

The Hidden Costs and Benefits of Part Time Ph D Degrees

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Abstract Enrollment by US nationals in engineering Ph D programs has been steadily falling for many years. High salaries for recently qualified engineers working in industry compared to stipends for graduate students from scholarships and grants makes the cost of earning a Ph D through full time study on a university campus too high for many potential Ph D students. Since 2000, Virginia Tech has allowed students in selected locations earn a Ph D through part time study while still employed full time. This paper calculates the hidden economic benefit of part time Ph D degrees, both to the student and to the university, and recommends a formula that assigns research credit to the faculty adviser for each part time student who graduates with the Ph D degree.

Keywords: Part time Ph D costs benefits

INTRODUCTION

The number of Ph D degrees in Electrical and Computer Engineering awarded to US Nationals at Virginia Tech fell steadily through the 1990s into the next decade, in common with most electrical engineering programs at other universities. Figure 1 shows this trend from 1998 through 2006 for all schools in the US, taken from data published by the National Science Foundation [NSF, 1]. The data in Figure 1 are not entirely comparable because the data from NSF is for Ph D degrees awarded in electrical engineering, while the data for Virginia Tech is for Ph D enrollments in electrical and computer engineering.

A steadily decreasing proportion of students graduating with master's degrees stayed on for the Ph D, preferring instead to take up employment in industry and government laboratories. There are many reasons for this decline, but it is clear that the cost of residence at a university campus and the loss of an industry-level salary are major factors. Scholarships and grants for graduate students have not kept pace with the rising salaries paid to engineering graduates qualified at the master's level. Prior to 2000, Virginia Tech required all Ph D students to spend at least two semesters in residence on the Blacksburg, Virginia, campus. Blacksburg is a small college town with relatively little industry, so once a student has left the university for employment elsewhere, residence on campus means relocating for at least nine months. The high cost associated with leaving a well paid job and the disruption to family life for married students has proved to be a major deterrent.

Since 2001, some Virginia Tech Ph D students have been able to remain in full time employment while earning a Ph D part time. The availability of the part time Ph D has significantly increased enrollment by US Nationals in the ECE Ph D program, which currently stands at 31% for full time Ph D students on campus and 56% for part time Ph D students, producing a hidden benefit of \$4.1 M per year. This figure does not include the direct benefit to an employer of keeping a full time employee in position instead of losing a productive young engineer for three or four years.

In 2003, the ECE department at Virginia Tech initiated the Direct Ph D program. Suitably qualified BSECE graduates can register for the Ph D rather than a master's degree, and can complete the Ph D degree without first completing an MS degree. Thus there are three options for completing a Ph D in Electrical and Computer Engineering at Virginia Tech: The traditional five years of full time study for the MS degree followed by the Ph D

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degree, the BS-MS option which allows a Ph D candidate to complete the Ph D in about four years after the BSECE degree, and one year of full time study for the MS degree followed by part time study for the Ph D. In some cases, students earn a master's degree part time and then proceed to the part time Ph D.

The proportion of US nationals in the direct Ph D program is much higher than for the regular Ph D, and contributes to the upturn in US national enrollments seen in Figure 1.

