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Microeconomics

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Abhishek Garg

Examining Social Costs of Electricity Generation in the United States
Sam Kurland
Oil Development in the Amazon

Abhishek Garg
Stanford University

Abstract In this paper I explore economic patterns of oil development in the Amazon and analyze their effects.
The Amazon rainforest is one of the most biodiverse but also one of the most oil rich places in the world. These two characteristics make policy decisions regarding the forest a dilemma between the temptation of extracting energy resources and the desire to protect the environment. Ecuador, a small country in South America is currently faced with this dilemma. The issue is over the Yasuni ITT (Ishpingo-Tambococha-Tiputini) - a stretch of Amazon rainforest within the Yasuni ITT in Ecuador with vast oil reserves consisting of 20% of the proven reserves of the country (Warnars 60). The Yasuni ITT is also a microcosm of indigenous life and a precious natural ecosystem.

This past summer, Raphael Correra, the president of Ecuador decided to extract oil in the Yasuni ITT after a failed initiative to ask foreign nations to pay Ecuador not to drill here commonly known as the Yasuni ITT initiative. We will evaluate this decision to extract oil in the Yasuni on two criteria. First, we will look at what are the benefits of drilling here verses the status quo of not drilling. Then secondly we will analyze the distributional effects of this decision as in which parties will be the better or worse off as a result and whether this distribution ethically justifiable.

This issue is critically important for three reasons. First, it will set a precedent for other environmental decisions in Ecuador and the rest of Latin America. Second, the Yasuni is a biological hotspot and several thousand species are endemic to this park. The oil development will affect the health of this ecosystem in ways that will be discussed later. Third, the Yasuni is home to indigenous peoples who vehemently oppose oil drilling here. Ecuador has had a sad history of environmental devastation due to oil spills in the past few decades that has made indigenous people very bitter to the idea of oil drilling. Pushing forward for oil development despite indigenous opposition raises moral issues that must be considered. It has been estimated that there are 900 million barrels of oil in the Yasuni ITT (Larrea 221). PetroEcuador, Ecuador’s state-owned oil company, has calculated that the potential profit from extracting this oil is $14.36 billion (Warnars 63).

![Figure 6.2 Projected petroleum production in ITT](source: Larrea et al., 2009)
On the cost side there are private costs and social costs. No data was available on what the private costs were or that they were increasing at the margin. Social costs come as a result of environmental damages that will result from drilling in the Yasuni. We can use data from Cano Limon oil field in Colombia to estimate what the environmental damage from drilling in the Yasuni ITT will be. This oil field lies in a similar terrain as the Yasuni and was drilled by Ecopetrol, the Columbian state-owned oil company. Ecopetrol has a similar environmental record to that of PetroEcuador, the Ecuadorian state owned oil company (Oil and Indigenous People). Drilling in the Cano Limon oil field destroyed 810,000 hectares of Amazon Rain Forest. With a lifetime of 50 years, producing 73,000 barrels of oil a day, this oil field produces 13,322,500 barrels of oil (McCollough) over its lifetime. We will use this information to deduce that producing a single barrel of oil destroys 0.00611 hectares of forest (810000 / 133225000). Conversely, we can say that destroying a hectare of forest allows us to produce 1/0.00611 or 163.4 barrels of oil. If we multiply this by the average price per barrel of crude oil over the past 5 years ($87.93) we get that the marginal benefit of destroying a hectare of forest for drilling is $14,367.76.

There is also a marginal cost of destroying a hectare of forest. A Brazilian organization, the Institute for Applied Economics Research, calculated the marginal cost of destroying a hectare of Amazonian forest (Anderson 34). We have changed the axes on this graph to match the situation of the Yasuni ITT. The marginal cost takes into account lost tourism value, existence value, carbon sequestration value, water recycling value, resource extraction cost, and other types of value (Anderson 11).

Figure 1: Costs and benefits of deforestation (2% discount rate)
Using this data, we find that it is most efficient to destroy 13% of the 980,000 hectare Yasuni ITT or 127,400 hectares. If destroying a hectare of forest allows for producing 163.4 barrels of oil, then destroying 127,400 hectares allows for producing 20,817,160 barrels of oil. The Yasuni ITT contains 900 million barrels of oil so it is efficient to extract 20,817,160 barrels (13%) of this oil. Doing so, will incur distributional impacts that will be discussed next.

The Ecuadorian government will be better off as a result of the oil revenues and international oil companies will be better off as they will have contracts with Petroecuador to help develop the infrastructure needed for the oil extraction. However, indigenous people living the Yasuni will be harmed as a result of environmental destruction and the ending of their isolation for the outside world. The Ecuadorian people will not see an increase in their standard of living despite the revenues from the oil extraction and people around the world will lose existence value of learning that oil will be extracted in the Yasuni and many endangered species will be harmed.

Indigenous tribes in the Yasuni depend on the land for their well being. Based on Petroecuador’s environmental record, it is likely that there be significant environmental damage resulting from the oil extraction. Drilling in the Amazon would incur damages to the environment in the form of habitat destruction due to installation of infrastructure necessary for drilling and due to leaks in pipelines transporting this oil. Petroecuador, the company drilling this oil has a particularly egregious track record in drilling this oil. Petroecuador has had a world record of 400 leaks per year on average and is known to dump “liquid garbage,” byproducts of oil drilling into lakes and streams in the Amazon (Warnar 54). Even if Petroecuador drills in a safer way than it has previously, the inherent process of drilling means “500 cubic metres of garbage and between 2500 - 3000 cubic metres of liquid garbage is produced… which may be either directly dumped into rivers and streams, or deposited into the soil” (Warnar 66). Also transportation networks developed such as pipelines and roads, increase indigenous peoples’ exposure to drug gangs and other negative influences that harm their way of life (Warnar 68).

Indigenous tribes do not use money and so it is not possible to compensate them monetarily for their loss. In the past, economic contact between indigenous people and mainstream Ecuador has been detrimental for their way of life. Contact increases alcoholism and drug use among indigenous people and often causes them to adopt environmentally destructive practices such as logging and unsustainable agriculture (Warnar 53-54).

Even though the Ecuadorian government will reap profits from selling the oil to the international market, the people of Ecuador will not realize this as an increase in their living standards. Historically, Ecuador has not developed despite extracting its vast oil reserves. Ecuador discovered oil in 1969 but since then the country has been growing at a rate of only 0.75% per year (Kraft). Places in Ecuador that have more oil reserves are generally poorer than places that don't. Rural areas such as those found in the country’s “eastern Oriente region, where most of Ecuador’s oil reserves are located” have poverty as high as seventy five percent (PBS). The oil revenues from the Yasuni will be used to pay off part of Ecuador’s debt which is at $14 billion, rather than be used as social spending for the benefit of the Ecuadorian people (PBS).
The Yasuni is one of the most biodiverse places on the planet and a reservoir for many near extinct species. Below is a chart of the species richness of the park.

<table>
<thead>
<tr>
<th>IUCN Category</th>
<th>Amphibians</th>
<th>Reptiles</th>
<th>Birds</th>
<th>Mammals</th>
<th>Plants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critically Endangered (CR)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Endangered (EN)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Vulnerable (VU)</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>46</td>
<td>57</td>
</tr>
<tr>
<td>Near Threatened (NT)</td>
<td>1</td>
<td>--</td>
<td>5</td>
<td>9</td>
<td>43</td>
<td>58</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2</strong></td>
<td><strong>2</strong></td>
<td><strong>7</strong></td>
<td><strong>17</strong></td>
<td><strong>97</strong></td>
<td><strong>125</strong></td>
</tr>
</tbody>
</table>

Threatened species are those listed as Critically Endangered, Endangered, or Vulnerable in the 2009 IUCN Red List of Threatened Species.

Source: Bass et al., p. 28.

100 scientists have written an open letter to the Ecuadorian government urging them to revoke their decision to drill in the Yasuni for fears doing so will “degrade its extreme biodiversity” (Amazon Watch). The scientists have said that “A single hectare of forest in Yasuni National Park is estimated to contain at least 100,000 arthropod species, approximately the same number of insect species as is found throughout all of North America.” The decision to extract oil from the Yasuni is also extremely unpopular among the Ecuadorian people. About 680,000 people have signed a petition calling for a referendum to reverse the decision to drill in the Yasuni (Reuters). This opposition to the drilling suggests that a large number of people derive an existence value from the ecological richness of the Yasuni and their existence value for the park would decrease as a result of oil extraction.

This distributinal outcome is not ethically justified. Article 26 of the UN Declaration of Indigenous Rights states that “Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired” (Warnar 61). The indigenous tribes in the Yasuni have vehemently opposed the extraction of oil on the land that they have been living on for centuries. Even the Ecuadorian Constitution specifically mentions the rights of the indigenous peoples living on the Tagaeri and Taromenane - parts of the Yasuni ITT - to not have natural resources extracted for their land: “The territories of peoples in voluntary isolation are ancestral homelands, irreducible and untouchable, and they will be off-limits to all extractive activities. The State will adopt measures to guarantee their lives, respect their self determination and will to remain in voluntary isolation, and ensure that their rights are respected. The violation of these rights will constitute the crime of ethnocide, and will be dealt with by the law” (Government of Ecuador, 2008). Two of the tribes living in the Yasuni live in complete isolation and have not been contacted before. Encroaching on their land would be a flagrant violation of both Ecuador’s constitution and the UN Declaration of Human Rights.

The corruption of the Ecuadorian government and the fact that the revenues will not go towards improving the standard of living of the Ecuadorian people makes the distributional effects even harder to ethically justify. Neither will the oil extraction benefit Ecuador’s growth in the long run. Alberto Acosta, a head of Ecuador’s leading
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research group investigating environmental issues, believes that Ecuador suffers from a “resource curse” and further extraction of oil will be extremely detrimental to the vitality of Ecuador’s economy (Vidal).

We have found that most efficient approach is for Ecuador to drill around 21 million of the 900 million barrels of oil in the Yasuni ITT. This conclusion was reached making assumptions based on Petroecuador's environmental record and the price of oil not changing drastically within the next decade. While this approach would achieve the most efficiency, it has distributional outcomes that are not ethically justifiable. Chief among these ethical concerns is that of violation of the rights of indigenous peoples who live in the Yasuni. Their way of life and habitat would be harmed. In economic terms, this cannot even be considered an externality - indigenous people do not use money so they do not lose any surplus as a result of the oil extraction.

The contentious issue of drilling in the Yasuni is reminiscent of other environmental issues in the Amazon such as gold mining. More broadly, it is a case study of a larger issue which is a dilemma between natural resource use and environmental protection. Through economic analysis, we strive to find an efficient balance between the two, by considering externalities rather than simply private costs. However, economic analysis needs to be accompanied with a holistic understanding of the issue in question as there are many practical distributional outcomes of ethical significance that may not be apparent in the economic analysis.

References:
Abstract This paper briefly reviews existing literature on social cost estimates for electricity generation in the United States and identifies existing policies intended to internalize these costs. It describes the value of social cost estimation and discusses commonalities among models of social costs resulting from electricity generation. In conclusion, it presents a collection of recommendations for future research and legislation.

Keywords: social costs, electricity generation, energy policy
Introduction: The Rise of Natural Gas

In November 2013, coal, natural gas, and nuclear electric power generating installations collectively comprised 87% of net electric generation in the United States, with renewable, hydroelectric, and a small quantity of petroleum sources providing the remaining capacity (U.S. Energy Information Administration (EIA), 2013). Between 2000 and 2010, the advent of widespread hydraulic fracturing and accompanying low natural gas prices fueled meteoric growth in natural gas-fired electricity generating installations, accounting for 81% of new electric power generating capacity in the United States over that period (U.S. EIA, 2011). During that decade, coal-fired generating capacity grew only slightly (Behrens et al. 2012), while U.S. nuclear power generation remained stagnant (Holt, 2013; World Nuclear Association, 2013). In 2006, natural gas electricity generation eclipsed nuclear sources as a fraction of U.S. net electricity generation (U.S. EIA, 2013a). Six years later, natural gas electricity generation equaled that of coal for the first time in history; in April 2012, coal and natural gas each provided 32% of U.S. net electricity generation (U.S. EIA, 2012).

Analysts have suggested a variety of causes for the anemia of recent growth in coal and nuclear generation, including expectations of continued rapid growth of natural gas supplies and the accompanying opportunity cost of developing coal or nuclear plants rather than potentially cheaper natural gas installations (Campbell et al., 2013). Other explanations include the negative fiscal impacts of environmental regulations on aging coal-fired infrastructure (Campbell et al., 2013) and concerns about waste disposal, weapons proliferation, terrorist attacks, and natural disasters that dominate current discussions about nuclear power development, particularly in the wake of the March 2011 Fukushima Daiichi nuclear plant disaster (Holt, 2013).

Consciously or not, firms weigh all of these factors carefully when deciding where and when to invest their capital. The surging popularity of natural gas provides a compelling example of this fact; lower upfront costs, less aggressive taxation, and lax regulation have made natural gas an attractive investment. Profit-maximizing utility firms, like the investor-owned utilities that provide electricity to 68.2% of customers in the U.S. (American Public Power Association, 2013), consider these private costs and benefits when deciding which sources of electricity generation they will pursue, and which they will phase out. However, profit-maximizing firms do not consider social costs or benefits of their business decisions, and therefore do not always settle on socially optimal choices (Boutilier et al., 2012). Does natural gas remain cheap in comparison with other electricity generation modalities when considering social costs?

This paper explores the existing literature on social cost estimates for electricity generation in the U.S. not to provide a definitive policy recommendation for the nation’s response to recent trends, but instead to identify the principal considerations that policy makers must consider to appreciate fully the scope of the costs of electricity generation and answer questions like this one. Though its analysis is by no means exhaustive, this paper will (1) describe the benefits of a social cost estimates in public policy discussions; (2) identify common methods among leading studies of social costs in the existing literature; (3) highlight impacts considered by these leading studies and examine the rationale for their selection; (4) identify existing regulatory strategies to internalize known social costs of electricity generation; (5) suggest priorities for future research; and (6) recommend
modification to existing programs and implementation of new mechanisms to internalize remaining social costs of U.S. electricity generation.

The Need for Comprehensive Cost Assessments in Energy Generation

In a competitive environment, firms take the price dictated by the market equilibrium. However, electricity generation has frequently been viewed as a natural monopoly, where the minimum efficient scale is nearly equal to or exceeds the size of the market (Taylor & Weerapana, 2012). As a result, the electricity market is not perfectly competitive; electricity generating firms have some ability to dictate their prices (Berg, 1995). In the interest of maintaining low prices for consumers, the U.S. government has sought to limit the market power of natural monopolists in the energy industry in a variety of ways. Since the early 1990s, incentive regulation has been the preferred method for limiting energy utilities’ market power (Berg, 1995). Under incentive regulation, the government sets a price near a firm’s average total cost of production and guarantees that price for a certain period, encouraging the firm to contain costs to maximize profit (Taylor & Weerapana, 2012).

However, the average total cost of production fails to account for a potentially significant fraction of real costs to the economy. While conventional cost estimates generally succeed in capturing “explicit” or “internal” private costs and benefits bourn directly by a producer and often passed onto consumers, they frequently fail to incorporate “implicit” or “external” social costs and benefits, which are bourn collectively by society as a result of one entity’s actions (Busquin, 2003).

Internalizing these costs results in an entirely different distribution of energy prices, in which costs for fossil fuel sources surge and more intrinsically expensive modes of generation, such as renewable sources, become far more economically attractive. In effect, social cost estimates seek to “level the playing field” for renewable or more sustainable sources against the generally lower internal costs of fossil fuel cycles, encouraging investment in sources with less damaging external impacts (Burtraw & Krupnick, 2012).

Social cost models can improve market performance in other ways, as well. By increasing electricity costs to account for all impacts of production, comprehensive cost models encourage a more optimal level of electricity conservation. Social cost models also account for discontinuous risks that firms and individuals acting in the free market frequently do not internalize successfully.

The Normative Choice Model: Encouraging Energy Conservation

In economics, the normative choice model indicates that individuals and firms act to maximize their utility; that is, they make choices to maximize their benefit while minimizing their harms or costs (Simon, 1955). Social costs of electricity generation are shared by all consumers and implicitly increase the price of consumption. However, consumers do not consider social costs when deciding what quantity of electricity they will purchase from their utility; instead they consider only the explicit price charged by the utility (if they consider the price at all) and their marginal benefit of consuming more electricity, which is decreasing but always positive. As a result, they consume too much electricity, because the lower explicit price is equal to their marginal benefit at a greater quantity than it would be if they were charged a price including social costs. This excessive consumption results in deadweight losses to the economy (Taylor & Weerapana, 2012).
If social costs are quantified and incorporated into electricity prices, the supply curve “shifts up” to a higher unit price for each quantity of production, resulting in a new intersection of marginal benefit and price. At this new intersection, a higher price and lower quantity reflect the true cost of electricity to the economy and deadweight loss is eliminated as consumers conserve electricity to avoid costs in excess of their marginal benefit from consuming more (Taylor & Weerapana, 2012).

![Figure 1. A simple supply and demand diagram illustrating deadweight loss (shaded region) due to the failure to internalize a negative externality. The market price (\(P_M\)) is lower than the ideal equilibrium price (\(P_E\)), while the market quantity (\(Q_M\)) is too great.](image)

Adapted from Taylor & Weerapana (2012).

Discontinuous Energy Generation Risks

Individuals and firms respond to risk by either investing in measures to mitigate risk or purchasing insurance, internalizing the cost of their risk (European Commission, 2005). The normative choice model suggests that individuals and firms maximize their utility by considering the probability of the undesirable event and the damage associated with its occurrence and investing accordingly. However, empirical studies do not support the conclusion that individuals and firms behave in this way in energy markets (Kunreuther, 2001). A variety of hypotheses have been proposed to explain this failure to maximize utility, including: misperception of risks, either due to faulty information or the failure to collect necessary information altogether; high social discount rates reflecting a strong preference for present rather than future benefits; perception that improbable risks are impossible; inefficiency of capital markets, inhibiting individuals’ and firms’ ability to make a utility-maximizing trade of financial or other capital for risk-mitigating measures; and the role of emotion in decision making, causing individuals to make choices based on emotions like fear or dread rather than on empirical dimensions such as potential economic gains or losses (European Commission, 2005; Kunreuther, 2001).

The failure of electricity generating firms to maximize utility by internalizing the costs of their risks results in serious economic hardship when devastating accidents or natural disasters cause unexpected releases of pollutants. The explicit cost of cleaning up the 2008 release of coal fly ash slurry when the impoundment pond failed at the Tennessee Valley Authority’s Kingston Fossil Plant is projected to exceed $1.2 billion; this cost must be passed onto the Tennessee Valley Authority’s ratepayers (Poovey, 2011). Failure to internalize the cost of a disaster like the Kingston Fossil Plant spill by proactively accounting for risks results in an artificially low price of electricity, skewing the choices of producers, who invest too much labor and capital into electricity production by a given means.
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Microeconomics (in the case of the Kingston disaster, coal burning), and consumers, who consume too much electricity produced by that means (Figure 1).

Common Characteristics of Social Cost Models in Electricity Generation

A number of studies have been undertaken to describe the social costs of electricity generation. These models identify and estimate significant impacts contributing to social costs, which they aggregate into one or more comprehensive cost estimates for a given mode of electricity generation. Four studies identified by Burtraw et al. (2012) are particularly notable for their scope and rigor. These exemplary studies share several attributes that improve their effectiveness.

Location Specificity

The geographic location of a source of pollution or other negative externality has a significant effect on the extent of its social impacts (Burtraw et al., 2012). A coal plant upwind of a major urban area will affect the health of many more people than an identical plant in a sparsely populated area (Grausz, 2011). Meaningful data for social impact estimates must control for the geographic characteristics of the study area.

