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Is it worth investing further in AFNR programs?: simulations from a supply-and-demand model[1]

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The recent proliferation of state and local universities and colleges compounded with the high unemployment rate among graduates of fields related to agriculture, fisheries, and natural resources (AFNR) questions the validity of government making it a standing policy to make AFNR tertiary education more attractive. This paper attempts to address this issue by way of a supply-and-demand model of AFNR services. Results of the simulations indicate that there are bleak prospects for AFNR graduates in paid employment. The source of the problem appears to be weak demand such that further expansion in AFNR programs and enrolment as well as proposals to further subsidize these programs should be reconsidered.

JEL classification: C69, J21, J64
Keywords: Philippines; labor market; unemployment; supply-and-demand model; agriculture, fisheries, and natural resources graduates

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1. Introduction

Many observers have noted that enrolment in fields related to agriculture, fisheries, and natural resources (AFNR) is generally on a downtrend, especially in the case of many state universities and colleges (SUCs). In fact, recent research by the National College of Public Administration and Governance (NCPAG) of the University of the Philippines (UP) estimates that enrolment in AFNR courses has declined by 6.2 percent in the ten-year period from 1998 to 2007.

Declining enrolment may eventually lead to a dearth of human capital essential to the complex innovation process, and knowledge creation and distribution in the AFNR sector. Equally important is the potential shortage of skilled graduates and professionals, especially in terms of individuals needed to support the operations of private firms.

It is along these lines that the government seems to have made it a standing policy to make AFNR tertiary education more attractive. For instance, from a total of 85 SUCs in 1993, the number of SUCs rose to 111 as of 2005. As for local universities and colleges (LUCs), the number rose from 29 to 50 over the same period (CHED AY 2004-2005 Statistical Bulletin). The proliferation of SUCs offering AFNR-related courses over the past few years and the provision of more scholarships and financial aid to students taking these courses are evident and seem to support this contention.

On the other hand, the NCPAG determined that 41 percent of AFNR graduates in their survey did not have jobs. Applying the "technical" definition of unemployment, about 22.77 percent of the AFNR graduates included in the survey could be considered unemployed. This may seem an unreasonably high estimate, especially when compared to the national unemployment rate. It must be considered that the estimate includes only those AFNR graduates who finished tertiary education within five years of the survey, which may make the estimate higher than the actual rate for all AFNR graduates.

However, surveys conducted by the then Department of Education, Culture and Sports in 1994 and 1997 found that the unemployment rate of tertiary graduates of 1991 and 1995 in the Philippines reached 24.01 percent and 30.34 percent, respectively [Alburo and Abella 2002]. In addition, in a 1982 study of the employability of graduates, Psacharopoulos [1982] reported that, for the Philippines, agriculture graduates have lower absorption rates compared to those from law, physical science, liberal arts, and business courses. Considering just these, the result of the NCPAG survey should not be surprising.

What has just been presented seems to be a conflicting picture: the government wanting to increase enrolment and thus the number of graduates of AFNR courses on the one side and a higher-than-average (or aggregate) unemployment rate of AFNR graduates on the other. The recent proliferation of state and local universities compounded by the high unemployment rate among AFNR graduates begs the question of whether further public investment in AFNR is warranted.

This paper attempts to address this issue by way of a supply-and-demand model of AFNR services. This involves an assessment of the current state and future capacity of human capital in AFNR alongside a consideration of the demand for AFNR human resources of the private and government sectors in order to identify gaps or future surpluses (shortages) in the AFNR labor market. The model is used to generate projections for AFNR graduates to the year 2020.

2. The model

At the outset, it is important to note that the market here is defined as services for which AFNR-related skills are required, and that such services are confined to workers that have a college degree. Moreover, equilibrium was not imposed in the model to allow for the estimation of potential shortages or surpluses in the AFNR labor market.

