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**Honors Contract Report: Economic Literature on Food Insecurity & Higher Education**

Food insecurity, and the implications it can have on academic achievement and general well-being, is a persistent issue in the United States. According the US Department of Agriculture, food insecurity is defined as “reports of reduced quality, variety, or desirability of diet”, while more severe, “very low food security” is considered “reports of multiple indications of disrupted eating patterns and reduced food intake” (USDA, 2018). At a national level, 11.8% of households were evaluated to be food secure at one time during the course of the 2017 year with 4.5% falling under the category of very low food security. For college students, this is not such an unlikely phenomenon. Although many private institutions report low levels of food insecurity, such as Westmont College’s 0% 2018 achievement in eliminating campus-wide food insecurity, as many as half of students in some college campuses may face food insecurity in any given year (UC GFI, 2017). The University of California statewide system, which is home to 10 universities, was reported to have 48% of their undergraduate student population facing some form of food insecurity at one point or another during the 2017-18 school year. Academic literature and reports have been accumulated over the years on the negative impacts of hunger and food-insecurity-related stress on academic success and general well-being, but despite these findings, few initiatives have been made at the state or federal level.

In this literature review, I will be discussing four economic papers in the fields of modern food insecurity and college finances in the hopes of better understanding the methodologies, concepts, and empirical results of these studies. I will write my own comments on the methodologies used, interpretation of the findings, and possible relevance to work I might later pursue in an honors thesis or other academic research. The first two papers provide more of a general overview as opposed to elaborate econometric models, so the focus for these will be weighted on the interpretation of findings. Finally, I will relate all the papers into a holistic understanding of food insecurity in higher education institutions and what possible avenues could be explored to better understand this relationship.

The Economics of Food Insecurity in the United States -Craig Gundersen, Brent Kreider, and John Pepper (2011)

In this study, the economic approach to understanding modern food insecurity is reviewed and evaluated under the general insights of what determines food insecurity, its causal effect on health outcomes, the impacts of food assistance programs, and other areas of limited or unexplored research within the field. Economists provide a unique insight on the issue due to their ability to evaluate monetary and resource constraint effects, as well as their revelations of key selection issues that can result in more accurate causal implications of certain factors. An extensive literature has accumulated on these issues, but many findings, particularly with regards to health impacts and the success of federal food programs, are obscured by correlation and lack of rigorous evaluation, which the researchers address.

The prevalence of food security in the U.S. is clear. Recent estimates come from 2001-2009 Current Population Survey results, since the 18-question Core Food Security Module for food insecurity evaluation was standardized at the beginning of this period. Rates for “food insecure” and “very low food insecure” individuals remained constant at 12% and 3-4%, respectively, until the great recession hit in 2008, when rates increased to 16.4% and 5.8%. These figures have since decreased closer to their original rates, although “very low food insecure” households remain high. These numbers are much worse children--after the great recession, we saw rates of 25% and 17.1% for this demographic.

Although it is commonly believed that income is the greatest determinant of food insecurity, economic evaluation indicates that this assumption may not be as precise an explanation as expected. In a replicated study using the 2001-2009 CPS data, the researchers reinforced three original findings (Fox, 2000). Firstly, although the probability of food insecurity declines with income, the decline is more significant for food insecurity and marginal food insecurity than for very low food security. Secondly, poverty is not synonymous with food insecurity; variations exist on both sides of the poverty line, with about 65% of households just below the threshold identifying. Lastly, the opposite also holds true, where a significant portion of middle-class households identify as food insecure. As the income-to-poverty ratio approaches two, food insecurity rates remain over 20%, and as the ratio approaches three, food insecurity rates still persist at around 10%.

The subsequent results, particularly the last two, indicate that a simple income-food insecurity model is not a sufficient foundation for causal inference. One reason may be the necessity of income spikes to be evaluated; one such model by Gundersen and Gruber (2001) found that average income over a two-year period provides more accurate results, since income volatility is associated with food insecurity at similar rates. Another economic study indicates that liquidized asset information helps to fill in the gaps of the income model. The most accurate income/food insecurity model to date is a complex fixed effect model using data aggregated to the state level in a 2011 study by Gundersen et al. They regressed the food insecurity rate on the unemployment rate, poverty rate, median income, and demographic indicators by state and year, with year and state fixed effects. This allowed them to conclude that the elasticity of the food insecurity rate with respect to the unemployment rate is greater than the elasticity with respect to the poverty rate. Since there is a substantial amount of research proving that many unemployed people are not poor, this provides evidence as to why poverty status is a better indicator for food insecurity.