Accounting for Fuel Cycle Costs

A comprehensive approach to social cost accounting must consider not only the power generation phase of the fuel cycle, but also the “upstream” and “downstream” costs of production, including fuel extraction, processing, distribution, and transportation, plant construction, and decommissioning costs. Analyses that only consider the electricity generating phase of the fuel cycle underestimate the social costs of production (Burtraw et al., 2012).

Willingness to Pay Valuations

Explicit monetary estimates of social costs are most easily comparable with internal costs firms and policy makers consider every day; these difficult estimates are therefore central to many social cost analyses in the literature (European Commission, 2005; Grausz, 2011). These valuations are based on either “revealed preference” or “stated preference” studies. Revealed preference valuations analyze patterns of behavior to estimate a population’s willingness to pay for a given resource. For example, the value of a recreation area might be estimated by the willingness to pay to travel to that area (Burtraw et al., 2012). Stated preference studies use carefully structured surveys to ask individuals about their willingness to pay for various improvements, such as reduced mortality risk or improved water quality (Burtraw et al., 2012; European Commission, 2005).

Factors Assumed to be Internal

Some factors are difficult to define as entirely internal or external. For example, the costs of an accident affecting only employees of an electricity generating firm may be internalized by wage premiums paid to workers. However, if labor markets are not perfectly efficient and workers are not well informed about the risks of their occupation, these costs would not be considered internal to production (Burtraw et al., 2012). Some models incorporate a simplifying assumption that all third-party transactions with electricity generating firms, including labor transactions, are based on complete information and internalize all applicable social costs (Rowe et al., 1995).

Factors Not Considered

Other external factors are considered by few, if any existing comprehensive studies of U.S. electricity generation. These factors, including
network effects such as transmission costs and the need to balance intermittent and constant sources to meet variable demand, are believed to represent minor fractions of total social costs and affect all current leading modalities similarly. Most importantly, they are particularly difficult to measure based on natural experiments alone. (Burtraw et al., 2012). Natural experiments are those conducted by an observer who cannot control the variables under examination (Taylor & Weerapana, 2012). Without the ability to conduct multiple natural experiments on a factor’s effects, analysts are unable to form quantitative estimates of a given source’s social impacts.

Identifying Social Impacts

Faced with limited time and resources, researchers studying social costs of electricity generation must decide which social impacts they will seek to measure and monetize (Burtraw et al., 2012). In doing so, researchers must make judgments about the relative importance of different impact vectors (such as carbon dioxide, fine particulate matter, or nuclear radiation) and physical endpoints (such as air pollution from burning of fossil fuels, infrastructure degradation from acid rain, or mortality from catastrophic release of toxins). Table 1 provides a summary of factors considered by four of the most comprehensive studies of the social costs of electricity generation in the existing literature (Burtraw et al., 2012).

Table 1. Summary of factors considered by four major studies of external social costs of electricity generation.

<table>
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<tbody>
<tr>
<td><strong>“Upstream” Considerations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational damages from mining and transport</td>
<td>Assumed internalized</td>
<td>Yes</td>
<td>Assume range of internalization</td>
<td>Assumed internalized</td>
</tr>
<tr>
<td>Public health damages from transport</td>
<td>Yes</td>
<td>Yes (nuclear only)</td>
<td>Yes</td>
<td>Not monetized</td>
</tr>
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<td>Road damages</td>
<td>Yes</td>
<td>Not monetized</td>
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</tr>
<tr>
<td>Facility construction</td>
<td>No</td>
<td>Assumed zero</td>
<td>Yes</td>
<td>Not monetized</td>
</tr>
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<td><strong>“Downstream” Considerations</strong></td>
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<td>Pollutants</td>
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<tr>
<td>SO$_2$</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>NO$_x$</td>
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<td>Fine particulate Matter</td>
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<td>Volatile Organic Compounds</td>
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<td>NH$_3$</td>
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<td>Yes</td>
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<td>Crops</td>
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<td>Yes</td>
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<td>Mortality</td>
<td>Yes</td>
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<td>Yes</td>
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Comparing Modalities

Social cost models for electricity generation allow robust comparisons of the true long term economic viability of various generation modalities. While the numeric conclusions of different models may vary considerably, trends that emerge in the results of multiple comprehensive studies may be noteworthy for policy makers and others involved in determining the future of the nation's electricity infrastructure (Burtraw et al., 2012). While four leading studies came to markedly different conclusions about the external costs per unit output of today’s leading generation technologies, they showed general concordance in the ordering of the three major fossil fuel sources by social cost per unit electricity generation: coal costs were highest, followed in order by petroleum and natural gas. The studies concluded variously that nuclear was either slightly more socially costly than natural gas or slightly less so, but all agreed that the costs of nuclear electricity generation were less than those of petroleum. Two studies found that social costs from biomass-based electricity generation exceeded those from the fossil fuels, but a third study, which considered an estimate of social costs due to climate change, estimated its costs to be far lower than those of the fossil fuels. Both studies considering wind power found its social costs to be substantially less than those of fossil fuels or nuclear power (Table 2).

| Table 2. Summary of estimates from four studies of external social costs, in $0.001 per kilowatt hour (2010 USD). Ranges, where given, reflect 5% and 95% confidence bounds. |
|-----------------|---------|---------|---------|---------|---------|---------|
|                 | Coal    | Oil     | Gas     | Nuclear | Biomass | Wind    |
| (Lee et al., 1995) | 2.3     | 0.35-2.11 | 0.35    | 0.53    | 3       | -       |
| (Rowe et al., 1995) | 1.3-4.1 | 2.2     | 0.33    | 0.18    | 4.8     | 0.02    |
| (European Commission, 2005)* | 27-202 | 40.3-148 | 13.4-53.8 | 3.4-9.4 | 0.67 | 0-3.4 |
| (National Resource Council, 2010) | 2-126 | -       | 0.01-5.78 | -       | -      | -       |

*Includes an estimate of social costs due to climate change.

Existing Taxes and Regulatory Solutions

Several existing U.S. taxes and regulatory measures are intended to internalize some of the social costs of electricity generation. This section introduces a selection of these government programs.

Coal Excise Tax

Coal mined in the U.S. is subject to an excise tax of $1.10 per short ton for coal extracted from underground mines and $0.55 per short ton for coal mined at the surface, capped at 4.4% of the coal’s market price (Humphries & Sherlock, 2013; Internal Revenue Service, 2013). At the November 29, 2013 price of Powder River Basin coal (the lowest grade standard reported by the Energy Information Administration), this cap would be $11.00 * 4.4% = $0.484; for Central Appalachian coal (the highest grade reported), the cap would be $62.58 * 4.4% = $2.754, and therefore would not be reached (U.S. EIA, 2013b).

Revenues collected by the coal excise tax, enacted in 1973, are dedicated to the Black Lung Disability Trust Fund, which provides “income maintenance and medical benefits,
when no coal mine operator can be held liable for payments,” to coal workers suffering from pneumoconiosis, a disease caused by the inhalation of dust (U.S. Department of Labor, 2012; Derickson, 1998). The fund also provides benefits to families of coal workers whose death was hastened or cause by pneumoconiosis (Humphries & Sherlock, 2013).

By providing health benefits to disabled miners whose former employers are bankrupt or otherwise unable to meet their obligation to compensate their employees, the coal excise tax helps to internalize the cost of harms to coal miners, reducing the total social costs unaccounted for in the coal fuel cycle (Burtraw & Krupnick, 2012).

**Nuclear Waste Disposal Fee**

The Nuclear Waste Policy Act (NWPA) of 1982 provides for the construction of a geologic repository for nuclear wastes, including spent civilian and military nuclear fuels and high-level wastes (HLW) generated by the Department of Defense. The civilian costs of this program were to be covered by a fee assessed to owners of nuclear reactors generating electricity (Holt, 2011). In 1987, Congress amended the NWPA to designate Yucca Mountain, NV as the site of the future nuclear repository (Committee on Technical Bases for the Yucca Mountain Standards, 1995). In 2009, President Obama ordered that work on a disposal project at the Yucca Mountain site be halted (Blue Ribbon Commission on America’s Nuclear Future, 2012).

Until recently, the Department of Energy used this authority to collect a fee of $0.001 per kilowatt hour of electricity generated by nuclear reactors, amounting to about 1% of average electricity costs and totaling approximately $750 million annually (Blue Ribbon Commission on America’s Nuclear Future, 2012). On November 19, 2013, the United States Court of Appeals for the District of Columbia Circuit ruled that the fee the Department of Energy was collecting for the permanent repository was not permissible under the NWPA. The court reasoned that, because President Obama had halted the Yucca Mountain project, the funds collected were not actively being used for their legislated purpose: providing permanent disposal of nuclear waste. Additionally, because the Secretary of Energy was unable to determine whether the collected funds were adequate for their purpose, the court ruled that the fees could not be permissible at all, regardless of the project’s status. Based on these conclusions, the court ordered the Secretary of Energy to submit a proposal to Congress to change the fee to zero until he can determine the appropriate level of fees or Congress “enacts an alternative waste management plan” (Natl Assoc., Reg. Util Commiss. v. Department of Energy, 2013).

As originally intended, the fees collected under the NWPA internalized the significant social costs of radioactive waste disposal by passing the obligation for disposal to the federal government, reducing the external costs of nuclear electricity generation.

**The Clean Air Act**

In 1970, President Nixon created the Environmental Protection Agency (EPA). Among the new agency’s other duties, the Clean Air Act, passed in 1970, provided the EPA with authority to establish air quality standards and limit emissions of hazardous air pollutants (U.S. EPA, 2013a).

On September 20, 2013, the EPA proposed new regulations on power plant installations under the Clean Air Act. The new proposal uses Section 111(b) of the act to set carbon emission standards for new power plants and proposes new regulations limiting carbon emissions of...
existing power plants under Section 111(d), which provides a framework for federal cooperation with states on state-administered programs meeting national goals (U.S. EPA, 2013a). Under the new proposal, fossil fuel-fired utility boilers, such as coal power plants, would be limited to 1,100 pounds of CO2 per megawatt hour over a 12-operating month period or a slightly lower quantity over an 84-operating month period. The cap for small natural gas units is the same, while larger natural gas installations will be subject to a cap of 1,000 pounds of CO2 per megawatt hour (U.S. EPA, 2013b).

Some commentators have suggested that these new standards would effectively prohibit new coal power plants, as the cost of complying with the carbon emissions cap using existing technologies may be prohibitive (Fazio & Strell, 2013). The 84-operating month compliance period is intended to allow coal plant operators more flexibility to develop and implement new technologies to meet the new standards (U.S. EPA, 2013b); however, critics contend that energy companies will not invest in new plants that rely on technologies that have not yet been proven on a commercial scale, limiting the effectiveness of the longer compliance period (Fazio & Strell, 2013).

The Clean Water Act and the Safe Drinking Water Act

Two years after the Clean Air Act became law, the U.S. Congress amended the Federal Water Pollution Control Act, originally enacted in 1948, to provide the EPA with robust authority to regulate “discharges of pollutants into the waters of the United States.” As amended in 1972, the law became known as the Clean Water Act (U.S. EPA, 2013c). While no recent programs developed under the Clean Water Act are specifically intended to target pollutants from electricity generation, the act provides a valuable framework for reducing external social costs from water pollution.

Shortly after enacting the Clean Water Act, Congress enacted the Safe Drinking Water Act of 1974 “to protect public health by ensuring the safety of drinking water” (U.S. EPA, 2013c). Under its combined authority granted by these two new laws, the EPA regulated underground injection wells like those used in modern hydraulic fracturing operations. However, following the 2001 recommendation of a Special Energy Policy Task Force chaired by Vice President Richard Cheney, Congress amended the Clean Water Act and the Safe Drinking Water Act to exempt hydraulic fracturing from all of their provisions (Hines, 2012). Some critics have suggested that Vice President Cheney’s former role as Chief Executive Officer of Halliburton, a leading energy company that is credited with inventing the modern hydraulic fracturing process, reflects negatively on the credibility of the task force’s recommendations; critics further complain that the task force’s secret meetings hindered public input in the decision making process (The Halliburton Loophole, 2009).

Where their provisions are applicable, the Clean Water Act and the Safe Drinking Water Act reduce or internalize many of the social costs resulting from water pollution. However, large exceptions to these acts limit their effectiveness at mitigating impacts from certain key sources, such as hydraulic fracturing (Hines, 2012).

Climate Change

Three of the four comprehensive studies identified here did not estimate social costs due to climate change (Lee et al., 1995; Rowe et al., 1995; National Resource Council, 2010). However, a new method of estimating the costs of climate change developed by the federal
government may provide a framework under which future social cost estimates may be more easily able to account for the substantial social costs attributable to climate change. In 2010, President Obama directed several agencies to estimate the social cost per unit of carbon dioxide emitted into the atmosphere over a given period. The resulting figure, called the Social Cost of Carbon (SCC), places a monetary value on the damages caused by each additional unit of carbon released into the atmosphere today. The working group that developed the SCC also provided valuations of damages from carbon emissions in future years, which increase over time because the tolerance of natural systems to increased carbon dioxide input is expected to decline over time as systems approach saturation (Interagency Working Group on the Social Cost of Carbon, 2013). The most recently revised estimate of the SCC was more than double the initial estimate published in 2010 (Interagency Working Group on the Social Cost of Carbon, 2010).

While its numeric value is still the subject of lively debate, the SCC estimate represents an important frontier in social cost discussions. If the figure can be applied successfully to new environmental policy, future social cost studies may benefit from a similar approach by developing robust “cost per unit” estimates for a variety of pollutants and other impacts.

Future Management: Open Questions and Policy Recommendations

A wide range of programs have been proposed to internalize social costs not already accounted for by existing management. This paper recommends the implementation of some of these measures and the conduct of further research in certain areas. It is worth noting that these recommendations consider only the technical suitability of these cost internalizing methods, and do not contemplate their viability in the current political climate.

Carbon Dioxide

As it does for other air pollutants, the Clean Air Act grants the EPA broad discretion in limiting the carbon dioxide emissions of new sources (U.S. EPA, 2013a); the agency should use that authority aggressively to spur investment in cleaner-burning technologies and renewables to reduce the total load of social impacts on the U.S. population. The Congress should also enact a comprehensive tax on carbon dioxide emissions, indexed to the Social Cost of Carbon (SCC). As new information becomes available, it is nearly certain that the SCC estimate will continue to change (Interagency Working Group on the Social Cost of Carbon, 2013). Public policy on carbon emissions must therefore be able to adapt dynamically to different estimates.

Whether imposed as a quota, a direct tax, or a “cap and trade” market, this new tax must not shy away from imposing the full social cost of electricity generation on producers and consumers. While such a move may cause some industries to shift production to other nations, the U.S. cannot continue to ignore the mounting social costs of its dependence on fossil fuels at home. While the World Trade Organization and the United Nations must one day consider and balance the social costs of carbon emissions on a global scale, Congress must not wait for these vast organizations to take the lead in regulating carbon dioxide appropriately; time is of the essence when confronting global climate change, and the short term costs of unilateral action pale in comparison to the vast expenses that will surely result from universal inaction.
**Labor Rights**

Many studies of social costs assume that injuries sustained by energy workers are internalized by wages because job seekers are well informed of the dangers of their trade and health care costs are often paid by workers’ compensation or trust funds (Rowe et al., 1995; Burtraw et al., 2012). The Department of Labor should collaborate with the Department of Energy and the EPA to ensure that this assumption, so long as it is held to be true by policy makers, is supported by fact. Workers are entitled to know all of the dangers they face on the job, and to be adequately compensated for injuries sustained there. Both rights should be guaranteed by law and supported by government trust funds that, like the Black Lung Disability Trust Fund (Internal Revenue Service, 2013), are financed by taxes on energy generation revenues.

**Hydraulic Fracturing and Natural Gas Extraction**

The EPA has identified a variety of potential impacts from hydraulic fracturing, including stress on surface water resources used to drill and fracture shale deposits, potential contamination of underground water resources including drinking water, and airborne pollution resulting from the release of volatile organic compounds and greenhouse gases (U.S. EPA, 2013d). The public has been particularly concerned about the effects of hydraulic fracturing on drinking water resources, prompting the U.S. Congress to direct the EPA to conduct a comprehensive review of impacts to drinking water (Hines, 2012). In December 2012, the EPA released a progress report on its study, detailing the methods it will use in its comprehensive analysis of effects of 350 representative natural gas wells, as well as the laboratory experiments and data reviews it will conduct to determine the toxicity of chemical agents used in the hydraulic fracturing process and their impacts on drinking water resources (U.S. EPA, 2012). This study, once completed, will provide regulators with vital information about the true impacts of this relatively new technology and will also allow future social cost models to provide more robust accounting for an uncertain phase of the natural gas fuel cycle.

Based on the results of the EPA’s review of the impacts of hydraulic fracturing, the agency should seriously consider implementing rigorous new restrictions on the technique. Regardless of the study’s conclusion, the so-called “carve outs” of hydraulic fracturing from the Clean Water Act and the Safe Drinking Water Act granted to energy utilities under a friendly administration in 2005 (Hines, 2012) should be repealed. If the landmark legislation this country has relied on to protect its water resources for decades is still good public policy, it should be applied uniformly regardless of the source of a suspected pollutant. As the editors of the New York Times shrewdly asked in a November 2009 column, “if hydraulic fracturing is as safe as the industry says it is, why should it fear regulation?” (The Halliburton Loophole, 2009).

**Nuclear Waste Storage and Disposal**

Based on the recommendations of the Blue Ribbon Commission on America’s Nuclear Future (2012), the Department of Energy should move quickly to establish adequate storage and disposal technologies for civilian nuclear wastes. As the authors of that commission’s final report wrote, “this generation has an ethical obligation to proceed toward developing permanent disposal capacity for high-level nuclear wastes without further delay... But until disposal capacity has been developed, society will have no choice other than continued storage of the wastes” (Blue Ribbon Commission on America’s Nuclear Future, 2012).
The Department of Energy must also develop an accurate estimate of the costs of this program so that it may resume collecting fees from owners of civilian reactors to cover the social costs of waste disposal (Natl Assoc., Reg. Util Commiss. v. Department of Energy., 2013). Failure to collect these fees on electricity consumed today places an unconscionable burden on future generations for the wastes of today’s electricity generation.

Conclusion

While precise valuations of social costs may vary from one study to another, the existence of vast external costs to society of today’s electricity generation is incontrovertible. Failing to account for these costs today is not a responsible means of stimulating the economy or encouraging growth; it is a tremendous gamble with modest short term payoff and no viable exit strategy. The costs that we do not internalize today will be borne by generations to come, who will have no opportunity to legislate or conserve the vast expenses away. It is striking that the legislators who complain most vociferously about the burden of mounting deficits on future generations so frequently oppose reforms to reduce the weight of the environmental damages we will leave our children. If these policy makers cannot be persuaded of the merits of internalizing social costs in today’s energy prices, they must be replaced by others who understand the seriousness of the challenges manifested in these costs.

References:


Final Research on Underage Cigarette Consumption

Angie Qin
An Hu
New York University

Abstract Over decades, we witness a significant increase in amount of research on cigarette consumption. Among these researches, many are focusing on the effects of cigarette prices on the cigarette consumptions among adults and adolescents. A majority of these researches reach conclusions such as the prices of cigarettes are significant determinants of its purchases.

While many economic researchers has established many economic relationships between the good and its various determinants, this paper will examine the association between the age and tobacco use. It provides a comprehensive review of the data on cigarettes consumption levels at different age in the United States of America. It hypothesizes that smoking is more common and prevalent in the older age groups where accessibility of tobacco is relatively high and easy.