Figure 1 shows the different sources of demand and supply for the market for AFNR graduates. Total demand is the sum of the quantities of AFNR graduates that all industries want to hire. The two major sources of

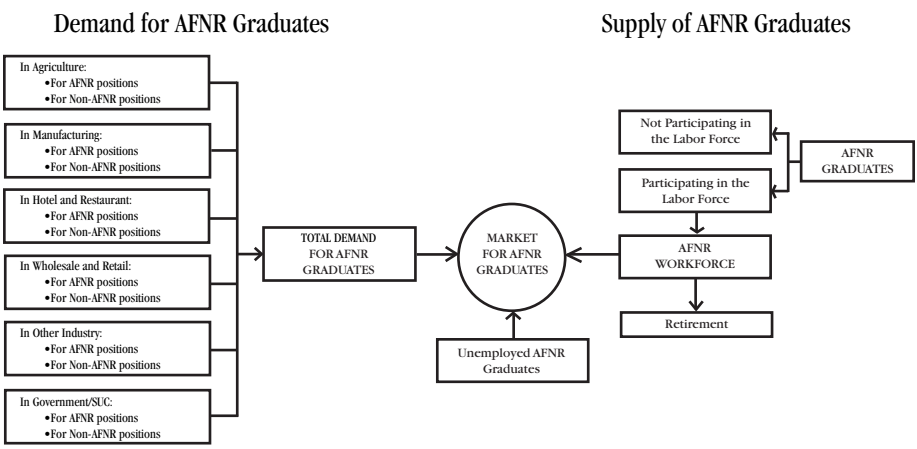

Figure 1. The market for AFNR services

the demand for AFNR graduates are industry and government/academe. Academe covers only SUCs since these are the primary providers of AFNR education. Industry is a general term that refers to all activities outside of government and the academe, and is disaggregated into five sectors: namely, Agriculture, Manufacturing, Hotel & Restaurant, Wholesale and Retail, and Others (rest of the economy).

The model recognizes that AFNR graduates are also hired by industries for tasks that are not directly related to the training that the graduates received in school. This is captured by the disaggregation between graduates who are hired for AFNR and non-AFNR positions in each industry. The presence of the latter provides a loose notion of job mismatch in which the graduate does not directly use skills acquired in school

Supply is represented by the AFNR workforce, or the quantity of AFNR graduates who are working or actively seeking work. It excludes AFNR graduates who have either retired or are not seeking employment. Figure 1 shows that, at any given period, the AFNR workforce (total supply of AFNR graduates) is either (a) unemployed or (b) employed in the various industries (total demand for AFNR graduates). Hence, the model can be described by a stock adjustment equation wherein for a certain time period, the workforce is equal to the value of the workforce in the previous period plus new AFNR graduates who have decided to join the workforce less AFNR graduates who retired during the period.

The model in Figure 1 is summarized by ten equation blocks. This may be classified as four blocks of behavioral equations and six blocks of identities. Four of the identities allow the model to generate estimates of the demand for AFNR graduates as a whole, by industry, and by positions. The remaining identities are used for estimating the AFNR workforce and unemployment. The four behavioral equations explain the industry demand for AFNR graduates in AFNR positions, industry demand for AFNR graduates in non-AFNR positions, supply of fresh AFNR graduates, and retirements of AFNR graduates by industry.

On the other hand, the supply of fresh AFNR graduates is assumed to be determined by freshmen enrolment in AFNR courses (with a four-year lag), current and lagged wages of AFNR and non-AFNR graduates, direct cost of education, and the ratio of farm to nonfarm incomes. Retirements are formulated as a fixed proportion of industry employment. Ideally, this should account for the age structure of the AFNR graduates. However, such information is not available. Hence, the formulation can be viewed as a compromise, which also gets around the issue of early retirements.

The analytical tool utilized secondary data collected from various sources. For the aggregate national level variables and indicators, data were gathered from the Civil Service Commission (CSC), Commission on Higher Education (CHED), Department of Budget and Management (DBM), Department of Education (DepEd), and the National Statistics Office (NSO). In addition, AFNR student information were collected from the NCPAG Tracer Study.

The above model is solved using the generalized algebraic modeling software (GAMS). The model was used to project demand and supply for 2006 to 2020.

3. Base case scenario

The base case scenario is a solution to the model from 2005 to 2020 using historical growth rates for the exogenous variables. This solution provides the projections of the model. It is also useful as a point of comparison for all model experiments.

