



## An Analysis of Gender Equity in MUFA Faculty Salaries

In fall 2012, the McMaster University Faculty Association (MUFA) raised the issue of gender pay gap at the Joint Committee of MUFA and the University Administration. At the request of David Wilkinson, Provost and Vice-President (Academic), the Office of Institutional Research and Analysis (IRA) conducted a preliminary study in summer 2013 to investigate whether there is a gender pay gap in salaries of full-time faculty members at McMaster University. This preliminary study used 2012 full-time faculty data as of October 1, 2012. In February 2015, the Joint Committee came to an agreement to conduct another study that considered MUFA faculty members, including both full-time and part-time, for two years, 2012 and 2013. This study was conducted by IRA with input from members of the MUFA Remuneration Committee represented by Dr. Michelle Dion, Associate Professor, Political Science and MUFA Vice-President, and using mutually accepted data and methodology.

### Analysis and Results

The Joint Committee agreed to use data as of July 1 for both the 2012 and 2013 datasets. In discussion with the MUFA Remuneration Committee, the datasets were reviewed to include both full-time and part-time MUFA faculty and members in associate vice president and decanal positions. Salary dollar amounts used in the analysis were annualized and excluded all stipends for administrative duties and/or any additional payments (for example, overload teaching payments). For part-time faculty, the amount used was the equivalent full-time salary, and for faculty with a contract lasting less than 12 months, the amount was the equivalent annualized salary. The distribution of annual salaries is not significantly skewed, and therefore the models include the untransformed salary (not logged). Table 1 lists the variables included in the datasets used.

Annual salary adjustments at McMaster are comprised of an across-the-board percentage or dollar amount, plus a career progression/merit (CP/M) component. The merit component is based on a pool that awards 120 merit points per 100 faculty members. Merit scores are converted into merit pay based on fixed dollar amounts per point that are larger for those with salaries below either of two specified break points. Consequently, faculty salaries at McMaster are likely to have a curvilinear relationship with experience or years in rank. The University of British Columbia (2010) report, "An Analysis of the Gender Pay Gap in Professorial Salaries at UBC" modelled salary as a curvilinear function of experience because their merit pay structure has a cumulative ceiling that flattens out salary increases for faculty with long years of service (Bakker et al, 2010). Similarly, this study modelled annual salary as a curvilinear function of experience and included both Years in Rank and Years in Rank Squared as predictors of salary.

### General Characteristics

At McMaster University, as of July 1, 2012, there were 939 MUFA faculty members: 356 full professors, 316 associate professors, 248 assistant professors and 19 lecturers. Female faculty members account for almost 36 percent of the total faculty population. The majority of the male faculty were full professors (46%) and associate professors (31%), while female faculty members were mainly associate (38%) and assistant professors (36%). The average annual salary was \$136,908: for male and female faculty, the average annual salary was \$142,108 and \$127,532 respectively, that is, the average female was lower than the average male salary by \$14,575. On average, male faculty members were paid higher than female

faculty members in the ranks of full professor (by \$6,019), associate professor (\$6,465) and lecturer (\$11,985). On average, female faculty members were paid higher than male faculty members in the rank of assistant professor (\$3,215).

Tenure-stream appointments accounted for approximately 75% of the full-time faculty population. Within this group, 494 (70%) of the 706 tenured full-time faculty were male, and of these, 266 (54%) were full professors. Among the female tenured appointments, the largest group was in the associate professor rank (94 of 212, 44%). Overall, male faculty members were older compared to female faculty members and had a higher average number of Years since First Degree, Years since Highest Degree, Years at McMaster and Years in Rank. In contract positions, female assistant professors had a higher average number of years for those five variables. Female associate professors were on average older than male associate professors and had a higher number of Years since First Degree, but female associate professors had a lower average number of Years since Highest Degree and similar average Years at McMaster and Years in Rank compared to male associate professors. On average, male lecturers were older and had a higher average number of Years since First Degree, Years at McMaster and Years in Rank but had a lower average number of Years since Highest Degree.

