Optimal Parental Leave with
Cost Differentials across University Faculties

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Abstract

We model the optimal length of paid parental leave for a university with clinical and nonclinical faculties. The optimal length of leave balances the marginal benefits and costs to the university. The benefits of additional paid leave include lower faculty turnover rates and reduced search costs, because the faculty value a policy that allows them to spend more time with their children at a critical stage of their physical and mental development without loss of income. The costs include a larger wage bill for replacement instructors and forgone grant and clinical revenues during the leave. The loss of clinical revenues introduces a key cost differential between the two faculties, which we will show leads to a shorter optimal paid leave for clinical faculty. We plan to conduct simulation exercises, using data for a large public university with a medical school, to investigate the sensitivity of the optimal leave lengths to key parameters in the cost-minimization problem.

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1. Introduction

As recently as the 1990s, many American universities had no formal leave policies, especially for family-related issues. Colleagues of female faculty absent for childbirth could cover their classes through informal arrangements.[1] Male faculty absent due to an extended illness could have their classes covered by similar arrangements. But a substantial increase in the proportion of female faculty members at many universities put these arrangements under greater strain. Furthermore, these women – still carrying disproportionate responsibilities for child care in the home – had concerns about how an extended absence in the formative stage of an academic career would be interpreted by colleagues and administrators.[2]

Such concerns, together with medical ones, created interest in mandated leave legislation. Debates over mandated parental leave played a major role in the presidential election campaign in 1988 (Summers, 1989, 177). The debates continued on the floor of the U.S. Congress into the 1990s, leading to family and medical leave legislation that passed both the House and the Senate twice, but each time President Bush vetoed the legislation (Trzcinski and Alpert, 1994, 543). In the 1992 presidential election, Bill Clinton differed strongly with the President over these decisions and emerged victorious. Indeed, the Family and Medical Leave

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[1] Corresponding policies in alternative occupations were often less accommodating for women. Trzcinski and Alpert, (1994, 538) point out that, "In the early 1970s in the United States, it was common for pregnancy-related conditions to be excluded from programs insuring workers against earnings losses. The Supreme Court ruled that this, and other related practices, did not constitute discrimination against women." They also note, however, that in a 1977 case where the Nashville Gas Company stripped all job seniority from women who had babies, the Court ruled against the company.

[2] In a national survey of 4,188 English and chemistry faculty at 507 U.S. colleges and universities, "18 percent of men and 32.8 percent of women did not ask for a reduced teaching load when they needed it for family reasons, because it would lead to adverse career repercussions" (Drago, *et. al.*, 2005, 23).

Act (FMLA) was the first piece of legislation signed into law by President Clinton after his

inauguration (Ruhm, 1997, 175).

Ruhm (1997, 176) distills the provisions of the FMLA, which took effect in 1993:

Under the act, eligible employees are entitled to 12 weeks of job-protected leave in a 12-month period to care for newborn or adopted children, relatives with serious medical conditions, or their own health problems. The legislation covers private establishments employing 50 or more persons within 75 miles of the worksite during at least 20 weeks of the current or previous year. Government workers are generally covered regardless of size. Individuals are eligible for FMLA leave if they have been with a covered employer for at least 12 months and worked for the employer 1,250 or more hours during that time. The employer is not required to pay wages during the job absence but must continue health insurance benefits on the same terms as if the worker had not taken leave.[3]

Prompted by the FMLA, universities began to develop formal parental leave policies, with

considerable variation across institutions. In a study of parental leave and modified duties

policies at eight Big Ten institutions for the Penn State Commission for Women, Drago and

Davis (2009) find that the leave length (covering most situations) varies from 12 weeks to 12

months, while the portion of leave for which an employee is paid ranges from 6 to 12 weeks.[4]

The lower bound on the length of leave matches the FLMA requirement exactly; however, *paid*

leave – which is <u>not</u> required by the FMLA – can be smaller. The modification of faculty duties

during the leave might include a full semester (or quarter) of relief from teaching, and

sometimes from committee service.

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[3] Some researchers distinguish between maternity and parental leave. Maternity leave accommodates only the physical demands of childbirth, and "the length of period considered adequate for physical recovery from normal pregnancy and childbirth in the United States is six weeks" (Trzcinski and Alpert, 1994, 536). Parental leave aims to capture both physical (e.g., breastfeeding) and psychological (bonding time) benefits for the parent and child. Title VII of the Civil Rights Act of 1964 requires that any parental leave benefits provided by employers must treat male and female employees the same (Trzcinski and Alpert, 1994, 542). Our use of parental leave encompasses both considerations.

