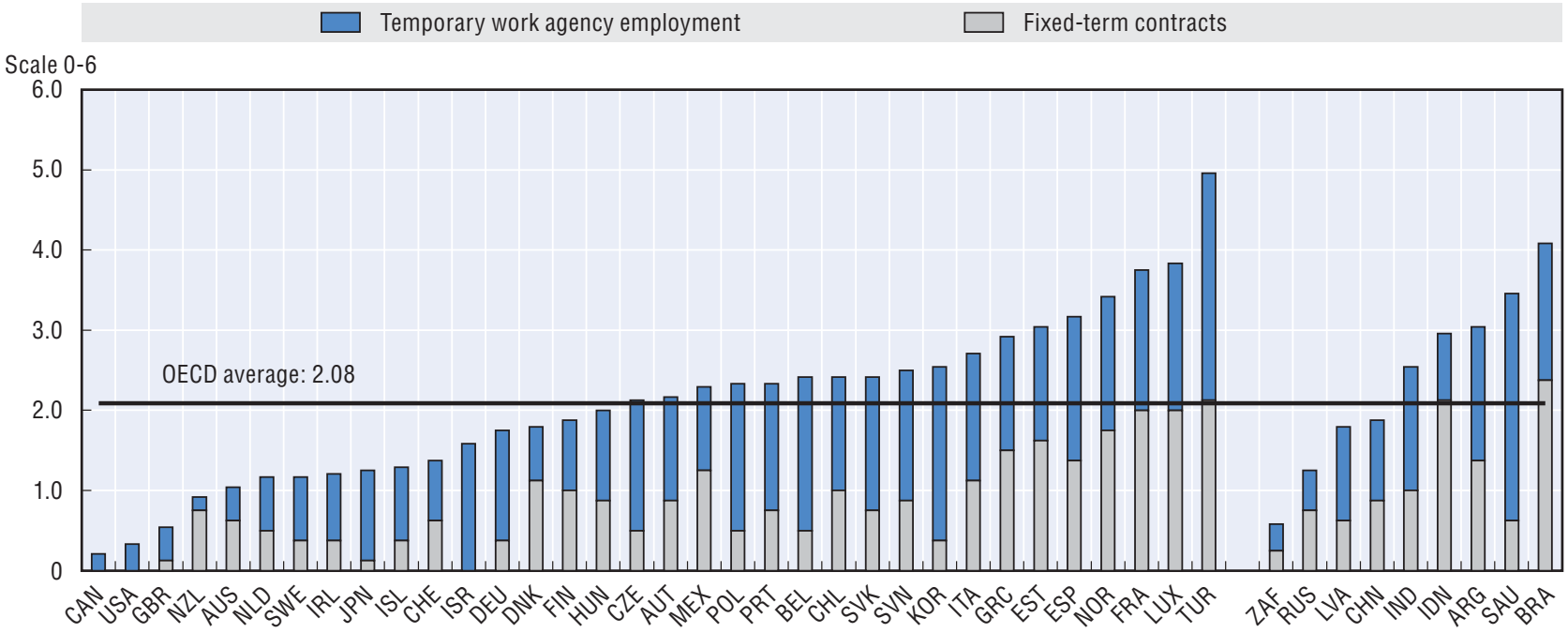


Note: Data refer to 2013 for OECD countries and Latvia, 2012 for other countries. The figure presents the contribution of employment protection for regular workers against individual dismissal (EPR) and additional provisions for collective dismissal (EPRC) to the indicator of employment protection for regular workers against individual and collective dismissal (EPRC). The height of the bar represents the value of the EPRC indicator.

Source: *OECD Employment Protection Database*, 2013 update, *http://dx.doi.org/10.1787/lfs-epl-data-en*.

Figure: OECD Employment Outlook 2013, Chapter 2.

Figure 2.9. **Regulation on temporary contracts**



Note: Data refer to 2013 for OECD countries and Latvia, 2012 for other countries. The figure presents the contribution of the indicator of regulation for standard fixed-term contracts (EPFTC) and the indicator of regulation for TWA employment (EPTWA) to the indicator of regulation on temporary contracts (EPT). The height of the bar represents the value of the EPT indicator.
Source: *OECD Employment Protection Database*, 2013 update, *http://dx.doi.org/10.1787/lfs-epl-data-en*.

Figure: OECD Employment Outlook 2013, Chapter 2.

