

ANALYSIS OF DIVERSIFICATION EFFORTS IN AGRICULTURAL EDUCATION

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Abstract

The study of agriculture continues to become less popular in most developed countries, including Canada and the Czech Republic. The analysis in this paper provides some interesting findings about activities of agricultural universities to increase enrolment into their programmes. While the study is focused on Canada, it is possible to draw implications also for the Czech Republic as many of the characteristics pertaining to the education and agricultural sectors are similar.

Enrolment into educational programs in agriculture in North America has been steadily declining in recent years. While the overall share of agriculture on the national gross domestic product has also been falling, the need for qualified people in agriculture is still important as the shift to sustainable agriculture appears to be one of the key priorities of governments in the US and Canada. One of the ways to stimulate the interest of prospective students in agricultural studies is to diversify the programmes by offering more major options. It is important to study the motivation and other stimuli for the choice of major in order to adapt the educational programmes to attract more students. In the paper, factors influencing the choice of major are studied by analysing survey data from the only agricultural college in Atlantic Canada. The results show significant differences in the socio-economic background among the prospective students, based on the choice of major. For example, students interested in the social sciences consider choices of major much more than students in the biophysical fields. Based on the findings from the analysis, several recommendations are made. It is suggested, for example, that for students interested in the biophysical sciences, sport plays an important role and thus, an appropriate promotional campaign about recreation and sport facilities of post-secondary agricultural educational institutions should be conducted. Analysis in this paper may

interest many educational institutions in agriculture as a guide on how to deal with existing or potential decline in enrolment by diversifying their major portfolio using appropriate promotional campaigns.

Key Words

Agricultural education, choice of major, socioeconomic factors, Canada, Czech Republic

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Introduction

Education is one of the top priorities of governments around the world. Europe and North America are both regions that put a high value on education, while at the same time their universities rank among the best (Kehm, 2006). The provision of education is based upon the needs of a society and is, therefore, related to many economic industries. It is clear, given the current structure and needs of an economy, that the highest emphasis is put upon education aiming at the consumption [or, consumer?] and processing industries (United Nations, 2010).

Nonetheless, education for a primary sphere of an economy cannot be neglected. One of the sectors of this sphere that requires highly skilled professionals is agriculture. The importance of the role of education in the agricultural sector is mentioned in papers published by many local and foreign authors (e.g. Slavík, 2004; Spiertz, Kropff, 2011; Tamini, 2011)

Higher levels of qualifications are important for the operation of this sector, given the advanced technologies implemented into current agricultural processes that are needed to increase efficiency in order to offset problems of population and purchasing power growth, etc. (Gebreselassie, 2006).

As the capital substitutes for labour to an ever larger extent in the agricultural industry, emphasis in agricultural education must shift from quantity to quality. Therefore, modern agricultural universities have to adapt to these processes and trends in society, and put stress on high quality agricultural education.

Agricultural universities have, so far, implemented several measures to offset the declining interest in agriculture, such offering a wider range of degrees, study fields, majors, and specialisations (e.g. MEYS, 2011)

This paper studies one of the ways to adapt to new conditions in agriculture by education institutions through an analysis of the position of agricultural education in Canada and the Czech Republic. The agricultural educational institution in Atlantic Canada, analysed in this paper, struggles with decreasing enrolment by offering new major options. The main results of the analysis suggest what important measures should be taken in order to enhance enrolment.

While the main focus of this paper lies in the analysis of one of the educational institutions in Canada, important implications are drawn for the Czech Republic, as the Czech educational system is currently being reformed (2011) to correspond more closely to other OECD countries, including implementation of tuition fees (MEYS, 2011).

Agricultural sector in Canada and the Czech Republic

Agriculture in Canada as well as in the Czech Republic contributes to the national economy by only a small share of roughly 2%. This can be seen in Table 1, where the structure of economies is presented for 2010.

Canada	the Czech Republic
GDP composition	
agriculture: 2%	agriculture: 2.2%
industry: 20%	industry: 38.3%
services: 78% (2010 est.)	services: 59.5% (2010 est.)