With regards to the consequences of food insecurity, much research has been done on correlated health effects, but little on direct causations. Among these findings, it has been observed that children who suffer from insufficient nutritional intake have a higher risk of suffering from anemia, asthma, mental health issues, and oral health issues. One might speculate that some of these issues have a more direct link to food insecurity than others, but no solid evidence has been presented on any of these matters. While food insecurity is a likely contributor to a variety of health problems, there may also exist unobserved factors that mutually influence whether a person is food insecure and in poor health; in other words, a selection problem may be present in these studies. In order to analyze these problems, economists analyzed the primary model used for these studies. In an average treatment effect model, where ATE(1,0) = P[H(FI = 1)] − P[H(FI = 0)], the probability of a “bad health” outcome occurring if an individual is from a food insecure household minus the probability of a “bad health” outcome occurring if an individual is from a food secure household is supposed to be indicative of the expected effect of food insecurity for the issue. However, the issue with this model is that a statistical “selection” problem may occur where one’s food security status is endogenous and may be subject to factors unobserved to the researcher, thus biasing the results.

In response to this issue, Gundersen and Kreider (2009) created a model for child health outcome in this field, subject to three assumptions. The first is the Monotone Treatment Response (MTR) assumption, which “requires that a child’s health status would not decline by becoming food secure”, which is reasonably safe to assume in most situations. Second is the Monotone Treatment Selection (MTS) assumption, which states that “food insecure children under the status quo would tend to remain less healthy than their food secure counterparts under the status quo under a policy that made all households food secure or all households food insecure”. This places restrictions for the selection mechanism to eliminate endogeneity, and is based on well-documented facts on the matter. Lastly, if the previous assumptions holds true, a Monotone Instrumental Variable (MIV) assumption can be imposed on a study, where “children residing in lower-income households on average are assumed to have no better health outcomes than children residing in higher-income households”. The MIV assumption does not imply any exclusion restriction, but since the alternative standard mean independence instrumental variable assumption requires a credible standard instruments for food insecurity status (which is nearly impossible to implement), it is a more accurate model. When comparing the two methods on a model for general health evaluations, the original model was found to have a significant downwards bias on the results.

When analyzing the implementation of policy addressing food security in the United States, the Supplemental Nutrition Assistance Program (SNAP) is by far the largest. The program reached 40.3 million individuals in each month in 2010, with an annual benefit distribution of about $68.3 billion (or about $288 per month per household of four). However, when it comes to evaluating its intended effects, economists have argued that SNAP recipients are likely to differ from non-recipients across unobserved factors, thus causing endogeneity in observations. Under a simultaneous equation model, results indicated that SNAP participants were no more likely to be food insecure than nonparticipants once they control for selection into SNAP and selection into food insecurity (Gundersen and Oliveira). They were able to control for this using an instrumental variable based on recipient’s perceptions of stigma associated with SNAP receipt, an all-too-common obstacle in achieving higher levels of enrollment. Similar findings were observed when evaluating restrictions on the eligibility of immigrants for SNAP, where few differences are observed between the two groups. Additionally, nonrandom classification errors also occur with people reporting not being in the program when they actually are.

Second to SNAP, the National School Lunch Program (NSLP) is the second-largest food security program in the U.S., although its primary mission was to provide more nutritionally balanced meals to students when it was first implemented in 1946. In 2010, NSLP provided over 31 million children with daily nutritious meals, half of whom received them for free and another 10% at a reduced rate of no more than 50¢. One study using NSLP data confirmed the assumption that food insecurity is higher in the summer for kids (Nord et al). In another that aimed to measure the direct effects of the program, the researchers overcame the same endogeneity issues discussed previously by implementing MTS, MTR, and MIV assumptions. Two instruments were used, one for income and another for eligibility comparisons, in addition to classification error restrictions due to hypothesized errors in parent’s stated child enrollment in the program. Under the restricted and unrestricted models, it was found that participation in the program decreased food insecurity status in children by 3.2-15.8 and 2.3-9 percentage points, respectively.