Figure 4.5. **Temporary employment by age group, 2011-12**

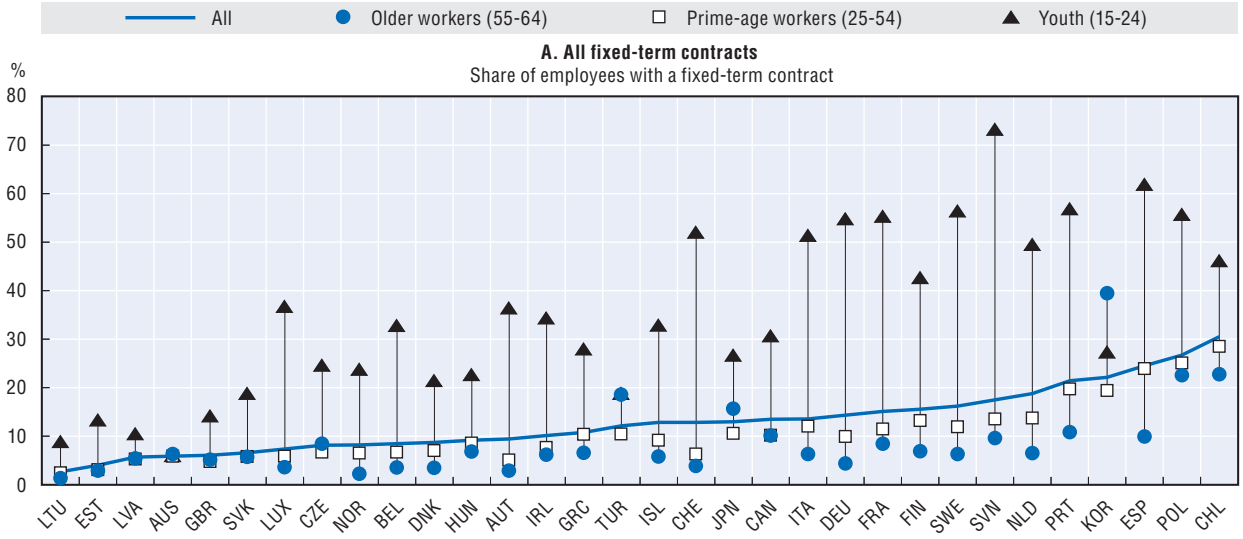


Figure 4.6. **Temporary employment by level of education of people aged 25-54, 2011-12**

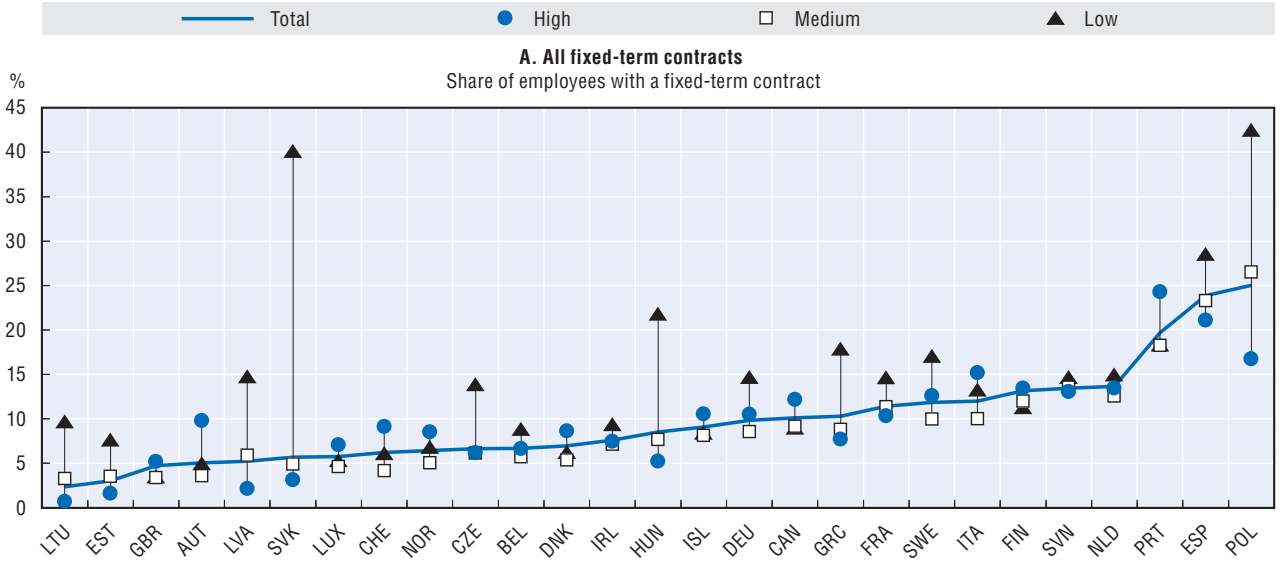


Figure: OECD Employment Outlook 2014, Chapter 4.