In modern times, the social gradient of smoking is well established for our citizens: smoking has been widespread for several decades and its health-retarding effects can also be measured reliably. Thus, throughout our times, many researchers, scientists and academic elites have attempted to understand the motivations and rationale behind the consumption of cigarettes. What are the determinants? What are its impacts on society besides its hazardous effect to our health? As a lot of researches have been done on the relationship between health, prices, elasticity and income, our group will attempt to delve into the relationship between consumption of cigarettes and underage consumers in the United States. We aim to construct a model via using US country-level data of underage tobacco consumption and see an indication of significant association between the older age group and the higher number of healthy-damaging behavior in the form of cigarette consumption.
Introduction

It is hard to deny that the prevalence of cigarette consumption among American teenagers has been rising since the 1990s. In fact, the proportion of 8th and 10th graders as current cigarette smokers has increased dramatically between the years 1991 and 1996, according to the Monitoring the Future Surveys (MTFS). Similarly, the proportion of current smokers in the 12th grade has also increased significantly between the years 1992 and 1994.¹

This phenomenon has caused a great deal of concern among public healthy advocates as well as parents of these young smokers. As a result, many researchers have looked into this upward trend of cigarette smoking through investigating its relationship with factors including effects of prices, taxes, income and policy as well as many other economic and noneconomic factors. As many people have already known, the varied health related indications of consumption of cigarettes include life expectancy, infant mortality, HIV infection rates, robbery rates, low birth weight, and the list goes on and on. However, as the endless health-retarding effects of tobacco consumption have been made clear to the public, the consumption of cigarettes has yet to undergo any dramatic decrease in our society. In fact, we often see youngsters these days having cigarettes between their fingers. Another interesting fact our team found out through extensive research is that while numerous determinants as mentioned above have been studied widely, age does not seem to have been considered as a major variable that carry big significance. Therefore our team believes it would be useful and enlightening to study the association between age of the underage population and cigarette smoking after taking into consideration standard determinations of smoking. We will start our research and examination by using US country-level data for underage tobacco consumption, cigarettes price per pack, Trends in harmfulness of Drugs as perceived by different graders (raging from Gr.8 to Gr.12) and trends in availability of drugs as perceived by different graders (raging from Gr.8 to Gr.12) income level and cigarettes consumption.

As we all know, because cigarette is an age conscious consumer good, age thus is a major determinant of its consumption. Domestic (within United States) comparisons and data show a strong association between the age of the underage consumers and the level of consumption. Within the United States for which data exists, lower age groups embody lower volume of tobacco consumption, at any given age, than do the older age groups. Therefore, we know that age affects cigarettes consumption.

In addition to the age determinants, eighth, tenth and twelfth graders will be our focus for this research paper. The differences in tobacco consumption levels between different age groups will be discussed and used as evidence to test our hypothesis. We will close with a short discussion of the possible reasons why the relatively older underage individuals smoke more than the younger ones. Finally, if our hypothesis is proven right, the paper will conclude that the health-retarding behavior are concentrated more heavily on the elder underage group in the United States. If otherwise, the paper will reject the proposed hypothesis and explain why the hypothesis is to be rejected.

We believe that by understanding the initiation of the youth smoking will help the society to take actions in improving the current situation. Through investigating the determinants of smoking ignition among underage smokers, we will be able to understand the factors that affect youth’s decisions to start smoking.

Literature Review
Underage crime rate, drug usage and cigarette consumption have always been the concerns of our modern society. Many research have shown a strong association between the age indicators and the consumption of tobacco consumption. In “Key Findings on Adolescent Drug Use” by Lloyd D. Johnson, the researchers established their findings regarding to illicit drug, smoking, and drinking problems among youth population. They related the perceived effect of these drugs by youth population to the actual usage of drugs and concluded that both 8th graders and 10th graders are showing evidences of a slight decrease in smoking since mid-1990s with the increase in perceived risk. Therefore, proving a positive relationship between perceived riskiness by the underage drug users and their actual consumptions. Similarly in the article of “Teen smoking continues to Decline” published by Institute for Social Research, researchers also found a statically significant drop in the teenage cigarette consumption.

The Model
a) The Variables
In our model, have specified that year and price of cigarette per pack are two of the main variables. And within the underage group, we have divided to three parts- grade 8, grade 10 and grade 12, because we consider teens who are under grade 8 (correspond to Age 12) are hard to choose to smoke themselves. Furthermore, we will also includes Trends in Harmfulness of Drugs as Perceived by different grade level of teenagers. Lastly, Trends in Availability of Drugs as Perceived by different groups of teens are also important to the underage smoke rate. We hypothesize that if there is a high availability of drugs to teens which means they are under more exposure, one may expect positive relation between this trend in availability and underage cigarette consumption.

b) The Equation
\[ \text{L(CONSi)} = \alpha_1 + \alpha_2 \text{(Grade 8)} + \alpha_3 \text{(Grade 10)} + \alpha_4 \text{(Price)} + \alpha_5 \text{(TIH)} + \alpha_6 \text{(TIA)} + \alpha_7 \text{(YEAR*)} + \text{ui} \]
\text{CONSi} = \text{portion of investigated entity consuming cigarettes}
\text{Grade 8 and Grade 10} = \text{dummy variables coded 0 and 1 (0 = no, 1=yes)}
\text{Price} = \text{average price of cigarettes}
\text{TIH} = \text{portion of investigated entity considering cigarettes to be harmful}
\text{TIA} = \text{percentage of investigated entity considering cigarette to be easy to get}
\text{Year*} = \text{the number of year-1990}
\text{ Ui} = \text{residual}

Data
The data from Table 1 represents the values for the independent variables we chose. Those data are collected by the University of Michigan Institute for social research. it consists of over 45,000 students for 395 secondary schools and it has lasted for over 20 years since 1991. Out data set contains the data collected since 1991 to 2012 and is divided by 3 age groups, which include the 8th, Grade, the 10th Grade and the 12th Grade. We also includes the statistic information: Trends in Harmfulness of Drugs and Trends in Availability of Drugs, those two kinds of variable are all extracted from the original data source by Johnston, Lloyd. For the average price of cigarette, we extracted the number from the report of “The Economics of Tobacco Control” written by Frank J. Chaloupka. We will analyze each of the factors below and compare them with Smoke Rate-CONSi separately.

---
As it is shown in the graph above, we observed there is a negative correlation between number of year and smoke rate, and there is an increasing trend as grade goes up. So we expected there is a negative sign for the coefficient of the variable YEAR*.
From these three graphs above, it can be observed that there is also a negative correlation between Smoke Rate and Trends in Harmfulness of Drugs. And as knowledge about harmfulness increase as the grade level goes up, the smoke rate decrease. Therefore, we expected that there would be a negative sign for the coefficient of Trends in Harmfulness of Drugs.

From these three graphs on the following page, it can be observed that there is also a negative correlation between Smoke Rate and Trends in Availability of Drugs. And as the availability of drug increase as the grade level goes up, the smoke rate also goes up. Therefore, we expected that the sign of the coefficient of Trends in Availability of Drugs would be positive.

It can be observed from the graph of Smoke Rate vs Cigarette price that as the price of cigarette goes up, the smoke rate goes down. So we expected there would be a negative coefficient for the variable Price per pack.
Grade 8 Smoke Rate vs TIA rate

\[ y = 1.700x + 44.10 \]
\[ R^2 = 0.933 \]

Grade 10 Smoke Rate vs TIA rate

\[ y = 0.903x + 65.47 \]
\[ R^2 = 0.905 \]

Grade 12 Smoke Rate vs TIA rate

\[ y = 0.903x + 65.47 \]
\[ R^2 = 0.905 \]
### Regression Results

**Dependent Variable:** CONSI  
**Method:** Least Squares  
**Date:** 12/08/13  
**Time:** 20:14  
**Sample:** 1 66  
**Included observations:** 66

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---

![Graph showing the relationship between smoke rate and price per pack](image.png)

**Equation:**  
y = -4.645x + 45.58  
**R²:** 0.714
To test the significance of each variable independently, we have run OLS six times and the regression results, which are listed in the Appendix, are all significant at 1%, 5%, 10% levels.

**Regression Results**

At the first time, we have tested the model uses the variable year as the actual year rather “the number of the year-1990”.

As the result shown in table in we found that there is a huge std-error in the intercept parameter C. After experiments, we consider the huge variability may be due to the large numbers appeared in the equation, such as the number of year. So we use the variable YEAR* calculated by “number of year-1991”) to substitute the original variable-YEAR. So we ran our second equation.

From the Table2, it can be observed that the std.error of the intercept get significantly decreased.

In this regression result, the variable PRICE, dummy variable GRADE8 and GRADE10 and the intercept - C are significant at 1% level. The variable Trend in Harmfulness of Drugs and the variable Trend in Availability of Drugs are significant at 5% level. And, the variable - YEAR* is not significant. However, from the graph which shows the relation between number of year and CONSi, which shows a clear negative relation, so we still decide to add this variable in our model.

Using the method of ordinary least squares we are able to obtain the following regression model:

\[
\text{L(CONSi)} = 49.34 - 15.04 \text{L(Grade 8)} - 8.41 \text{L(Grade 10)} - 3.43 \text{L(Price)} - 0.44 \text{L(TIH)} + 0.22 \text{L(TIA)} + 0.23 \text{L(YEAR*)} + ui
\]
Heteroskedasticity Test: White

| F-statistic | 2.177296 | Prob. F(24,2) |
| Obs*R-squared | 36.98283 | Prob. Chi-S |
| Scaled explained SS | 26.34191 | Prob. Chi-S |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 12/08/13   Time: 20:39
Sample: 1 66
Included observations: 66
Collinear test regressors dropped from specification

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<td>1.618431</td>
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<tr>
<td>PRICE*TIH</td>
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</tr>
<tr>
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<tr>
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<td>GRADE8*TIH</td>
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<tr>
<td>TIA*TIH</td>
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</tr>
<tr>
<td>TIA*YEAR1</td>
<td>-0.689295</td>
<td>0.4093</td>
</tr>
</tbody>
</table>

Correlation Table

| CONSi  | 1.000000 | -0.615821 | 0.006428 | -0.619285 | 0.894776 | 0.2  |
| PRICE  | -0.615821| 1.000000 | -6.66E-18| -6.66E-18 | -0.20580 | 0.2  |
| GRADE10| 0.006428 | -6.66E-18| 1.000000 | -0.500000 | 0.143824 | -0.0 |
| GRADE8 | -0.619285| -6.66E-18| -0.500000| 1.000000  | -0.32250 | -0.2 |
| TIA    | 0.894776 | -0.205580| 0.143824 | -0.32250  | 1.000000 | 0.3  |
| TIH    | 0.280659 | 0.283905 | -0.017495| -0.224995 | 0.314651 | 1.0  |

When using the White test we find again that the p-value and chi-squared value are insignificant on the 95%, 99% confidence interval. We do not reject the null hypothesis that this regression is homoskedastic and we can conclude that this regression does not feature heteroskedasticity.

From the correlation metrics table, it can be observed that excluded the variable- year*, there is considerable low correlation between different variable, which means there is no significant correlation problem within the model.

Summary and Conclusion

From our model through which we ran the regression, we are able to reach the following conclusion:

1. Our regression model is
   \[ L(\text{CONSi}) = 49.34 - 15.04L(\text{Grade 8}) - 8.41L(\text{Grade 10}) - 3.43L(\text{Price}) - 0.44L(\text{TIH}) + 0.22L(\text{TIA}) + 0.23L(\text{YEAR}^*) + u \]

2. The price of cigarette has a strong effect on the teenagers’ consumption rate. As price goes higher, the underage smoke rate goes down.

3. The underage smoke rate is highly correlated with the number of the year. As years go up, the consumption rate goes down.

4. Higher grades get higher consumption rate, from 8th grade to 12 grade.

5. Higher rate of perception of the harmfulness of cigarette, the lower consumption rate. Higher rate of availability to drugs, the higher consumption rate.

Through the conclusion, we see a matching result with the former research done by Lloyd D. Johnson.
References:

Estimating the Compensation Differential for Paid Sick Leave Benefits

Shawn Du
Princeton University

Abstract In this paper, we seek to estimate the wage compensation differential for paid sick leave in the United States using national-level data from the 1996-2010 data from the Medical Expenditure Panel Survey (MEPS) household component. The standard theoretic labor models suggest that wages are a function of paid sick leave benefits, other job characteristics, employee characteristics, other immeasurable worker characteristics. Testing this simplified theory, we find that estimates were significant but wrong-signed (from the perspective of our theory); workers who gained access to sick pay had also exhibited an increase in wages, and vice versa for those who lost access to sick pay. As such, we find that state-level data may, or perhaps more specific data may be needed to pin down causality, where exogenous policy variation can be captured.
Introduction

The primary focus of this study is to estimate the wage compensation differential for paid sick leave in the United States. Sick leave benefits are defined as paid time off while an employee temporarily cannot work because of a nonwork-related illness or injury.¹ Most standard theories of wage differentials in the labor market predict that workers will bear the cost of fringe benefits, and empirical studies tend to support the claim that the majority of the cost of these fringe benefits fall on the burden of the workers.² All else equal, jobs that provide more in the way of such fringe benefits as paid sick leave pay lower wages or salaries.

At present, there are fairly few federal laws that pertain either directly or indirectly to the employer provision of paid sick leave or sickness absence insurance, with the exception of the Family and Medical Leave Act (FMLA) of 1993, which grants (unpaid) sick leave benefits to employers for various health-related reasons.³ Recently, however, city and state governments in San Francisco, Seattle, Connecticut, and elsewhere have passed paid sick leave ordinances, and several other states such as Arizona, Minnesota, and Illinois are considering such legislation.⁴ Legislation mandating employers provide sick paid leave benefits have major implications on wage levels and wage differentials. If uncovered workers were to gain paid sick leave benefits through laws mandating employers to cover such amenities, employers would perhaps be inclined to cover a significant portion of this added cost through lower wages. An understanding of the relationship between wage levels and levels of employer provided fringe benefits, then, is key to understanding the effects of related policy proposals which are likely to appear in the future.

Literature Review

Although there exists extensive literature on the estimation of the compensation differentials for employer-provided health care coverage, literature regarding paid leave access, including paid sick leave and other fringe benefits of this kind, has been given relatively short shrift. There exists evidence, as presented in Morrisey (2001), that health insurance provision in particular is significantly correlated with paid sick leave provisions.⁵ Because of the strong connection between health care and fringe benefits, it will be helpful to take a brief look at the review the literature of the compensation differential for health care benefits.

Miller (2004) uses data from the 1988-1990 Consumer Expenditure Surveys (CEX) to look at men who had either gained or lost health insurance coverage between the first and final rounds of the surveys. He finds that workers who lose employer-provided health insurance are compensated with an approximately 10% wage increase. By utilizing a fixed effects specification, it can be inferred that the wages of those with health insurance are approximately 10% lower than they would be otherwise. One shortfall of this approach, however, was that the author (admittedly) did not control for other fringe benefits, including paid vacation and paid sick leave, which have been shown to be correlated to both wages and health care/insurance benefits.⁶

Levy and Feldman (2001) conduct a similar study using both CEX data from 1998 to 1990⁷ as well as MEPS data from 1996. This paper builds on the estimations by recognizing the need to include such explanatory variables as employee premium contributions, measures of health status, and other individual attributes that would affect expected medical spending and valuation of benefits. The paper thus further

¹ Diaz, I. and R. Wallick 2009.
² This will be discussed this in greater detail in the Literature Review section.
³ Levine, L. 2009.
⁴ Buck Consultants 2012.
⁶ Morrisey, M.A 1993.
⁷ Same data set used in Miller (2004)
addresses the need to consider the individual's implicit valuation of employer-provided health care benefits as well as how much the individual might prefer such benefits given their health status and health expenditures. The authors chose to analyze the MEPS data in particular because it included further information on expenditures and self-reported health status; this scale displayed more variation than any other possible measure.8

In summary, there exists convincing empirical evidence of the existence of a wage-health insurance trade-off and a significant link between health insurance and paid sick leave in terms of how they affect wages. This paper aims to build upon the literature by taking these aforementioned factors into account and estimating the compensation differential on paid sick leave using fixed effect regression techniques. Furthermore, our study utilizes the MEPS 2009 to 2010 Panel 14 data set, which was a data set released in October of 2012. Although a few studies, such as Levy and Feldman (2001), used MEPS data sets to find the compensation differential for health insurance, none have utilized the data sets from more recent years.

Data

The data used in the study comes from the 2010 Medical Expenditure Panel Survey (MEPS) household component, which is a self-reported, publicly available data set meeting all of these requirements and is nationally-representative. Furthermore, the MEPS data from 1996 to 2010 provides a consistent time frame to analyze and extend this study on how the compensation differential had perhaps changed over time.

Theory and Methodology

The basic model wage differential compensations is fairly simple; let us first consider a simplified model where a worker is compensated by only two things: wages and paid sick leave benefits. The marginal rate of substitution of these economic goods should be positive as both are desired forms of compensation. As workers view both wages and paid sick leave as normal goods. Similarly, for employers, the first order conditions of profit maximization imply that a worker's total compensation is equal to his marginal revenue product or productivity. As such, it is optimal for them to offer a decrease in other forms of compensation (such as wages) when paid sick leave benefits are increased.

One caveat to note is that as both wages and paid sick leave are normal goods, productivity of workers is positively correlated to both higher wages and greater access to paid sick leave. As a result, controlling for productivity (or the worker’s marginal revenue product) will be very important in the study, and thus a key focus of our methodology. This simplified model suggests that wages (w) are a function of: 1) paid sick leave benefits (Sick), 2) other job characteristics, such as those listed in the previous data section (Job), 3) employee characteristics (Emp), and 4) other immeasurable worker characteristics (such as ability; these are incorporated in the error term), labeled as (M).9 This can be expressed as: ln(wage)=w(Sick, Job, Emp,M)

If the assumption is held that the function w is linear to the parameters of interest, then a preliminary OLS regression can be estimated as follows:

\[ \ln(\text{wage}) = B_1 \text{Sick} + B_2 \text{Jobs} + B_3 \text{Emp} + \epsilon \]

Here, \( \epsilon \) is the error term for which includes the theoretical vector M of unmeasurable characteristics described earlier. It is expected that \( B_1 \) should be negative. At this stage, however, there exists the possibility of misspecification, due to various observed effects within the error term.

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9 This delineation is adapted from Miller (2004).
These characteristics include productivity, ability bias, signaling bias, etc., which are likely to be correlated positively with compensation. In the next step, individual fixed effects regressions are run, controlling for unobserved omitted variables influencing paid sick leave benefits, which differ from one person to the next but tend to remain constant over time. In other words, the fixed effects are used to try to eliminate the unobservable aspects of productivity which are individual worker-specific. These fixed effects specifications are used under the assumption that the unobservable characteristics (M) are time-invariant. (Here, a is the variable for individual fixed effects). Then, the resulting specification is: 

$$\ln(\text{wage})_a = B_1 \text{Sick}_1 + B_2 \text{Job}_a + B_3 \text{Emp}_a + a_i + e_a$$

Separate, specific regressions are then run for workers who lose paid sick leave at any round of the panel survey and those who gain it, as dummy variables. This way, the underlying symmetry assumptions of the previous specification can be addressed and rid of. Naturally, both variables equal zero for workers whose paid sick leave status was the same between all the time periods. Standard theory predicts that the coefficient on sick pay for gainers should be the same as the coefficient for losers. By analyzing the regression results for gainers and losers of sick pay separately, potentially good insight regarding the symmetry of our estimates might be found.

