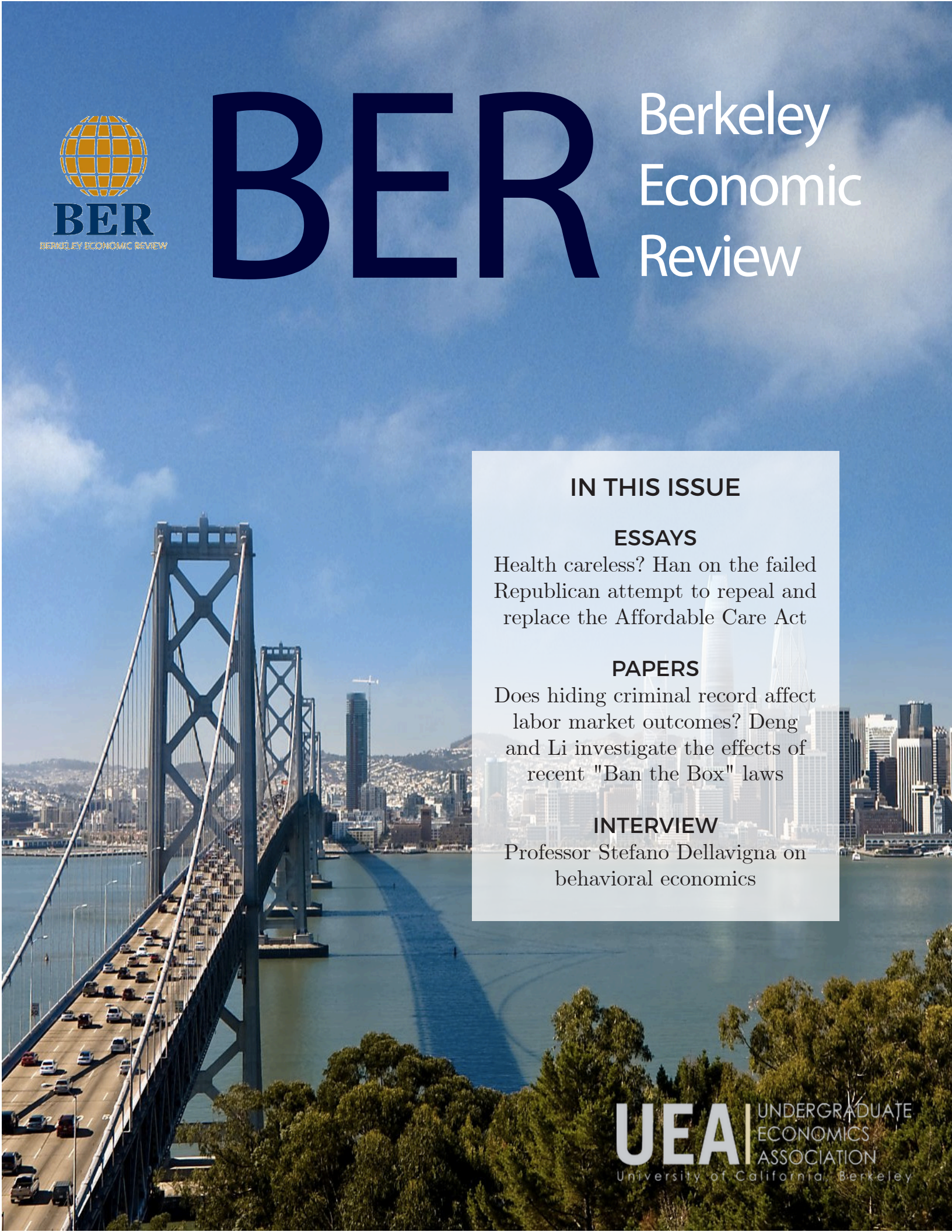

BER Berkeley Economic Review

BERKELEY ECONOMIC REVIEW

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UEA UNDERGRADUATE ECONOMICS ASSOCIATION
University of California, Berkeley

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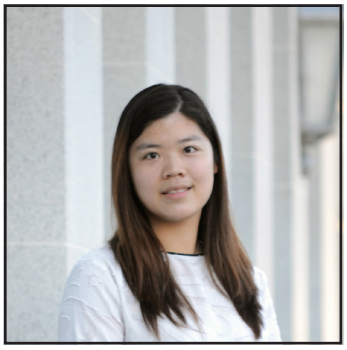

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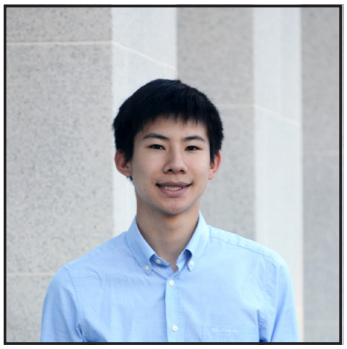

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SPRING 2017 ESSAY CONTEST

"Select one of Donald Trump's proposed economic policies and examine its implications. Who would benefit? Who would not? How much would it cost, and who would pay for it? You may wish to consider Trump's stance on trade, taxes, defense spending, minimum wage, student debt, infrastructural investment, domestic manufacturing, financial regulation, or a topic of your choice."

Infrastructure

Joseph Hernandez
Class of 2019
Economics, History

In the 2016 campaign, trade dominated both primaries, but infrastructure investment inexplicably faded from public debate, perhaps because it was assumed that the candidates all had "similar" views. Eight months later, President Trump's infrastructure "plan" warrants dissecting, even though it has only been partially released. At present, what the Trump administration has outlined does not seem bipartisan, fails to fit with the administration's other policies, and will not benefit the Trump coalition economically.

The myth of infrastructure investment as an area of bipartisan agreement should be dispelled before discussing the specifics of Trump's plan. Republicans believe that too much tax revenue ends up wasted on projects that give too little back. Their position is epitomized by the infamous 2005 "Bridge to Nowhere" in Alaska, a pork-barrel project funded while victims of Hurricane Katrina lost roads and schools (Utt 1). Democrats typically favor government spending over private finance. They prefer public infrastructure investments and have called for repairing damaged infrastructure before initiating new projects. Conservatives view the Democratic position as an opaque misuse of public funds, while liberals take fault with the privatization of public goods, such as highways and utilities. Inarguably, the long-term infrastructure goals of each party are not aligned and deviate along traditional "big" government versus "small" government lines.

Trump's supposedly "trillion-dollar" plan addresses infrastructure spending through a quasi-conservative middle-ground. His proposal offers massive tax credits to private contractors to help finance new projects, mostly related to transportation, and allows them to eventually own highways and bridges. Elaine Chao, Secretary of Transportation, said that minimal direct federal spending would be necessary, and that the administration wanted a "deficit neutral" plan through these tax credits (Politiplatform 105). However, the math just is not there. Just how the government plans to extract revenue anywhere near the upfront cost of the tax credits, an estimated $167 billion, remains an issue the administration has not yet addressed (Bradley 4).