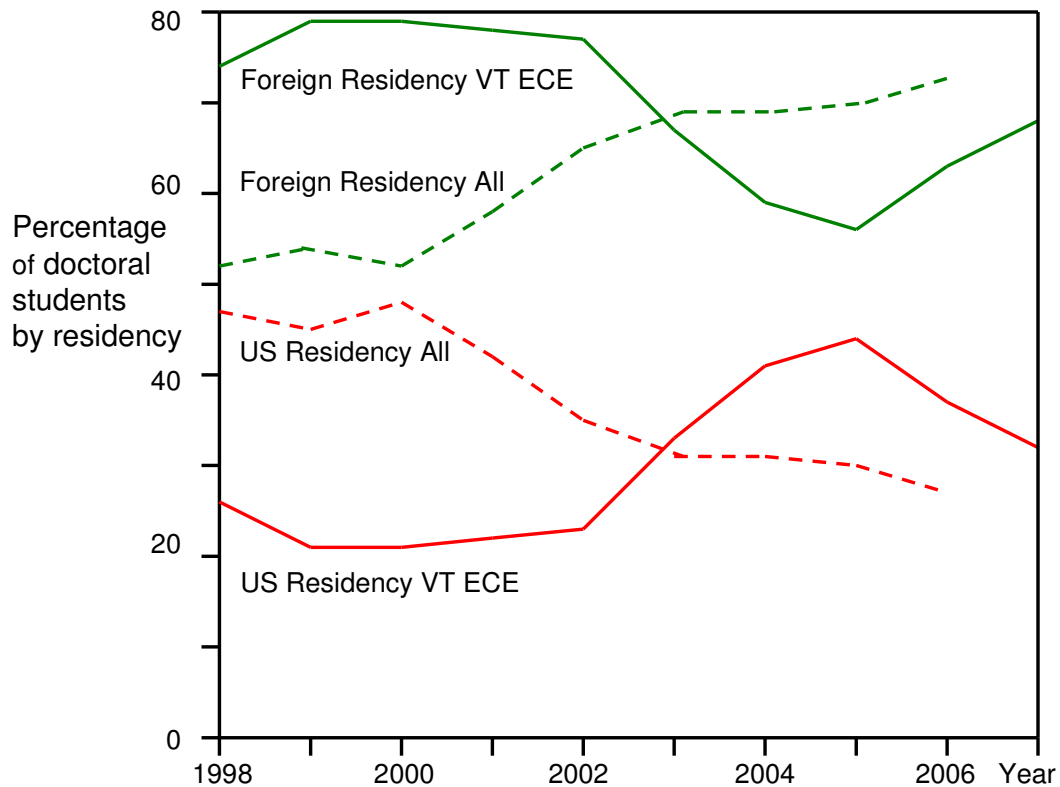


Figure. 1 Ph D degrees in Electrical Engineering awarded in the United States (All) [NSF, 1] and enrollment in Ph D programs in Electrical and Computer Engineering at Virginia Tech (VT ECE)

THE COST TO EARN A PH D DEGREE

Table 1 estimates the cost to a married student without children of relocating to an apartment in Blacksburg for a three year period, leaving a job that pays \$80,000 a year to take up a graduate scholarship of \$30,000 a year. Table 1 assumes that the tuition and fees for this student are paid either from a scholarship or from a research contract, and ignores incidental expenses such as text books. The tax adjustment is an estimate based on a family with no children taking the standard deductions for federal and Virginia state taxes. Any sensible student is going to calculate how long it will take to recover the investment to earn a Ph D degree, and might expect to be moving ahead of his or her contemporaries within five years of leaving the university (if patient). To recover the net loss of earnings of \$116,000 over the three years it has taken to earn a Ph D, when the student returns to industry he or she must earn at least \$23,200 more than his or her contemporaries for the next five years. A high flyer can certainly earn such a salary in industry, which represents a 45% increase over a three year period, but there is no guarantee. It is evidently a gamble that not many potential Ph D students from the US National pool who are employed full time are willing to take. Instead of relocating to campus for three years, some students can complete residency in nine months, return to their jobs, and then become part time Ph D students. Table 2 shows the cost to a Ph D student of a nine month residency period on the Blacksburg campus, using the same basis for calculation as Table 1. The amount to be recovered is now \$29,000 over a five year period, which requires a salary increase to \$89,000 assuming that the

Ph D student receives a 5% increase in base salary at the end of the year. The company is giving our student an 11.1% pay raise for being gone for nine months; feasible, but still a gamble. If the potential Ph D candidate has bought a \$200,000 house with a 25 year mortgage, the monthly payments of \$1,544 plus apartment rent of \$800 per month while on campus will almost equal the \$30,000 scholarship and make any such move impossible. Unless the student has a spouse who can find a well paid job in Blacksburg, or has extensive private means that they are willing to expend in the pursuit of a Ph D, there is no possibility that he or she will return to the Blacksburg campus, even for a nine month residency period unless the company grants a leave of absence and keeps paying the student's salary.

Table 1 Cost to earn a Ph D degree by three years of full time study on campus

Loss of gross salary per annum	\$ 50,000
Adjustment for taxes per annum	11,300
Net loss per year	38,700
Cost for three years	\$ 116,100

Table 2 Cost to earn a Ph D degree with nine months of residency on campus

Loss of gross salary	\$ 37,500
Adjustment for taxes	8,475
Net loss over 9 months	\$ 29,025
Loss of gross salary	\$ 37,500

Graduate student scholarships continue to fall behind salaries paid to young engineers in industry, and the trend towards fewer and fewer US nationals enrolling in full time Ph D and master's degree programs is likely to continue. Many of the companies hiring ECE graduates are engaged in defense related work and require employees to be US nationals and to obtain security clearances. This has pushed up starting salaries for new BSECE graduates, resulting in the same declining trend in enrollments in full time master's degrees. Table 3 shows the mix of US and foreign graduate students in the ECE department at Virginia Tech in fall 2007. Most of the part time students are US nationals (56%) and not located at the main campus, while most of the graduate students on the Blacksburg campus are foreign nationals (67%).