Signaling How do workers act?

- Job candidates know their productivity better than firms. How do they act?
- Firms anticipate the actions of workers and act accordingly.
- What job offers should firms make to discriminate between high and low productivity workers?
- Very high wages after a probation period with low wages?
  - ...should attract high ability workers
  - ...should deter low ability workers
- Example
  - Workers of type D and E
  - Investment bank wants to hire E
  - Period: probation 1 year, afterwards at least 1 year
  - Alternative/outside wage: $W_D = 175,000$, $W_E = 200,000$ per year
  - Wrong decision after one year: 10% (keep a D, fire an E)

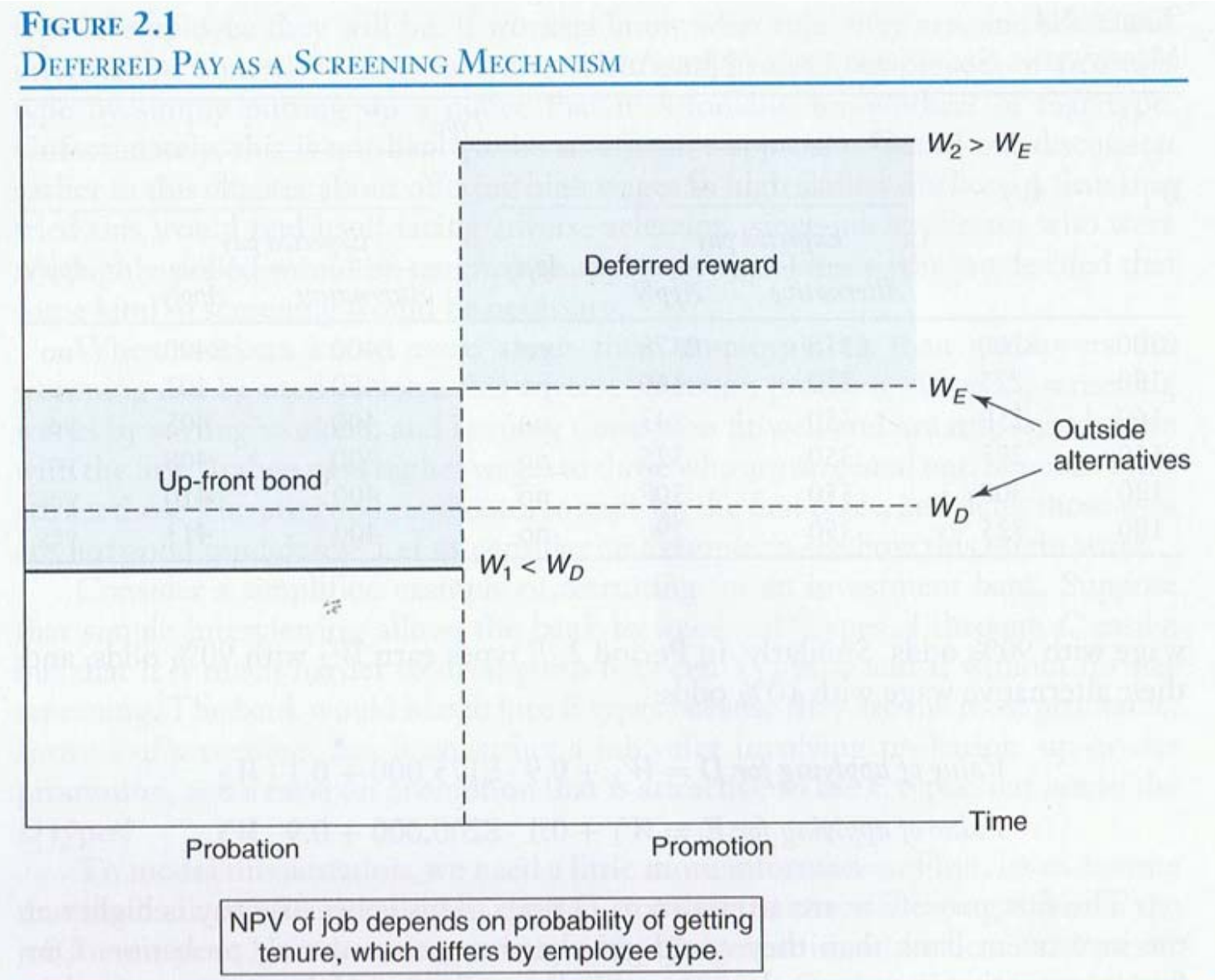
Signaling Probation and self-selection

Table 2.4
Motivating Self-Selection of Job Applicants

W_1	W_2	Type: D, Expected pay: Alternative	D, Expected pay: Apply	D, Apply	E, Expected pay: Alternative	E, Expected pay: Apply	E, Apply
£200	£200	£350	£378	yes	£400	£400	no
180	225	350	360	yes	400	403	yes
160	250	350	343	no	400	405	yes
140	275	350	325	no	400	408	yes
120	300	350	308	no	400	410	yes
100	325	350	290	no	400	413	yes

$$\textit{Value of applying for } D = W_1 + 0.9 \cdot 175 + 0.1 \cdot W_2$$
$$\textit{Value of applying for } E = W_1 + 0.1 \cdot 200 + 0.9 \cdot W_2$$