Also, trillions in spending on infrastructure, financed by tax breaks and without tax increases, would clearly add to the deficit, which Republicans have promised to shrink for nearly a decade. Trump's new tax plan, severely less progressive than the current system, is bound to bring in less revenue, while the administration calls for concurrent increases in defense and infrastructure investment. Without major revisions, the infrastructure plan as it stands seems unlikely to pass muster in Congress. It begs the question of what motived the President to initially promote the bill. An educated guess points to the traditional connection between public projects and increased employment, which bolstered the Trump base in the depreciating Midwest. However, many large highway and bridge projects would favor metropolitan areas, generally blue territory, which have tight labor markets as is. Overall Trump's infrastructure plan seems likely to result in no change to current deficit levels, have a real impact on unemployment, or be politically feasible.

Trump's Trade

Donald Trump's election has cast a wave of uncertainty over the future of the American economy. Several of his proposed policies, if implemented, could have significant ramifications across the United States and the world. At the top of Trump's agenda may be his foreign trade policy.

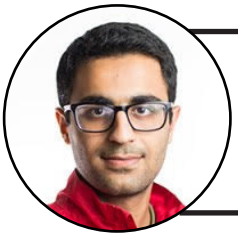
Trump's protectionist agenda revolves around the goal of creating and safeguarding American workers' jobs. He has already withdrawn the United States from the Trans-Pacific Partnership (TPP), and he intends to renegotiate the North American Free Trade Agreement (NAFTA) and levy tariffs on cheaper imported goods. On the one hand, the country's decreased involvement in foreign trade agreements would require more American jobs to offset the shortfall of imported goods, thereby increasing employment. On the other hand, imposing taxes on foreign goods would discourage foreign businesses from selling products in the United States, effectively reducing competition. In theory, American consumers would be forced to support American businesses.

However, Trump's policies could have negative consequences. For one, by mainly taxing imports from countries with which the United States has the largest bilateral deficits, Trump could provoke an international trade war. Countries such as China and Mexico could respond by taxing and boycotting American exports, which would harm American businesses that hope to sell to global markets. Also, Trump's plan to raise the prices of American-made products by 11% (after levying tariffs) would hurt American families—especially those earning lower incomes—and would worsen economic disparity. While the richest 10 percent of households would lose $5,001 (3 percent) per year of their after-tax income and the average household would lose $2,200 (4 percent), the lowest 10 percent would lose $924 (18% percent) under Trump's plan. And, interestingly enough, for someone who advertises himself as business savvy, Trump might actually lower investment activity. Faced with more expensive goods, Americans could be deterred from financing the capital (such as machinery or the construction of buildings) necessary to start or grow businesses. For a country so reliant on innovation, neglecting stimulating economic activity would not bode well for long-term sustainability.

Admittedly, Trump is still laying the groundwork for his trade policies, so their anticipated effects have not yet been felt. However, if he lives up to his campaign promises, the taxpayer's pocketbook and the country's economy might take a hit.

Jeremy Dake
Class of 2019
Business Administration

President Trump Wants to Increase Defense Spending On the Backs of the Working Class



Azwar Shakeel
Class of 2019
Public Health, Political Economy

In his recent address to Congress, President Trump proposed a $54 billion dollar increase in defense spending. Dictatorial military showmanship aside, this proposal is highly dangerous for the economy. Coupled with the tax cuts he is willing to shower on the wealthy, it has the potential to blow the budget deficit through the roof.

Trump promised to give a voice to the "forgotten men and women of this country" and rode to victory on the backs of working class people, who were continuously reassured during the presidential campaign that they would be the focus of government spending in the future. He promised to build new infrastructure, give Americans jobs, and stop foreign intrusion into the American job market. But with the path his administration has taken, it is not clear how he plans to do so.

An increase in military spending can only be justified if it is balanced by a decrease in spending elsewhere. These cuts will apparently come from the pockets of the very people Mr. Trump claims to champion. The recently released Republican healthcare plan would have reduced Medicare coverage, eliminated the individual and employer mandate, and decreased taxes on the wealthy meant to subsidize health insurance. While there is no saying how much the new plan might have cost taxpayers, it was opposed by Republicans and Democrats alike, and was bound to cost a lot of people affordable health coverage. If passed, it would have cost 24 million people affordable health coverage in 10 years, according to the Congressional Budget Office report (Park).

His position on free trade and immigration will also cost a lot of people good quality jobs. Contrary to popular myths, free trade increases access to higher-quality, cheaper goods and promotes growth. Bipartisan studies have shown that immigration improves GDP and productivity and is business-friendly (OECD, EOP).

"America has always been a nation of immigrants, and throughout the nation's history, immigrants from around the globe have kept our workforce vibrant, our businesses on the cutting edge, and helped to build the greatest economic engine in the world," read a 2013 White House report on the importance of fixing a broken immigration system.

With these policies, the current administration is crushing the common people of America. At the same time, however, Trump has maintained his pro-wealthy stance by proposing corporate tax cuts. In addition, Trump's promise to cut two business regulations for every new one will create a market that promotes the needs of big businesses while muffling

the cries of the working class. And instead of "draining the swamp," as he roared during the campaign, he has filled his cabinet almost exclusively with wealthy corporate officials and lobbyists.

Economists have argued that federal spending benefitting the common people of America has the potential to pay back in terms of economic growth and greater spending power for the masses. John Maynard Keynes, one of the most influential economists of recent history, advocated for greater government spending to create jobs and utilize capital, which he believed would boost economic output.

But the policies proposed by President Trump have alarmed even fiscal conservatives. He wants to build up the military, which is economically useless for the working class, and make up for increased costs by exploiting his biggest voter base: the working class. At the same time, he is protecting his peers in corporate boardrooms through tax cuts and regulation rollback.

His defense proposal is yet another example of the heightened expectations and failed promises that we have all come to expect from the President. I hope Trump realizes sooner than later that tax cuts do not promote economic prosperity – contributing our fair share to the system does.

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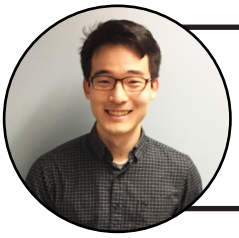
Health Careless



Jaeyong Danny Han
Class of 2019
Economics

After seven years of arguing for the repeal and replacement of the Affordable Care Act (ACA, also known as Obamacare), House Republicans revealed their new health plan on Monday, March 6. Known as the American Health Care Act (AHCA), the plan received the support of the White House but was criticized by members of both main political parties.

It is a well-known fact that any health care bill will have winners and losers, and with the AHCA, the winners were likely to be the healthy and wealthy, while the losers were likely to be the sick and poor. The American Hospital Association said that the new plan would throw into doubt "our most vulnerable" (BBC 1). If the AHCA had passed Congress, the individual mandate would be gone and would be replaced by the continuous coverage provision. This would enable insurers to penalize consumers with a 30% increase in premiums should consumers stay uninsured for over 63 days. The individual mandate was never popular; in fact, the Obama administration had to face the Supreme Court in 2012 over whether the provision was constitutional. However, the mandate allowed the health care market to function because it kept the healthy individuals in the market to subsidize the sick. The continuous coverage provision decreased the incentive for healthy individuals to stay in the health insurance market compared to the individual mandate. This is because under the continuous coverage provision, individuals would only need to pay the penalty once, when they re-enter the market, rather than paying it annually, as they do under the mandate. As the healthy drop out, premiums will rise for the unhealthy individuals remaining in the market. The Republican provision could prevent the market from collapsing if it provided sufficient subsidies to the poor, but the AHCA stated that tax credits, which would replace subsidies in the plan, would be based on age rather than income level.