After reading this paper, I was left with more questions than answers. Although I understand the insights economists can provide in understanding food insecurity in the United States, from reanalyzing the methods linking health issues with nutritional deprivation to understanding monetary effects and implications on the issue, many of the contributions made have been inconclusive or contradictory to prior beliefs. The issue appears to derive from significant portions of a very extensive list of factors, few of which have been quantified or even identified due to their complex nature. For example, a household below the poverty line may avoid food insecurity by allocating funds from other necessities over to food, but why these priorities vary is conceptually unfathomable to me, although I also believe further evaluations might provide incentives for such behavior.

The implementation of the Monotone assumptions to identify health implications was particularly informative to me. It helped me to understand how economic tools can help to evaluate issues typically thought of through a biological, psychological, or clinical lense. Furthermore, it helped to strengthen my understanding of selection bias, endogeneity, and the role of instrumental variables.

In the conclusion, the authors summarized their key findings, but went on to discuss various questions that had yet be answered. Among these was “What are the effects of private food assistance programs on food insecurity?”, with added speculation on the combined effects of such programs (such as food banks) with federal programs like SNAP. This question was particularly enticing to me, since my own work experiences with both the AS Food Bank of UCSB and CalFresh enrollment for the UCSB student population has led me to be consider possible research into these fields, to be discussed at the end of this paper.

Subsidies, Hierarchy and Peers: The Awkward Economics of Higher Education: Gordon C. Winston (1999)

Likewise to the previous paper, Winston’s study is more of an evaluation and theoretical speculation of a current phenomena with limited original findings based on econometric models. However, he takes a unique take on issues such as the high tuition of college, differences between public and private institutions, and other relevant matters by applying the modern realities of higher education to economic theories and examples. In short, this paper “asks how well our extensive experience with commercial businesses—and the microeconomic theory of firms and markets that has evolved to describe them—helps in understanding the economics of higher education”.

Winston begins by using Henry Hansmann’s 1980 seminal paper to highlight the functional and foundational parallels of higher education institutions that enable them to be considered nonprofits for theoretical, as well as legal and financial, observation. Higher ed institutions, like most nonprofits, often emerge in markets where, due to an asymmetry of information, the consumer is highly susceptible to the high vulnerability of the seller’s opportunism. The nonprofit structure is ideal for these “trustmarkets”, because the consumer can assume an ideological focus of the organization as opposed to a profit-maximizing one, thereby stimulating efficiency in the market. Likewise, university’s ability to provide investment in human capital (a risky purchase with uncertain payoffs) is reflective of the same circumstances. Although private schools generate much of their own funds, even they are thought to functionally and, to some extent, legislatively identical to nonprofits due to their ideological motivation of ‘‘the pursuit of excellence’’, their non-distributional constraint to allocate profits to “outsiders”, and their characteristic “donative-commercial nonprofit” structure of taking subsidized/asset reimbursing and net-tuition funds to pay for costs. More can be said about the nonprofit classification of higher education institutions, but the last major point Winston strived to connect was the implication that the relative position of the institution takes on special importance due to the underlying motivator of optimizing educational quality (and, to some extent, equity) as opposed to profits.

In addition to the nonprofit market behaviors that can be identified in these institutions, Winston went on to make two observations of his own on the economic uniqueness of these “firms”. The first is the unusual peer effects, known economically in this circumstance as consumer-input technology, found in the relationship between the consumers with other consumers and the suppliers. In essence, this observation indicates that the higher the quality of the students, the more “profitable”, or in this case higher-rank due to the implied goals of these institutions, a college will be. The same holds true for faculty members, but the quality of both individual students and of the student body as a group counts for a great deal in the quality of educational services the institution delivers, both directly through the conglomeration of like-minded individuals and indirectly through increased future funding through higher postgrad incomes resulting in increased donations. To put it concisely, “as an argument of the educational production function, peer quality is, technically, an input to a college’s production and one that cannot be bought from anyone other than its own customers”. However, it is unclear if this “input” has substitutes (although I predict, to a limited extent, it does), and as a result of these findings typical models of microeconomic theory are inappropriate for this instance.