Table 3 Masters and Ph D students enrolled in Virginia Tech's ECE department in Fall 2007

	Masters	Ph D All	Ph D Full time	Ph D Part time	Direct Ph D
US Nationals	94	98	83	25	21
All graduate students	159	300	265	45	41
Percent US Nationals	59%	33%	31%	56%	51%

Counting the cost

The data presented in Tables 1 and 2 show the cost to the Ph D student of spending three years in full time study, or nine months in residency, in Blacksburg. Students who come to campus leaving a well paid job in industry or government no longer generate wealth for their former employer, and no longer pay as much income tax. The

assumption in Tables 1 and 2 is that the Ph D student is paid a stipend of \$30,000 while on campus, and that tuition and fees of approximately \$9,000 per year for a full time, in-state graduate student are being paid on the student's behalf. Let us assume for simplicity that this money comes from an endowment or a similar fund within the university, although in practice it is likely to come from a research contract. In addition to stipend and tuition, the on-campus student must be provided with office space, equipment, and utilities. These costs are estimated at \$10,000 per year for a full time Ph D student and \$ 5,000 for a student completing residency.

Tables 4 and 5 show the hidden cost of taking a productive young engineer out of paid employment and supporting that student for three years and nine month respectively while earning a Ph D degree or completing residency. No account is taken of the loss to the former employer because of the absence of a productive employee. Adding the cost to the student of leaving employment to become a full time Ph D candidate to the cost to the economy as detailed in Tables 4 and 5 yields a figure of \$80,300 per year. This is the partly visible and partly hidden cost to all parties for a young engineer with an MSECE degree who has elected to become a full time Ph D student. Over a three year period the total cost of earning the Ph D degree will be \$240,900.

Table 4 Cost to the economy for a student to earn a Ph D degree by three years of full time study

Loss of gross salary p.a.	\$ 50,000
Tuition and fees p. a.	9,000
Lost tax revenue p.a.	11,300
Lab space and equipment p.a.	10,000
Cost for three years	240,900

Table 5 Cost to the economy to earn a Ph D degree with nine months residency on campus

Loss of gross salary	\$ 37,500
Tuition and fees	9,000
Lost tax revenue	7,330
Lab space and equipment	5,000
Cost for nine months	58,830

The part-time Ph D degree

In 2000, Virginia Tech's Graduate School approved a new policy that allows Ph D students at specific locations to complete their residency without relocating to Blacksburg. The requirements specify that the student should be working in a research environment, with access to resources paralleling those available to a student on campus. Several such locations have been approved since 2000, notably Virginia Tech's Advanced Research Institute (ARI) in Northern Virginia and the Naval Surface Warfare Center (NSWC) in Dahlgren, Virginia. Based on Ph D enrollment statistics for the Virginia Tech ECE department, Table 3 shows that the department now has 45 part time Ph D students enrolled, of whom an estimated 25 (56 %) are US nationals. By comparison, only 98 out of a total of 300 full time ECE Ph D students (33%) are US nationals. A number of these full time students are on leave from their companies, government agencies, or military positions on full salary and 41 are in the Direct Ph D program. The part time Ph D has become a popular alternative to the high cost of being a full time Ph D student for many of the US nationals in the program, a trend that is unlikely to reverse in the foreseeable future.

The economic benefit obtained by keeping young engineers in gainful employment while working part time on a Ph D degree accrues to the employer, the student, and the university. In the case of a state supported institution such as Virginia Tech, the direct benefit to the Commonwealth of Virginia is a reduction in the cost of operating the university because there are 45 fewer students occupying space on campus and requiring support services, and in increased tax revenues from the higher salary being paid to the engineer.