While the GOP kept its promise to immediately repeal the individual mandate, the party softened its stance on Medicaid expansion. Medicaid is designed to provide health insurance for the poor. Republicans originally signaled that the expansion under Obamacare would be rolled back immediately alongside the mandate, but the AHCA proposed keeping the expansion until 2020. Under Obamacare, anyone earning below 138 percent of the poverty line is covered under Medicaid (Kliff 1). Another significant change was that states would receive block grants from Washington to fund Medicaid, instead of funds per person specifically for the use of Medicaid funding. This could have allowed states to charge higher premiums and deny some people insurance (Kliff 2), leaving the poor at risk of losing health insurance in the future.

Passing a health care bill is never an easy task: health care has been one of the longest ongoing US political debates in recent history. President Obama had to use a significant portion of his political capital to pass the ACA in his first term, and the AHCA was no different. Despite holding majorities in the House and Senate, the Republicans realized that they fought an uphill battle in passing the AHCA, especially given the dissenting voices among their own party members.

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DOES HIDING CRIMINAL RECORD AFFECT LABOR MARKET OUTCOMES?

-- EVIDENCE FROM "BAN THE BOX" LAW

BY: Jin Deng (Nanjing University)
Lambert Li (University of California, Berkeley)

Jin Deng

Lambert Li

Does Hiding Criminal Record Affect Labor Market Outcomes? Evidence from "Ban the Box" Laws

Jin Deng
Nanjing University
Class of 2018
Economics, Finance

Lambert Li
University of California, Berkeley
Class of 2017
Sociology, Organizational Theory

Abstract

Scholars have long documented hiring discrimination against certain racial, gender, and age groups. Ex-offenders are equally, if not more, prone to discrimination. Given the increased number of ex-offenders in United States, the fact that criminal record disclosure hinders reentry into the labor market induces a huge burden to the economy and society. In response to this rising concern, states have passed "Ban the Box" laws to prohibit criminal record disclosure during various stages of the hiring process. Drawing from information asymmetry and statistical discrimination, this paper builds a game-theoretic model to predict employers' hiring preferences. It tests the effect of the law on the probability of employment of disadvantaged groups, the employment rate and the incarceration rate with national data. We find 1) the law improves young black men's chance of getting a job; 2) the law does not significantly improve employment overall; and 3) the law reduces the incarceration rate of young white men.

Acknowledgements

We want to express the utmost gratitude to Professor David Card, Professor Heather Haveman and Professor Haluk Ergin for their invaluable suggestions. We would also like to thank David Berger, Vincenzo Pezone, Tamas Batyi, Yipei Zhang, and Dmitri K. Koustas for their devotion to this paper. D-Lab provided computing support.

Contents

I. Introduction

The United States maintains the largest incarcerated population worldwide (Walmsley, 2013). The country has witnessed rapidly increasing incarceration in the past 40 years. The incarcerated population has grown by over 700% since the 1970s. Today, more than 1 in 100 adults are in jails or prisons nationwide (Henrichson, et al. 2015). This rate of incarceration has resulted in large costs to our society. Federal and state governments spend $80 billion annually operating prisons and jails. The U.S. economy loses $70.5 billion (in 2016 dollars) of total production per year, after accounting for prison production (McLaughlin et al. 2016).

The negative social effect of the mass incarceration occurs not only during the prison term, but also after release. Incarceration is strongly correlated to the negative life outcome of former prisoners. Roughly half of ex-prisoner populations remain jobless up to a year after their release, inducing a long-lasting burden to the economy and the social welfare system (Visher, 2011).

The difficulty of launching a job after release can be explained from both the labor and employer perspective. On the supply side, scholars argue that ex-offenders are statistically less qualified for selective positions than non-offenders. On average, they have less than 12 years of education and receive low score on cognitive tests. Many of them have little work experience prior to incarceration. In fact, at least one-quarter to one-third of inmates were unemployed at the time of their incarceration. Some of them have history of substance abuse or mental illness (Travis, 2004; Bureau of Justice Statistics, 1994). In short, incarceration intersects with other disadvantaged social categories to lower job candidates' attractiveness.

However, ex-convicts' bleak job prospects cannot be attributed to individual disposition only; imprisonment itself poses great difficulty. The temporary isolation from the labor market results in depreciated skills and reduced incentive to work (Western,

2006). It also disrupts social networks and familial relationships, which are often critical in securing employment (Hagan, 1993; Granovetter, 1973).

On the demand side, there are laws disqualifying ex-offenders from certain types of jobs. The restrictions can last for a specified period or for life. Even if not required by laws, employers are reluctant to hire ex-offender to fill positions that require customer interaction and cash handling, according to employer surveys (Holzer, et al. 2007) and audit studies (Neumark, 1996; Agan and Starr, 2016). Information asymmetry and transaction costs explain such reluctance. Given the limited information available in the job application and the additional cost of scrutiny, employers, fearing potential complaints and lawsuits, exclude ex-offenders without due consideration on an individual basis (Arrow, 1973).

Given the aforementioned reasons, employers more frequently inquire about applicants' criminal histories or conduct background checks (Blumstein and Nakamura, 2009). Revealing prior convictions often hurts the ex-offender's chance of getting a job. With an increased number of ex-offenders seeking employment, the economic and social costs caused by criminal record disclosure in the hiring process have become a serious policy concern.

In order to reintegrate ex-offenders into the labor market and society, several cities, counties, and states have passed laws that prohibit employers from soliciting applicants' criminal histories in the screening process, and delaying background checks until later stages in the hiring process. These laws are known as "Ban the Box" laws (BtB). BtB was first passed in Hawaii in 1998, then in New Mexico, Massachusetts and Connecticut in 2010. It quickly spread to more states in the recent years, including Colorado (2012), Rhode Island (2013), Illinois (2013), Maryland (2013), Delaware (2014), New Jersey (2014), Nebraska (2014), Georgia (2015), Minnesota (2009, 2013), New York (2015), Ohio (2015), Oregon (2015), Virginia (2015), Oklahoma (2016), Louisiana (2016),

Missouri (2016), and Wisconsin (2016).

However, the effects of such legislation continue to be debated. This paper aims to answer two interrelated questions. First, does BtB improve overall employment and social welfare? Second, does the law negatively affect minorities?

To answer the first question, we establish a game-theoretic model in which employers maximize profit. We consider possible scenarios in the hiring process and discuss equilibria before and after the passage of BtB for each scenario. We then turn to survey data to look at the variation in state employment and incarceration rates before and after BtB. No significant evidence shows that BtB increases employment or reduces incarceration overall.

To answer the second question, we look at changes in the probability of employment and incarceration indifferent demographic groups. We focus on young men ages 25 to 35, as they are most affected by BtB. We use econometric techniques such as difference-in-difference, event study, and linear probability models to test repeated cross sectional data from the American Community Survey. We find that BtB increases the probability of employment for black men ages 25 to 35 without a high school degree. We find that BtB reduces the incarceration rate of young white men ages 25 to 35, especially for those without a college degree.