[4] Two weeks plus accrued time at the University of Illinois – Urbana-Champaign.

A university making a parental leave policy has several considerations to balance. Departures from prevailing practices at other universities – reducing the length of leave or granting leave without pay – could raise both its turnover rate and search costs substantially. On the other hand, paying for replacement instructors becomes increasingly costly the longer the leave. For universities with a medical campus, a faculty absence can be particularly costly due to lost clinical revenues. We model the university's choice of (paid) leave length as a cost-minimization problem. The importance of reducing costs has been recently pressed upon universities, especially public ones, due to severe state budget crises created by the recession of 2007-2009. At many universities, administrators have been forced to make deep budget cuts, which has led to a review of many policies, including parental leave benefits.

We organize the paper as follows. Section 2 presents in more detail the various considerations that universities must take into account in setting the optimal length of paid leave, and specifies the formal cost minimization problem. Section 3 derives implications for optimal leave policy. Section 4 summarizes the main results and suggests possibilities for future research.

2. Specification of the Problem

Consider a university with two separate faculties, clinical (c) and nonclinical (n). Through its parental leave policy, the university determines the duration of paid leave, which may differ across faculties (x for clinical and y for nonclinical). We assume that the duration of paid leave influences several variables that affect the university's costs: its turnover rate (some employees value the paid leave benefits), its search costs (some applicants also value the paid

leave benefits),[5] the wage bill for replacement faculty, and clinical revenues and grant funding forgone while faculty are on leave. Taking all of these considerations into account, we attempt to answer the following question: what length of paid leave across faculties minimizes the institution's total costs?

We separate its total costs into five components. First, it has an annual wage bill for regular faculty, which can be written as $w_c \cdot E_c \cdot 52$ and $w_n \cdot E_n \cdot 52$, where w is the average weekly wage (salary) for faculty and E is the number of faculty employment positions in each division – c for clinical and n for nonclinical. Second, it has an annual wage (or salary) bill for replacement instructors, which can be written as $(\alpha_c \cdot w_c)(p_c \cdot E_c)x$ and $(\alpha_n \cdot w_n)(p_n \cdot E_n)y$, where $0 < \alpha < 1$ stands for the fraction of regular wages required to secure replacement instructors – perhaps differing across divisions – inclusive of search costs, and $0 < p < 1$ denotes the proportion of regular faculty who take parental leave – perhaps differing across divisions.[6]

Third, it has turnover costs in each division, which can be written as $s(x)[t(x)]E_c$ and $s(y)[t(y)]E_n$, where s represents search costs for regular positions and t denotes the turnover rate. Fourth, it loses revenue while faculty are on leave, $r_c(p_c \cdot E_c)x$ and $r_n(p_n \cdot E_n)y$, where r_c and r_n are the average weekly clinical and grant revenues per regular faculty member in the clinical

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[5] There is growing evidence of beneficial effects of parental leave on the physical and mental development of children: lower death rates for infants and young children – perhaps due to breastfeeding (Ruhm, 2000), higher rates of immunizations and cognitive and behavioral test scores at ages 3 and 4 (Berger, Hill, and Waldfogel, 2005), and higher verbal and mathematics achievement at ages 5 and 6 (Ruhm, 2004).

[6] For simplicity, we treat p as a parameter. Using CPS data, Han, Ruhm, and Waldfogel (2009, 29) find a positive, but small, relationship between the duration of leave (represented by x or y here) and leave-taking (denoted by p here): "Our main finding is that leave extensions are associated with increased leave-taking by both mothers and fathers. The magnitudes of the changes are small in absolute terms but large relative to the baseline for men and much greater for college-educated or married mothers than for their less-educated or single counterparts." In an earlier study using CPS data, Waldfogel (1999, 294) also found increases in leave-taking among women with infants after the FMLA, with the most substantial responses from those employed in medium-size firms. For our analysis, the most important issue is whether the relationship between p and x or y differs substantially for clinical and nonclinical faculty. This seems unlikely, given their similar education levels.