Along with paid sick leave, the same fixed effects models on access to paid vacation leave are also run, including comparisons between those who had gained and lost vacation leave during the rounds. Although the primary focus of our paper is on sick leave, paid vacation leave is significantly correlated with paid sick leave as mentioned earlier. These results might yield insight on the behavior of compensation differentials of fringe benefits on a more general level. The regressions are then run again, both to observe its effect on hourly wages on average throughout the time period as well as during the 2 rounds where the change took place (the “instantaneous”). The model is analogously defined below:

$$\ln(\text{wage})_a = B_1 \text{Vacation}_1 + B_2 \text{Job}_a + B_3 \text{Emp}_a + a_i + e_a$$

There are also several potentially interesting ideas explored by changing minor details on these models and through basic tabulations. For instance, there are significant differences in perceived health status between those who have access to sick pay and those who do not as seen in table 3 and take this into account when the coefficients on the health status in our regressions are observed. Table 9 shows change in jobs with change in sick pay status. Empirically there seems to be a correlation between change in health insurance (also with other fringe benefits) and change in jobs. Intuitively, this also makes sense. The major categories of reasons for changing jobs (in the MEPS data set) are: a) the worker got laid off/had their job end, or b) the worker quit the current job for another job. Our final set of regressions isolate workers who have observed both a change in sick pay as well as a job change, to focus specifically on the differences in how sick pay affected their hourly wages depending on the reason for their job change. Again, only the two rounds before/after the change in sick pay status and jobs are included. The intuition here is that workers who got laid off/had their job end would probably prioritize simply finding a new job over any of the fringe benefits, whereas workers who had quit their current job for another job are more likely to change only if they prefer their new job over the old one for some particular reason; the new job could potentially offer fringe benefits such as sick pay which the worker

10 This method was also used in Levy and Feldman (2001).
11 Miller, R.J. 2004
Comparative Advantage  Spring 2014

Microeconomics

previously did not have. As a result of this theory, it may be likely that workers who lose their current jobs (which might have sick pay) tend to also lose sick pay, while workers who change jobs of their own accord (who did not previously have sick pay) tend to both see an increase in wages as well as in the likelihood of having sick pay.

Results

Table 1 displays the summary statistics regarding workers with different benefit classifications. In the cross section, workers who have paid sick leave benefits tend to have significantly higher wages contrary to our theory, greater access to employer-provided health care and higher education levels than those without these benefits; these are benefits for which compensation differentials would be expected. All of these findings are similarly reflected in the paid vacation leave statistics. These findings reinforce the idea that wages and the differential are not determined merely by sick leave; it is likely to be the case that jobs which offer higher wages are also more relatively likely to offer paid sick leave, and further productivity bias have not been properly accounted for.

Next, table 2 shows workers of interest, who had observed a paid sick leave status change between any rounds of the survey. There is a significantly greater proportion of part time workers who gained paid sick leave compared to those who lost or were unchanged. This basic finding goes in line with the recent trend that paid sick leave benefits have typically been increasingly extended to these workers with lower relative wages and compensation who may not have had it before. Another interesting finding is that a significantly higher proportion of sick leave gainers had access to employer provided health insurance in the previous round, compared to those unchanged, and the opposite was true for sick leave losers. This could support the idea that the two fringe benefits are correlated as stated in Morrisey (2001). However, it is also interesting to note that these results show the opposite of what our theory predicts: workers who had lost paid sick leave benefits were also “compensated” by a decrease of on average 15.33% in wages, and vice versa for those who gained paid sick leave benefits (average increase of 20% in wages). This result, although not statistically significant, again points us to the fact that further omitted variables would need to be controlled for by using a fixed effects specifications in our regressions.

One other interesting result comes from table 3, our tabulation of access to paid sick leave and self-perceived health status. While the latter measure could be biased because it is a self-reported, qualitative measure, the hypothesis that the health measure is the same between workers with and without sick pay can be rejected, with $\chi^2 > 127.1$. Generally, workers without sick pay tend to be slightly “less healthy” than those with sick pay.

The standard OLS regression is present first, in part to see how well the standard linear estimate matches our expectations; these results are presented in table 4. The coefficient for sick pay is positive and significant (at the 5% level), suggesting that comparing otherwise identical workers, a worker with sick pay would be expected have a 56% higher wage (meaning hourly wage) than a worker without sick pay. Obviously, there is bound to be significant omitted variable bias in this result; our purpose for this regression was to get a basic understanding of this relationship at face value. When other worker and occupation characteristics are included in column 2 (which had been described earlier in the data section), the coefficient on sick pay drops to 0.106, and is still
significant. Furthermore, our R-squared value increases from 0.2 to 0.45; these facts suggest that the variation in log wages is largely due to other factors besides sick pay access, which makes intuitive sense. Furthermore, the significant negative coefficient on health status, which increases as one is less healthy, suggests that a one unit increase on the health status scale (from 1-5) is associated with 2.54% lower wages. This implies that in our model, workers who are less healthy tend to have lower wages, all else equal. But overall, the positive coefficient on paid sick leave suggest that workers who have paid sick leave also tended to earn over 10% more than their counterparts without these benefits. Also, a Breusch-Pagan test for heteroskedasticity on our standard linear model yields find that, with p-value < 0.001, the null hypothesis of homoskedasticity can be soundly rejected. Thus, all of our future regressions are run with heteroskedasticity robust standard errors.

Columns 3 and 4 of table 4 depict similar regressions, except the variables of interest are now “gain” and “loss”, indicator variables set equal to one if a worker gains or loses paid sick leave in the time period, respectively. These results describe the workers who will be of primary focus later on in the fixed regressions, namely those who have had change in access to sick pay. Workers who lost sick pay during the time period earned around 13.6% less wages (significant) than their counterparts on average throughout the rounds, but those who gained sick pay during the time period did not significantly different earnings. There is a possibility of asymmetry in wages between gainers and losers of paid sick leave, mainly that losers of sick pay had generally earned less wages to begin with. As noted before, job changes that correspond to changes in access to paid sick leave (as well as the reasons for the particular job changes) could be a major reason for these discrepancies.

Next, the basic fixed effects regression is run with controls shown in column 1 of table 5, followed by a Hausman test on this model by comparing the estimates between our specification based on fixed effects and random effects. With p-value < 0.001, the null hypothesis is rejected, that sick pay estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. This gives a justification for the usage of the fixed effects for the remainder of the study.

The main fixed effects regression shows that having sick pay is associated a 23.2% increase in wages. Unfortunately, this result is significant, but in the direction opposite of what the hypothesis of the study - it might be the case that even with our fixed effects model, the other unmeasured reasons for changes in paid sick leave could not have been fully eliminated. Columns 2 and 3 specifically focus on workers who have lost sick pay during the time period, and the regressions in column 4 and 5 to workers who have gained sick pay during the time period. This way, the change of the wages of workers can be observed by comparing all rounds before and after their respective change in sick pay. The results are similar when the sample is restricted to workers who have exhibited a gain in paid sick leave. Thus, there still exists a general association of higher wages with sick pay benefits even when incomes within the pools of gainers and losers of sick leave are compared separately.

Table 6 presents analogous results, now estimating the compensation differential of paid vacation benefits. While this is not the primary focus of our analysis, there are noticeable similarities with our sick pay results. There are generally significant, positive (which is the opposite of what our theory predicts) coefficients on paid vacation leave, both in general and when workers who have observed a gain or loss in paid vacation leave are isolated.
Table 7 presents a key point of our analysis, with the regression of log hourly wages on the change in access to sick pay for workers, but only comparing the round before and the round after the sick pay change took place. A more direct change in wages that results from the change in sick pay can be identified in this way, instead of just taking the average of the before/after change periods (in tables 5 and 6). Again, the focus is specifically on workers who have either had a gain or loss in sick pay. The basic fixed effects regression on workers who gained sick pay are shown in columns 1 and 2 of table 7, and even after adding controls, the workers who gained sick pay also tended to gain 24.2% in wages, which is the significant coefficient on sick pay. These coefficients are generally in line with what has been observed before, but now there is a clearer discrepancy in how wages are affected by a gain versus a loss of sick pay for the workers in our data. The result that gainers of sick pay also tended to have a significant increase in wages accompanying their gain (while losers of sick pay saw no significant change in their wages following the loss) suggests that there might be an underlying factor, possibly job switches and reasons for the job switches, which might be responsible for such change in paid sick leave.

Contrary to initial assumptions, the data shows that most changes in sick pay were also accompanied by a change in the “current main job” of the worker. Table 9 presents this data; 58.3% of workers who lost sick pay had changed jobs at the time of the loss, and 76.4% of workers who gained sick pay had changed jobs at the time of the gain. This implies that most changes in paid sick leave are accompanied by changes in jobs. Given that job characteristics are certainly not homogenous (in terms of wages, hours worked, etc.) and that endogenous reasons for changes in for sick pay have not been fully controlled for, this would serve as a probable threat to the validity regarding some of the previous results.

More importantly, the workers’ reasons for changing jobs could provide valuable insight as to why our model might not have been able to yield results as originally hypothesized. Table 10 shows that amongst workers who had gained sick pay and changed jobs in the same round, 67.33% of them changed jobs because they quit their current job for another job. On the other hand, less than 40% of workers who lost sick pay and changed jobs cited the same reason for the job change, while they cite much higher proportions due to their job ending or being laid off. A column Chi-squared test yields \( \chi^2 = 20.40 \). So, the null hypothesis is soundly rejected, that workers who had lost sick pay versus those who had gained sick pay have similar proportions in their reasons for changing jobs.

The next major focus is on the data regarding the gainers and losers of sick pay who had changed jobs and how their wages were affected by this change in sick pay, separated by their reason for their job. Tables 11 and 12 show fixed effects models on sick leave job changes, for gainers and losers of sick pay, respectively. As in tables 7 and 8, both tables present data from the round before and after each change took place. In general, workers who had changed jobs and gained sick pay tended to have around a 42% increase in wages after the job change.

Finally, table 12 shows that Amongst losers of sick pay, workers hourly wages did not significantly change if they quit their current job for a new job, losing sick pay in the process. The results from these tables 11 and 12 as well as our earlier tabulations seem to confirm that even with our fixed effects models, the fundamental reasons for the job changes, which seems to be a main underlying motivating factor for the changes in sick pay, could not be properly accounted for. An ideal observation would entail perhaps a worker who had exhibited an exogenous change in sick pay at his current job (i.e. due mandated sick pay legislation in his state, and there was access to the
proper state-level data) or had exhibited this change whilst moving to a similar new job, to keep other factors constant. But because of workers’ endogenous reasons for changing jobs, our fixed effects models were not able to capture these omitted variations to properly test our model. These ideas are further discussed in the next section.

**Conclusion and Discussion**

Overall, our estimates from the MEPS 2010 data set were significant but wrong-signed (from the perspective of our theory): workers who gained access to sick pay had also exhibited an increase in wages, and vice-versa for those who lost access to sick pay. These results continued to hold and remain significant even after specifying fixed effects with further controls, both on the immediate rounds where the changes in sick pay took place as well as on the averages of wages before and after the change throughout the survey rounds.

As noted earlier, the failure in finding our expected result could be due to the absence of exogenous variation in sick pay status; those who gain or lose sick pay seem to be largely experiencing other productivity-related changes which threaten the validity of our fixed effects identification strategy. Along these lines, employers often exert significant effort to identify workers who are more productive, i.e. more motivated, dependable, highly skilled, etc. It is highly likely that some of these workers could have switched to jobs that better match their skills, and their gain in wages and sick leave benefits may reflect their greater productivity at the new job. Other workers who have switched might have encountered health problems or other events which might have diminished their productivity. If so, these unmeasured productivity changes would bias the findings and cause a threat to validity.

However, it is to be noted that our unexpected results do not represent evidence against the wage compensation differential hypothesis. Rather, they draw attention to the fact that significant exogenous variation in sick pay status will be necessary in order to test this hypothesis. A possible solution is to identify in the available data a natural experiment as suggested by Gruber (1994); this would cause an exogenous variation based around an event in the past decade which might have affected sick leave benefits to workers in the United States. But because legislation has been restricted mostly to the city and state levels, a challenge to such a study is the availability of new micro-data on sick pay. This scenario can more easily be examined once an exogenous change (usually an extension of sick pay) takes place on the national. Such knowledge would undoubtedly be crucial in building a greater understanding of the effects of mandated paid sick leave benefits that are likely to come up in the next few years.
### Tables (Appendix)

#### Table 1: Sick Pay and Paid Vacation Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Sick Pay</th>
<th>No Sick Pay</th>
<th>Paid Vacation</th>
<th>No Paid Vacation</th>
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<tr>
<td>Count</td>
<td>3453</td>
<td>2321</td>
<td>3975</td>
<td>1846</td>
</tr>
<tr>
<td>Percent Total</td>
<td>59.80%</td>
<td>40.20%</td>
<td>68.29%</td>
<td>31.71%</td>
</tr>
<tr>
<td>Average Hourly Wage</td>
<td>$22.83</td>
<td>$13.07</td>
<td>$21.42</td>
<td>$13.39</td>
</tr>
<tr>
<td>(Standard Deviations)</td>
<td>($13.65)</td>
<td>($9.07)</td>
<td>($13.26)</td>
<td>($10.18)</td>
</tr>
<tr>
<td>Part-Time Employment</td>
<td>8.53%</td>
<td>41.98%</td>
<td>8.76%</td>
<td>50.22%</td>
</tr>
<tr>
<td>Employer-Offered Health Care</td>
<td>95.73%</td>
<td>58.44%</td>
<td>94.20%</td>
<td>51.84%</td>
</tr>
<tr>
<td>Education Level (%)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Less than HS Diploma</td>
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<td>34.78</td>
<td>15.11</td>
<td>34.05</td>
</tr>
<tr>
<td>HS Diploma</td>
<td>46.54</td>
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<td>49.51</td>
<td>48.57</td>
</tr>
<tr>
<td>Some College/Bachelor’s</td>
<td>27.38</td>
<td>9.87</td>
<td>24.04</td>
<td>11.81</td>
</tr>
<tr>
<td>Graduate School</td>
<td>14.37</td>
<td>3.09</td>
<td>11.33</td>
<td>5.57</td>
</tr>
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</table>

#### Table 2: Unchanged vs. Changed Paid Sick Leave Status Statistics

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<tr>
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<th>Gained</th>
<th>Lost</th>
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<td>Count</td>
<td>6517</td>
<td>418</td>
<td>198</td>
<td>220</td>
</tr>
<tr>
<td>Change in Hourly Wage</td>
<td>$0.01</td>
<td>$0.03</td>
<td>$2.68</td>
<td>-2.36</td>
</tr>
<tr>
<td>(Standard Deviation)</td>
<td>($1.89)</td>
<td>($9.62)</td>
<td>($8.35)</td>
<td>($10.07)</td>
</tr>
<tr>
<td>Average % Change Hourly Wage</td>
<td>0.00%</td>
<td>1.40%</td>
<td>20.00%</td>
<td>-15.33%</td>
</tr>
<tr>
<td>(Std. Dev, in Percentage)</td>
<td>(9.58%)</td>
<td>(56.66%)</td>
<td>(55.68%)</td>
<td>(52.25%)</td>
</tr>
<tr>
<td>Part-Time Employment</td>
<td>20.48%</td>
<td>29.67%</td>
<td>45.40%</td>
<td>16.92%</td>
</tr>
<tr>
<td>Employer-Offered Health Care</td>
<td>78.98%</td>
<td>76.84%</td>
<td>90.91%</td>
<td>62.22%</td>
</tr>
<tr>
<td>Education Level (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS Diploma</td>
<td>48.54</td>
<td>56.66</td>
<td>57.54</td>
<td>55.88</td>
</tr>
<tr>
<td>Some College/Bachelor’s</td>
<td>20.16</td>
<td>18.28</td>
<td>17.32</td>
<td>19.12</td>
</tr>
<tr>
<td>Graduate School</td>
<td>9.98</td>
<td>4.70</td>
<td>6.15</td>
<td>3.43</td>
</tr>
</tbody>
</table>

#### Table 3: Perceived Health Status

<table>
<thead>
<tr>
<th>Health Status:</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Sick Pay</td>
<td>25.6%</td>
<td>33.2%</td>
<td>30.7%</td>
<td>9.2%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Sick Pay</td>
<td>25.9%</td>
<td>38.6%</td>
<td>28.1%</td>
<td>6.5%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Total</td>
<td>25.8%</td>
<td>36.5%</td>
<td>29.1%</td>
<td>7.5%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>
### Table 4: OLS Regressions

<table>
<thead>
<tr>
<th>Key Ind. Variable</th>
<th>Sick Pay</th>
<th>Sick Pay</th>
<th>Loss Sick Pay</th>
<th>Gain Sick Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Var.</td>
<td>Log Hourly Wages</td>
<td>Log Hourly Wages</td>
<td>Log Hourly Wages</td>
<td>Log Hourly Wages</td>
</tr>
<tr>
<td>Sick Pay</td>
<td>0.560*** (0.00686)</td>
<td>0.239*** (0.0124)</td>
<td>-0.0536*** (0.00318)</td>
<td>-0.0525*** (0.00362)</td>
</tr>
<tr>
<td>Emp. Health Care</td>
<td>-0.0307* (0.0156)</td>
<td>-0.0546*** (0.0170)</td>
<td>-0.0724*** (0.00326)</td>
<td>-0.0202*** (0.0141)</td>
</tr>
<tr>
<td>Age</td>
<td>0.00587*** (0.000318)</td>
<td>0.00714*** (0.000326)</td>
<td>0.00724*** (0.000326)</td>
<td>0.00724*** (0.000326)</td>
</tr>
<tr>
<td>Part Time</td>
<td>-0.148*** (0.0139)</td>
<td>-0.207*** (0.0142)</td>
<td>-0.202*** (0.0141)</td>
<td>-0.202*** (0.0141)</td>
</tr>
<tr>
<td>Health Status</td>
<td>-0.0254*** (0.00453)</td>
<td>-0.0258*** (0.00456)</td>
<td>-0.0255*** (0.00456)</td>
<td>-0.0255*** (0.00456)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.197*** (0.00843)</td>
<td>-0.184*** (0.00859)</td>
<td>-0.184*** (0.00856)</td>
<td>-0.184*** (0.00856)</td>
</tr>
<tr>
<td>Education</td>
<td>0.265*** (0.00532)</td>
<td>0.279*** (0.00530)</td>
<td>0.280*** (0.00529)</td>
<td>0.280*** (0.00529)</td>
</tr>
<tr>
<td>Loss</td>
<td>-0.136*** (0.0225)</td>
<td>-0.136*** (0.0225)</td>
<td>-0.136*** (0.0225)</td>
<td>-0.136*** (0.0225)</td>
</tr>
<tr>
<td>Gain</td>
<td>0.0276 (0.0241)</td>
<td>0.0276 (0.0241)</td>
<td>0.0276 (0.0241)</td>
<td>0.0276 (0.0241)</td>
</tr>
<tr>
<td>Constant</td>
<td>2.429*** (0.00540)</td>
<td>2.424*** (0.00510)</td>
<td>2.416*** (0.00514)</td>
<td>2.428*** (0.00512)</td>
</tr>
<tr>
<td>Observations</td>
<td>26,212</td>
<td>20,154</td>
<td>19,956</td>
<td>20,154</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.203</td>
<td>0.449</td>
<td>0.429</td>
<td>0.429</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1

### Table 5: Fixed Effects: Sick Leave

<table>
<thead>
<tr>
<th>Key Ind. Variable</th>
<th>Sick Pay</th>
<th>Gain Sick Pay</th>
<th>Lost Sick Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Var.</td>
<td>Log Hourly Wages</td>
<td>Log Hourly Wages</td>
<td>Log Hourly Wages</td>
</tr>
<tr>
<td>Sick Pay</td>
<td>0.232*** (0.0393)</td>
<td>0.170*** (0.0293)</td>
<td>0.0851* (0.0488)</td>
</tr>
<tr>
<td>Emp. Health Care</td>
<td>-0.00127* (0.000705)</td>
<td>0.0332 (0.0605)</td>
<td>-0.149* (0.0848)</td>
</tr>
<tr>
<td>Age</td>
<td>0.00206 (0.00214)</td>
<td>-0.0398 (0.0274)</td>
<td>0.0373 (0.0322)</td>
</tr>
<tr>
<td>Health Status</td>
<td>0.00170 (0.00169)</td>
<td>0.0232 (0.0250)</td>
<td>-0.0130 (0.0282)</td>
</tr>
<tr>
<td>Constant</td>
<td>2.636*** (0.110)</td>
<td>2.536*** (0.0191)</td>
<td>4.194*** (1.053)</td>
</tr>
<tr>
<td>Observations</td>
<td>23,671</td>
<td>814</td>
<td>606</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.055</td>
<td>0.808</td>
<td>0.847</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1
### Table 6: Fixed Effects: Paid Vacation