This paper contributes to literature on BtB and hiring discrimination. First, we assess whether BtB affects the employment rate of the treated states. Second, we use ACS to approximate incarceration rate and assess the effect of BtB on incarceration. Third, we define the treatment variable by excluding Hawaii, which was treated in 1998. Fourth, we use more recent data, and more states are included in the treated group. Fifth, we develop a theoretical framework to describe employers' utility-maximizing behavior and analyze equilibrium.

This paper applies theories of asymmetric information in labor market. It shows

that the more informed side of the market maintains its advantage by hiding unalterable traits such as criminal history.

The structure of the paper is as follows: Section II is a literature review, section III builds the conceptual framework, and Section IV contains information on our data and methodology. Results are presented in Section V. Discussion is presented in Section VI.

II. Literature Review

Asymmetric information describes a situation in which one side of the market is better informed than the other. It holds true in the labor market in that the job applicant knows more than the employer about his personal history. "Hiring is an investment under uncertainty," Spence (1973) argues. "To hire someone is to purchase a lottery [ticket]."

The information asymmetry may be reduced through further investigation of the prospective employee. However, such in-depth inquiry is often difficult due to the transaction costs (Williamson, 2007).

Spence (1973) discusses market equilibrium under asymmetric information. He argues that two types of personal information are disclosed during the hiring process. The first type are index, or unalterable, attributes such as race and sex. The second type is signal, or alterable, attributes such as education and work experience. He argues that employers predict the productivity of future employee based on both types of attributes. In our case, black ex-offenders have disadvantaged index, namely race, and disadvantaged signal, namely criminal history. Thus, they will end up with lower equilibrium in the labor market. In other words, they will have less chance of finding a job or receive lower pay (Azariadis, 1983).

There are two types of discrimination. The first and the most intuitive type is taste-based discrimination, in which employers dislike certain social groups without rational justification. The second type, statistical discrimination, is more salient in the hiring process. In this case, employers have limited information about applicants and infer their future behavior from past experience and current traits through essentialist logic (Finlay, 2009). Though such inference from prototype is often reification and subject to ecological fallacy, employers' goals are to maximize profit, and they often believe they have a better chance of achieving this goal by making such inferences. In other circumstances, they do not necessarily discriminate against the excluded groups (Akerlof, 1976). Yet statistical discrimination still harms these disadvantaged groups through a self-reinforcing vicious circle (Rodgers et al. 2009) and wage differentials (Aigner and Cain, 1977).

In our case, when employers do not know applicants' criminal histories, or when it is too costly for them to obtain such information, they may infer criminal history from past experience and personal traits, such as lengthy unemployment gaps and being a member of a disadvantaged race. Pager (2003) evidences such discrimination in an experimental audit study. BtB may reasonably have the same effect.

Empirical evidence supports this hypothesis. Amanda and Sonja (2016) conducted a field experiment to assess the effects of BtB. They submitted fictitious job applications to companies in New Jersey and New York, randomizing race and holding all else constant. Before BtB, white applicants were slightly more likely to receive an interview call than black applicants. After BtB, the racial gap became six times larger, suggesting statistical discrimination. This approach has limitations, as it does not take later steps of the hiring process into consideration. Although much fewer black applicants received interviews, they might have a better chance of receiving job offers by not disclosing criminal records (Doleac and Hansen, 2016).

Starr (2015) also documented the negative effect of BtB on minorities. With CPS data from 2004 to 2014, she found that BtB reduced the employment rate of black men ages 18 to 64. However, she did not use other races or non-BtB states as control groups. Some employers report more torts and crimes by ex-offender employees (Hughes et al. 2013), as well as vicarious liability or negligent hiring lawsuits (Connerley, 2001). Even if the law allows them to conduct background checks in later stages of the hiring process, employers must hold more interviews and spend more money on hiring.

Other empirical research offers opposing evidence in support of BtB. Shoag and Veuger (2016) used data from 2005 to 2014 from the American Community Survey to assess the effect of BtB on neighborhoods with different crime rates. Using the difference-in-difference method, they found low-skilled black men ages 19 to 65 living in high-crime neighborhoods had better job prospects after BtB.

BtB may reduce recidivism. D'Alessio (2014) assessed the effect of the BtB law passed in 1998 in Hawaii. Logistic regression shows that felony criminal defendants in Honolulu are 57% less likely to have a prior conviction after the passage of BtB.

III. Conceptual Framework

We deploy a game-theoretical model with one player, an employer, to understand the hiring process.

3.1 General setup of the game

In the game, the player is a rational employer. Applicants apply for an open position. Then the employer screens every profile and chooses candidates for interviews. After the interview, the employer decides whether to hire the applicant or not.

3.1.1 Assumption 1

A good fit applicant is an applicant whom the employer finds qualified for the position. Assume that in the population of applicants, 50% of applicants are a good fit for the employer and 50% of applicants are bad fit; 25% of applicants have a criminal record and 75% of applicants do not have criminal record. Given a good fit applicant, the expected payoff from hiring the applicant does not depend on the status of his or her criminal record.

$T_i = (\theta_i, \varphi_i)$ is the type of applicant where:

$\theta_i \in \{Good\ fit\ applicant, bad\ fit\ aplicant)$

$\varphi_i \in \{with\ cirminal\ record,\ no\ criminal\ record\}$

Table A-1 shows the joint distribution of 4 types of applicants:

Table A-1: Joint distribution of types of applicants

	with criminal record	no criminal record
Good fit	1/16	7/16
Bad fit	3/16	5/16

According to table A-1, the following conditional probabilities are calculated:

$$Prob(good\ fit \mid no\ criminal\ record) = P(good\ fit\ \&\ no\ criminal\ record)/P(no\ record) = \frac{7}{12}$$

$$Prob(good\ fit \mid with\ criminal\ record) = P(good\ fit\ \&\ criminal\ record)/P(with\ record) = \frac{1}{4}$$

$$Prob(bad\ fit \mid no\ criminal\ record) = P(bad\ fit\ \&\ no\ criminal\ record)/P(no\ record) = \frac{5}{12}$$

$$Prob(bad\ fit \mid with\ criminal\ record) = P(bad\ fit\ \&\ with\ criminal\ record)/P(with\ record) = \frac{3}{4}$$

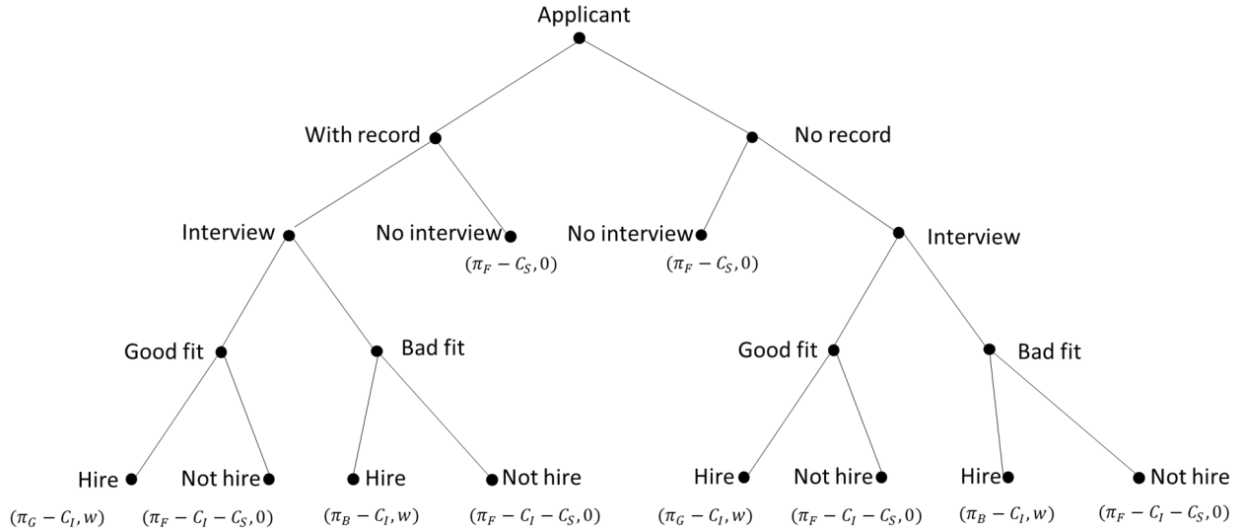
Also, we denote the employer's beliefs about whether or not an applicant has a record as follows:

$$Prob(applicant\ has\ record \mid everything\ employer\ knows\ about\ the\ applicant) = \mu_R$$

$$Prob(applicant\ has\ no\ record \mid everthing\ employer\ knows\ about\ the\ applicant) = \mu_{NR}$$

Figure A-1 describes the hiring process using a rooted tree:

Figure A-1: The rooted tree of the hiring process



$\pi_G = expected\ payoff\ from\ hiring\ a\ good\ fit\ applicant$

$\pi_B = expected\ payoff\ from\ hiring\ a\ bad\ fit\ applicant$

$\pi_F = expected\ payoff\ from\ future\ hiring$

$C_I = expected\ cost\ of\ one\ interview$

$C_S = expected\ cost\ of\ searching\ one\ applicant$

$w = wage\ given\ by\ the\ employer$

3.1.2 Assumption 2

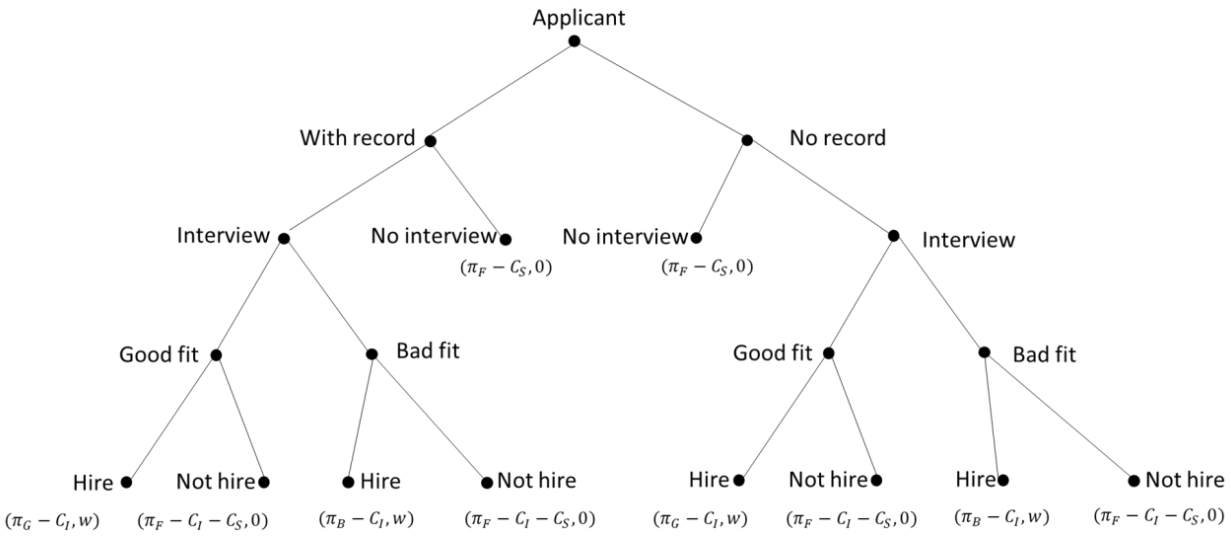
The payoff of hiring a good fit applicant is greater than the payoff of hiring a bad fit applicant. In other words, whenever the employer interviews a good fit applicant, he prefers hiring to refusing the applicant. This gives the constraint: $\pi_G - \pi_F > -C_S$

3.1.3 Assumption 3

The payoff of refusing a bad fit applicant is greater than the payoff of hiring a bad fit applicant. In other words, whenever the employer interviews a bad fit applicant, he prefers refusing to hiring the applicant. This gives the constraint: $\pi_F - C_S > \pi_B$

Based on Assumption 2&3, the hiring process is modified as Figure A-2:

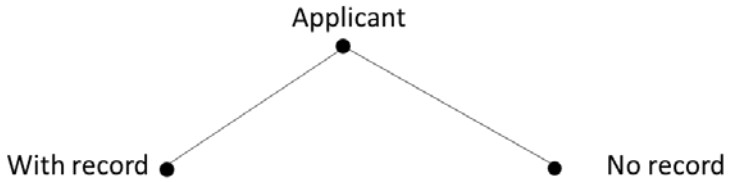
Figure A-2: Modified game tree of hiring process



First, the employer reads the profile of the applicants. The employer is aware of whether the applicant has criminal record or not. Second, the employer decides whether to interview the applicant or not. Third, according to the interview, the employer decides whether the applicant is a good fit for the position. Lastly, the employer either makes an offer or rejects the applicant.

3.2 Before the implementation of a "Ban the Box" law

Figure A-3: The first stage of hiring process in the game tree



When the employer is allowed to ask about criminal records, he or she knows whether the applicant has a record or not. In this case, $\mu_R = 1, \mu_{NR} = 0$ for applicants with a record and $\mu_R = 1, \mu_{NR} = 0$ for applicants without a record. Using the distribution of different types of applicants, the expected payoff of interviewing or not interviewing a certain type applicant can be calculated.

3.2.1 Case 1

If the employer knows that the applicant has a criminal record, the expected payoff of not interviewing the applicant is greater than the expected payoff of interviewing. That is:

$$E(payoff\ from\ interviewing\ an\ applicant\ with\ record)$$
$$< E(payoff\ from\ not\ intervieing\ an\ applicant\ with\ record)$$
$$\Leftrightarrow P(a\ good\ fit\ applicant\ with\ record) * E(hiring\ a\ good\ fit\ applicant) +$$
$$P(a\ bad\ fit\ applicant\ with\ record) * E(hiring\ a\ bad\ fit\ applicant) < \pi_F - C_S$$
$$\Leftrightarrow \frac{1}{4}(\pi_G - C_I) + \frac{3}{4}(\pi_F - C_S - C_I) < \pi_F - C_S$$
$$\Leftrightarrow 7\pi_G - 28C_I < 7\pi_F - 7C_S$$