As of July 1, 2013, there were 943 MUFA faculty members: 373 full professors, 314 associate professors, 238 assistant professors and 18 lecturers. Female faculty members accounted for almost 37% of the total faculty population. The majority of the male faculty members were full professors (48%) and associate professors (30%), while female faculty members were mainly associate (38%) and assistant professors (36%). The average annual salary was \$139,906: for male and female faculty, the average annual salary was \$146,769 and \$128,225 respectively, that is, the overall average female to male salary difference was \$18,544. Male faculty members were paid higher than female faculty in all ranks: full professor (\$5,316); associate professor (\$7,407); assistant professor (\$525) and lecturer (\$15,972).

Tenure stream appointments accounted for about approximately 75% of the full-time faculty population. Within this group, 488 of the 707 (69%) tenured full-time faculty were male, and of these, 281 (55%) were full professors. Among the female tenured appointments, the largest group was in the associate professor rank (94 of 219, 43%). Overall, male faculty members were older compared to female faculty members and had a higher average number of Years since First Degree, Years since Highest Degree, Years at McMaster and Years in Rank. Female assistant professors had a higher average number of years for all of the above variables except Years since Highest Degree where they tie with male assistant professors. Female associate professors were older and had a higher average number of Years since First Degree but a lower average number of Years since Highest Degree, Years at McMaster and Years in Rank. Male lecturers were older and had a higher average number of Years since First Degree, Years at McMaster and Years in Rank but a lower average number of Years since Highest Degree.

## Regression Analysis

The question in this study is whether the differential salary is related to gender, while recognizing that salary differences may also be explained by different levels of experience, discipline, or other characteristics of male and female faculty members. A multiple regression model was built to determine whether gender played a significant role in determining salary level and to estimate how the average annual salary (dependent variable) changes with independent variables such as Gender, Years in Rank, Years in Rank Squared, Faculty, Appointment Stream, and Highest Degree. The null hypothesis was that

there is no significant correlation between annual salary and gender. If the null hypothesis is rejected, one could conclude that faculty annual salary varies significantly by gender after controlling for other known factors that determine salary. The criterion used for statistical testing is a 5% significance level.

The variables Years in Rank, Age, Years since First Degree, Years since Highest Degree, and Years at McMaster that were found to be highly correlated. Therefore, in order to avoid multicollinearity, only Years in Rank was kept as the primary measure of academic experience, along with Years in Rank Squared.

The multiple regression results indicate that the average annual salary of female faculty members was lower than the average annual salary of male faculty members at McMaster University by \$2,992 in 2012 and by \$4,037 in 2013, after controlling for all other statistically significant predictors of annual salary in the model. The p-value of Gender is 0.0114 for 2012 and 0.0013 for 2013. Therefore this analysis indicates that there is sufficient evidence to reject the null hypothesis and conclude that there is a statistical significant relationship between the salary differential and gender at the 5% significance level in both 2012 and 2013 (see Tables 2 and 3).

Literature suggests that there are several factors that could potentially explain the difference in salary between male and female faculty. Firstly, men in general are more likely to negotiate for a higher starting salary than women. Second, studies on the marriage patterns of faculty members suggest that men in academia are less likely than women to be in a dual-career relationship (Baker, 2012). Consequently, male faculty may be more mobile, giving them an edge over their less mobile female colleagues when negotiating salary increases. Third, women are more likely to take pregnancy or parental leave and often assume primary responsibility for childcare, which can lead to lower merit pay increases during the first years of parenthood. Finally, research also suggests implicit gender biases, including how women's research, teaching, and service activities are evaluated, may also contribute to unexplained differences in pay (see Baker, 2012).

The difference in the salary differential between 2012 and 2013 of about \$1,000 in the findings of this study could be an artifact of volatility in the model. When checking the goodness-of-fit of the regression model using studentized residuals (a technique used to assess the validity of a fitted model and observations that have a studentized residual less than -2 or greater than 2 are considered statistically significant at the 5% significant level), there were sufficient potential outliers to expect the regression model to err in predicting the salary differential related to gender. Note that about 93% of the population was common between 2012 and 2013, and the characteristics of those who dropped out of the 2013 dataset (Sample D) were quite different from those who came into the 2013 dataset (Sample N). There are 6 male faculties in Sample D who have studentized residuals less than -2 compared to 6 (Sample N) while there are 24 male faculty members that have studentized residuals greater than 2 in Sample D compared to 27 in Sample N. The lowest male annual salary was around \$66,000 and \$67,000 in Samples D and N respectively but the highest was just under \$256,000 and just over \$333,000 respectively. For female annual salary, the lowest was around \$66,000 and \$64,000 and the highest was just under \$174,000 and just over \$242,000 in Samples D and N respectively.