<table>
<thead>
<tr>
<th>Key Ind. Variable</th>
<th>Paid Vacation</th>
<th>Gain Paid Vacation</th>
<th>Lost Paid Vacation</th>
<th>Log Hourly Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid Vacation</td>
<td>0.207*** (0.0372)</td>
<td>0.137*** (0.0294)</td>
<td>0.139*** (0.0523)</td>
<td>0.279*** (0.0398)</td>
</tr>
<tr>
<td>Emp. Health Care</td>
<td>-0.00146** (0.000720)</td>
<td>0.00373 (0.0497)</td>
<td>-0.0885 (0.0659)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.00267 (0.00218)</td>
<td>0.00356 (0.0248)</td>
<td>0.0333 (0.0365)</td>
<td></td>
</tr>
<tr>
<td>Health Status</td>
<td>0.00225 (0.00174)</td>
<td>0.00701 (0.0241)</td>
<td>-0.0162 (0.0283)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.615*** (0.110)</td>
<td>2.489*** (0.0195)</td>
<td>2.308** (0.946)</td>
<td>2.426*** (0.0278)</td>
</tr>
</tbody>
</table>

Observations: 23,671, 876, 665, 700, 515
R-squared: 0.048, 0.835, 0.852, 0.757, 0.803

*** p<0.01, ** p<0.05, * p<0.1

### Table 7: FE Sick Leave Consecutive Terms

<table>
<thead>
<tr>
<th>Key Ind. Variable</th>
<th>Gain Sick Pay</th>
<th>Lost Sick Pay</th>
<th>Log Hourly Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sick Pay</td>
<td>0.235*** (0.0535)</td>
<td>0.242*** (0.0868)</td>
<td>0.167*** (0.0411)</td>
</tr>
<tr>
<td>Emp. Health Care</td>
<td>-0.214 (0.142)</td>
<td>0.0278 (0.126)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.178* (0.0994)</td>
<td>-0.0555 (0.131)</td>
<td></td>
</tr>
<tr>
<td>Health Status</td>
<td>-0.0342 (0.0618)</td>
<td>0.131** (0.0619)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.503*** (0.0379)</td>
<td>8.713*** (3.251)</td>
<td>2.518*** (0.0291)</td>
</tr>
</tbody>
</table>

Observations: 322, 254, 398, 298
R-squared: 0.735, 0.787, 0.791, 0.855

*** p<0.01, ** p<0.05, * p<0.1
### Table 8: FE Paid Vacation Consecutive Terms

<table>
<thead>
<tr>
<th>Key Ind. Variable</th>
<th>(1) Gain Sick Pay</th>
<th>(2) Lost Sick Pay</th>
<th>(3) Gain Sick Pay</th>
<th>(4) Lost Sick Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid Vacation</td>
<td>0.137*** (0.0294)</td>
<td>0.139*** (0.0523)</td>
<td>0.279*** (0.0398)</td>
<td>0.176*** (0.0633)</td>
</tr>
<tr>
<td>Emp. Health Care</td>
<td>0.00373 (0.0497)</td>
<td>-0.0878</td>
<td>0.00356 (0.0248)</td>
<td>-0.0155 (0.0277)</td>
</tr>
<tr>
<td>Age</td>
<td>0.00356 (0.0248)</td>
<td>0.0354</td>
<td>0.00701 (0.0241)</td>
<td>0.0277</td>
</tr>
<tr>
<td>Health Status</td>
<td>0.00701 (0.0241)</td>
<td>-0.0155</td>
<td>0.00701 (0.0241)</td>
<td>-0.0277</td>
</tr>
<tr>
<td>Constant</td>
<td>2.489*** (0.0195)</td>
<td>2.398** (0.946)</td>
<td>2.426*** (0.0278)</td>
<td>1.734* (1.032)</td>
</tr>
</tbody>
</table>

| Observations      | 876               | 665               | 700               | 515               |
| R-squared         | 0.835             | 0.852             | 0.757             | 0.803             |

*** p<0.01, ** p<0.05, * p<0.1

### Table 9: Change in Jobs Given Change in Sick Pay

<table>
<thead>
<tr>
<th>Reason</th>
<th>Lost Sick Pay</th>
<th>Gained Sick Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not change job</td>
<td>41.71%</td>
<td>22.98%</td>
</tr>
<tr>
<td>Changed job</td>
<td>58.29%</td>
<td>76.40%</td>
</tr>
</tbody>
</table>

### Table 10: Reasons for Changing Job

<table>
<thead>
<tr>
<th>Reason</th>
<th>Lost Sick Pay</th>
<th>Gained Sick Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Ended/Laid Off</td>
<td>38.95%</td>
<td>15.84%</td>
</tr>
<tr>
<td>Quit for Another Job</td>
<td>39.95%</td>
<td>67.33%</td>
</tr>
<tr>
<td>Other Reason</td>
<td>21.05%</td>
<td>16.83%</td>
</tr>
</tbody>
</table>

### Table 11: Fixed Effects: Sick Leave Job Change Losses (Consecutive)

<table>
<thead>
<tr>
<th>Dependent Var.</th>
<th>(1) Job Ended/Laid Off</th>
<th>(2)</th>
<th>(3) Quilt for other job</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sick Pay</td>
<td>0.175 (0.167)</td>
<td>0.439** (0.198)</td>
<td>0.327*** (0.0744)</td>
<td>0.416*** (0.141)</td>
</tr>
<tr>
<td>Emp. Health Care</td>
<td>-0.00155 (0.0392)</td>
<td>-0.0136 (0.0176)</td>
<td>-0.0168 (0.189)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.342 (0.254)</td>
<td>-0.136 (0.189)</td>
<td>(0.147)</td>
<td></td>
</tr>
<tr>
<td>Health Status</td>
<td>-0.227 (0.349)</td>
<td>-0.136 (0.189)</td>
<td>(0.147)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.572*** (0.118)</td>
<td>13.66 (7.926)</td>
<td>2.441*** (0.0526)</td>
<td>3.177 (5.665)</td>
</tr>
</tbody>
</table>

| Observations | 32 | 32 | 136 | 125 |
| R-squared    | 0.842 | 0.858 | 0.751 | 0.774 |

*** p<0.01, ** p<0.05, * p<0.1
<table>
<thead>
<tr>
<th>Dependent Var.</th>
<th>Log Hourly Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Job Ended/Laid Off</td>
<td>Sick Pay</td>
</tr>
<tr>
<td></td>
<td>0.227***</td>
</tr>
<tr>
<td></td>
<td>(0.0825)</td>
</tr>
<tr>
<td>Quit for other job</td>
<td>0.131</td>
</tr>
<tr>
<td></td>
<td>(0.0823)</td>
</tr>
<tr>
<td></td>
<td>0.0323</td>
</tr>
<tr>
<td></td>
<td>(0.127)</td>
</tr>
<tr>
<td>Observations</td>
<td>74</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.842</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1
References:
The Path to Being an Economics Professor: What Difference Does Graduate School Make?

Zhengye Chen
University of Chicago

Abstract What success do United States graduate economics programs have in terms of having their graduates achieve associate or full professor status in top-ranked economics departments? Of the 137 PhD economics programs in the United States, the top 15 produce a substantial share of successful economics research scholars. These top programs in turn get 59% of their faculty from just the top six schools, with 39% coming from only two schools – Harvard and MIT. Details for assistant professors, young stars today, American Economics Association Distinguished Fellows, John Bates Clark Medal recipients, Nobel Laureates, and top overseas economics departments are also discussed.¹

JEL classification codes: A10, A11.
Keywords: economics PhD market, top economics departments, economics professors.
**Introduction**

Most senior academic faculty in American graduate economics programs received their graduate education from top-ranked schools. This paper examines the extent of concentration in PhD origins of faculty members in these fifteen schools. To do this, I examine the top six schools (Tier 1) in economics and the schools between 7th and 15th place (Tier 2), as ranked by the National Research Council (NRC) in 2010. These 15 schools employ 606 faculty members in the economics department, 459 at the associate or full professor status and 147 as assistant professors.

Prior literature on ranking economics departments, including Coupé (2003) and Grijalva (2008), have focused mainly on the number of citations faculty members receive from their work. However, a few papers like Wu (2005) and Amir (2005) evaluate the quality of economics department by the success of their graduates in attaining faculty positions at top schools. Similar to Wu's paper in which he analyzed the doctoral origins of faculty at top schools in six different disciplines, I provide an extension to his study by focusing only on the top economics departments. Also, unlike other literature that attempt to rank economics departments based on graduate placement at top schools, I focus only on the success of top economics PhD programs in placing their graduates into faculty positions at top economics departments.

**Methodology**

According to the NRC rankings of economics graduate programs, the Tier 1 schools in 2010 are, in order: Harvard University, University of Chicago, Massachusetts Institute of Technology, University of California at Berkeley, Princeton University, and New York University. The Tier 2 schools, in order, are: Stanford University, Yale University, University of Maryland at College Park, University of Pennsylvania, University of Wisconsin at Madison, Northwestern University, Columbia University, Brown University, and University of Minnesota at Twin Cities. I examine these 15 schools' graduate training and the age and rank of their faculty members (see Appendix).

**Results**

The respective percentages for these categories are listed in Table 1. In general, the highest-ranked schools produced a higher concentration of faculty in the top 15, with 30% graduating from just the top two schools, MIT and Harvard. The highest concentrations of graduate school origins of economics professors employed at the top 15 economic departments, regardless of faculty age or rank, are as follows: MIT (16%), Harvard (14%), Princeton (8%), Chicago (7%), UC Berkeley (6%), NYU (2%). In total, the top six economics graduate programs accounted for 53% of PhD degrees received by all faculty members – assistant, associate and full professors – employed at the top 15 schools; 26% were produced by just Harvard and MIT. Considering that there are 137 economics PhD programs in the U.S., this figure is noteworthy.
Grouping the faculty members by age shows a slightly lower concentration of faculty from the top 15 schools under the age of 46 graduating from the top six schools (50%), as opposed to the 54% for those over 45 years old. MIT and Harvard accounted for a total of 27% (under 46) and 33% (over 45). 42% of assistant professors from the top 15 schools received their PhD degrees from the top six schools. Hence, the survival rate to promotion of graduates from the top six schools historically has been higher than the current assistant professor ratio.

If we focus only on the 267 economics faculty members employed at the six Tier 1 schools themselves, as shown in Table 2, 59% graduated with PhD degrees from the same top six economics graduate programs. At the Tier 2 schools shown in Table 3, the percentage of faculty members who graduated with PhDs from Tier 1 schools dropped to 45%. 81% of all faculty members at Tier 1 schools come from the top 15 schools, which implies that only 19% of these faculty members came from all other PhD programs around the world. 77% of faculty members at Tier 2 schools come from these same top 15 schools.

This shows how the Tier 1 schools have successfully and steadily placed its PhD graduates in top economics departments over time.
Accounting for only the faculty at the top 6 schools who were over age 45, 64% came from the same top six economics graduate programs. Harvard and MIT accounted for 42% of this segment of the market, with 23% and 19% graduates, respectively.

Let us consider those who received early promotions, an indication of exceptional research performance. In 2011, there were 24 associate and full professors under the age of 36 at the top 15 schools. Of these, thirteen, or 54%, came from three schools: Harvard University (6), University of Chicago (4), and Stanford (3).

The top overseas schools for economics, according to the Research Papers in Economics (RePEc) rankings by the University of Connecticut, are the London School of Economics and Oxford University. Applying the same methodology in analyzing the profiles of LSE and Oxford faculty, 32% of faculty members from these two schools earned PhD degrees from the six Tier 1 US schools.

Success in top programs is only one measure of achievement. I also looked at the education backgrounds of 66 of the 68 total Nobel Laureates in economics from 1969-2011 and 89 of 94 Distinguished Fellows of the American Economic Association (AEA) from 1965-2011. 44% of all Nobel Laureates internationally and 48% of AEA Distinguished Fellows graduated with a PhD from the top six economics graduate programs. Among winners of the John Bates Clark medal, awarded to the best American economists under the age of 40, 68% came from the top six schools and 50% came from Harvard and MIT. For more detailed results, see Table 4.

**Table 4: Other Data**

<table>
<thead>
<tr>
<th>Graduate School</th>
<th>I.S.E. &amp; Oxford Fac.</th>
<th>Nobel Laureates</th>
<th>AEA Dist Fellows</th>
<th>John Bates Clark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard</td>
<td>12%</td>
<td>15%</td>
<td>13%</td>
<td>21%</td>
</tr>
<tr>
<td>Chicago</td>
<td>2%</td>
<td>11%</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>MIT</td>
<td>4%</td>
<td>12%</td>
<td>9%</td>
<td>29%</td>
</tr>
<tr>
<td>UC Berkeley</td>
<td>8%</td>
<td>3%</td>
<td>8%</td>
<td>6%</td>
</tr>
<tr>
<td>Princeton</td>
<td>6%</td>
<td>3%</td>
<td>8%</td>
<td>6%</td>
</tr>
<tr>
<td>NYU</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>32%</td>
<td>44%</td>
<td>48%</td>
<td>68%</td>
</tr>
</tbody>
</table>

**Conclusion**

The primary goal of this study is to provide information for undergraduate students aspiring to become leaders in the economics research profession. These results are consistent with Wu’s earlier study that graduates of top economics schools continue to hold the majority of faculty positions at leading research universities. Moreover, I found that faculty over the age of 45 hold a higher percentage of top faculty positions than those under 46 across all faculty ranks. These survival statistics from the 15 schools should provide a solid glimpse of the narrow career path of an economics researcher, especially if one aspires to become a “prominent” economist. These results also have implications for those graduate programs that aspire to be top-tier.
NOTES

1. Motivated by my desire to understand the paths of success in the economics profession, I undertook this project with assistance from Dr. Lee Benham of Washington University in St. Louis. I thank Dr. Benham for sharing his expertise and substantial comments.

2. This is an extension of Wu’s study “Where do faculty receive their PhDs,” (2005) with analysis of faculty at top economics schools based on age, rank, and doctoral origin.

3. The original NRC ranking in 1993 categorized schools into Tier 1, with the top six schools, and Tier 2, ranked 7th through 15th. For this ranking in 2010, we used the same groupings.

4. The NRC data was collected during the 2005-2006 academic year from over 5,000 doctoral programs at 212 universities and covers 62 fields.

5. On the economics department website of each school, under the faculty listings, I found the CVs of faculty members.


7. I use the rankings found on the RePEc website found here: http://ideas.repec.org/top/top.inst.all.html

8. Two Nobel Laureates, John Hicks and James Meade, did not graduate with a PhD degree. I found the names and education backgrounds of Nobel Laureates from www.nobelprize.org/nobel_prizes/economics/laureates/

9. I could only find the PhD origins of 89 AEA Distinguished Fellows. Names of AEA Distinguished Fellows were found on the AEA website at www.aeaweb.org/honors_awards/disting_fellows.php

10. The list of John Bates Clark Medal winners and their biographies were collected came from http://en.wikipedia.org/wiki/John_Bates_Clark_Medal

11. Wu looks at the concentration of PhD graduates from the top 10 and top 20 schools, who held faculty positions across six disciplines, including economics, at the top 25 Liberal Arts Schools and Research Universities in 2004. He found that graduates from the top PhD programs held an overwhelming share of faculty members at top college and universities.

12. In this respect, it is of interest that Emory University – ranked 79 – announced in September 2012 that it is closing its graduate economics program. (http://www.ajc.com/news/news/local/emory-university-to-eliminate-programs/nSByn/)
References:
A Framework for Selecting Quality Course Providers at Competitive Prices

Paige Gonye
Adeeb Sahar
Kyle Vandenberg
Scott Ferron
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Abstract This paper develops a coherent payment mechanism for supplemental courses that incentivizes quality student outcomes and forms the basis for practical and adaptive state level policy.

In coordination with the Stanford University Public Policy Program and Digital Learning Now, an initiative of ExcelinEd
Visual Framework for Selecting Quality Course Providers at Competitive Prices

- Actions Taken by Providers
- Actions Taken by a State

START

Issues Request for Application (RFA)

Submit course applications

Conducts quality review

Invites qualified applicants to submit sealed bids

Submit bids

Reviews bids based on:

- Price per course
- Breakdown of base pay and incentive pay

Offers agreements to provider(s)

FINISH
Executive Summary

Educational systems face new opportunities and challenges in the 21st century. Technology and new models of learning allow students to receive instruction increasingly personalized to their interests, tailored to their pace and available without restrictions on geography and time. At the same time, these systems are under mounting pressure to reduce costs while maintaining or improving student outcomes. To improve educational productivity, many school districts and states are turning to online learning. However, an emerging problem confronting state policymakers and education leaders is determining what states should pay for a specific course as part of an offering of supplemental courses. Traditionally, this figure is established without any rigorous analysis or rationale. The funding mechanism often creates a market structure that compensates providers with a fee-for-service rather than pay-for-performance model. As a result, some providers are priced out of serving students and others face pressure to maximize their price to capture as much of the funding subsidy as possible. Recognizing this tension, we have created a framework using a sealed bid auction to identify quality providers at competitive prices and to reward providers that promote student success.

The framework is formed on the basis of recommendations by leaders in academia, including Professor Alvin Roth, a Stanford Professor of Economics and Nobel Laureate, leaders in the online education field, and state officials responsible for implementing course choice programs.

This paper presents the framework for selecting online providers in a visual form, breaks down the visual step by step, highlights its benefits, and acknowledges the remaining components of an online education system that a state must consider (e.g. student enrollment, logistics of provider compensation, and provider assessments). It is meant to inform state policy by introducing a framework that is adaptable across states, which may be considering different factors when implementing online education policy. There are still areas for further research, and this framework is not intended to answer all of the many questions that face the nascent online education field. It is, however, intended to offer states a coherent process that they can use to select quality online course providers and pay competitive prices for their products while encouraging student success.

Framework Explained
1. State Issues Request for Application

The framework for provider selection starts with a state issuance of a Request for Application (RFA), alerting providers of the opportunity to submit course applications for quality review. The state can decide whether to request either subject-specific or general provider applications. Subject-specific applications would allow states to specify which subjects it would allow for online course enrollment and accordingly receive applications only from providers who offer those subjects. On the other hand, general applications would allow providers to submit course offerings in any subject.

2. Providers Submit Course Applications

Next, providers interested in offering online courses would respond to the state’s RFA with a completed application. Provider applications should include information on course curriculum, initial cost proposal, as well as other basic information that allows decision-makers to form a judgment on the course quality of the applicants.

3. State Conducts Quality Review

The next step is for the state to conduct a quality review. The purpose of this screening is twofold: 1) to screen out low-quality providers and 2) to identify high-quality providers that have
the greatest potential to improve student learning.

An important focus of our process is on ensuring quality online courses. The International Association for K-12 Online Learning (iNACOL) has offered a list of quality standards by which providers and courses could be evaluated. Organizations such as Quality Matters offer detailed rubrics operationalizing several quality standards. States, such as Louisiana, are offering more substantive review processes that led to the selection of only 41 out of an initial 94 provider applicants.

In particular, we recommend that states closely emulate Louisiana’s four-step process for assessing and approving course providers. In Louisiana, the state first reviews provider applications, and might even consider allowing rejected applicants to revise and resubmit applications for reconsideration. To improve outcomes, primary application readers may consult with content experts and/or a secondary reader to help ensure that readers fully understand the specific merits of each application.

Next, qualified volunteers from the state Education Department staff members or independent subject-matter experts conduct interviews of prospective providers. Using clear and effective criteria to evaluate course providers, the state can greatly improve its understanding of providers’ course offerings and course designs during this interview process.