Table 1 – The structure of GDP in Canada and the Czech Republic in 2010, Source: WB, 2011

From the demographic standpoint, the share of the rural population in the total population, as well as the share of economically active population in the agricultural sector, are on a similar level in both countries as seen in Table 2.

Total Population - Both sexes (1000's)	2007	2009	2011
Canada	32945	33573	34208
Czech Republic	10268	10369	10443
Share of Czech population in relation to Canadian population	31.17%	30.88%	30.53%
Rural population (1000's)	2007	2009	2011
Canada	6495	6555	6604
Czech Republic	2724	2748	2756
Share of rural population in total Canadian population	19.71%	19.52%	19.31%
Share of rural population in total Czech population	26.53%	26.50%	26.39%
Agricultural population (1000's)	2007	2009	2011
Canada	670	642	616
Czech Republic	695	662	628
Share of agricultural population in total Canadian population	2.03%	1.91%	1.80%
Share of agricultural population in total Czech population	6.77%	6.38%	6.01%
Total economically active population in Agriculture (1000's)	2007	2009	2011

Canada	346	336	325
Czech Republic	353	334	316
Share of economically active population in agrarian sector in total population in Canada	1.05%	1.00%	0.95%
Share of economically active population in agrarian sector in total population in Czech R.	3.44%	3.22%	3.03%

Table 2 – Selected parameters of population development in Canada and the Czech Republic, Source: FAO, 2011

Based on the aforementioned numbers, it is clear that there are similar characteristics related to the position of the agricultural sector in the individual economies of Canada and the Czech Republic. While there are some similarities, the agricultural sectors also have many differences. These are especially prevalent in the agricultural output, agricultural production frontiers, and position of each country's sector in global trade, as well as the perception of agriculture in the societies of each country.

As the efforts of both countries in the field of agriculture focuses on environmental protection to an ever larger extent, it is necessary to increase the number of highly educated professionals through the university education, as it is the only way to maximise agricultural output while minimising environmental degradation (NRPPZARV, 2009).

Studies of enrolment into agricultural universities show, however, a decrease in attractiveness of agricultural education to the young generation (Esters, 2005). Thus, in order to maintain or increase enrolment into agricultural programmes, governments in developed countries must act. In the following

two sections, the peculiarities of university-based agricultural education in both countries are introduced.

Characteristics of Tertiary Agricultural Education in the Czech Republic

Between 2002 and 2008, the total number of students at all levels of university education increased to 370 thousand. In the studied period this was an increase of almost 50% (CZSO, 2011) as demonstrated in Table 3.

	2002	2003	2004	2005	2006	2007	2008
Number of students	248 756	272 192	298 196	269 435	323 765	344 180	369 619

Table 3 – University students in the Czech Republic, Source: CZSO, 2011

The analysis of the numbers studying in the different fields of study in the Czech Republic shows that highest proportion of students are studying in the field of social and behavioural sciences and law. Table 4 shows that this study field accounted, in 2008, to more than 130 thousand students, which represents approximately one third of all students enrolled in all educational programmes.

Number of students	2002	2008
Education	30 644	46 802
Humanities	22 857	39 556
Social and behavioural sciences and law	61 360	131 289
Physical and life sciences and technologies	23 351	37 037

Architecture, engineering and related technologies	53 692	69 024
Agriculture, natural resources and conservation	8 873	15 261
Health, parks, recreation and fitness	17 669	28 245
Services	8 729	15 137

Table 4 – The number of students attending the main fields of study in the Czech Republic, Source: CZSO, 2011

Between 2002 and 2008, enrolment in this study field more than doubled (114%). This rise is twice as much as compared to the rise in the total number of students. The least attractive, measured by the number of students, is the study field of Technical science, production and construction, which saw an increase of only 29%, whereas in total, the share of students in this study field has declined by 8%. All other fields have risen by 50 to 70%, thus following the general trend in the rise of total enrolment. Agricultural education, while following a general increase, is the second least popular study field as of 2008.