The results further indicate that the average annual salary of MUFA faculty members at McMaster is influenced by a number of significant factors, namely: the Canada Research Chair status, Years in Rank, Faculty, Appointment Stream, and Rank. The average annual salary of a faculty member who is a Canada Research Chair was estimated to be about \$17,421 and \$15,063 higher than one who is not in 2012 and 2013

respectively. With respect to Years in Rank, for (x) year of increase, the average annual salary was estimated to increase by about  $\$2,760*(x) - \$66*(x^2)$  and by about  $\$2,444*(x) - \$56*(x^2)$  in 2012 and 2013 respectively. In addition, the rate of change in average annual salary was estimated to change by  $\$2,760 - 132*(x)$  in 2012 and by  $\$2,444 - 112*(x)$  in 2013.

To determine whether the salary differential is greater in some faculties or ranks compared to others, further regression with interactions between gender and faculty and between gender and rank respectively were conducted. The results did not consistently indicate that the annual salary differential by gender was larger in one faculty than in another faculty, nor did the salary differential vary significantly or consistently by academic rank. Overall, the size of the salary differential found at McMaster (in dollar amounts and as a percentage of average salary) is similar to that found at other Canadian institutions, including the University of British Columbia (Bakker et al. 2010), the University of Calgary (Wallace 2005), and the University of Western Ontario (Campbell et al. 2005), using similar data and methodologies.

### **The Blinder-Oaxaca Decomposition**

This study also employed another popular methodology proposed by Blinder (1973) and Oaxaca (1973) that is often used to analyze salary gaps by gender or race. The decomposition technique studies the mean differences between two groups in a counterfactual manner. When used to study salary differences, it divides the salary differential between two groups into a part that is “explained” by group differences in pay determining characteristics, such as education level or years of highest degree, and a residual part that cannot be accounted for by such differences in salary determinants. The “unexplained” part is often used as a measure for discrimination, but it also subsumes the effects of group differences in unobserved predictor variables (see Jann, 2008).

The results of the pooled two-fold decomposition show that there is an average difference of \$14,575 and \$18,544 in favour of male faculty in 2012 and 2013, respectively. Of the difference, about 79% in 2012 and 78% in 2013 can be explained by the pay determining characteristics identified through the regression methodology, namely Canada Research Chair, Highest Degree, Years in Rank, Faculty, Appointment Stream, and Rank. The remaining 21% (\$2,992) and 22% (\$4,037) of the difference is said to be the unexplained gender pay gap. As the associated p-values are lower than 0.05, this unexplained difference is deemed to be statistically significant at the 5% significance level. This finding is consistent with the regression analysis finding.

### **Conclusion**

The analysis based on two years of snapshot data of MUFA full-time and part-time faculty consistently suggest that there is a salary differential of \$2,992 and \$4,037 in favour of male faculty that can be explained by the Gender variable. The average annual salary difference is \$3,515 over the two years. The difference between these results is due to a significant shift in the population from one year to the next, indicating that the result, while significant, is somewhat volatile. Thus, the estimated differential salary is not robust and is sensitive to yearly fluctuations in the data. For this reason, the Joint Committee agreed that rather than accepting the salary differential estimated for any one of the two years, to apply \$3,515 as the salary differential for McMaster at this time. In the absence of conclusive evidence that the salary differential varied among the Faculties, the Joint Committee concluded that a single differential would be

applied across the university. The evidence also does not consistently indicate significantly different gender pay gaps by rank. Therefore, it was also decided that the adjustment would be a fixed dollar.

On the basis of this study, the university has decided to award a special base salary adjustment of \$3,515 to all full-time female MUFA faculty members on staff at McMaster at the time of the announcement. Part-time faculty will receive a prorated adjustment. This adjustment will take effect on July 1, 2015.