After provider interviews are performed, independent expert panels review applications. We recommend that the expert panels operate similar to those in Louisiana. There, appropriately-qualified, independent experts volunteer to conduct a close review of applications which have made it to that point in the quality review process. Utilizing volunteers rather than outsourcing to third-party experts reduces costs and leverages the capabilities of talented community stakeholders.

In the final step, the state gives its final approval to providers recommended by the independent panels. The quality review should be thorough enough that nearly all providers approved by the independent panels are quickly approved by the state and invited to participate in the silent bid auction.

4. State Invites Qualified Applicants to Submit Sealed Bids

When soliciting the bids from the qualified applicants, the state faces a choice. It can decide to set a price ceiling for each course it chooses to offer and communicate the price to providers, or it can wait to receive the bids and decide how much it is willing to pay based on the numbers it receives. A state that values simplifying the bid review process and ensuring savings may choose the former option, but the latter option allows for more flexibility. This will be explained in Step 6 when the state reviews the bids.

The sealed bids will take the following format. Each provider will be asked to provide a total price per course for each course it wishes to offer. The state asks each provider to submit a bid that allocates that price between two factors: 1) the requested base pay, or the amount the provider expects to be paid per student enrolled in the course regardless of performance, and 2) the requested incentive pay, or the amount the provider expects to be paid per student enrolled in the course based upon “successful” completion of the course.

5. Qualified Providers Submit Bids

In response to a state’s solicitation of bids, the qualified providers submit their bids for each course. When submitting these bids, they will be competing for state contracts based on 1) the price per course and 2) the portion of that price allocated to base pay and to incentive pay. If the state has communicated a price ceiling, providers may choose to compete more on incentive pay allocation since the range of price competition is more limited. If the state has not communicated
a price ceiling, providers’ bids may demonstrate a wider variety of total price per course bids.

6. State Reviews Bids

In this step, the state reviews the bids offered by the qualified providers. There are two criteria used: the total price per course bid and the breakdown of this price into base pay and incentive pay.

**Price per Course**

The state will examine the total price per course of each bid. If it has chosen a price ceiling before the bid process, it can eliminate any bids above this ceiling. The state may also choose to decide on how much it is willing to pay after it has received the bids, using the bid amounts as additional data points. How much a state relies on total price as a criterion will likely be determined by the amount of money a state is willing or able to allocate to these courses.

By having providers compete on total price for contracts, the state ensures that it is paying competitive prices for the courses it offers its students.

**Breakdown of Base and Incentive Pay**

The other primary criterion used by the state to evaluate bids is the portion of the price bid allocated to incentive pay. This portion of the providers’ payment is contingent on the successful administration of the course. States may use different quality metrics in determining what constitutes successful completion. We provide one example of a possible system in Appendix A. While states may differ in how they evaluate the quality of a course, the incentive payment allocation will ensure that some of the providers’ payment is tied to whether or not they meet selected quality metrics.

The following graph demonstrates how a state might evaluate 6 similar bids using the incentive pay allocation. In this example a state communicated a price ceiling of $500 and received 6 bids at that level and wants to choose 2 providers to offer contracts. For simplicity, each total price per course bid was $500, although in practice the price per course may vary. Each provider also submits a proposed base pay and proposed incentive pay, totaling $500 per student. If the state is selecting the top two bids, it would choose providers 6 and 2, who bid incentive allocations of 70% and 60% respectively.

By selecting the providers that have the largest amount of their potential revenue tied to their performance, the state encourages providers to accurately assess their own ability to provide quality courses. By having providers to compete for contracts, the state encourages
.providers to actually bid at the levels that correspond to their ability to provide these courses.

*Using Both Criteria*

Combining these criteria gives a great degree of adaptability for each state. A state may want to focus more on cost reductions and weight its evaluation more heavily on total price. That kind of state might choose to offer contracts to providers that bid lower prices per course but are less concerned with high allocation to incentive pay. Alternatively, a state might choose to weight its evaluation more heavily on incentive payment allocation, signaling that it is willing to pay higher prices as long as they guarantee quality courses. A final option is that a state might choose to diversify its portfolio, selecting a mix of providers who offer bids with lower prices and lower incentive allocations and providers who offered bids with higher prices but more of the payment tied to quality.

*Re-Bidding*

States may want to allow the option for renegotiations to occur if they believe the initial set of bids does not represent what it believes to be a fair value for the course. If, for example, a state had decided an algebra course was worth around $600 but only received bids greater than $1000, it might choose to communicate that price ceiling to providers and ask them to submit new bids.

7. State Offers Agreements to Provider(s)

Once a state has reviewed the bids and evaluated them based on the aforementioned selection criteria, it will decide which providers to choose and offer them agreements. While the selected providers have won an opportunity to teach a course in the state, however, the competition is not over. They have already competed on price to be selected as a provider; they will now compete on perceived quality to maximize their enrollment. This could involve factors such as differentiated curricula, instructional styles, amounts of feedback, or other academic variables.

To ensure that providers continue to compete solely on course quality, states should hold them accountable to a code of conduct that makes clear a firm policy of no improper gratuities or inducements from providers to students.

*Framework Benefits*

*Equity of Access.*

Increasing the availability of courses that have been vetted and held accountable will increase access to high-quality courses, for example for students at a school that does not offer an AP course or the honors version of a core subject.

*Targeted Approach.*

We expect that, in order to maximize their incentive pay, course providers will engage students and incorporate formative assessments to determine whether students are on track to perform well in the course.

*Quality Incentives.*

The model alters online education from fee-for-service to pay-for-performance, encouraging course providers to cater to the students in most need and greatly accelerate their learning because increased growth brings increased profits.

*Educational Accountability.*

Rewarding for performance at the level of each individual student avoids the problem in which schools that reach a certain threshold of proficiency holistically among their student body no longer have to worry about any students who
remain below proficient (as far as legal mandates go). Evaluating course providers on how each individual student is served rather than on how the cohort as a whole performs sidesteps this problem.

Cost Savings
The bidding and incentive payment create cost savings, which could be passed on to districts, invested in technology upgrades, or put towards another beneficial education initiative.

Adaptability
States can adopt the model, and then make their own value judgments at different steps in implementation (e.g. setting course prices) to fit its own policy and political needs.

Districts Benefit
Districts can use online courses to fill instructional gaps in hard-to-staff subjects (e.g. language, AP, STEM, career and technical). Schools could also bring their workforces into the modern, digital world through supporting teachers who team together to put together their own homegrown online offerings and become competitive providers themselves.

Looking Ahead
While this framework represents a significant step forward in advancing online courses with a focus on student success, there remain topics for consideration. Each state will need to determine how to enroll students across online courses, how to assess a provider’s impact on student learning, and how to allocate the incentive pay to providers based on their bids. We offer an in-depth example of such an assessment and incentive payment allocation system in Appendix A.

The incentive pay aspect holds course providers accountable for promoting student success in order to profit. However, the delay in such a large part of the providers’ payment could pose a barrier to entry for new, innovative providers who lack the capital reserves of larger, already-established players. In addition, it often takes a matter of months to collect and analyze academic data, and this lag in assessment may result in the state having to decide whether or not to renew the agreements of providers for Year 2 before they have full knowledge of the results of Year 1. These issues are similar to those faced by current state-level online course choice programs, such as those in Utah and Louisiana. Incorporating contemporary measures, for example student engagement levels, could be one way to balance the need to assess student success with practical timing needs. These problems do not have easy or immediate answers, but the framework outlined in this paper offers a solid foundation for policymakers to address them. It is adaptable while allowing for dynamic growth, and it offers coherence that current online education payment mechanisms lack.

Acknowledgements

Team Description
Scott Ferron, Paige Gonye, Adeeb Sahar, and Kyle Vandenberg are seniors at Stanford University majoring in Public Policy. The paper originated during their Senior Practicum in September 2013 and has undergone numerous iterations since then. Now, the seniors are pursuing public policy work in the online education field as an independent study under the guidance of Professor Keith Hennessey and leaders at Digital Learning Now, an initiative of ExcelinEd.

List of Advisors
Professor Alvin Roth (Stanford Economics, Nobel Laureate)
Professor John Shoven (Stanford Economics)
Professor Mark Tendall (Stanford Economics)
Professor Andrzej Skrzypacz (Stanford Economics)
John Bailey (Digital Learning Now)
Nathan Martin (Digital Learning Now)
Appendix A: An Example of Possible Pay Allocation System

The implementation of a base pay and incentive pay system requires the state to have a mechanism for determining how much of the incentive pay to award to each course provider. A state could go about this is by 1) selecting a number of performance measures of student success, 2) assessing how well students perform on those measures compared to an external standard and compared to students in other providers’ courses, and 3) determining how much to weight each measure when calculating incentive pay to award to each provider per student in each course.

Selecting Performance Measures
There are a number of possible measures of student success, and states should use a variety in order to capture different aspects of the learning experience. The four measures highlighted below offer one such possible combination.

Completion. Rewarding course completion can encourage providers to avoid a growing pain of the online education industry: too few students finishing courses.

Proficiency. Including a proficiency measure supports states’ goals of helping students meet or surpass a certain bar of achievement.

Growth. Incorporating growth recognizes that bringing a student who is three years behind grade level up to one year behind grade level is at least as laudable as boosting an already near-proficient student just above the proficiency bar. A growth measure can also motivate providers to target students who will benefit the most from their course(s).

Student Surveys. Student satisfaction is the most important factor in whether a student chooses to take and benefit from other online courses. A significant and growing body of research, including a recent study from the MET Project, supports the validity of student surveys as accurate assessments of a instructional effectiveness.

Assessing Student Performance
Policymakers would weight their selected performance measures based on value judgments of the relative importance of these measures, allocating from a total of 100 percentage points. Then, policymakers would determine how much to weight performance compared to an external standard (“year-on-year improvement”) and performance compared to other providers (“competitive comparison”), again allocating from a total of 100 percentage points.

Determining Calculation of Incentive Pay
Once a state determines how much to weight each measure and collects the necessary data on student performance, it will calculate how much in incentive pay to award each provider for each student in each course. The following is an example calculation:

- For a particular course the state determined a maximum $150 payment per student
- This provider’s winning bid split it $50 base pay, $100 possible incentive pay per student
- The state weights 75% year-on-year self-improvement, 25% competitive comparison
- The state weights 10% proficiency, 10% completion, 40% growth, 40% surveys

1 Note: Like education, health care is a sector that integrates public and private players, and prioritizes both quality and cost. The features of the healthcare market correspond closely with those of the online education market: quality improvements correspond to better cost-structures, market entry is marked by high levels of initial investment, and provider performance is a function of quality and cost. The following pay-for-performance example is based on two Medicare programs: the Hospital Readmissions Reduction Program, which ties funding to hospitals’ performance on patient readmission rates, and the Hospital Value-Based Purchasing Program, which fund hospitals based on their performance relative to that of other hospitals as well as relative to their own prior performance.
In this example, a particular student in this course:
• Completed and passed the course
• Had a moderate growth rate relative to last year
• Gave the course a high rating in a post-course survey

And that on average students in this course:
• Passed at a lower rate compared to students in competitors’ courses
• Achieved a moderate growth rate compared to students in competitors’ courses
• Completed the course at high rates compared to students in competitors’ courses
• Rated the course comparably in surveys compared to students in competitors’ courses

Thus, the incentive pay for this student in this course offered by this provider would be calculated as such in the table below, keeping in mind that each of the eight separate dollar amounts is arrived at by multiplying the weight of the measure, the weight of the year-on-year or competitive improvement, and how the student performed on that measure:

![Incentive Pay Table]

(total: $72.50 out of max per-student incentive pay of $100)
References:
Finance

In this section:

The Provision of Microfinance in the Nilgiris District

Aishwarya Ramesh
Abstract In this essay, I responded to the research question “What Impacts has the Provision of Microfinance had on Thirteen Self Help Groups in the Nilgiris District of Tamil Nadu?” I evaluated the individual and household impacts of microfinance for these 13 self-help groups in the towns of Kotagiri, Ooty and Coonoor, in order to analyse and assess the benefits of microfinance. The scope of this investigation was to determine the extent to which microfinance helped individuals by using data pertaining to their income levels, type of education and healthcare that they have access to, and belongings and valuables they own that reflect their standard of living. I did this by using the data to derive calculations in relation to the amount of monthly income they earn, the loan that they owe, and the proportion of income needed to repay the loan. I investigated the financial stability of each of the groups, and evaluated the benefits gained from microfinance. My primary data included interviews with the self-help groups in the Nilgiris and the REPCO foundation in Chennai. My secondary data consisted of economic statistics, which I obtained from the Office of the Assistant Director of Statistics in Ooty, and research papers from the Internet.
Introduction

My research question is “What Impacts has the Provision of Microfinance had on Thirteen Self Help Groups in the Nilgiris District of Tamil Nadu?” and it addresses the socio-economic impact of microfinance in the Nilgiris district. The Nilgiris district, known for its flourishing tea estates, has a population of around 735071 people, 360170 males and 374901 females. The Nilgiris district comprises of four main towns, which are Gudalur, Coonoor, Ooty (also known as Udhagamandalam) and Kotagiri. My essay will focus solely on the aid given by the Repco Foundation for Micro Credit to self-help groups in Ooty, Coonoor, and Kotagiri. I will assess the impacts the foundation has had on the citizens of the Nilgiris.

The Repco Foundation for Micro Credit, a subsidiary of the REPCO government bank, is a non-profit organization that is “committed to the development of self-help groups (SHG’s)” and provides micro finance to poor men and women in urban and rural areas in order to alleviate poverty and empower them. A self-help group is a group formed by 12–20 people in order to set up a joint or individual business. The money that they receive is divided equally between the members of the group. The interest rates that the RFMC charges are 17% for loans up to two lakhs ($4508 SGD) and 18% for loans that exceed two lakhs. RFMC’s head office is based in Chennai, and has 40 branches that provide credit to 23 different districts, of which it has loaned the most to the district of Nilgiris. RFMC has lent a total of 7150.12 lakh rupees ($16,119,450.65 SGD) to 2340 self-help groups in the Nilgiris alone and its total disbursement to the 23 districts adds up to 25507.01 lakh rupees ($575,037,885.94 SGD) for 18158 SHG’s.

I will answer the research question by assessing and evaluating the benefits of micro financing to 13 recipient groups of women. I will also consider the effect of microfinance on the individuals and their households.

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1Office of the Assistant Director of Statistics, Ooty, Nilgiris
finance after observing the ubiquitous poverty that was present throughout my home country India, particularly in rural areas. The idea of micro finance intrigued me, and working with REPCO bank gave me the opportunity to understand the power of micro finance and look into how it affects the individuals I interviewed in the Nilgiris. Microfinance is an important economic tool, since it can impact the development of a country by raising standards of living, improve literacy rates, and give more people access to merit goods such as education and healthcare.

Methods of Data Collection

In order to gauge how effective microfinance is to the recipients surveyed in the Nilgiris, I will need to assess what impact it has had on individual households who have received micro loans. I will summarize the positives and negatives of microfinance and the success of RFMC so far.

The majority of the loans that RFMC gives are to female groups. For the purpose of this essay I will be focusing on the female subset of the groups that receive microfinance. Narrowing my focus will allow me to investigate the significant impacts that microfinance has on females as individuals.

My research consists of mainly primary data and some secondary data that I will analyse in order to respond to the research question. I have interviewed the project managers at RFMC Chennai and Kotagiri, as well as 13 self-help groups based in the Nilgiris to address the issue of the advantages and disadvantages of microfinance. My secondary data will comprise of research from the Internet, books and economic data that I have collected from the Office of the Assistant Director of Statistics in Ooty to determine the impact of microfinance on factors that effect economic growth.

Theory

Microfinance, an important concept in business and economics, is a financial service that is provided to people who live in rural areas and cannot access banking facilities in order to start businesses to raise their income and standards of living.

Microfinance is given to individual entrepreneurs or is lent to small businesses where a few entrepreneurs form a self-help group (SHG) and start up a joint or separate venture. The entrepreneurs use the money they receive to start up a business and they are trained in requisite skills in order to run the business. Once the business starts to prosper, they are able to buy assets such as jewellery (an important store of value in India) and are able to give their children good healthcare and education. Figure 2 shows how microfinance works and the cyclical nature of microfinance.

Figure 2: Microfinance Cycle
Microfinance is essentially a small loan given to poor people, and the loans are generally between $100-$500 per person, since they may have difficulty in repaying bigger loans along with interest.

**Analysis of the Benefits and Costs of Microfinance to the Target Groups**

In order to assess the extent to which microfinance aids the poor, I conducted interviews with 13 different self-help groups, all of which are engaged in a diverse range of businesses. Table 1 summarizes the research collected from the interviews and gives insight into the businesses run by the groups and the size of their current loan.

**Table 1**

<table>
<thead>
<tr>
<th>Group Name - Number of People</th>
<th>Enterprises</th>
<th>Current Loan (SGD)</th>
<th>Monthly Income Per Group (SGD)</th>
<th>Monthly Income Per Member (SGD)</th>
<th>Group Income in 25 Months (SGD)</th>
<th>Amount Each Group has to Pay Back (SGD)</th>
<th>% of Income Needed to Repay Loan within 25 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roja women - 13 people</td>
<td>Tea Cultivation</td>
<td>4th Loan - $11237</td>
<td>$2041</td>
<td>$157</td>
<td>$51025</td>
<td>$13260</td>
<td>26.0%</td>
</tr>
<tr>
<td>Thalirgal - 12 people</td>
<td>Vessels (aluminium) Shop</td>
<td>2nd Loan - $11237</td>
<td>$369</td>
<td>$33</td>
<td>$9900</td>
<td>$13260</td>
<td>133.9%</td>
</tr>
<tr>
<td>Sunflower - 12 people</td>
<td>Tea Shop, Tea Cultivation, Tailoring, Provision Store</td>
<td>3rd Loan - $11237</td>
<td>$672</td>
<td>$56</td>
<td>$16800</td>
<td>$13200</td>
<td>78.9%</td>
</tr>
<tr>
<td>Diamond - 12 people</td>
<td>Canteen, Candles, Tea Shop, Tailoring</td>
<td>3rd Loan - $11237</td>
<td>$1080</td>
<td>$90</td>
<td>$27000</td>
<td>$13260</td>
<td>49.1%</td>
</tr>
<tr>
<td>Mount Rose - 12 people</td>
<td>Paper Bag Production</td>
<td>3rd Loan - $10788</td>
<td>$540</td>
<td>$45</td>
<td>$13500</td>
<td>$12730</td>
<td>91.6%</td>
</tr>
<tr>
<td>Joy - 13 people</td>
<td>Chocolates, Tailoring, Pickles, Canteen, Detergents</td>
<td>2nd Loan - $7866</td>
<td>$1755</td>
<td>$135</td>
<td>$43875</td>
<td>$9282</td>
<td>21.1%</td>
</tr>
</tbody>
</table>

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6Appendix 1. Question 10 Interview with Mr Srinivasan  
7Appendix 2. Interview with Self Help Groups
<table>
<thead>
<tr>
<th>Group Name - Number of People</th>
<th>Enterprises</th>
<th>Current Loan (SGD)</th>
<th>Monthly Income Per Group (SGD)</th>
<th>Monthly Income Per Member (SGD)</th>
<th>Group Income in 25 Months (SGD)</th>
<th>Amount Each Group has to Pay Back (SGD)</th>
<th>% of Income Needed to Repay Loan within 25 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rose Wing - 12 people</td>
<td>Incense Sticks, Dairy Farm, Handicrafts, Chocolates, Canteen</td>
<td>2nd Loan - $11237</td>
<td>$1620</td>
<td>$135</td>
<td>$40500</td>
<td>$13260</td>
<td>32.7%</td>
</tr>
<tr>
<td>Varashakti - 14 people</td>
<td>Herbal Oils, Handicrafts</td>
<td>2nd Loan - $8090</td>
<td>$2198</td>
<td>$157</td>
<td>$54950</td>
<td>$9546</td>
<td>17.4%</td>
</tr>
<tr>
<td>Muthamil Women - 12 people</td>
<td>Pickles, Toys, Handicrafts</td>
<td>4th Loan - $15732</td>
<td>$1344</td>
<td>$112</td>
<td>$33600</td>
<td>$18564</td>
<td>55.3%</td>
</tr>
<tr>
<td>Thiruvan-namalai - 12 people</td>
<td>Handicrafts</td>
<td>2nd Loan - $6742</td>
<td>$804</td>
<td>$67</td>
<td>$20100</td>
<td>$7956</td>
<td>39.6%</td>
</tr>
<tr>
<td>Pearl - 14 people</td>
<td>Nursery, Canteen</td>
<td>4th Loan - $15732</td>
<td>$1260</td>
<td>$90</td>
<td>$31500</td>
<td>$18564</td>
<td>58.9%</td>
</tr>
<tr>
<td>Silver Moon - 4 people (8 people defaulted)</td>
<td>Beauty Par-lour</td>
<td>2nd Loan - $1685</td>
<td>$1080</td>
<td>$270</td>
<td>$27000</td>
<td>$1971</td>
<td>7.3%</td>
</tr>
<tr>
<td>Mangalam - 14 people</td>
<td>Provisions Store</td>
<td>4th Loan - $15732</td>
<td>$1260</td>
<td>$90</td>
<td>$31500</td>
<td>$18564</td>
<td>58.9%</td>
</tr>
</tbody>
</table>

In Table 1, I have calculated how much each group has to pay at the end of 25 months and the proportion of income needed in order to do so. The interest rate is 17% for loans under $4597 and 18% for loans above $4597. I have assumed that the interest rate is not annual, and is 17% - 18% for the whole period of 25 – 60 months. The rate of conversion that I have used to convert from Indian Rupees to Singapore Dollars is 43.5 INR: 1 SGD. To calculate the loan they need to repay and the proportion of income that is needed in order to repay the loan within 25 months, I found the total income earned in 25 months, calculated the amount of interest they have to pay on each loan and added it to the loan. I then divided the total loan amount by the total income and multiplied it by 100 in order to get the percentage of income needed to repay the loan.