Characteristics of Tertiary Agricultural Education in Canada

While Canadian tertiary education also enjoys an increase in the number of enrolled students, the increase is not as dramatic as in the Czech Republic. Between 2001 and 2007, the number of enrolled students has increased by approximately 15%, which is 35% less than in the Czech Republic.¹

1 Statistics Canada

	2001/2002	2003/2004	2006/2007*
All instructional programs	886665	993768	1069703
Personal improvement and leisure	66	51	234
Education	69492	76875	77452
Visual and performing arts and communications technologies	27915	33858	37524
Humanities	133149	158115	160521
Social and behavioral sciences and law	138552	162972	187302
Business, management and public administration	141534	161235	174714
Physical and life sciences and technologies	78255	87261	93564
Mathematics, computer and information sciences	46035	43977	43390
Architecture, engineering and related technologies	74847	85785	85755
Agriculture, natural resources and conservation	14943	14769	15501
Health, parks, recreation and fitness	80991	92397	108450
Personal, protective and transportation services	1185	1299	2238
Other instructional programs	79698	74832	83058

Table 5 - University enrolment, by instructional program, 2001/2002 to 2006/2007m, *) official data and own estimation, Source: Statistics Canada, 2008

While the total number of students enrolled in agriculture in the analysed period is constant, the share of the agricultural students in total enrolment decreased. This is apparent from Table 5 above.

Comparison of Agricultural Education in Canada and the Czech Republic

Given the analysis of post-secondary agricultural education in both countries, there are many similarities. Total enrolment in agricultural programmes is similar, while the share in all study fields is low and showing no tendency to rise. For a more detailed analysis of agricultural education, two specific agricultural institutions are chosen from both countries. The Czech University of Life Sciences (CULS) is the biggest agricultural university in the Czech Republic. For Canada, the Nova Scotia Agricultural College (NSAC), the biggest agricultural education in Atlantic Canada, is chosen as a good representative of general trends in agricultural education. According to materials from each institution, they are both attempting to broaden their education in agriculture into other fields by extending the number of majors (NSAC), or by extending the number of study fields (CULS), to attract more high school students into their undergraduate programmes.

This paper tries to analyse this attempt to attract high school students into their programmes by analyzing their decision making process of how a major of studies is chosen.

Materials and Methods

In this paper, significant factors influencing the choice of major (educational institution) are analysed in order to identify proper marketing efforts in order to enhance enrolment. The analysis is carried out on data of prospective high school students entering the university programme. This analysis is helpful in providing insight to offset a decrease in enrolment by making study programs more attractive.

After a general overview and descriptive analysis of agricultural educational sectors in both countries, based on the data availability and inference opportunities, econometric modelling of choice of majors at NSAC is conducted using the limited dependent variable approach.

Post-secondary agricultural educational institutions in North America have been experiencing an overall decline in the number of enrolments (Russell, 1993; Blank 1998). Russell (1993) argues that "growing pressures during the 1980s for youth in the public schools to pursue rigorous academic tracks to meet increasing college entrance requirements has reduced the pool of secondary age youth who study agriculture and have interest in studying agriculture in college ...and so...with fewer youth going into agriculture, the long-term future of the agricultural industry is in question" (Russell, 1993, p13).

In recent decades, many agricultural colleges in the US have changed their name from "College of Agriculture." (Iowa State University, 1999). In Europe, many of the agricultural universities have changed their name and organization such as the University of Copenhagen, Faculty of Life Sciences (formerly Royal Veterinary and Agricultural University in Copenhagen) or Czech University of Life Sciences (formerly Czech University of Agriculture in Prague). In Canada, where

agriculture still plays an important role in national policies and among the general public, a similar trend of changes in the names of programmes and institutions may be observed. Of all the universities and colleges offering agricultural education, one of the few institutions keeping "Agriculture" in its name is the Nova Scotia Agricultural College (NSAC). Even though the name of the institution remains unchanged, it is true that the Nova Scotia Agricultural College, an agricultural educational institution in Atlantic Canada, has shown an increase in the overall enrolment, thus contradicting the trend of declining number of students enrolling into the food and agricultural sciences programmes (Uberoi, 2007). Blank (1998) argues that, on average, colleges of agriculture which increased their total enrolments did so by diversifying their programmes. It is therefore likely that one of the possible explanations as to why NSAC has attracted more students into its academic programme is a relatively large portfolio of majors. It is important to study what drives the motivation of high-school students to choose a particular major. The traditional biophysical agricultural majors should be compared with majors in social sciences. Understanding the motivation for choosing a major can help agricultural colleges to conduct better targeted promotional campaigns. Econometrics provides a powerful set of tools to analyse these marketing decisions.