Table 1 shows the growth rates of the exogenous variables that were used in generating the base case scenario. Most of the values were derived from data provided in the *2008 Philippine Statistical Yearbook* of the National Statistical Coordination Board (NSCB) (employment data) and the Annual

Table 1. Baseline growth rates of exogenous variables, in percent per annum

Item	Growth (%)
Sectoral employment	
Agriculture/fishery/forestry	1.4
Manufacturing	0.9
Hotels	3.2
Wholesale/retail trade	5.3
Government & SUCs	0.5
Others	6.5
Freshmen enrolment	-3.5
Wage rate in non-agri positions	0.6
Wage rate in agri positions	0.3
Ratio of farm to nonfarm incomes	-1.55
Cost of education	0

Survey of Establishments of the NSO (wages and ratio of farm to nonfarm income). As direct information was not available, the growth of the total enrolment in AFNR courses in SUCs was used as a proxy for the growth of freshmen enrolment. The base case scenario also assumes that the direct cost of education is constant over the simulation period.

Table 2 summarizes the projected average annual growth rates of the endogenous variables in the base case scenario. It indicates that the demand for AFNR graduates is projected to grow sluggishly (0.4 percent per annum) over the simulation period. Among the different sources of demand, the demand for AFNR graduates in non-AFNR positions is projected to grow faster than the demand for AFNR graduates in AFNR positions. The finding that the growth rate of the AFNR workforce (1.0 percent per annum) is expected to grow faster than demand explains the relatively rapid growth of unemployed AFNR graduates (2.6 percent per annum). The number of fresh AFNR graduates is also projected to contract at an average annual rate of 1.9 percent over the simulation period.

The simulation results raise four important points. First, the projected decline in the number of fresh AFNR graduates is inconsistent with recent historical trends, which show a 1.6 percent annual growth in AFNR graduates from school year (SY) 1999/2000 to SY 2007/2008 (NCPAG survey). This is explained mostly by the assumption that the number of AFNR freshmen are projected to contract in the base case. Second, the workforce is projected to grow despite the negative growth of AFNR graduates. The reason is that AFNR graduates, even if these are declining, still represent additions to the

Table 2. Baseline growth rates, average in percent per annum, 2010-2020

Variable	Growth (% per annum)
Demand for AFNR graduates	
Non-AFNR positions	0.70
AFNR positions	0.26
All positions	0.41
AFNR graduates	
Workforce	1.00
Unemployed	2.56
Fresh AFNR graduates	-1.89
Retirements	0.42

workforce. It also suggests that the additions to the workforce (due to new graduates) still outweigh the number of retirements. Third, despite the relatively fast growth of the demand for graduates in non-AFNR positions, trends in total demand are still heavily influenced by the growth of the demand for AFNR positions. The reason is the relatively high initial share of the latter in total employment. Fourth, the increase in the unemployment rate is a cause for concern. As a result, the unemployment rate among AFNR graduates is projected to rise from about 22.8 percent in 2005 to 30.1 percent in 2020 (see Figure 2).

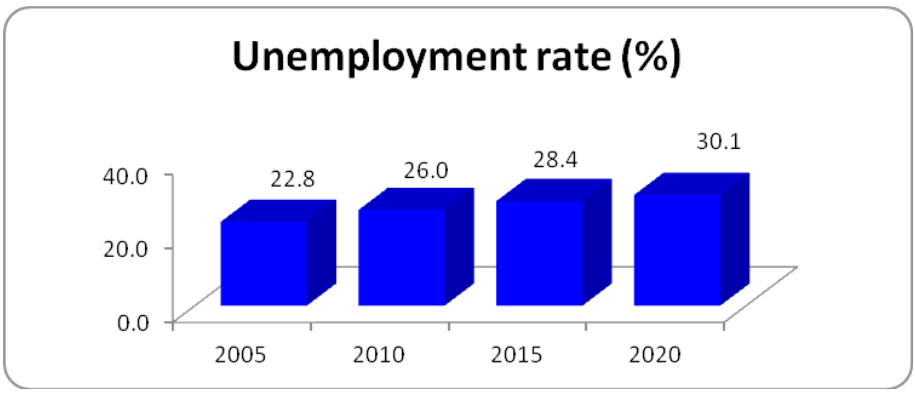

Figure 2. Projected unemployment rates for AFNR graduates in the base case scenario, in percent

Industry-specific results suggest that fastest growth rates in the demand for AFNR graduates are in the service sectors (see Table 3). The demand from the agriculture, fishery, and forestry sector is expected to grow at a relatively

Table 3. Baseline growth rates, all positions, by industry, average in percent per annum, 2005-2020

Demand for AFNR graduates	Growth (%)
Agriculture/fishery/forestry	0.42
Manufacturing	0.30
Hotels	1.45
Wholesale/retail trade	1.33
Government & SUCs	0.11
Others	1.16

slow pace (0.42 percent). Since this sector is the most significant employer of AFNR graduates (84.4 percent), the slow growth of the agriculture, fishery, and forestry sector explains the low rate of growth in the demand for AFNR graduates and, by extension, the projected increases in unemployment of AFNR graduates.