*Appendix 1. Question 10 interview with Mr. Srinivasan*

\[e.g. \text{Roja Women}\
\]
\[\text{Income for 25 months} = 51025\]
\[\text{Current Loan Amount} = 11237\]
\[\text{Interest on Loan} = 18\%\]

\[0.18 \times 51025 = 2023\]
\[\text{Total Loan to be Repaid} = 13260\]

\[\text{Proportion of Income used for Loan} = \frac{13260}{51025} \times 100 = 26.0\%\]
Although microfinance is useful as an alternative source of cheap credit, people may sometimes find it difficult to repay their loans fully or on time. I will further explain this in the next section. Below is a Likert Scale that shows the views of the thirteen self-help group members on their repayment ability.

From the calculations that I derived in Table 1, we can see that some of the groups’ opinions on their loan repayment ability do not correspond with the data. The groups highlighted in red in Table 1 think that their repayment ability is excellent or very good but are required to pay above 50% of their income to repay their loans. 50% is a significant proportion, and these groups earn relatively less than most of the other groups, the highest group income over 25 months being $33600.

The group highlighted in blue, has to pay 133.9% of their income and this concurs with their opinion on their loan repayment ability. This is because the group income earned in 25 months is only $9900, and this could be due to a lack of demand for their products. We can see that their choice of product is not profitable since none of the other groups engage in selling vessels, and have higher incomes. All of Thalirgal's income is taken up in repaying loans, which means they are in debt. This highlights one of the cons of microfinance and emphasizes the fact that microfinance does not guarantee the success of any business. After the groups receive training and microfinance, it is up to them to choose a profitable good to sell.

Alternatively, the groups highlighted in purple pay less than 50% of their income to repay the loans. This is because these groups have a higher income compared to the others, enabling them to repay loans relatively easily. The range of incomes over 25 months is from $20100-$54950, which is

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Table 2. How easily are you able to repay the loan with interest?\(^9\)

<table>
<thead>
<tr>
<th>SHG</th>
<th>Excellent</th>
<th>Very Well</th>
<th>Satisfactory</th>
<th>Not Well</th>
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\(^9\)Appendix 2. Question 4 Interview with Self Help Groups
the highest income out of all the group incomes. The group scheme that RFMC follows, teaches prospective loan receivers the importance of saving money and repaying loans on time. Clients only receive loans after they have saved money for 6 months and demonstrated the ability to repay loans. This accounts for REPCO’s high repayment rate of 97%-98%\textsuperscript{10}. The Likert scale below shows how successful each group thinks their business is.

Table 3. How is the business doing and how well do you think you manage it?\textsuperscript{11}

<table>
<thead>
<tr>
<th>SHG</th>
<th>Excellent</th>
<th>Very Well</th>
<th>Satisfactory</th>
<th>Not Well</th>
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From the data in tables above, we can see that in most cases there is a direct correlation between the success of the business and the ability to repay the loans.

Thalirgal and Silver Moon are both unsuccessful in their businesses since they are not able to repay the loans on time. Silver Moon, highlighted in green in Table 1 cannot repay their loans on time is because 8 out of 12 people have defaulted from the group, and the business they are engaged in requires them to pay employees. This means that the burden of repaying the loans has fallen on four people, and the income generated from their businesses is not sufficient to repay the loans, provide their family with basic necessities and pay wages. There is no way to ensure that group members will always co-operate with each other and contribute towards repaying loans, which is one of the flaws of the self-help group model. Since there is no rule that prevents people from leaving a group, if a group member’s/ members’ business fails to make profits they can default from the group. This poses a problem for the remaining members since they now need to

\textsuperscript{10}Appendix 1. Question 10 Interview with Mr. Srinivasan
\textsuperscript{11}Appendix 2. Question 5 Interview with Self Help Groups
find a way to make extra income in order to repay the loan taken by all the group members in addition to supporting their family. Even though this problem happens rarely in RFMC, it is one of the social costs of microfinance.

Another problem with microfinance is that everyone who receives funding does not have the ability to run a successful business. Although RFMC equips the self-help groups with training and the skills required to produce goods such as chocolate, candles and various others, microfinance does not always prove to be beneficial. “Microfinance is not for everyone. Entrepreneurial skills and ability are necessary to run a successful microenterprise and not all potential customers are equally able to take on debt” This is evident in the case of group 2, Thalirgal. We observe that a lack of expertise of running business, poor managerial skills along with low demand for the goods produced has caused them difficulty in repaying loans. In addition to this, even though the microfinance given by RFMC is handed out only after checking the clients’ business plans and saving patterns, it does not guarantee that the self-help groups will use the money responsibly after receiving it.

Lennart Båge stated, “The microfinance revolution started with the recognition that poor people needed access to loans and that they could use these funds productively. It has also changed the perception that poor people are not credit worthy.” This is observed in the data in the tables above. It shows that most of groups are able to pay back their loans on time, and this is because of their responsible use of the loan given to them. In addition, some businesses that are successful are able to pay back loans easily due to synergy between team members, the ability to identify which goods sell, and efficient production of the goods. This reinforces that they are creditworthy and are capable of returning loans.

The social impacts of microfinance can be quantified using information such as whether the clients have access to basic necessities. The Grameen Bank has a set of indicators which determine the whether their clients are being benefited by microfinance. Some of these include “having a house with a tin roof, beds for all members of the family, access to safe drinking water, and all school-age children attending school”.

To assess some of the impacts that microfinance from RFMC has had on individual households, I included some key questions in the interview in relation to how their socioeconomic status had risen after taking loans.

In order to measure the change in their standard of living, I asked them what assets they bought with the profits obtained from the businesses and the type of healthcare and education they have access to. This information is necessary to understand what each group can spend their income on, and differences in their expenditure before and after receiving microfinance.

13 Appendix 1. Interview with Mr. Srinivasan
14 The President of International Fund for Agricultural Development (till 2009)
Graph 1. Have you bought any assets for yourself such as televisions, jewelry, vehicles, etc.?\textsuperscript{17}

Graph 1 shows us that the assets the most groups purchased with the income earned with the aid of microfinance were expensive goods such as houses, televisions and jewellery. This shows that the impact of microfinance has been positive for most of the households as they can now afford to buy what they regard as ‘luxury goods’. In most families, there was only one breadwinner before they received aid. Due to this, they could not buy any goods other than basic necessities such as rudimentary housing, food and clothing. The revenue generated from the loan provided to them has acted as a source of extra income, enabling them to buy important assets that help raise their standard of living such as jewellery, better housing and land. The fact that they are able to buy expensive assets suggests that they also spend a higher proportion of their income on basic necessities and are able to buy better quality clothes and more food. By taking frequent loans, self-help groups are able to learn how to handle their money better and are able to diversify their businesses, thus increasing their income and assets. This was observed in a study conducted in Vietnam where “participants state that they are now short of rice for less than one month per year compared to three previously; participants have also diversified their productive activities and have acquired more assets than non-borrowers”\textsuperscript{18}. In addition to this the study also stated “Improvements in school attendance or in provision of educational materials are also widely reported. Invariably this related to increased household income.”\textsuperscript{19} This relates to the next part of my investigation where I will analyze the impact of microfinance on the education of the self-help groups’ children.

\textsuperscript{17}Appendix 2. Question 8 Interview with Self Help Groups
There are four categories of households – Schedule Cast, Schedule Tribes, Other Backward Castes and Other Households. Most of the self-help groups belong to Other Households and according to economic statistics are better off than the other three categories of households. Economic statistics show that 16.1% of Other Households in Kotagiri, 7.41% of Other Households in Coonoor and 1.91% of Other Households in Ooty have a monthly income of $11 (499 rupees) or less\(^{20}\). This indicates that 80% and above of Other Households in each of the three towns are earning more than $11 and it supports the data in Table 1 and Graph 1. Microfinance gives every individual the opportunity to set up a business to try and earn extra income. The data shown in Table 1 and Graph 1 indicates that most groups are able to purchase expensive assets and have incomes of $33 (1500 rupees) and above, which is evidence that microfinance is beneficial and plays a crucial role in any household.

Although microfinance has some benefits, the opposite is also true. Graph 1 also shows that two of the groups that bought no assets at all. This could be due to the fact that they only had enough to repay the loans and buy basic necessities, and hence could not spend money on other valuables. Furthermore, author Nick Hamilton noted, “Microfinance is supposed to promote business growth. It would be far more beneficial to all if MFIs assessed their potential borrowers and only lent to those individuals who showed enough promise to mount and grow a business to a size where they could employ other members of their community.”\(^{21}\) Another reason could be that the income generated from microfinance is too little to expand their business. Since the loan amounts are quite small, the profits generated will also be relatively small. This limits the scope for expanding the business and increasing productivity since a business needs employees in order to grow and progress. Employees are needed for businesses such as provision stores and canteens since they will increase the amount of income earned in a day and increase levels of productivity. For example, limiting the number of people working in canteens increases the waiting time for the customers, causing them to go to another eatery, resulting in a loss of potential income.

\textbf{Charts 1 & 2.} Do your children go to school? If so, what type of school did they go to before you received microfinance, and what type of school do they go to now (private or government schools)?\(^{22}\)

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\(^{22}\)Appendix 2. Question 10 Interview with Self Help Groups
Charts 1 and 2 illustrate the change in the number of groups that can afford to send their children to private schools. The ratio of groups that send their children to private schools to groups that send their children to government schools using the income generated from their businesses is 5:1 in contrast to the previous ratio of 1:2. The members Silver Moon do not have school-going children; hence they do not need to spend on education. The fact that they are still not able to repay the loan even after forgoing expenditure on education, reiterates that the income they earn is not sufficient to support their family and raise their living standards. In the Nilgiris District, education seems to be very important to families since one of their main priorities is to earn enough money to enrol their children in private English medium schools. In the long run this is very beneficial since a good education will increase literacy levels and their children will have better chances of securing jobs.

Besides having an impact on children’s education, microfinance also influences the literacy rates of its clients. A specific question that I included in my interview was “Has your literacy improved in any way? If so, what is the cause of this improvement?” and the answer was unanimous. They all said that their literacy had improved tenfold after receiving the loan. The loan compelled them to learn banking skills and how to write in English. This answer can be validated using economic data pertaining to the literacy rate in the Nilgiris. In 2001 the literacy rate was 80.0% and in 2011 it increased by 5.65%. Since my essay focuses on the female self-help groups I also found the literacy rate for the females alone. The female literacy rate in the Nilgiris is the fifth highest in the whole of Tamil Nadu, exceeding the female literacy rate in Tamil Nadu by 5.58%. The female literacy rate had increased from 71.6% in 2001 to 79.44% in 2011. Part of this increment in female literacy rate can be attributed to microfinance since most of the females that are poverty-stricken in the Nilgiris are either housewives or have started their own businesses with the aid of microfinance. Developing their literacy was a necessary skill in order for them to be familiar with the procedures involved in applying and receiving loans.

The next aspect I investigated to determine the social impact of microfinance was healthcare. Charts 3 and 4 show the percentage of self-help groups that go to government and private hospitals.

Charts 3 & 4. Do you feel you have more access to health care than before? What type of hospital did you go to before receiving microfinance and what type of hospital do you go to now (government or private)?

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23 Office of the Assistant Director of Statistics in Ooty
24 Appendix 2. Question 11 Interview with Self Help Groups
The information in the charts indicates that there has been a decrease in the number of groups that go to government hospitals. Microfinance provided them access to better medical care, which is useful not only to them, but also to the people around them since they have a lesser risk of getting sick. Private hospitals are considerably more expensive than government hospitals due to the better quality of healthcare available. The increase in the percentage of groups who go to private hospitals shows that they now spend a higher proportion of their income on healthcare.

One thing that I noticed when interviewing all the women’s self-help groups was that all of them were very confident. I realized that microfinance not only helped elevate living standards, but also helped empower them.

I asked them whether they had learnt any life skills from this process, and the answer that I got from everyone was that they were now independent and they had learnt banking skills. Additionally, they also stated that they did not depend on their husband’s income anymore and could contribute income to their household and pay for healthcare and education.

**Conclusion**

In response to my research question “What Impacts has the Provision of Microfinance had on Thirteen Self Help Groups in the Nilgiris District of Tamil Nadu?” I have realized that microfinance has had a positive impact on the members of most of the groups surveyed.

Microfinance has more benefits than costs, and if used correctly, can provide optimal results that will be useful in aiding families with education and healthcare, expanding their businesses and living standards. Furthermore, it has also empowered the women, and made them independent and helped them contribute income towards household expenditure. Despite microfinance having many benefits, it does not guarantee that any business set up by a client will be successful. Another pitfall of microfinance is that it can create debt for some, like the second group Thalirgal, who have to pay back an amount that is 33% more than their income. Sometimes groups might borrow more loans in order to pay back microfinance loans, leading to even more debt. This was mentioned in a study conducted by MIT “microfinance is displacing more effective anti-poverty measures or even contributing to overborrowing and therefore even greater long term poverty. Indian households are being “carpet-bombed” by loans, leading to extreme overindebtedness.”

This study of microfinance does leave us with some unresolved questions, one of which is the degree of sustainability of microfinance and the self-help groups themselves. There is also the issue of whether, as the value of the Indian rupee continues to depreciate, the interest rates charged by RFMC will increase and reach the same levels as those charged by loan sharks. Furthermore, we start to question whether the income gained through microfinance will be enough to cope with economic downturns and inflation.

**Evaluation**

Some things that I could have investigated were the levels of expenditure on healthcare and education of the self-help groups compared to people who don’t use microfinance and the range of expenditure on healthcare and education within the self-help groups themselves to determine the cause of the disparity. Also, I was limited to a representative sample size of 13 groups since it was all I could gather with the time I had.

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**References/Research Papers:**


**Economic Data:**

Office of the Assistant Director of Statistics, Ooty, Nilgiris

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**Appendix I - Interview with RFMC Chennai Representative Mr Srinivasan**

**1. What is the geographical coverage for REPCO?**

Up to 20km range within the villages. We help more rural places than urban places.

**2. What are the advantages and disadvantages of micro financing?**

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<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Credit Portfolios increase</td>
<td>Fraudulent Activities</td>
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<tr>
<td>Multi finance</td>
<td>MFI's exploit people by charging higher interest rates</td>
</tr>
<tr>
<td>Financial help at low rates of interest</td>
<td>Multi lending reduces repayment power of people</td>
</tr>
</tbody>
</table>

**3. Where have you lent the most loans?**

Gudalur and Kotagiri

**4. Do you have any government support?**

Tamil Nadu Women Government Corporation. The Government provides subsidies to groups.

**5. How flexible are your rules compared to MFI's & Banks?**

They are much more flexible compared to normal MFI's and banks.

**6. How much do you lend, who do you lend it to, and what for?**

We lend a maximum of 7.5 lacs ($16856) and minimum of 60000 rupees ($1337). Vegetable shops, agricultural purposes, catering, beautician centres, jewellery shops, textiles, rice business, provisional stores, fruit shops and various other activities. SHG’s have to open savings bank account and save x amount each month. For 6 months they have to have meetings and prove each of them have saved and put it in their savings account before qualifying for loans.
7. How do you recover your administrative costs?
From documentation charges, audit fees and 2% of disbursement loan

8. How do you decide to whom you lend to?
We analyse what the main needs of the SHG’s are by looking at their financial situations, taking account of the credit plans of each person in the group and ascertaining what they will use the money for.

9. How do you decide how much you lend to them?
We decide based on the project that they decide to pursue.

10. What is the interest and repayment rate like?
Repayment period - 25 months - 60 months. 97% - 98% payback
Interest Rate – 17% for up to 2 lacs ($4597) & 18% for above 2 lacs

11. How successful do you think the business is?
It is a big success but we are facing difficulties due to individual moneylenders. Moneylenders don’t need group schemes – 10000 rupees for each member,
We have a very low interest rate compared to others
Some MFI’s charge 24% – 26% interest rates

12. How are you different from Banks/MFI’s?
Our approach is development oriented rather than target (bank) or profit (MFI) oriented. The rules are more flexible than the rules of MFI’s & Banks. We try to educate people about repayment at the time of loan disbursement and people mostly repay the money on time with interest.
Our transaction costs are low for customers and financiers whereas for banks and MFI’s transaction costs are high for the customers.

13. How do you reach people in the remote areas?
We have mobile branches for collecting loans, savings bank acceptance & withdrawals in places that don’t have access to banks – 90% of collections. Disbursements are done in the Coonoor Branch (REPCO BANK branch)

Appendix II - Sample Interview for the Self Help Groups

1. What was the loan amount that you received?

2. What businesses do you use the money for?

3. To what extent has the loan you have received helped you? (Benefits and Losses)

4. How easily are you able to repay the loans with interest?

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<th>SHG</th>
<th>Excellent</th>
<th>Very Well</th>
<th>Satisfactory</th>
<th>Not Well</th>
<th>Poor</th>
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</table>

5. How is the business doing and how well do you think you manage it?

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<th>Product</th>
<th>Excellent</th>
<th>Very Good</th>
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6. Has life improved/worsened after receiving the loans?