Secondly, a unique structural factor in the market for higher education institutions is their hierarchical model as a result of donative wealth over time. These initial differences are the foundation for both an institutions commercial (tution-raising) and future donative revenue (in addition to certain managerial and program-specialization details to be discussed later, but irrelevant for the purposes of the theoretical framework). This can have large implications for market entry, institutional ranking, and other economic moves that determine the identity of an institution within the market. For example, although average subsidies received are similar between public and private schools (in the form of programs such as FAFSA), differences in total costs cause an average difference in students price/cost ratios for school expenses of 12.4% vs. 45.9% in public and private schools, respectively (1994-95 data). The model used to predict this was created by Winston by controlling for housing costs and external expenses, and it should be noted that subsidization varies largely across individual institutions depending on their wealth. Therefore, it can be concluded that “any differences in managerial skill or luck or location or imagination among schools will often be overwhelmed by differences in sheer donative wealth that become differences in price, cost, and subsidy”, which varies greatly.

With regards to the implications of these characteristics in the higher education market, many unique effects can be observed in the costs, benefits, and overall implications for both the firms and the consumers. Due to university reliance on consumer-inputs, we see what might resemble price discrimination where more subsidies are allocated towards admitted students with stronger indicators of academic achievement, such as higher SAT scores or GPA. However, a more unique finding is unravelled with the other end of the peer effect-colleges control who its customers are. This is necessary to optimize the inputs of its consumers, and is achieved by generating excess demand to pick and choose from the best potential students.

In order to achieve this, institutions ensure student demand is robust at the relevant price relative to supply by heavily subsidizing enrollment for all admitted students, regardless of expected marginal input benefits. This not only comes in the form of “low” tuition costs (an argument to be elaborated on later), but also top-of-the-art facilities, access to computers and software, and other desirable factors. A similar efficiency wage mechanism applies to the hiring of faculty faculty at wealthy schools: a large pool of applicants lured in at wages well above market-clearing support a selection process that is completed with the granting of tenure after a long period of inputs in the name of school-name recognition and other prestige factors. Unsurprisingly, strategic restriction of supply allows for excess demand and increased subsidization per student, since donative resources are fixed (although this does come at the cost of decreased net tuition revenue, which is marginal). Moresoe, private schools have the subsidy incentive than public, since their donations are more fixed than the marginal, student-by-student legislative appropriations (grants) granted by the government.

One final interesting observation as to how universities deal with enrollment is their varying input proportions. Geographic positioning (by the beach or the middle of the desert), residential options (affordable dorms with peers vs. expensive apartments), and other non-monetary inputs can be a big determinant in university attractiveness and prestige. Most fascinating is the use of consumer-inputs to lower operation costs: if a school is prestigious enough, they can utilize the student body to cover education costs by hiring TA’s to teach entire classes due to their credibility as quality-educated individuals, thus lowering production costs to be allocated elsewhere.

When it comes to market competition, perhaps the largest deviations in atypical firm behavior can be found in the market for higher education. The hierarchy, or ranking, of institutions has already been stated to be the primary indirect motivational factor in college operations, which subject to one’s level of access to donative resources for subsidization, and how they choose to utilize those funds. This funding determinant is amplified by the resulting feedback from the resources, institutional quality, student quality, demand, and selectivity to greater student quality, which correlate back to funding utilization. Top institutions, therefore, are able to make the most out of this situation by highly subsidizing prices and institutional factors, thereby sustaining the feedback loop. Lower-tier institutions, inversely, rely less on subsidies and peer performance, acting more like a typical firm by utilizing conventional production factors and operating on a more inclusive level of consumer choice. As a result of these market powers, a classic barrier to entry and to upward movement within the hierarchy is formulated, skewed towards the wealthiest institutions, resulting in the rigid universities rankings we are familiar with today.