Based on these facts, this paper tries to confirm whether factors that traditionally play an important role for people who choose agriculture as their major, also influence people who choose a different major such as economics or business within the agricultural sector. In addition, it is important to identify any differences in the motivation of students who want to pursue four years BSc in social sciences versus bio-physical sciences.

Finally, new marketing policies based on research findings are proposed.

The outline of this paper is as follows. Firstly, literature relevant to the choice of major is reviewed. Secondly, a model is developed based on utility maximisation. Thirdly, data and factors influencing the choice of major are introduced. Fourthly, some improvements for NSAC promotion campaign policies are recommended. Lastly, conclusions are made.

Choice of Major

Education is understood to be a means of overcoming handicaps, achieving greater equality and acquiring wealth and status for all (Sargent, 1994). Those, who want to pursue post-secondary education in particular, face a number of different choices. These choices, including choice of university, selection of degree, declaration of major or choice of study length, have been subject to a number of studies by both economists and sociologists.

For example, Cebula and Lopes (1982) examine in their study the effect of different monetary and non-monetary characteristics influencing the choice of major. Their study suggests that "earning differentials among fields and differences in the rate of change in earnings among fields are the most important factors in the student's decision" (Cebula and Lopes, 1982) Another study by Simpson (2002) deals with racial differences in the factors influencing choice of academic major in the US among European Americans, Asian Americans and African, Hispanic and Native Americans. Simpson tries to identify the different processes that influence a racial group's choice of major such as mother's influence, high-school characteristic and others. The author's main finding is that "differences in choice of major that previously existed between racial groups are no longer evident". Simpson recommends further investigation into why

students choose different majors. A different study deals with a specific major choice. Wildman and Torres (2002) identify five principal factors that influence the choice of major in agriculture: 1) exposure to agriculture, 2) family and friends, 3) recruitment activities of the college of agriculture, 4) professionals and 5) job considerations. Turner and Bowen (1999) study the differences in choice of major between men and women. One of the conclusions is a gap between the life sciences and mathematical/physical fields of study. The authors argue that "differences in SAT scores² account for only part of the observed gap, and an array of residual forces - including differences in preferences, labor market expectations, and gender-specific effects of the college experience-account for the main part of today's gender gaps in choice of academic major" (Turner and Bowen, 1999).

During the literature review no study has been revealed that would specifically deal with choice of different majors within agricultural colleges or universities. Hence, the purpose of this study is to analyse the choice of majors at NSAC, a prominent agricultural college within Atlantic region.

Data

The cross-sectional data for the year 2007 is analysed in this study. The data were obtained during promotional events at different high schools within the Atlantic region in Canada for 2007. A total of 504 high-school students were asked several questions such as about their prospective careers and post-secondary study interests.

For the purposes of this study, the choice of major has been chosen as a dependent variable. Fifteen different options were grouped into three categories i , where $i=1$ are the students

² SAT scores: "Scholastic Assessment Test" - a standardised test for college admissions in the USA and Canada

interested in Business/Social Science studies at BSc. level, $i=2$ are those student interested in Biophysical studies at BSc. level.

The dataset included invalid records with nonsense or missing values. After deleting the invalid records, the dataset consists of 424 observations, which is a relatively large sample size.

Factors Influencing Choice of Major

Different socio-economic characteristics of students are believed to play an important role when choosing a major. Unfortunately, based on the literature review the data from the survey lacks factors that influence the choice of major in agriculture. Thus, findings in this paper about factors influencing the choice of major at NSAC may be used as a pilot study for future comparison among all post-secondary agricultural institutions in North America.