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<th>Group</th>
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7. How much income do you earn per month?
8. Have you bought any assets for yourself such as televisions, jewelry, vehicles, etc.?
9. Do you think the process has taught you any life skills? If so, what?
10. Do your children go to school? If so, what type of school did they go to before you received microfinance, and what type of school do they go to now (private or government schools)?
11. Do you feel you have more access to health care than before? What type of hospital did you go to before receiving microfinance and what type of hospital do you go to now (government or private)?
12. Has your literacy improved in any way? If so, what is the cause of this improvement?
Macroeconomics

In this section:

Macroeconomic Forces within the Market for Prostitution
Cody Cook, Scott Loring, Teddy Niemiec, Kayla Reinherz
Abstract This paper explores the impact of macroeconomic forces on the market for prostitution. Specifically, we use cross-sectional unemployment rate, labor force participation rate, average household income, and the S&P 500 as macroeconomic indicators to investigate the effects of the 2008-2010 recession on the market for prostitution in Chicago. We use the number of prostitution-related arrests from 2005 to 2011 in Chicago as a proxy for the equilibrium quantity of prostitution. Indeed, we are able to show that a 1% absolute increase in the unemployment rate in Chicago corresponds to a decrease of 184 arrests in a given year, roughly a 4.5% decrease in the average total number of arrests. We also demonstrate that there is reason to believe that, during the recession, the consumer demand effect dominates the labor supply effect within the Chicago market for prostitution.¹

¹We would like to thank Alex MacKay for helpful comments, insights, and guidance in the preparation of this paper.
Introduction

In the U.S. alone, prostitution is a $14.6 billion industry, larger than the $12.8 billion generated by the NFL and NBA combined. As noted by Levitt and Venkatesh, the market-based nature of prostitution has lent itself to economic studies with real policy applications. In this paper, we consider one case -- the market for prostitution in Chicago. The City of Chicago has a long history with prostitution. In 1910, Mayor Fred Busse created a 30-person committee to create a policy recommendation concerning the nearly 5,000 professional prostitutes in the city. In 2007, almost a century later, Levitt and Venkatesh (2007) estimated 4,400 prostitutes working the streets.

The city has strict laws concerning prostitution. Being caught offering services as a prostitute is a strict Class A misdemeanor in Illinois, which carries a maximum penalty of 1 year in prison and a $2500 fine. Meanwhile, solicitation for prostitution (i.e. by a customer, or "john") remains only a Class B misdemeanor, which carries a maximum penalty half as severe -- 6 months in prison and a $1500 fine. Not only does the law more harshly punish prostitutes compared to johns, but so do arrests; from 2003-2013, 31,314 prostitutes were arrested for soliciting on a public way, while only 426 johns were arrested for patronizing a prostitute. Clearly, current law enforcement is strongly focused on the supply side of the prostitution market. While a specific policy recommendation for the focus of legislation or law enforcement is outside the scope of our paper, we will address the labor supply and consumer demand forces that shape the size of the prostitution market in a changing macroeconomic environment. These insights are necessary for a thorough re-evaluation of current legislative and enforcement best practices.

Crucial to our assessment of how macroeconomic factors impact the market for prostitution is a theoretical framework of the supply and demand effects surrounding the market before, during, and following a recession. We explore which of these two simultaneous effects dominates by observing the sign on the change of the size of the overall market. We include Figure 1 as a helpful visual for the below discussion.

- Consumer Demand Effect: The recent global economic recession saw increased unemployment and depressed incomes across the United States. Its effect ran from December 2007 well into the beginning of the 2010’s. As a result of this shock, Chicago’s unemployment rate rose to a high of 12.9% in January 2010. As consumer wages decrease, johns will reduce their consumption of prostitution. In fact, we have reason to believe that the recession has a particularly prominent impact on prostitution, as virtually all consumers of sex work are male and, during the recession, men experienced more unemployment and lower income than women. These men reduced their consumption of all goods, including entertainment. Thus, as the unemployment rate increases and average income decreases, demand for prostitution will likely decrease.2

- Labor Supply Effect: According to an OECD report, the 2009 recession drove people to seek more informal employment, which implies a positive effect on labor supply of prostitution, an informal profession. Therefore, we assume that as employment opportunities in the formal sector become scarce, individuals will be more willing to enter into prostitution. Indeed, The Economist reports that in the UK, the recent recession led to a large increase in the labor supply of prostitution. So, as the recession worsens, the supply curve for prostitution shifts outward.

2Note that if some johns view low-end street prostitution as a cheaper alternative (i.e. to higher-end prostitutes, escorts, or finding their own partner), then demand for street prostitutes in our sample could actually increase during a recession. While we will not directly address this question in our paper, we believe that our results show that this effect is outweighed by the larger macro-driven consumer demand effect.
On a purely theoretical level, it is difficult to extract the magnitude of each effect to determine which one dominates. However, using empirical data centered about the recession -- as well as other variables -- we arrive at a likely answer. In particular, if the labor supply effect dominates the consumer demand effect, we would expect the size of the prostitution market, ceterus paribus, to increase in a recession. Conversely, we would conclude that the demand effect dominates the supply effect if the size of the prostitution market decreases during a recession, ceterus paribus. Thus, we will control for demographic and seasonal variance between different geographies in the greater Chicago area as well as police budget, and focus on the effect of certain indicators that vary significantly during a recession, such as unemployment, labor force participation, income, and the S&P 500 returns.

Before proceeding with our analysis, we should note that we are restricting our view of prostitution to street prostitution. As discussed earlier, Cunningham and Kendall noted that this is the largest subset of prostitution arrests. The majority of prostitution is solicited indoors or online, but there is no available data on prostitution where arrests are not made. This has several effects, including understating the prevalence of prostitution in richer areas where online and pimp-based prostitution are more common. Nevertheless, the findings of our analysis are still important because these results may still carry policy implications for Chicago on conducting street arrests and refining relevant laws.

**Related Literature**

Our paper mainly draws on Levitt and Venkatesh’s 2007 working paper *An Empirical Analysis of Street-Level Prostitution*. The premise for our paper relies on their evidence that prostitution, like narcotics, is market-based due to its distinctive geographic patterns, high spatial persistence, and price maximization via price discrimination. In addition, we use their observation that the labor supply of prostitutes is relatively elastic in our labor supply effect hypothesis. Levitt and Venkatesh base this finding on the observation that more prostitutes enter the market on July 4th to take advantage of the significantly increased demand. Furthermore, the authors note that arrests are an imperfect proxy for the quantity of prostitution activity since arrests
are jointly determined by the amount of prostitution and the intensity of policy enforcement. Though we use arrest data in our own research, we correct for the possible concerns broached by Levitt and Venkatesh in two ways: first, we control for the Chicago Police Department (CPD)’s budget over time; and second, we control for the general crime trend cross-sectionally to control for any change in the overall arrest rate, either because of a deliberate decrease in CPD vigilance or due to a simple decrease in Chicago crime.

We use Cunningham and Kendall’s 2011 paper to examine the differences in the indoor sex market with respect to the street level prostitution market. They find that street level prostitution only accounts for an estimated 15% of all prostitution activity, but are 85-90% of arrests. Edlund et. al. (2002) focus on the wage premium for different ages of prostitutes, its connection to the cost of forgoing marriage, and reasons for choosing work in the informal sector.

There is a significant lack of academic literature on the effect of the macroeconomic environment on street-level prostitution market. While some newspapers have run articles on the effects of the recent recession on prostitution, their evidence has been circumstantial and based on interviews. We aim to use empirical evidence to explore a question that has yet to be asked by the largely microeconomic literature on prostitution. Lacking price data, we explore changes in the size of the market.

Data

We gathered data on number of arrests across Chicago, disaggregated by Public Use Microdata Area (PUMA), from the Chicago Police Department website from 2005-2011. This data categorized each arrest by its crime, and detailed the latitude and longitude of the arrest. This allowed us to identify the PUMA in which the crime occurred.

Because we notice no significant changes in Chicago prostitution law from 2005-2011 or CPD statements regarding prostitution, we assume that the police pursue prostitution with approximately the same level of vigor across the years and locations of our sample. However, to further control for the possibility of either temporal or geographic variance in CPD enforcement, we add the total number of arrests to our regression. Figure 2 below displays the percent change in number of arrests from the prior year for prostitution and for all other crimes.

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Figure 2: Percent Change in Number of Arrests from the Prior Year

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3PUMAS are artificial boundaries created by the Census Bureau, each containing about 100,000 residents.
4A quick thanks to Tim Brophy for sending us an advance copy of an unreleased Stata routine, gpsmaps.ado, which allowed us to map latitude/longitude values to the corresponding PUMA.
While the trend of all other crimes has a slow, steady decline (an average of 4.66% decrease per year over the time period), prostitution experiences higher variance in its arrest rate percentage changes. Noting that the differential between the two is largest during the recession, we may hypothesize that prostitution is more sensitive to changes in unemployment, income, or other macrofactors that decrease consumer demand.

In Figure 3, we can see that the number of prostitution arrests, while mirroring the trends in all crimes prior to 2007, diverges to fall more quickly than all other crimes around the onset of the recession. When we separate out narcotics, which is another markets-based crime with high spatial persistency that Levitt and Venkatesh often compared to prostitution, we see that prostitution still falls more quickly than narcotics beginning around 2007, as shown in Figure 4 on the next page. We will show that at least part of this divergence is attributable to prostitution’s fairly unique sensitivity to macroeconomic factors.

Finally, Figure 5 on the following page documents the changes in the number of arrests by Chicago neighborhood over time. These heat maps visually display the decreasing number of prostitution-related arrests over time, as well as the spatial persistence of high prostitution areas, a characteristic of markets-based crimes. We can see that neighborhoods such as Austin and Humboldt Park are consistently areas with the highest concentration of prostitution arrests, whereas neighborhoods such as Hyde Park consistently have little to no arrests.

Parameters of Interest and Controls

Our parameters of interest are unemployment rate, average household income, labor force participation rate, and S&P 500 weekly closing prices, as these indicate how macroeconomic forces, which varied significantly during the recession, impact the market for prostitution. Weekly S&P 500 closing prices, obtained from
Yahoo! Finance, proxy for overall economic health. Note that we choose the S&P 500 over other indicators such as GDP because it is widely followed by a larger subset of the population and has more frequent observations. Our other parameters of interest are cross-sectional data for average household income, labor force participation rate, and unemployment rate from the U.S. Census Bureau and American Community Survey on a cross-sectional level by PUMA. We control for PUMA fixed effects by generating a dummy variable for each PUMA. This helps us capture only temporal variance, rather than geographical differences between PUMAs.

Preliminary Analysis

We regress cross-sectional prostitution-related arrests on four parameters of interests -- unemployment, labor force participation, average household income, and the S&P 500 weekly closing prices -- and the other controls specified above. We expect there to be a negative coefficient on unemployment if the demand effect outweighs the supply effect. This is because as unemployment increases, there are less johns frequenting prostitutes, so we have fewer prostitution-related crimes being committed, and hence fewer arrests. Furthermore, if the prostitution market is driven by demand in Chicago, we also expect there to be positive coefficients on labor force participation and income. This is because as labor force...
participation increases and as income increases, more Johns are receiving income and thus may afford to be consumers of the prostitution market. So, one would expect more arrests to occur because more prostitution crimes are being committed.

Regression Results

We first note that almost all of our coefficients are statistically significant at the 99% level, with weekly average temperature control at 95% significance, and the marriage rate, divorce rate, and percent with some college the only insignificant controls. These facts -- combined with an R² value of .3555 -- imply that we explain a fair amount of the variance of the prostitution market with our OLS approach.

As expected, our cross-sectional unemployment coefficient is negative (-0.1770), and our labor force coefficient is positive (0.1442). This implies that a 1% additive increase in the unemployment rate (e.g. from 9% unemployed to 10%) would decrease the number of prostitution arrests by 184 per year city-wide. It is important to remember that arrests are a small subset of overall street prostitution, which is a subset of the overall prostitution market. So, our estimate is biased downward. Similarly, a 1% additive increase in the labor force participation would increase expected prostitution by 142 arrests per year.

Against our initial expectations, our average household income has a negative coefficient (-0.0002). However, this could simply be confirmation of the intuitive expectation that low-income areas have higher incidence of street prostitution. While we control for PUMA fixed effects,
gentrification or deterioration of neighborhoods over time could capture some of this income variance and the resulting impact on street prostitution.

We also see that higher weekly S&P 500 closes are linked to more prostitution arrests, with a coefficient of (0.0020). This again supports the demand hypothesis. As the S&P 500 rises, we would expect that even individuals who do not directly have money invested in the stock market, would connect this widely broadcasted news to positive economic prospects. Conversely, when the stock market tanks, so does the market for prostitution.

With regards to our controls, we see that arrests are lower in areas with higher education. “Percent Married” and “Percent Divorced” are not significantly different than zero. Finally, the “CPD Budget” variable has a coefficient of -0.0078. So, as the CPD budget increases, we observe fewer prostitution arrests.

We see that as the number of cross-sectional weekly arrests for other crimes increase, the number of prostitution-related arrests also increase, as evidenced by the coefficient value of (0.0162). This makes sense, because prostitution is often related with other crimes, such as narcotics due to gang activities, or sexual assault. Such a correlation may happen for two reasons. First, if individuals become more inclined to engage in one criminal activity, there may be a spillover effect such that they are more likely to increase their participation in or production of their general share of criminal activity. Another reason may be that police attack crimes with more or less vigor depending upon the situation, so their pursuit of general crime will spillover into their pursuit of prostitution-related activities. Overall, it is not surprising that prostitution arrests move in the same direction as other arrests.

Finally, we see that weather also has a significant effect on the arrest rate of prostitution. As temperature increases, arrests decrease, while the converse is true for precipitation: more precipitation, more prostitution arrests. As these are aggregated weekly, they are not particularly telling and serve more to account for seasonality. The coefficient for temperature could be interpreted as showing a decrease of prostitution over the summer and an increase during the cold Chicago winters. Interestingly, the reverse is true for other crimes -- generally, temperature has a positive coefficient, indicating an increase in the summer (see table 3).

### Uniqueness of the Prostitution Market

To demonstrate the unique response of the prostitution market to macroeconomic factors, we ran the regression with the same specification as before, except with different regressands. First, we ran Other Crimes against our parameters of interest and controls. The results are in Table 3. Note that nearly every coefficient’s sign flips. This indicates that while the arrest rate for prostitution responds negatively to many macroeconomic factors, the overall crime rate increases in response to these same factors. While this regression cannot be considered causal -- it does not control well for trends in CPD arrests -- it does give a descriptive look into the differing responses of criminal activities in a recession.

As we have noted before, the market for prostitution shares a number of similarities with the market for narcotics. Both are, of course, market-based crimes and demonstrate high spatial persistence. However, as the regression output in Table 4 shows, narcotics arrests are actually positively related to unemployment -- as unemployment increases, so does narcotics arrests. The differing results of these two regressions compared to prostitution helps solidify the significance of our study: prostitution did have a unique response to many of the changing macroeconomic factors of the recession.
### Table 2: Estimation results: Other Crimes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>(Std. Err.)</th>
<th>Prostitution Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment (Cross-sectional)</td>
<td>3.3972**</td>
<td>(0.5103)</td>
<td>-0.1770**</td>
</tr>
<tr>
<td>Labor Force Participation</td>
<td>-5.1960**</td>
<td>(0.6510)</td>
<td>0.1442**</td>
</tr>
<tr>
<td>Household Income</td>
<td>0.0077**</td>
<td>(0.0002)</td>
<td>-0.0002**</td>
</tr>
<tr>
<td>Percent Married</td>
<td>-7.5592**</td>
<td>(0.4478)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Divorced</td>
<td>-4.0328**</td>
<td>(1.4581)</td>
<td>0.0865</td>
</tr>
<tr>
<td>Percent with HS Diploma</td>
<td>-0.8371*</td>
<td>(0.3342)</td>
<td>-0.0598**</td>
</tr>
<tr>
<td>Percent with Some College</td>
<td>-2.5568**</td>
<td>(0.3203)</td>
<td>0.0086</td>
</tr>
<tr>
<td>CPD Budget</td>
<td>-0.4383**</td>
<td>(0.0185)</td>
<td>-0.0078**</td>
</tr>
<tr>
<td>S&amp;P500</td>
<td>0.1356**</td>
<td>(0.0089)</td>
<td>0.0020**</td>
</tr>
<tr>
<td>Average Temperature (Weekly)</td>
<td>1.6288**</td>
<td>(0.1391)</td>
<td>-0.0186*</td>
</tr>
<tr>
<td>Total Precipitation (Weekly)</td>
<td>0.1266**</td>
<td>(0.0072)</td>
<td>0.0017**</td>
</tr>
<tr>
<td>Intercept</td>
<td>651.3892**</td>
<td>(65.0102)</td>
<td>25.0976**</td>
</tr>
<tr>
<td><strong>PUMA Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N: 8322  
R²: 0.6327  
F (29,8292): 492.4755

Significance levels:  †: 10%  *: 5%  **: 1%

### Table 3: Estimation results: Narcotics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>(Std. Err.)</th>
<th>Prostitution Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment (Cross-sectional)</td>
<td>3.1309**</td>
<td>(0.8550)</td>
<td>-0.1770**</td>
</tr>
<tr>
<td>Labor Force Participation</td>
<td>-3.821**</td>
<td>(1.0549)</td>
<td>0.1442**</td>
</tr>
<tr>
<td>Household Income</td>
<td>0.0064**</td>
<td>(0.0004)</td>
<td>-0.0002**</td>
</tr>
<tr>
<td>Percent Married</td>
<td>-5.2479**</td>
<td>(0.7753)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Divorced</td>
<td>-1.4899</td>
<td>(2.3939)</td>
<td>0.0865</td>
</tr>
<tr>
<td>HS Grad Rate</td>
<td>-0.5365</td>
<td>(0.5725)</td>
<td>-0.0598**</td>
</tr>
<tr>
<td>Percent with Some College</td>
<td>-2.5877**</td>
<td>(0.5716)</td>
<td>0.0086</td>
</tr>
<tr>
<td>CPD Budget</td>
<td>-0.3189**</td>
<td>(0.0341)</td>
<td>-0.0078**</td>
</tr>
<tr>
<td>S&amp;P500</td>
<td>0.1238**</td>
<td>(0.0155)</td>
<td>0.0020**</td>
</tr>
<tr>
<td>Average Temperature (Weekly)</td>
<td>1.7158**</td>
<td>(0.2432)</td>
<td>-0.0186*</td>
</tr>
<tr>
<td>Total Precipitation (Weekly)</td>
<td>0.1422**</td>
<td>(0.0124)</td>
<td>0.0017**</td>
</tr>
<tr>
<td>Other Arrests (Cross-sectional, weekly)</td>
<td>0.7011**</td>
<td>(0.0674)</td>
<td>0.0162**</td>
</tr>
<tr>
<td>Intercept</td>
<td>261.2277*</td>
<td>(112.9996)</td>
<td>25.0976**</td>
</tr>
<tr>
<td><strong>PUMA Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N: 2925  
R²: 0.6251  
F (26,2898): 185.8275

Significance levels:  †: 10%  *: 5%  **: 1%
Conclusion

Based on the significance of our coefficients in our regression, we can confidently say that macroeconomic factors do affect the prostitution market. Forces such as the S&P 500 weekly closing prices, the unemployment rate, the average household income, and the labor force participation rate all may meaningfully predict movements in the incidence of prostitution in respective Chicago PUMAs. Furthermore, we notice that the demand effect appears to dominate the prostitution market -- while the supply curve may shift out during a recession as people become more willing to enter the informal market, the signs on our regressions show that, ceterus paribus, the demand effect dominates. In a case like this, this implies price should drop sharply. While we do not have pricing data to confirm this, the Economist recently interviewed a number of prostitutes who universally noted that they have offered deep discounts to account for the lack of demand and increased supply.

It is important to note that we should not immediately assume that stricter enforcement on johns (the demand side) would have a larger impact on the overall market than enforcement on prostitutes (the supply side). Our results cannot be extrapolated to imply that the Chicago Police Department should shift their focus without further investigation. After all, there may be high marginal costs for switching the policy -- i.e., the cost of arresting one more john may be substantially greater than arresting one more street prostitute. Furthermore, arresting prostitutes may lead to tips for arrests related to other crimes, so merely arresting johns might not be as productive. Instead, the police may want to be aware that as the economic environment improves, prostitution rates will increase.

This leaves room for further research. In particular, we recommend further research into the economic feasibility of such a policy change for the CPD. Furthermore, we believe that some of the market for prostitution has shifted to the internet, which should be considered to generalize our results. Additionally, investigation into other potential factors that could drive a decline in the prostitution market would allow for a more robust understanding of how to most effectively shape policy.

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