The unique competition that arises at the top of the hierarchy has several economic results that are often felt by students and other participants in the market. Due to intense competition at the top, ‘‘competitive amenities’’ may occur for programs a competing university provides that may not even be marginally beneficial (such as adding a new department that is rising in popularity despite its large and possibly unprofitable operation). The main question on everyone’s mind, however, is on the other end of the spectrum-”Why do tuition costs keep rising?” According to Winston, the answer varies according to the type of institution in question. For public schools, tuition has gone up because, since the mid-1980s, their donative resources have gone down as a manifestation of a national tax revolt and disenchantment with higher education, resulting in lower inputs and higher tuition costs to compensate. For the (often low-tier) private institutions that compete to sell their services, sticker prices have risen to allow more price discrimination, in the form of financial aid, among potential buyers. For the wealthy private institutions that compete to buy scarce student quality, the positional race has created pressure on each school to obtain more donative resources, as well as increase tuition costs to stay on top.

Due to the commercial-donative nonprofit nature of higher education institutions, the battle between rationality and ideology, competition versus independent growth, results in tension. This is best described by the instance of a court trial that took place when the Justice Department sued a group of top institutions over their mutual coordinating with regards to tuition costs and financial aid. The schools took the stance of operating under a charitable agreement to minimize tuition costs and eliminate some of the effects of competition, while the opposition speculated ill intentions and for-profit motivation. The Justice Department won in trial court—colleges and universities are commercial entities—but MIT won on appeal—colleges and universities are, in fact, also charities. As a result of the case, price coordination ended, tuition costs increased (although the effect is speculated to only be a small portion of this trend). An argument is to made that the Justice Department interfered with need-blind admission and need-based aid policy by eliminating the collaboration that had limited competition, thereby decreasing equality of opportunity and further pressuring the youth of America with increasing tuition costs.

Although this paper did not have as many direct connections to college finances as I had originally expected, I found this to be one of the most interesting studies of economic principles at work in a market setting. For example, during Winston’s evaluation of colleges’ nonprofit structure, he did admit that, although they operate on revenue-cost equilibrium,the “non-distribution constraint serves to soften the incentive that a for-profit supplier has to take advantage of the partially informed buyer.” Examples of this are seen regularly in the form worker strikes against the high salaries of administrators, disproportionate funding for certain departments, and other allocations which favor some within the system. Although students are advised to “trust the system” and take prices as given, this concept makes me wonder to what extent administrators in schools such as UCSB are able to allocate funds for specific self-interests, and what actions/regulations have been made to monitor and restrict excessive distribution of funds.

Another striking observation from this paper was Winston’s case study of the 1991 antitrust court case against the collaboration of top universities in negotiating financial allocations. Although Winston certainly believes the end to the collaboration to have been an unwise move for both students and universities, I understand the Justice Department's skepticism, seeing as how collaboration under such a particular, oligopolistic-like market of top universities could go either way in helping or hurting the consumer. Furthermore, Winston’s claim that cuts from government funding in the 80’s are the responsibility for rising public school tuition costs is a striking observation, although one with limited factual backup in this paper, and perhaps could be the topic of an economic study on its own.

How Are SNAP Benefits Spent? Evidence from a Retail Panel -Justine Hastings and Jesse M. Shapiro (2018)

This study, seemingly as a response to Gundersen et al.’s paper reviewed above, addressed their exact question of how the Supplemental Nutrition Assistance Program (SNAP) affects household spending. According to contemporary economic theory, if the monthly electronic benefits transfer (EBT) a household receives is less than what they already spend on groceries, the additional income should be considered fungible in the eyes of the consumer, and monthly grocery expenses should not change. However, drawing from Richard Thaler’s concept of mental accounting, researchers believe that SNAP recipients may receive income sources in different manners, thereby resulting in average marginal propensity to consume food (MPCF) out of SNAP benefits to far exceed that of the MPCF out of cash. If this is the case, the stated goal of the program to increase household food expenditures and decrease food insecurity would hold true.

To conduct this research, Hastings et al. used three different models using 02/06-12/12 data tested for over 500,000 Rhode Island grocery store users of a large retailer. A possible threat to external validity due to the limited region of observation, but it was the only feasible manner which the researchers could undertake to eliminate error, and their final results have proven reasonable in simple comparisons. This data included all the expenses of its shopper during this time period, their payment method, and gasoline expense information for retailers with stations available. This data was supplemented with information on SNAP recipients in RI, including the start of each households benefit period, its end, the amount of money received, and other related information. Finally, policy information on SNAP benefits was publically available by the USDA.