and nonclinical divisions. Fifth, it has fixed costs (buildings, equipment, supplies, etc.), which

are independent of x and y, and are denoted by a constant K. We combine all five cost

components to obtain the university's annual total cost function, $C(x,y)$:

$$(1)\ \ C(x,y) = w_c \cdot E_c \cdot 52 + (\alpha_c \cdot w_c + r_c) \cdot (p_c \cdot E_c)x + s(x)[t(x)]E_c + w_n \cdot E_n \cdot 52 + (\alpha_n \cdot w_n + r_n)(p_n \cdot E_n)y +$$

$$s(y)[t(y)]E_n + K.$$

The university's problem is to find the values of x and y that minimize $C(x,y)$. Note that the

wage bills for regular faculty ($w_c \cdot E_c \cdot 52$ and $w_n \cdot E_n \cdot 52$) and the other costs (K) do *not* depend on

the choice of x or y.[7] Thus, they are fixed costs for our purposes and are, therefore, irrelevant

to the solution of the problem.

3. Implications of the Analysis

The first-order conditions for cost minimization are:

$$(2)\ \ \partial C / \partial x = (\alpha_c \cdot w_c + r_c) \cdot (p_c \cdot E_c) + \{s_c^*[t'(x^*)] + [s_c'(x^*)t_c^*]\}E_c = 0$$

$$(3)\ \ \partial C / \partial y = (\alpha_n \cdot w_n + r_n) \cdot (p_n \cdot E_n) + \{s_n^*[t'(y^*)] + [s_n'(y^*)t_n^*]\}E_n = 0,$$

where x^* and y^* are the optimal values for x and y, $s_c^* = s(x^*)$ and $s_n^* = s(y^*)$ are optimal search

costs for clinical and nonclinical faculty, $t_c^* = t(x^*)$ and $t_n^* = t(y^*)$ are the optimal turnover rates

for clinical and nonclinical faculty, t' is the first derivative of the turnover function, and s' is the

first derivative of the search cost function. These first-order conditions can be rewritten as:

$$(4)\ \ (\alpha_c \cdot w_c + r_c) \cdot (p_c \cdot E_c) = - \{s_c^*[t'(x^*)] + [s_c'(x^*)t_c^*]\}E_c$$

$$(5)\ \ (\alpha_n \cdot w_n + r_n) \cdot (p_n \cdot E_n) = - \{s_n^*[t'(y^*)] + [s_n'(y^*)t_n^*]\}E_n.$$

The term on the left side of each expression is the marginal cost of parental leave to the

university (i.e., additional wages for replacement instructors plus forgone grant and clinical

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[7] If the leave were *unpaid*, the university's wage bills would depend on the length of leave.

revenues in each division), while the right side of each expression is the marginal benefit of

parental leave to the university (i.e., the turnover cost savings[8] for each division).[9] Hence,

conditions (4) and (5) imply that the optimal policy combination (x^* and y^*) equates the

marginal benefits and marginal costs *within each division*, as divisional costs are fully

independent.

Dividing (4) by (5) and multiplying both sides of the resulting expression by E_n/E_c, yields:

(6) $[(\alpha_c \cdot w_c + r_c) \cdot (p_c)] / [(\alpha_n \cdot w_n + r_n) \cdot (p_n)] = - \{s_c^*[t'(x^*)] + [s_c'(x^*)t_c^*]\} / - \{s_n^*[t'(y^*)] + [s_n'(y^*)t_n^*]\}$

To see an important implication, suppose the same proportion of faculty in each division takes

parental leave ($p_c = p = p_n$). Condition (6) then simplifies to

(7) $(\alpha_c \cdot w_c + r_c) / (\alpha_n \cdot w_n + r_n) = - \{s_c^*[t'(x^*)] + [s_c'(x^*)t_c^*]\} / - \{s_n^*[t'(y^*)] + [s_n'(y^*)t_n^*]\}$

Suppose further that $(\alpha_c \cdot w_c + r_c) > \alpha_n \cdot w_n + r_n$ (the cost of leave per faculty member is greater for

clinical faculty than for nonclinical faculty). Then the optimal policy requires that:

(8) $- \{s_c^*[t'(x^*)] + [s_c'(x^*)t_c^*]\} > - \{s_n^*[t'(y^*)] + [s_n'(y^*)t_n^*]\}$.