Based on the data available we can examine the differences in three identified categories of majors i , $i = 1$ social science, and $i = 2$ biophysical science. During data examination, it was possible to extract more information from the data set and thus expand our analysis options. Ten different explanatory variables were chosen to explain the motivation for choosing a particular major. These are provided below and grouped into two categories: 1) Socio-economic background and 2) Study field and career expectations. However, some of the important groups of explanatory variables such as academic aptitude or family background are missing. It is therefore, necessary, to include questions pertaining to these factors in future research questionnaires.

Socio-economic Background

Number of extracurricular activities is denoted as *extrac* and takes a value from 0 to 9. This indicates the overall involvement in

the extracurricular activities. It is hard to make any *a priori* conclusions as to how this could influence the choice of major. The more active the students are, the better grades they could have.

Number of non-sport (social science based) extracurricular activities such as writing, drama, music, involvement in voluntary activities, or desire to get involved in student government, should be more prevalent among business and economics students than by the others. These activities are denoted as *nonsport* in the model and take a value from 0 to 3 based on the number of activities of each individual.

Province of residence is an important consideration with respect to choice of university. Here, *province* takes a value from 1 to 4, where 1 is Nova Scotia, 2 are all Atlantic provinces except Nova Scotia, 3 are all other provinces within Canada, and 4 is out of country location. This is denoted as the *province* variable. Historically, *gender* equity has played an important role in education. In the last century various policies were aimed at increasing the number of females pursuing post-secondary education, lately an adverse effect in some of the fields was observed (Turner and Bowen 1999). Gender takes a value of 1 if the individual is female and 0 if the individual is male, and is denoted by *gender*.

Although the Nova Scotia Agricultural College offers a set of majors, it is reasonable to assume that due to the college's strong agricultural background these factors will play an important role in choosing any major offered. As indicated in the study by Simpson (2002), rural background is one of the factors that motivate people to pursue studies in agriculture. Unfortunately the only information in the dataset that could confirm this hypothesis is the *hometown* identification that is denoted as *town*. For the purposes of the study, the variable *town* takes the value

1 if the person indicated a city as a hometown and 0 otherwise. Urban areas with more than 100,000 people were considered to be cities.

Geographic location influences the choice of university (Bratti, 2001). It is interesting to look at its influence upon choice of majors. For the purposes of this study the variable *geoloc* takes a value of 1 if hometown is Truro and surrounding or 0 otherwise.

Study Field and Career Expectations

Number of majors chosen can explain students' behaviour in different ways. Students that are determined and focused would tend to choose a lower number of majors. On the other hand, this indicator can be also perceived as some kind of risk decision process. Students who want to spread the risk would choose more majors. This variable is denoted as *majors* and takes a value from 0 to 9.

The information about the *planned years of study* could point at differences between categories Bio and Social. This variable is denoted as *years* and ranges from 0 to 5.

Number of career fields considered, denoted as *fields*, is an indicator that tells us about the determination of students. The less career fields are chosen by students, the more the students are determined. It is also true that the more different career fields a student considers, the more "universal" a student might be perceived by university recruiters.

Since one of the questions enables identification of people who think about *post-graduate studies*, it was chosen to be one of the explanatory variables and is denoted as *grad*. Including this variable provides valuable information about which group is

more likely to pursue post-graduate studies and thus enables one to target better that group within the recruitment process.

Results

Choice of base is an important consideration in the estimation process. Even though the choice of base is arbitrary, its choice is crucial for interpretation of the results. In this study, students interested in bio-physical sciences were chosen to be a base. This implies that social science students are compared to students in the bio-physical field. Estimation results for social science students are summarised in Table 6. Out of 10 explanatory variables, 5 variables are either significant or close to being significant in at least one comparison at the 5% level.

Social science students			
Y=1	estimate	t-value	prob.> t
const	-3.406	-4.625	0.000
majors	0.406	2.723	0.003
nonsport	0.670	1.548	0.061
years	0.352	2.209	0.014
fields	0.191	1.201	0.115
province	-0.024	-0.109	0.457
gender	-1.042	-2.501	0.006
town	-0.080	-0.098	0.461
geoloc	-0.060	-0.084	0.467
extrac	-0.196	-1.539	0.062
grad	-2.888	-2.027	0.022

Table 6 - Estimation results with biophysical science students base, Source: own processing, 2011

The results of the estimation are explained further in the Discussion section below where the intuitive interpretation of variables that are significant is provided.