Signaling Probation and self-selection



Signaling Probation and self-selection

- Wage pairs (entry wage + wage thereafter) determine the application decision of different types of workers.
- Sufficiently low entry wages and high wages in the second period solve adverse selection problem.
- Conditions:
  - $W_1 < W_L \Longrightarrow$ deters low-ability workers
  - $W_2 > W_H \Longrightarrow$ attracts high-ability workers
  - + account for potential wrong decisions
- Applying is a (credible) signal of ability.

Signaling Examples

- Sellers of used cars
  - They grant (potentially costly) warranties to credibly signal the quality of the car.
- Joint ventures
  - Both firms invest capital into the joint venture to signal seriousness of intentions.
- Venture capitalists
  - They typically demand the entrepreneur to take personal liability (invest funds in the business or even mortgage own home) to signal confidence into the new business idea.
- Hiring firms
  - Pay for performance compensation schemes are risky and pay off for high ability workers only (probation, commission rates, bonuses). Selection into these jobs signal ability.

Signaling Education

- Michael Spence (QJE, 1973)
- Education does not influence productivity but serves as signal for high productivity (vs. Human capital theory)
- More talented students find it easier to learn the material (costs of education are lower for high ability individuals)
- More productive individuals invest in education and are able to signal their ability on the labor market
- Assumptions
  - Ability in school and on the labor market are positively related.
  - Costs of investing in education are lower for high ability students.

Signaling Education

- Model
  - Types of individuals: H with fraction α and L with $(1-\alpha)$
  - Productivities: $Q_H > Q_L$
  - Costs of education: $C_H < C_L$
- No signaling
  - Firms can not distinguish between high and low ability types and pay according to the expected value
  - Mean productivity: $\overline{Q} = \alpha Q_H + (1-\alpha) Q_L$
- Signaling
  - H want to distinguish themselves, L do not
  - What conditions enable H to distinguish themselves?

Signaling Education

- Three Conditions
  - If all H signal their ability and all L do not, it must be better for H to invest in education: $Q_H - C_H > Q_L$
  - If all H signal their ability and all L do not, it must be better for L not to invest in education: $Q_H - C_L < Q_L$
    $\Longrightarrow$ in total $C_H < Q_H - Q_L < C_L$
  - Signaling must pay for H: $Q_H - C_H > \overline{Q}$
- Results
  - If conditions are not satisfied, nobody invests in education and everybody gets $\overline{Q} \Longrightarrow$ ***Pooling Equilibrium***
  - If conditions are satisfied, only H invest in education and earn Q_H, all L do not and earn $Q_L \Longrightarrow$ ***Separating Equilibrium***
- When are these conditions more likely satisfied?
  - Costs of education differ a lot
  - Fraction of H (α) is not too high (otherwise pooling wage is high)

Education as signal? Empirical studies

- Human capital theory and signaling theory imply that higher education leads to higher earnings
  - Human capital theory: education increases productivity
  - Signaling: education signals productivity
- What theory is dominating?

Education as signal? Empirical studies

Natural experiments: events that influence education but are not related to ability

- Lang and Kropp (QJE, 1986)
  Extension of compulsory schooling in the US, should only influence schooling of people less prone to education, but highly talented go to school longer after the reform (college instead of high school, master instead of bachelor) to signal their talent and distinguish themselves $\Longrightarrow$ **Signaling**
- Chevalier, Harmon, Walker, Zhu (EJ, 2004)
  Compulsory schooling reform in Great Britain had no effect on higher education $\Longrightarrow$ **Human Capital Theory**
- Bedard (JPE, 2001)
  High school dropouts residing in areas close and far away from universities; lower dropout rates in regions with large distance to universities; individuals finish high school to not be distinguishable from other high school students who do not go to university because of distance $\Longrightarrow$ **Signaling**

Education as signal? Empirical studies

"Estimating the Labor Market Signaling Value of the GED"
Tyler, Murnane, Willett (The Quarterly Journal of Economics, 2000)

- Exogenous variation in signaling status among individuals with similar levels of human capital
- GED (General Educational Development) credential
- Second chance diploma for high school dropouts in the US
- Passing standards differ between states
- Individuals have similar GED test score, but some got the GED and others do not
- Do they differ in earnings?