Note that this condition cannot hold if $x^* = y^*$, because the two expressions would then be

equal. To determine whether x^* is smaller or larger than y^*, we must impose assumptions on

both the turnover and search cost functions. We assume that $t' < 0$ (the turnover rate declines

as the length of parental leave increases) and $t'' > 0$ (the turnover rate declines less and less as

the length of parental leave increases). We assume further that $s' < 0$ (search costs decline as

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[8] A full accounting of the search costs of replacing workers who terminate employment would include the time costs for administrators, faculty, and staff (e.g., managing and screening applications, conducting off-campus and campus interviews, reaching decisions about the merits of the candidates, etc.), in addition to the monetary costs. Indeed, the later are only the tip of the iceberg. This point applies in principle to finding short-term replacement instructors for faculty on leave, but those searches are usually far less time-consuming.

[9] Our analysis captures only the costs and benefits of parental leave for one employer. For an analysis of the broader labor market consequences of parental leave, see Mitchell (1990), Ruhm (1998), Waldfogel (1999), Waldfogel, Higuchi, and Abe (1999), and Han, Ruhm, and Waldfogel (1999).

the length of parental leave increases) and $s'' > 0$ (search costs decline less and less as the length of parental leave increases). That is, t and s are both convex functions.

All of these properties hold for the turnover function $t(x) = A \cdot e^{-\alpha x}$ and for the search cost function $s(x) = B \cdot e^{-\beta x}$, where $0 < A < 1$, $B > 0$, $\alpha > 0$, and $\beta > 0$ are parameters. Note that $t(0) = A$ and $s(0) = B$, so A and B are the university's turnover rate and search costs, respectively, when it offers no parental leave. The parameter α determines the rate at which turnover changes as x increases, while the parameter β determines the rate at which the search costs change as x increases. Finally, we can replace x with y in each function to obtain $t(y)$ and $s(y)$.

Equation (8) can be rewritten as

$$(9) \quad s(x^*) \cdot [-t'(x^*)] + [-s'(x^*)] \cdot t(x^*) > s(y^*) \cdot [-t'(y^*)] + [-s'(y)] \cdot t(y^*).$$

We now make the following observations:

- Given that $t' < 0$, $t'(x^*)$ and $t'(y^*)$ are both negative.

- Given that $s' < 0$, $s'(x^*)$ and $s'(y^*)$ are both negative.

Thus, all four terms on the right and left sides of expression (9) are positive. Moreover,

- Given that $t'' > 0$, $t'(x^*)$ and $t'(y)$ become less negative as x^* and y^* increase.

- Given that $s'' > 0$, $s'(x^*)$ and $s'(y^*)$ become less negative as x^* and y^* increase.

We illustrate these observations in Figures 1 and 2. There we can see that for $x^* < y^*$,

- $s(x^*) > s(y^*)$ and $t(x^*) > t(y^*)$

- $-t'(x^*) > -t'(y^*)$ and $-s'(x^*) > -s'(y^*)$, so that

- $s(x^*) \cdot [-t'(x^*)] > s(y^*) \cdot [-t'(y^*)]$ and $[-s'(x^*)] \cdot t(x^*) > [-s'(y^*)] \cdot t(y^*)$,

which ensures that equation (9) is satisfied. By similar reasoning, the six inequalities above are all reversed when $x^* > y^*$, which violates equation (9). Therefore, if leave-taking occurs at the

same rate in both divisions and the cost of leave per faculty member is greater in the clinical

division, then it must be the case that $x^* < y^*$ at the cost minimum. That is, the logic of cost

minimization (with our assumptions) implies that *parental leave must be <u>shorter</u> for clinical

faculty than for nonclinical faculty*.

From the first-order conditions of the university's cost minimization problem, given by

equations (4) and (5), we can derive an expression for the optimal length of paid parental leave

in each division (x^* and y^*), which will depend on the parameters in the model. We derive such

an expression for the clinical division; the corresponding expression for the nonclinical division

is analogous. Dividing both sides of equation (4) by E_c, and using the search and turnover

functions specified above, we obtain

$$(10) \ (\alpha_c \cdot w_c + r_c) \cdot (p_c) = -\{B \cdot e^{-\beta x^*}[-A \cdot \alpha \cdot e^{-\alpha x^*}] + [-B \cdot \beta \cdot e^{-\beta x^*}]A \cdot e^{-\alpha x^*}\},$$

which simplifies to

$$(11) \ (\alpha_c \cdot w_c + r_c) \cdot (p_c) = A \cdot B \cdot e^{-(\alpha+\beta)x^*}(\alpha+\beta).$$