For their first empirical strategy, the researchers constructed a panel event-study design using trends prior to SNAP adoption to diagnose confounds. Their first observation was that, after the average household adopts SNAP benefits, SNAP-eligible purchases rise by about $110 while SNAP-ineligible remain about the same. This was a promising sign the the researchers, who were able to use a ~$200 baseline to make their initial assumption that the MPCF out of SNAP benefits likely.

To further verify the results, an instrumental variable fixed effect regression with a time instrument for the six-month benefit periods of participant activity in the program and controls for gasoline expenditures during times of price-spikes. Although participants in the program may be enrolled indefinitely if their income and household statuses remain in the appropriate range over time, bi-annual reviews and interviews are conducted in order for SNAP to verify eligibility, allowing for a distinct threshold for which a fuzzy regression discontinuity was available. The theory behind the gasoline is that gasoline price spikes, although inelastic in the short run, should have larger effects for SNAP eligible households in changing out-of-pocket purchasing behavior. Two-stage least squares estimates of changes in spending from one month to the next, with the endogenous regressor being change in SNAP benefits and change in the additive inverse of fuel spending, their coefficients indicated the MPCF’s of SNAP and cash spending to be 0.58 and 0.00, respectively. Although this was the case to some extent, overall spending still increased with price spikes, and the results of the regression indicated that SNAP-eligible purchases did not deviate even as out-of-pocket gasoline purchases did, indicating the hypothesis for the low MPCF indicated in the first model.

The last model used for analysis was a difference-in-differences design exploiting legislated changes to benefit schedules. In 2008 and 2009, two major legislative decisions, the implementation of the Farm Bill and ARRA, each increased average benefits received to household participants in SNAP. The average SNAP benefits granted increased from $225 to $300 from 01/08 to 12/09 (with the “before” period being prior to the legislation, and “after” post-legislation), and SNAP-eligible spending for these families increased for an average of $470 to $530. With SNAP recipients acting as the treatment group, the researchers were able to evaluate a new MPCF out of SNAP benefits from this model of 0.53, and an insignificantly negative value for the MPCF for out-of-cash spending, which is consistent with the previous results.

Following the empirical findings of the data, the researchers went on to conduct a series of interviews at a Rhode Island food bank to collect qualitative data on people’s stated spending preferences under a series of scenarios related to SNAP. Most notably, when asked about how they would spend an additional $100 in SNAP benefits versus $100 in cash, respondents often reported they would spend the money on food or “general household needs” such as cleaning supplies or utility expenses, respectively. Based on these findings, a parametric model of behavior was made where households choose expenditures and shopping effort subject to short-run time preference and mental accounting, which took on an experimental form with elements of loss aversion and the effects of coupons on spending behavior. Results from this experiment supported the previously established claims, while contributing support to the idea that coupons are more effective in reducing out-of-pocket or SNAP expenditures on SNAP-eligible goods as opposed to ineligible ones.

After having carefully read through this paper a number of times to identify and distinguish between the multitude of empirical models employed, I found them to vary greatly in complexity and control. The decision to measure marginal propensity to consume food between SNAP benefits and cash as opposed to sheer average increases in money spent was a clear and universal calculation, allowing for more flexible comparisons than those reviewed in Gundersen et al.’s paper above. Furthermore, the decision to such a large pool of models to measure a single effect proved to be very influential for their claim since results remained consistent and the causal effect of the program is vastly unclear due to the large number of relevant factors that could obscure results.

The model which puzzled me the most, but is perhaps most effective in instances such as these when omitted factors are vastly unclear, was the instrumental variables regression utilizing the six-month participation benchmarks and gasoline price spikes as controls. The elasticity relationships between the goods in question and the expected results of individuals given fluctuations in price is clear, but the incorporation of the time variable remains uncertain to me. The model appears to resemble a fuzzy regression discontinuity, but due to the lack of an algebraic model in the paper I was not able to verify my speculations. However, the graphical and numerical results are clear, so this leads me to conclude that I should review and expand on my knowledge of instrumental variables within the context of other empirical models. Most of the other models, such as the difference-in-difference for the treatment of legislative policy on SNAP benefits, were much more clear and intuitive, but there is still a long way to go before I can conduct large-scale regressions such a these on my own.