3.2.2 Case 2

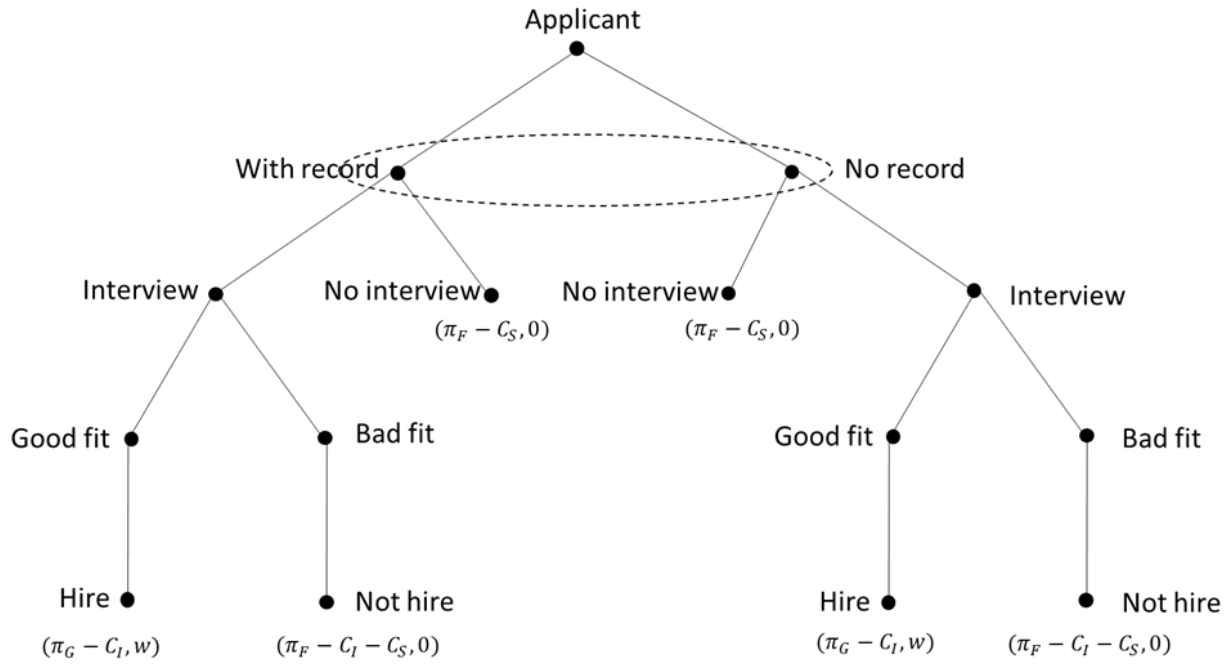
If the employer knows that the applicant does not have a criminal record, the expected payoff of interviewing the applicant is greater than the expected payoff of not interviewing. That is:

$$E(payoff\ from\ interviewing\ an\ applicant\ with\ no\ record)$$
$$> E(payoff\ from\ not\ intervieing\ an\ applicant\ with\ no\ record)$$
$$\Leftrightarrow P(a\ good\ fit\ applicant\ with\ no\ record) * E(hiring\ a\ good\ fit\ applicant) +$$
$$P(a\ bad\ fit\ applicant\ with\ no\ record) * E(hiring\ a\ bad\ fit\ applicant) > \pi_F - C_S$$
$$\Leftrightarrow \frac{7}{12}(\pi_G - C_I) + \frac{5}{12}(\pi_F - C_S - C_I) < \pi_F - C_S$$
$$\Leftrightarrow 7\pi_G - 12C_I > 7\pi_F - 7C_S$$

3.3 After the implementation of a "Ban the Box" law

After BtB, the employer is not allowed to ask or check whether the applicant has a criminal record when screening profiles of applicants. In other words, at the first stage of the tree model, information is not revealed to the employer. The dotted circle in figure A-3 shows the information set of two possible applicant types. In this model, no other information provided by the applicant affects the employer's knowledge of his or her criminal record.

Figure A-3: The game tree under "Ban the Box" law



$$E(\textit{interviewing an applicant}) = E(\textit{payoff from interview and hiring a good fit applicant}) * Prob(\textit{a good fit applicant}) + E(\textit{payoff from interviewing and refusing a bad fit}) * Prob(\textit{a bad fit applicant}) = \frac{1}{2} * (\pi_G - C_I) + \frac{1}{2} * (\pi_F - C_S - C_I)$$

$$E(\textit{not interviewing an applicant}) = \pi_F - C_S$$

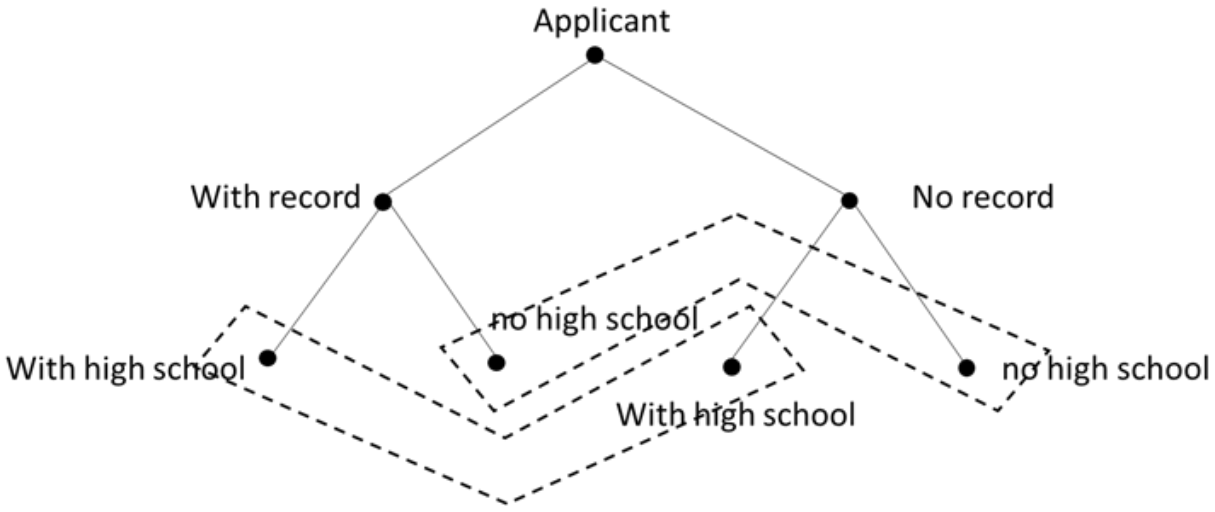
There is a scenario in which "Ban the Box" laws would help. The employer would interview every applicant if:

$$E(interviewing\ an\ applicant) > E(not\ interviewing\ an\ applicant)$$
$$\Leftrightarrow \pi_G - \pi_F + C_S - 2C_I > 0$$

3.4 After the implementation of a "Ban the Box" law, with additional information

If additional information from the applicant correlates to his criminal history, the employer's inference of the status of applicant's criminal record may change. For example, the employer observes that an applicant hasn't been employed for ten years and assumes he or she was in jail.

Figure A-4: The first two stages of hiring process under "Ban the Box" law



$$\mu_R \in \left(0, \frac{1}{4}\right), \mu_{NR} \in \left(\frac{1}{4}, 1\right)$$

Figure A-4 describes the case in which the employer believes high school attainment in negatively correlated with having a criminal record. There are two

information sets: one for applicants with high school attainment and unknown status of criminal record, and another for applicants without high school attainment and with unknown status of criminal record. If the employer believes that applicants with high school attainment are less likely to have criminal records, then in the model, μ_R will decrease for high school graduates while μ_{NR} will increase for non-high-school graduates.