While this one-time adjustment to the base salary of female faculty will help correct the salary gap, ongoing action by Faculty Deans and other academic leaders must be taken to address potential root causes in order to ensure gender equity in pay prevails now and into the future. Given that merit pay is a component of salary increases, ensuring a fair and equitable merit increase process will directly impact gender equity in pay positively. Whether or not a process results in good or poor outcomes is also dependent on secondary factors including content of related guidelines and policies concerning research, pregnancy and parental leaves, institutional climate or departmental culture and perception, clarity, accountability and transparency surrounding the merit process. The Equity Task Force, whose report was released in January, 2014 contains recommendations related to the hiring and support of female faculty members at the University. Two of the recommendations of the Task Force's Report pertain to pregnancy/parental leave and have been the focus of a committee that has concluded a review of the Pregnancy/Parental Leave Policy culminating in recommendations that would ensure a systematic and unbiased approach is used in applying CP/M to faculty who are on leave.

Table 1: Dataset Variables

Variable	Description
<b>Dependent variable (response):</b>	
Annual Salary	Annual rate of salary. Not reduced by sabbatical or other leaves. Excluded administrative stipends.
<b>Independent variable (predictor):</b>	
Gender	Male=0, Female=1
Rank	Full, Associate, Assistant, Lecturer
Appointment Stream	Tenure, Special, Teaching, CLA
Faculty	Faculty individual staff member belongs to
Age	Age as of October 1, 2012
Years in Rank	Years since staff member attained their current rank
Years at McMaster	Years of experience at McMaster University in a full-time continuing position
Years Since First Degree	Years since completing first degree
Years Since Highest Degree	Years since completing highest degree
Highest Degree	Highest degree earned
Canada Research Chair	No=0, Yes=1

Table 2: Summary Table of Regression on Annual Salaries (2012)

Variable	Label	Parameter Estimate	Heteroscedasticity Consistent			Variance Inflation
			Standard Error	t value	p-value	
Intercept	INTERCEPT	141207	2112.09	66.86	<.0001	0.00
Gender (base=Male)	GENDER	-2992.18	1179.82	-2.54	0.0114	1.25
Canada Research Chair	CRC	17421	3141.58	5.55	<.0001	1.04
Years in Rank	YAPRANK	2759.635	246.32	11.20	<.0001	11.61
Years in Rank <sup>2</sup>	YAPRANK2	-65.7172	10.04	-6.54	<.0001	11.08
Highest Degree (base=PhD)	DEG_PRO	-3300.27	4954.07	-0.67	0.5055	1.04
	DEG_MAS	3067.79	2217.05	1.38	0.1668	1.41
	DEG_BAC	3254.972	3914.81	0.83	0.4059	1.18
Faculty (base=Social Science)	FAC_BUS	27156	2741.72	9.90	<.0001	1.46
	FAC_ENG	7563.407	1850.19	4.09	<.0001	1.96
	FAC_HUM	-7687.64	2028.43	-3.79	0.0002	1.78
	FAC_SCI	-893.202	1644.69	-0.54	0.5872	2.12
	FAC_HSCI	11740	2094.02	5.61	<.0001	2.73
Appointment Stream (base=Tenure- stream)	APTP_SPECIAL	-8042.13	2662.51	-3.02	0.0026	1.46
	APTP_CLA	-11920	1750.70	-6.81	<.0001	1.89
	APTP_TEACH	1875.114	2060.24	0.91	0.363	1.55
Rank (base=Full professor)	RANK_ASOC	-22647	1393.40	-16.25	<.0001	1.44
	RANK_ASST	-48962	1744.09	-28.07	<.0001	2.35
	RANK_LECT	-57012	5303.46	-10.75	<.0001	1.61

R-Square = 0.7667

Adjusted R-Square = 0.7622

Table 3: Summary Table of Regression on Annual Salaries (2013)