Dividing on both sides of (11) by $A \cdot B \cdot (\alpha+\beta)$, taking natural logarithms on both sides, and solving

for x^* yields

$$(12) \ x^* = -\ln\{(\alpha_c \cdot w_c + r_c) \cdot (p_c)]/[A \cdot B \cdot (\alpha+\beta)]\} / (\alpha+\beta).$$

Equation (12) implies that a university would offer some paid parental leave ($x^* > 0$) in the

clinical division only if $(\alpha_c \cdot w_c + r_c) \cdot (p_c) < A \cdot B \cdot (\alpha+\beta)$. From our earlier interpretation of equation

(4), $(\alpha_c \cdot w_c + r_c) \cdot (p_c)$ captures the marginal cost of parental leave to the university, expressed per

employment position. Using equations (4) and (10), we can see that $A \cdot B \cdot (\alpha+\beta)$ is the marginal

benefit of parental leave to the university, expressed per employment position, when x = 0

(there is no paid leave). Therefore, the university offers paid parental leave only when the marginal benefit of the *first* week of leave exceeds the marginal cost.

4. Conclusions

With many states facing budget crises in recent years, public universities have been forced to manage costs more carefully. Within the area of personnel policies, parental leave benefits have come under review. Many universities provide *paid* parental leave, which goes beyond the legal requirements of the FMLA, signed into law by President Clinton in 1993. Also, for public universities with clinically-licensed faculty (e.g., those with medical schools), offering extended leave can be particularly costly due to forgone clinical revenues.

We model the optimal length of paid parental leave for a university with clinical and nonclinical faculties. The optimal length of leave depends on the marginal benefits (reduced faculty turnover and search costs) and costs (higher wage bill for replacement instructors and forgone grant and clinical revenues) of providing additional leave. We show that, if the faculty in the clinical and nonclinical divisions take leave at the same rate, and leave is more costly (due to lost clinical revenues) in the clinical division, then cost minimization implies that the optimal length of paid leave must be shorter in the clinical division.

In future research, we plan to calibrate the model's parameters using data for an institution in the University of North Carolina system to determine (1) the sensitivity of the optimal leave lengths to various parameters in the model, such as grant and clinical revenues, and (2) the additional costs to the university of adopting a uniform parental leave policy, rather

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than separate leave policies across divisions, which places a constraint on its cost minimization

problem.

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Figure 1:
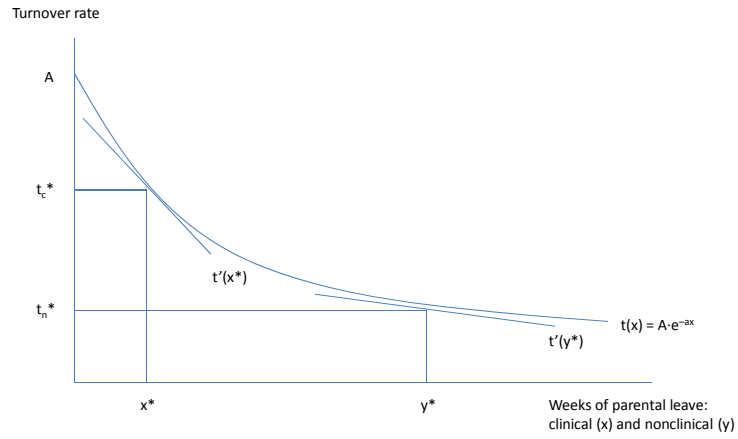## Faculty Turnover as a Function of Parental Leave Length

Turnover rate

A

t_c*

$t'(x*)$

t_n*

$t(x) = A \cdot e^{-ax}$

$t'(y*)$

x*   y*   Weeks of parental leave:
                    clinical (x) and nonclinical (y)

Figure 2:
Search Costs as a Function of Parental Leave Length

Search costs

B

s_c*

$s'(x*)$

s_n*

$s(x) = B \cdot e^{-\beta x}$

$s'(y*)$

x*   y*   Weeks of parental leave:
                    clinical (x) and nonclinical (y)