4. Alternative scenarios

Five scenarios/experiments were implemented using the model. These were designed to illustrate the properties of the model in capturing the possible impacts of policy initiatives and other events on the market for AFNR graduates. It is important to note that the magnitudes or sizes of the shocks were arbitrarily chosen. Hence, the insights generated from the experiments matter more than the actual magnitudes of the impacts.

The experiments implemented in the model are as follows:

- Experiment 1: 10 percent increase in the cost of education. This experiment can represent a policy implemented by authorities in the education sector. It could be in the form of (a) a decline in the subsidies received by AFNR students, (b) an increase in tuition fees, (c) a decline in the value of scholarships provided to students, etc.
- Experiment 2: 10 percent decrease in the cost of education. This is the exact opposite of Experiment 1.
- Experiment 3: The number of freshmen entering AFNR courses grows at a rate that is 1 percent faster than the base case. This may be due to an active policy implemented by education authorities to attract high school graduates to AFNR programs. It may also be due to an external event that makes such courses more attractive to high school graduates.
- Experiment 4: Employment in the agriculture, fishery, and forestry sector grows at a rate that is 1 percent faster than the base case. This experiment represents an event that is beyond the control of the education authorities.
- Experiment 5: Employment in all sectors, or the entire economy, grows at a rate that is 1 percent faster than the base case. This experiment is an event that is beyond the control of the education authorities. This is designed to show the importance of the agriculture, fishery, and forestry sector in affecting the market for AFNR graduates.

Note that Experiments 1 and 2 represent *level* increases—that is, higher values of the exogenous variables with the growth rates of the variables remaining the same over time. The remaining experiments represent changes in the growth rates—that is, faster growth. The following discussion highlights some of the key findings, particularly relating to unemployment.

4.1. Experiments 1 and 2

For Experiment 1, the model projects that the average number of fresh AFNR graduates will grow at a slower pace compared to the base case. The reason is that higher costs of education make it more expensive for students to enroll in AFNR courses. Fewer AFNR graduates mean fewer entrants to the workforce (negative growth). Since the costs of education do not affect the demand for AFNR graduates in the model, the declining workforce translates to falling unemployment rates among AFNR graduates. For reasons that should be patently obvious, the impacts under Experiment 2 are the exact opposite of those found in Experiment 1.

The results from Experiments 1 and 2 have an important implication with respect to policies in the market for AFNR graduates. If current trends continue and projections in the base case hold, then attempts to reduce the direct cost of education in AFNR courses are likely to exacerbate the unemployment problem among AFNR graduates in the future. The model projects that a 10 percent decline in the cost of education is expected to raise unemployment among AFNR graduates by about 2 percentage points in the year 2020 (see Experiment 2 in Figure 3).

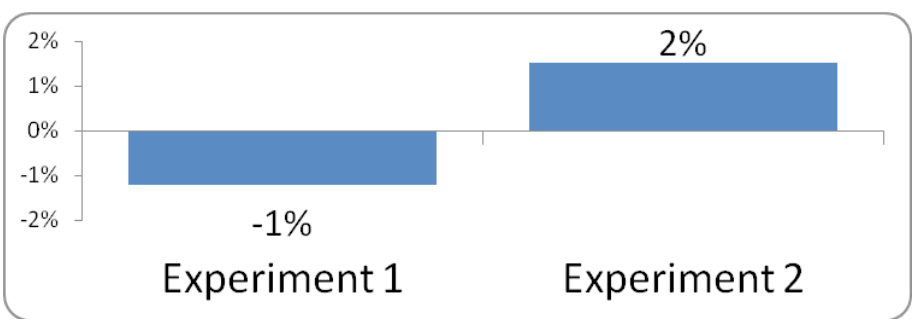

Figure 3. Impacts on the unemployment rate of AFNR graduates of Experiments 1 and 2, 2020, in percentage point deviation from the base