Discussion

Based on the estimation, several recommendations can be made. For the purposes of broader analysis, it is suggested that more questions need to be asked in future surveys. For example, up until now, students' scholastic abilities or their financial background have not been examined. This is the main drawback associated with the survey from 2007.

However, the results from this study can contribute to targeting the promotion campaign at the prospective students more efficiently. For example, while looking at the left part of Table 6 (*majors*), students interested in the social sciences are more likely to choose more majors (have more possibilities). This could imply that people interested in social sciences would consider a bigger choice of major possibilities. More options could possibly increase their enrolment rate. Although not largely significant, it is not surprising that people interested in social sciences are involved more in "art-type" extracurricular activities (*nonsport*). Departments dealing with social sciences at tertiary agricultural educational institutions can target the students using this information and better tailor its campaign. Estimate by *years* suggests that students interested in business and economics plan, in general, to study longer than students in the biophysical sciences, even though biophysical students are much more likely to pursue post-graduate studies (*grad*). This is an interesting result, which suggests strengthening graduate programmes. The estimation results also (estimate by *gender*) suggest that female high-school students are less likely to pursue studies in social sciences than in the bio-physical study

field. In order to follow the gender equity philosophy not only on the university level, but also within individual study fields, it seems desirable to change the promotion campaign to attract more women into the social science programme. Furthermore, the results (estimate by *extrac*) suggest that people with more extracurricular activities (primarily sports) are less likely to choose a social science background. This offers a number of interpretations, for example, biophysical students would be more likely to come to agricultural college if it offers and more promotes its sport activities.

Based on the study of both the Canadian and Czech agricultural educational system, it can be argued that Czech universities are subject to the same trends as the Canadian ones. When the results of the analysis are generalised, the following recommendations can be made for the Czech agricultural educational institutions. Particularly, students in the high schools with social science orientation should be targeted by promotional campaigns. Among many other factors, it is important to stress the factors such as the number and structure of offered study programmes.

Conclusions

The Nova Scotia Agricultural College (NSAC), an agricultural educational institution in Atlantic Canada has shown an increase in the enrolment (Uberoi, 2007), thus contradicting the overall trend that "...enrolments in colleges of agriculture have suffered in recent years, despite growing opportunities for college graduates in the food and agricultural sciences" (Russell, 1993). In 2007, 504 high school students were surveyed to answer questions not only about their future plans such as choice of major, but also about their personal preferences such as sports, or their social background like their hometown location. In this study, multinomial logit was used to analyse how the choice of major is driven by various socio-economic characteristics of the surveyed high-school students.

Unfortunately, some of the desired questions about students' academic abilities or financial background have not been answered. Nonetheless, interesting findings were made in the identification of differences between prospective social science BSc. students and biophysical sciences BSc. students. For example, students interested in the social sciences are more likely to choose more majors (have more possibilities) than biophysical students. This could imply that people interested in social sciences would consider a larger choice of major possibilities. Furthermore, students interested in business and economics plan, in general, to study longer than students in the biophysical sciences, even though biophysical students are much more likely to pursue post-graduate studies.

Based on the available data, further research could be done for lucrative/non-lucrative fields of long-term career interests. Also, the background of students (ranking of high-schools) or distance from the college could be estimated. If more data is available in the future, the analysis could be significantly

strengthened and thus, provide necessary information for future promotional campaigns at high schools not only for the Nova Scotia Agricultural College across Atlantic Canada, but given the data availability, for any agricultural post-secondary educational institution in the world.

Although the Canadian educational system differs from the Czech one, some of the outputs of the analysis can be applied to the area of post-secondary education in the Czech Republic. These can help in maintaining and increasing the position of Czech agricultural educational institutions among the competing universities. As new changes, such as tuition fees, or the reform of Bachelor and Master studies, etc., are introduced into the Czech system, it is important to learn from countries that traditionally successfully operate within a similar system, and adopt some of their strategies in order to enhance competitiveness of Czech agricultural post-secondary education.

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