Variable	Label	Parameter Estimate	Heteroscedasticity Consistent			Variance Inflation
			Standard Error	t value	p-value	
Intercept	INTERCEPT	146977	2591.13	56.72	<.0001	0.00
Gender (base=Male)	GENDER	-4036.84	1253.86	-3.22	0.0013	1.26
Canada Research Chair	CRC	15063	3394.92	4.44	<.0001	1.04
Years in Rank	YAPRANK	2443.75	314.21	7.78	<.0001	11.31
Years in Rank <sup>2</sup>	YAPRANK2	-55.9156	11.21	-4.99	<.0001	10.68
Highest Degree (base=PhD)	DEG_PRO	-3291.56	7716.87	-0.43	0.6698	1.04
	DEG_MAS	635.7566	2466.38	0.26	0.7966	1.45
	DEG_BAC	659.215	4109.99	0.16	0.8726	1.09
Faculty (base=Social Science)	FAC_BUS	29720	3333.96	8.91	<.0001	1.47
	FAC_ENG	7539.988	1988.36	3.79	0.0002	1.95
	FAC_HUM	-5327.86	2011.90	-2.65	0.0082	1.74
	FAC_SCI	-580.462	1641.73	-0.35	0.7237	2.10
	FAC_HSCI	13439	2203.95	6.10	<.0001	2.60
Appointment Stream (base=Tenure- stream)	APTP_SPECIAL	-9138.02	2594.77	-3.52	0.0004	1.51
	APTP_CLA	-10140	2524.92	-4.02	<.0001	1.79
	APTP_TEACH	6073.593	2350.73	2.58	0.0099	1.64
Rank (base=Full professor)	RANK_ASOC	-25464	1643.16	-15.50	<.0001	1.41
	RANK_ASST	-55593	2393.51	-23.23	<.0001	2.29
	RANK_LECT	-60309	6984.45	-8.63	<.0001	1.65

R-Square = 0.7397

Adjusted R-Square = 0.7346



## References

- Baker, M. (2012). *Academic Careers and the Gender Gap*. Vancouver: UBC Press.
- Bakker, K., Boyd, L., Fortin, N., Johnson, J., Patch, T., Trowell, M., and Sudmant, W., (2010). "An Analysis of the Gender Pay Gap in Professorial Salaries at UBC", The University of British Columbia.  
[http://www.facultyassociation.ubc.ca/docs/news/GenderPayEquity\\_Report\\_DATA.pdf](http://www.facultyassociation.ubc.ca/docs/news/GenderPayEquity_Report_DATA.pdf)
- Blinder, A., (1973). "Wage Discrimination: Reduced Form and Structural Estimates", *Journal of Human Resources* 8: 436-455.
- Campbell, K., Chelladurai, R., Darnell, R., Hanford, P., Koval, J., Macfie, S., and Schroeder, J., (2005). "Report of the Faculty Pay Equity Committee", The University of Western Ontario.  
<http://www.uwofa.ca/@storage/files/documents/149/2005payequityreport.pdf>
- Cotton, Jeremiah.(1988). "On the Decomposition of Wage Differentials," *Review of Economics and Statistics* 70:236 – 243.
- Elder, T.E., Goddeeris, J.H., Haider, S.J., (2010). "Unexplained gaps and Oaxaca–Blinder decompositions", *Labour Economics* 17: 284-290.
- Fortin, N., Lemieux, T., Firpo, S., (2010). "Decomposition Methods in Economics", *Handbook of Labor Economics*, Vol. 4, North-Holland.
- Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., (2009). "Multivariate Data Analysis", Seventh edition. Prentice Hall.
- Jann, B., (2008). "The Blinder- Oaxaca Decomposition for Linear Regression Models", *Stata Journal* 8: 435-479.
- McDonald, J. A., Robert, J. T., (2001). "Comparable Worth in Academe: Professors at Ontario Universities", *Canadian Public Policy / Analyse de Politiques* 27: 357-373.
- O'Brien, R.M., (2007). "A Caution Regarding Rules of Thumb for Variance Inflation Factors", *Quality & Quantity* 41: 673-690.
- Oaxaca, R., (1973). "Male-Female Wage Differentials in Urban Labor Markets", *International Economic Review* 14: 693-709.
- Wallace, J., (2005). "Faculty Salary Equity Report. Prepared for The Academic Women's Association", University of Calgary.  
[http://ucalgary.ca/president/files/president/Salary\\_Equity\\_Report\\_May-2005.pdf](http://ucalgary.ca/president/files/president/Salary_Equity_Report_May-2005.pdf)
- Equity Task Force. (2014). "Women faculty, now and in the future: Building excellence at McMaster University," McMaster University.  
[http://www.mcmaster.ca/vpacademic/documents/Yates\\_Report\\_on\\_Gender\\_Equity\\_January\\_2014.pdf](http://www.mcmaster.ca/vpacademic/documents/Yates_Report_on_Gender_Equity_January_2014.pdf)