Similarly, the employer may believe there is a positive correlation between belonging to a minority race and having a criminal record. Facing two applicants who are the same in all other aspects, if employer prefers to hire a white applicant to a Hispanic applicant, the prior belief will decrease μ_R for the white applicant while increasing μ_{NR} for the Hispanic applicant. If perceived$|correl(race, record)|$ is high enough, it is more likely that the employer will not interview applicants of certain races. The field experiment which Agan and Starr (2016) conducted is evidence of this framework. Comparing callbacks before and after BtB, they found that the racial gap in callbacks grew in BtB-affected companies. Before BtB, white applicants had received about 7% more callbacks than similar black applicants, but BtB increased this gap to 45%. In this paper, we use ACS data to measure the differential effects of BtB across different racial groups.

IV. Data and Methodology

As scenario (c) of the game-theoretic model suggests, if the effect of statistical discrimination is relatively small, it will not override the benefit gained by the party with more information. Blacks and other disadvantaged groups will have a better probability of getting a job and a higher employment rate by not disclosing criminal history. Otherwise, as scenario (d) suggests, BtB may harm disadvantaged groups. Which scenario is the case? We test it with the national data.

Our analysis draws on data from 2006 to 2015 from the American Community Survey Integrated Public Use Microdata Series, provided by the Minnesota Population Center. ACS is a yearly repeated cross-sectional survey targeting 890,000 households. It provides information on individual age, sex, race, ethnicity, education attainment, employment status, residential state and group quarter type. Table 1 presents summary statistics. Table 2 presents the states with BtB that we include as treated states. After aggregate-level analysis, we proceed to assess whether there is any effect on the individual's probability of employment using a linear probability model:

$$Employed_{i,state,year} = \alpha + \alpha_{state} + \alpha_{year} + \beta_1 * treatment_{i,state,year} + \beta_2 * X + e \quad (1)$$

$Employed_{i,state,year}$ is equal to 1 if the individual in state s and year t is employed, and 0 otherwise. $Treatment_{i,state,year}$ is a dummy equal to 1 if the individual is in a state s and year t that BtB has taken effect. X includes demographics like sex, age, and race. To see the differential effect of BtB on different racial groups, we also add dummies for black and Hispanic racial groups.

To approximate incarceration rate we use the group quarter variable. This variable indicates the type of quarters within which an individual resided. With this

variable, we can distinguish between institutions and non-institutional group quarters. Non-institution quarters include large rooming houses, hotels, college dormitories, dormitories for workers, general hospitals, etc. Institution quarters include correctional and penal institutions, mental institutions, and homes for the aged and needy. Employees in institutions are classified into non-institutional groups. ACS reports the total number of people in institutions. In 2010, there was a slight change in the threshold number of people for a group quarter to be calculated in the sample, so the number of people in institutions increased for all states.

By restricting our sample to young men ages 25 to 35, we can safely exclude those in homes for the ages. However, our sample is still flawed in that we include some people from mental institutions, rather than only those in correctional and penal institutions. Also, criminals in federal prisons can be from other states. Though we can approximate the incarceration rate for each state in each year, we cannot tell whether the estimation is biased downward or upward.

After dropping individuals in institutions, the employment rate for each state in each year can be calculated. Then we use the difference-in-difference method to test the effect of BtB on incarceration rates and employment rates using the following specifications:

$$Incarceration\ Rate_{state,year} = \alpha + \alpha_{year} + \alpha_{state} + \beta_1 * treatment_{state,year} + \beta_2 * X + e \quad (2)$$

$$Employment\ Rate_{state,year} = \alpha + \alpha_{year} + \alpha_{state} + \beta_3 * treatment_{state,year} + \beta_4 * X + e \quad (3)$$

In equation (2), the dependent variable is the incarceration rate in each state and each year, α_{year} and α_{state} are year fixed effect and state fixed effect, $treatment_{state,year}$ equals 1 if BTB is effective in that $state$ and$year$. X includes state average demographics like average age and average education. The coefficient of interest is 1, and it tells us the effect that a BtB policy has on the state level incarceration rate. In equation (3), the dependent variable is the employment rate in each state and each year, and other covariates are the same as in (2). The coefficient of interest is 3, which tells us the effect that a BtB policy has on the state level employment rate. We used person weight from the raw data and standard errors are clustered by state.

To see the gradual effect, we also implement an event study model:

$$
\begin{aligned}
Employment_{state,year} &= \alpha + \alpha_{state} + \alpha_{year} + (\beta_1 * Before_4) + (\beta_2 * Before_3) + (\beta_3 * Before_2) \\
&+ (\beta_4 * Before_1) + (\beta_5 * After_1) + (\beta_6 * After_2) + (\beta_7 * After_3) \\
&+ (\beta_8 * After_4) + (\beta_{10} * X) + e
\end{aligned} \tag{4}
$$

Where $Before_i$ is the dummy that equals 1 if the year is i years before the effective year, $After_i$is the dummy that equals 1 if the year is i years after the effective year. The year that BtB takes effect is omitted in the equation.

V. Results and Discussion

We first tested whether BtB increases the probability of employment and how the effects vary among different racial groups. We tested this though a linear probability model and results are presented in Table 3 and 4. Table 3 shows results for young men ages 25 to 35 with no college degree. From column (1) to (3), only the dummy for treatment is included and controls vary across three identifications. It shows no significance. From column (4) to (8), dummies for black and Hispanic minorities are included. As more controls are included, there is an effect for black and Hispanic minorities, but this is not robust to all specifications. It seems there is no heterogeneous effect across races.

Table 4 presents results for young men ages 25 to 35 with no high school degree. From column (1) to (3), only the dummy for treatment is included and controls vary across identifications. It shows no significance. However, when dummies for racial groups are included from column (4) to (8), almost all the specifications show significant results at a 95% confidence level for black men. Compared to young white men without high school degrees, the probability of employment increases by about 12 to 17% for young black men. The increased probability of employment indicates that BtB has a positive impact on young black men with no high school degree. However, the finding relies on a much smaller sample size and we should not over-generalize the interpretation.
These results are consistent with scenario (c), but inconsistent with scenario (d) in the game-theoretic models. They suggest that the effect of statistical discrimination is not large enough to override the benefit gained by the party with more information. Not disclosing criminal history has an overall positive effect for groups affected by prior convictions.

Then we test the effect of BtB on the employment rate of young men. Table 5 shows the results for men ages 25 to 35. The sample is restricted to black men from column (1) to (6) and to white men from column (7) to (12). There is no effect for black men. In column (8) there is an effect for white men but it goes away as demographics are included. Then we restrict the sample to young men with no college degree. The results are presented in table 6. There is an effect for black men with no college degree, but no effect for white men without college degrees. The significance in column (1) and (4) indicates that the employment rate of black men ages 25 to 35 with no college education increases by 1.5% due to BtB.