4.2. Experiments 3 to 5

Figure 4 shows the net impacts of the changes in the growth of supply and demand on unemployment. It indicates that the growth of unemployment is expected to be slower with faster employment growth in the sectors (Experiments 4 and 5) but faster with the accelerated growth of AFNR freshmen (Experiment 3). Since supply is unaffected in Experiments 4 and 5, the slower growth of unemployment under these scenarios is solely due to the enhanced demand for AFNR graduates. In contrast, the slight increase in the growth rate of unemployment under Experiment 3 would be explained solely by the slightly faster growth in the supply of AFNR graduates unanswered by any growth in the demand.

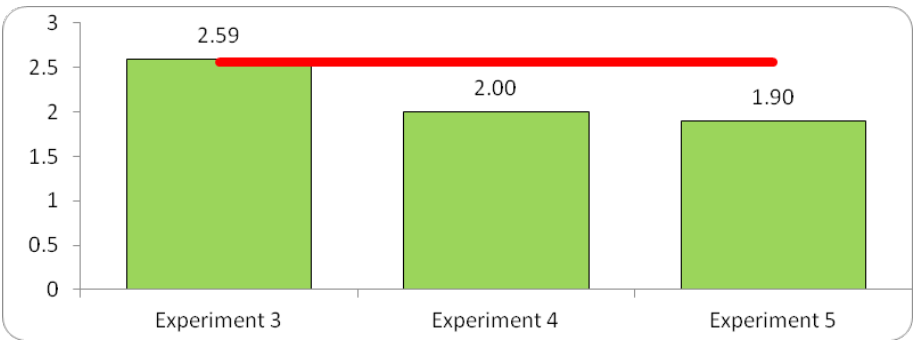

Figure 4. Average annual growth rates of unemployment under Experiments 3 to 5, 2010-2020, in percent (baseline growth rate = 2.56%)

5. Beyond the education sector

The projected increase in the unemployment rate among AFNR graduates must be of concern, and apparently expanding employment in the agriculture, fishery, and forestry sector would effect a reduction in the disconcerting projections. In this regard, the model can be useful in providing a crude estimate of the changes in agricultural employment that are necessary to achieve targets for AFNR graduates.

If the target is to have an unemployment rate among AFNR graduates in 2020 that is equal to its counterpart in 2005, the model suggests that employment in the agriculture sector should grow by 5.39 percent per annum. This change is quite large and is almost 3.8 times larger than its growth rate in the base case. An even more ambitious target of reducing

2020 unemployment rates to half its 2005 levels will require a growth rate in agricultural employment of 10.99 percent per annum, or 7.9 times as much as its growth rate in the base case.

The experiments above highlight the difficulties associated with reducing unemployment through increases in agricultural employment. The growth rates required to prevent the projected unemployment from rising are large especially when compared to historical values.

6. Conclusion and recommendations

The major conclusion of this study is that there are bleak prospects for graduates of AFNR courses in paid employment.This is based on substantial increases in projected unemployment in the next ten years. Since freshmen enrolment was assumed to be declining over the simulation period, the primary source of this result is weak demand. Moreover, reversing this result requires an expansion in the agriculture sector which is very large, especially when taken in the context of its recent performance.

The recommendations of this study are as follows. First, any further expansion in AFNR programs and enrolment should be reconsidered. Based on the results of the study, such initiatives are more likely to raise the number of unemployed graduates in the future. For similar reasons, the second recommendation is to carefully reevaluate proposals to further subsidize, be it directly or indirectly, AFNR programs.This is especially the case if such initiatives encourage further entry of students to AFNR courses.

Finally, strengthening the quality of training and perhaps the more aggressive marketing of graduates in the workplace may raise the employability of AFNR students. However, pursuing this objective requires taking cognizance of the finding in this study that the source of the problem is weak demand. While outside the purview of the key decision makers in the education sector, policies and initiatives to promote a more robust growth of the agriculture sector are key to reducing the projected burden of unemployment among AFNR graduates. However, bold changes might be needed given the magnitude of the expansion that is required.

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