The findings of the study were supplemented with a warning by the researches about the possible negative effects on legislation limiting the number of SNAP-eligible goods for the program. A component of general food security is not only having enough food to avoid hunger, but also access to quality, nutritious food that can sustain a healthy lifestyle, so further research on the cost-benefit analysis of such changes to the program at a larger scale than grocery expenses would be an interesting topic to keep in mind for future research.

The Impact of Global Warming on U.S. Agriculture: An Econometric Analysis of Optimal Growing Conditions -Wolfram Schlenker, W. Michael Hanemann, and Anthony C. Fisher (

In this study, Schlenker et al. attempt to create a comprehensive model for predicting agricultural yield variations as a results of the change in global climate variations for land east of the 100th meridian in the United States. There is a significant literature on the presence of anthropogenic climate change, its effects on farmer yields, and the expected accelerated effects to come over the next century. The importance of having an accurate model is to understand optimal abatement technologies, future economic shifts in the productivity of a region, and the stability of the agricultural market to provide food to a growing population.

Two models have already been established for this purpose, the agronomic and computable general equilibrium (CGE) approach, but both have their flaws. While an agronomic model is great for measuring spatial variations and minor variations, they do not take into account fixed costs, and fail to connect findings with the greater economy, which would make the input prices and input allocations to agriculture endogenous. A CGE model, on the other hand, fixes endogeneity issues for incomplete data sets, they come at the cost of “drastic aggregation in which spatially and economically diverse sectors are characterized by a representative farm or firm”. This is particularly detrimental to the findings of this large of a study, due to large variations in soil quality, north/south climate norms, and other such factors. Therefore, a middle ground was reached with the employment of a Ricardian approach, “a hedonic model of farmland pricing, based on the notion that the value of a tract of land capitalizes the discounted value of all future profits or rents that can be derived from the land”. This approach is both specifies the spatially heterogeneity between farms and counties while also incorporating price elasticities of the market, capitalization ratios, and other measures of macroeconomic implications towards land values and yields. The primary contributions this model makes towards understanding projected changes is its more realistic, nonlinear use of climate variables under the measurement of “degree days”, the researches formulation of a new spatial dataset in creating those variables by combining satellite, soil quality, and temperature data, allowing for the error terms to be spatially correlated for more efficient and unbiased coefficients, and applying multiple climate change scenarios defined by the IPCC for 2020-2049 and 2070-2099 for forecasting purposes.

π¯i,j,k = πk(pk , ωi,j , zi,j) − Ci,j,k

The farmland value model used for projected impacts of climate change can be broken down into several parts. First, the average profit for the “k”th potential use of land of farm “i” in county “j” (π¯i,j,k) is equal to the profit of a certain land use (πk) with regards to its output prices for that use (pk), input prices (ωi,j), and fixed inputs (such as soil quality) (zi,j) minus its fixed costs (Ci,j,k).

V¯i,j,k = θπ¯i,j,k

Multiplied by a given capitalization ratio θ, the average value of the land is V¯i,j,k. Now that both spatial and macroeconomic elements are monitored for in that calculation of project land value for a given scenario, the formalized regression can be constructed.

f (Vi,j,k) = f (V¯i,j,k) + ξi,j,k = f (θπk(pk , ωi,j , zi,j) − θCi,j,k) + ξi,j,k

This regression includes an additive random error associated with the kth use of land, denoted ξi,j,k , for a given transformation for expected farm value. This approach is based on the assumption that land is put to its most profitable use, as well as other related theories regarding the independent variables.

f(Vj) = f(V¯j) + ηj = z’jβ + ηj

The error term is broken down to two parts: error attributable to farm location and error attributable to specific land use. The bias present was identified by running three fixed-effect regressions, prompting the necessary use of an instrumental variable. By estimating the parameter of spatial correlation and premultiply the data in the first of a two-stage least squares regression, the researchers were able to control for the spatial error to eliminate variability and bias. Due to numerous data restrictions and differences with the observed lands in the study to western counties--which are much more reliant on irrigation, contain different types of soil content, and a variety of other substantial difference--but some assumptions can be said about those outcomes based on the results of this model and reference to previous literature.