There is an additional but less tangible benefit because the university does not have to provide research equipment. In a specific case, a part time Ph D student works in a government research laboratory that has over \$200,000 worth of instruments. The laboratory space and the instruments are shared among a research group, increasing their utility and productivity. If the student were full time at the Blacksburg campus, either the university would have to supply the instrumentation through its own funds, in this case the State Council for Higher Education in Virginia (SCHEV) equipment trust fund, or the student's Ph D adviser would have to obtain a research contract to cover the purchase of the equipment. If only one student is working in that specific research area, it is particularly difficult to obtain funding from either source.

Graduation Rates

Tracking the progress of part time students has always been problematic, because they do not register every semester, are not physically on a campus, and frequently disappear for periods of time. Full time students are easier to track, although the ECE Department does not keep statistics of the Ph D graduation rate. For full time Ph D students who have completed the master's degree the graduation rate is estimated at 75%. It is lower for the direct Ph D because a significant proportion of the entering students elect to graduate with an MS degree. Part-time Ph D students inevitably take longer to graduate. There is a higher graduation rate where students complete the master's degree full time on campus and then move on to a part time Ph D, with perhaps 50% graduating within seven years. Students who complete an MS degree part time, typically taking four or five years, and then enroll in the part time Ph D program are at much higher risk of dropping out, probably because of the very long time it takes to complete the two degrees. Strong support from the employer is essential to the eventual success of the part time Ph D student.

Changing the accounting model

In Virginia Tech's ECE department, as at most research-oriented universities, productivity of the faculty is counted in research dollars obtained through contracts and grants and by the number of papers published in refereed journals. Part time Ph D students working away from the university campus don't need stipends and research equipment, and tend to produce fewer papers than full time students. Thus faculty have a disincentive to advise part time students and those that do are penalized in the rewards process. Yet every one of those part time Ph D students is creating an economic cost benefit exceeding \$80,000 per year, assuming very modest figures for the cost of research equipment and laboratory space at the university. Assuming a well motivated student who completes the Ph D degree in three years, there is a cost benefit of \$240,000 for every Ph D degree awarded. The obvious solution is to assign an in-kind credit for each part time Ph D student advised. Faculty would then have an incentive to take on part time Ph D students, even to seek them out, and everyone would benefit.

The sum of \$240,000 per graduating part time Ph D student should be added to the research expenditures of the university as an in-kind contribution, a number that goes into program rankings and which seems to be of great interest to those concerned about the ranking of their university. All Ph D graduates, whether part time or full time, contribute to rankings via the numbers of graduates, but only those students supported by grants and contracts yield sums that are added to research expenditure. Adding the hidden benefit of the part time Ph D and MS degree recipients simply reflects the hidden cost devoted to their obtaining those degrees; dollars that are just as legitimate as those received in the form of grants and contracts that often include sums for in-kind contributions.

Table 6 takes a different approach to calculating the in-kind contribution of an employer who supports a part time Ph D student. Virginia Tech's ECE department requires a co-adviser for each part time Ph D student at the place of employment, usually someone with a Ph D, who can advise the student and ensure that he or she is given adequate time to pursue their research. Typically, employers will grant an employed Ph D student 25% of their time to devote to their research work. Assuming a salary of \$80,000 for the Ph D student and a \$7500 contribution from the co-advisor, together with a \$10,000 allowance for laboratory equipment and a conservative contribution to company overhead, Table 6 shows a direct in-kind contribution by the employer of \$57,500 per year. If the part time Ph D student completes the Ph D degree in four years, the employer has made a \$172,500 in-kind contribution to the degree. This sum is in addition to the \$240,900 in economic benefit calculated previously and is the minimum research dollar credit that a faculty member should receive when the part time Ph D student finally graduates.

Table 6 In-kind contribution by an employer supporting a Ph D student

25% salary of employee p.a.	\$ 20,000
Contribution by on site adviser p.a.	7,500
Equipment and laboratory space p.a.	10,000
Overhead on employment p.a.	20,000
Cost for three years	172,500

CONCLUSION

This paper has shown that the ECE department at Virginia Tech successfully reversed the steady decline in the percentage of US nationals enrolled in its Ph D programs. This has been achieved by the introduction of the part time Ph D and the direct Ph D. Both programs have significantly higher US national enrollments than the full time Ph D. Part time Ph D students who continue to work full time in industry and government laboratories create an economic benefit exceeding \$100,000 per year and do not require space, equipment or overhead at the university campus. This in-kind contribution should be included in the research earnings of the university, and recognized as research earnings by the faculty who advise part time Ph D students.

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