Education as signal? Empirical studies

TABLE III
GED SCORE GROUPS FORMED BY COMBINING MINIMUM AND MEAN SCORES
(OUTLINED CELLS = VARIATION IN GED-STATUS BY STATE, DARK SHADING = ALL POSSESS GED, NO SHADING = NONE HAVE GED.)

	Mean score	
Minimum score	<45	> = 45
20–34	Score group 1	
35–39	Score group 2	Score group 4
40–44	Score group 3	Score group 5
45–46		Score group 6
47–48		Score group 7
49–50		Score group 8
51–52		Score group 9
53+		Score group 10

- Experiment 4 (GED $\geq$ group 4 versus $\geq$ group 5)
- Experiment 3 (GED $\geq$ group 3 versus $\geq$ group 5)
- Experiment 3* (GED $\geq$ group 3 versus $\geq$ group 4)

Education as signal? Empirical studies

$$\hat{\alpha} = (\overline{Y}_T - \overline{Y}_C) - (\overline{Y}_{THi} - \overline{Y}_{CHi}),$$

where

$\overline{Y}$ = mean earnings of any group;

T indexes the treatment group—individuals in the affected score group who are in a low-passing-standard state in a given experiment, and thus have a GED;

C indexes the comparison group—individuals in the affected score group who are in a high-passing-standard state, and thus do not have a GED;

THi indexes individuals in treatment states that are in a scoring group *higher* than the affected score group, and thus have a GED;

CHi indexes individuals in comparison states that are in the same *high scoring* group as the THi group, and thus also have a GED.

Education as signal? Empirical studies

TABLE V

DIFFERENCE-IN-DIFFERENCES ESTIMATES OF THE IMPACT OF THE GED ON 1995 EARNINGS OF DROPOUTS WHO TESTED IN 1990 (STANDARD ERRORS ARE IN PARENTHESES.)

	Experiment 4			Experiment 3			Experiment 3*		
	State passing standard is		Low-High standard contrast	State passing standard is		Low-High standard contrast	State passing standard is		Low-High standard contrast
	Low	High		Low	High		Low	High	
Panel A: Whites									
Test score is									
Low	9628	7849	1779	9362	7843	1509	9362	8616	746
	(361)	(565)	(670)	(400)	(312)	(507)	(400)	(219)	(456)
High	9981	9676	305	9143	9165	−23	9143	9304	−162
	(80)	(65)	(103)	(135)	(63)	(149)	(135)	(135)	(150)
Difference-in-differences			1473*			1531**			907~
for whites			(678)			(529)			(481)
Panel B: Minorities									
Test score is									
Low	6436	8687	−2252	7005	7367	−363	7005	6858	147
	(549)	(690)	(882)	(347)	(347)	(495)	(347)	(290)	(452)
High	7560	8454	−894	7782	8375	−593	7782	7568	214
	(184)	(96)	(207)	(214)	(93)	(233)	(214)	(133)	(252)
Difference-in-differences			−1357			231			−67
for minorities			(906)			(548)			(518)

** = significant at the 0.01 level, * = significant at the 0.05 level, ~ = significant at the 0.10 level.

Experiment 4: Test Score Low: score group = 4; Test Score High score groups = 5–10.

Passing Standard Low: 35 minimum score and 45 mean score; Passing Standard High: 40 minimum score and 45 mean score.

Low Passing Standard states: All states except for TX, LA, MS, NE, FL, NY, CA, WA, and CT; High Passing Standard states: NY and FL.

Experiment 3: Test Score Low: score group = 3; Test Score High score groups = 5–10.

Passing Standard Low: 40 minimum score *or* 45 mean score; Passing Standard High: 40 minimum score and 45 mean score.

Low Passing Standard states: TX, LA, MS, and NE; High Passing Standard states: NY and FL.

Experiment 3*: Test Score Low: score group = 3; Test Score High: score groups = 5–10.

Passing Standard Low: 40 minimum score *or* 45 mean score; Passing Standard High: 35 minimum score and 45 mean score.

Low Passing Standard states: TX, LA, MS, and NE; High Passing Standard states: all states except TX, LA, MS, NE, NY, FL, and CT.

Education as signal? Empirical studies

- GED effect for whites
  - $ 900 - 1,500 or
  - 10 - 19 percent increase in annual earnings
- Evidence for Signaling

Questions?