The estimated coefficients on the climatic variables are consistent with the results from previous agronomic approaches. Other findings included positive impacts from higher population pressure (although at a decreasing rate), higher,and soil content quality. Four emissions scenarios, which have been standardized by the IPCC, where applied to the model to measure varying effects in 2020-2049 and 2070-2099 yields. For the more short-term period, relative impacts range from a 10-25% decline in farmland value, which translates into a potential aggregate impact of -$3.1 to -$7.2 billion on an annual basis. However, Large regional differences were present, with many positive climate impacts in northern counties predicted to increase yields as much as 34%. For the later period, the differences increased, although the proportion of northern counties experiencing positive land value growth diminished. Average impacts range from a decline of 27% under the best scenario to 69% under the worst. However, for the northern counties that continued to see positive growth, land values exceeded as much as 52% growth. The authors noted that, especially in the 2070-2099 scenario, the results a strongly subject to unforeseen economic and technological developments, such as the desertification of large, currently agrable areas in the south or climate abatement technologies.

With regards to the empirical strategy employed for this study, many components proved to cause confusion upon initial approach. The concept of degree days, understanding how the production spatial errors were controlled for, and what is meant by the ineffectiveness of the state fixed effect to have any impact on the regression affected my ability to comprehend the model. However, although I am still uncertain about some of the assumptions and details, my understanding greatened while looking up the different components and analyzing the results.

One interesting observation was that the agronomic model produced similar results to the ricardian one, indicating that macroeconomic effects and state fixed effects were statistically insignificant in explaining farmland value growth (or decline). Inversely, this contributes to the strong argument that climate, geographic and land quality factors are much more indicative of these changes. Although the researchers did not comment too much on what a shifting U.S. economy might look like if agriculture makes a strong shift towards northern counties, more research on the possible effects of local southern economies would be an interesting

Conclusion

These studies have given me a strong foundation into the economic perspectives and approaches towards understanding food insecurity and the economics of college. Gundersen et al.’s review on economic approaches to the issue not only provided me with a large amount of empirical knowledge and what studies they can be traced back to, but also provided a long list of unexplored research avenues, one of which I intend on modeling a possibles senior thesis out of. Winston’s college economics paper not only helped me to understand the broader relevance of economic theory as it applies to financial struggles and tuition spikes, but also helped me to understand the administrative components and processes colleges incorporate into their decision making about what programs to initiate, who to admit to their schools, and what to do in response to growing competition. Hastings et al.’s in-depth review not only proved of the effectiveness of SNAP, but more broadly brought attention to the concept that allocating resources towards food security initiatives has strong impacts on increasing household food consumption despite traditional economic theory. Finally, Schlenker et al.’s paper highlighted the uncertainties of food production in the near future, and brought specific insights on the disproportionate effects it might have in affecting certain local economies in just the matter of a few decades.

Given this information, I have drafted an overview for a possible economic study on the impact of SNAP on food security and nutrition at the college level. The Arbor at the UCSB campus launched their acceptance of EBT for all food purchases in November of 2018, and keep records on all expenses made, what payment method was used, who made the purchase, and how much the sum costs were. With this information, as well as information about CalFresh (the California SNAP) enrollment for the program on campus that facilitates student applications for the program. After identifying the individuals who use CalFresh at the arbor, I could formulate a difference-in-difference model with students who started using EBT after the November launch as the “treatment” and using students who do not use EBT as the “control”. I would test not only for differences in average monthly expenditures, but also for food content by categorising certain foods as unhealthy, healthy or neutral. The results should reflect if the introduction of SNAP benefits caused any changes in snack expenditures for students who find themselves on campus for a long time and in need of food. Many assumptions, data approvals, and anonymity verifications would need to be made, but this is one of many possible projects I could employ given my knowledge of food insecurity and the economic approach to observing the behavior that causes it.

**Citations**

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