Table 7 shows results of the event study for the employment rate. For black men, the estimations have similar magnitude but are not precise anymore. For white men, the parallel trend assumption is violated since many pre-event coefficients are significant. We also test the effect of BtB on the incarceration rate of young men. Table 2 presents results for men ages 25 to 35. The sample is restricted to black men from column (1) to (6) and to white men from column (7) to (12). For black men, there is no effect. For white men, the coefficient on BtB is negative and significant in both column (7) and (10), and drops by 1% in size after demographics are included in column (10). This implies that BtB possibly drives incarceration rate in states that adopted BtB down by about 4%. This effect still holds for specification with three parameters in column (9). While point estimates indicate that the rate trend down before BtB and trend up over subsequent years, they are not distinguishable from zero. This supports the assumption that even timing is random.

Table 9 repeats the exercise, but this time focusing on men ages 25 to 35 without college degrees. There is still no effect for black men. However, for white men, the significant and robust effect still holds, and the size of the effect increases by about 3%. It shows that BtB helps decrease the incarceration rate of young white men without a

college education by about7%.

Table 10 presents the results of the event study model for the incarceration rate study. The sample is restricted to black men from column (1) to (4) and to white men from column (5) to (8). The dummy for the year that BtB takes effect is omitted. For black men, all pre-event dummies are never statistically significant. This satisfies the key assumption of parallel trends. There are significant after-event dummies but most significance tends to be taken away after the underlying trend is included. Comparing coefficients, the size seems too big to be reliable. The results for white men from column (5) to (8) are consistent with results in table 3. Results in column (5) and (6) shows that there is a significant decrease in incarceration for white men ages 25 to 35 in the two following years after BtB, and the size of the coefficients is similar to previous results. For white men ages 25 to 35 without a college degree, the significance goes away when the underlying trend is included.

VI. Conclusion

BtB does not have a significant effect on the probability of employment for white and Hispanic men. For young black men without a college education, there is a significant but not robust increase in the probability of employment. For black men without a high school education, the increase in the probability of employment is significant and robust, though the sample is relatively small. Such findings are consistent with the second scenario in the previous conceptual model. The probability of entering the next recruitment round may increase and qualified applicants with past convictions may have a greater chance of being hired after the implementation of BtB. Our result is corroborated by Agan and Starr's 2016 research. Using Survey of State Criminal History from the Bureau of Justice of Statistics, they find that BtB leads to 0.16 fewer criminal record checks per hire. In summary, information asymmetry in the labor market provides an advantage for the party with more information.

Besides the probability of employment, the actual employment rate for young black men with no college education increased by about 1.5%.

The incarceration rate for young white men is reduced by about 4 to 7% after BtB, and the effect is more robust for those with no college education. We propose a mechanism for this result: BtB improves job prospects for young white men with past convictions. Employment reduces their possibility of recidivism. However, since we do not consider other relevant factors, the mechanism in this side argument is a subject for further research.

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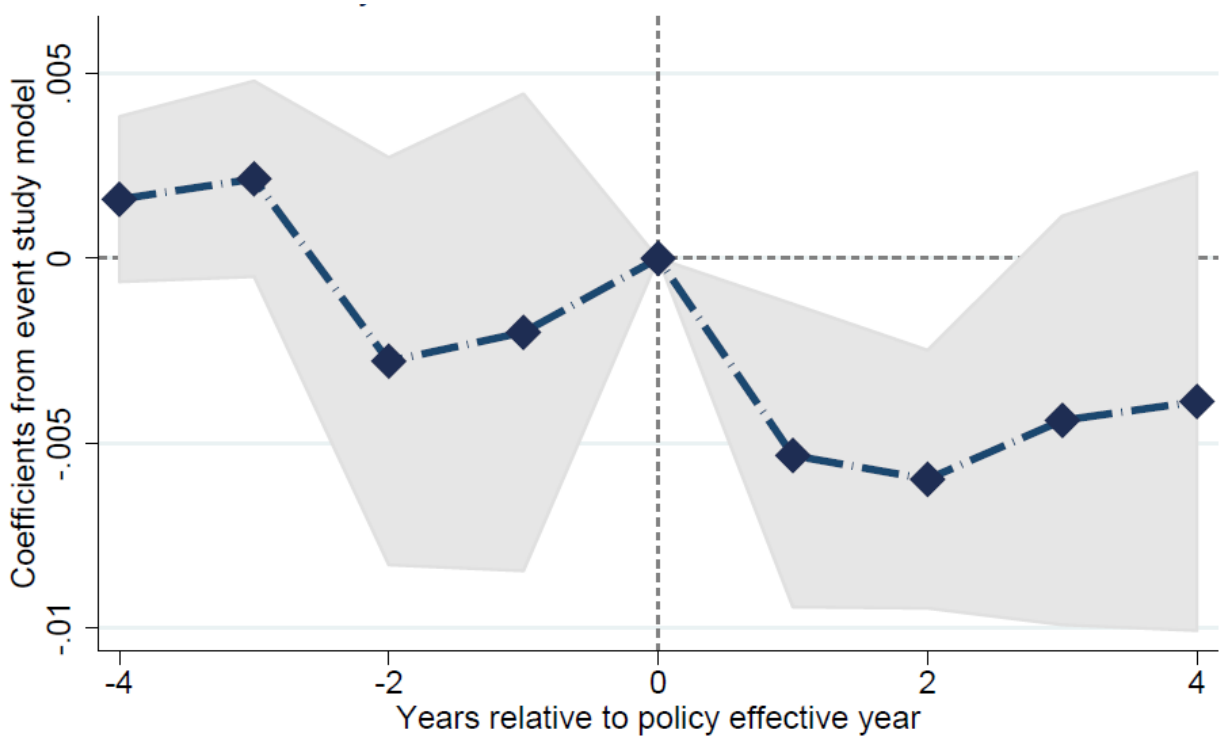
VIII. Appendices

Figure 1: Event Study for Effect of BtB on Incarceration Rate



Note: Data is from American Community Survey 2006 – 2015. Sample is restricted to white men ages 25 to 35. The plot shows coefficients from event study for effect of BtB on incarceration rate, specification (5) in table 3. This figure indicates that the parallel assumption in difference-in-difference design is satisfied.

Table 1: Summary Statistics

	Mean	(SD)	Min	Max
Employed	0.4560854	0.4980678	0	1
Ban the Box	0.1015359	0.3020371	0	1
Sex	1.513158	0.4998268	1	2
Age	39.95746	23.39165	0	96
Race	1.735656	1.783793	1	9
No college degree	0.6114736	0.4874153	0	1
College degree or more	0.3885264	0.4874153	0	1
Years of education	5.869214	3.230658	0	11
Black	0.1047176	0.3061892	0	1
White	0.7762223	0.4167748	0	1
Labor force	1.298675	0.7741942	0	2
Group type	0.1087877	0.6741479	0	9
Observations	30,557,511	30,557,511	30,557,511	30,557,511

Note: Data is from American Community Survey 2006 – 2015.

Table 2: States with Ban the Box law that are included in the sample

State	Jurisdiction	Start Date
California	State	June 25, 2010
Colorado	State	August 8, 2012
Connecticut	State	October 1, 2010
Deleware	State	May 8, 2014
Illinois	State	January 1, 2014
Maryland	State	October 1, 2013
Massachuset	State	August 6, 2010
Minnesota	State	January 1, 2009
Nebraska	State	April 16, 2014
New Mexico	State	March 8, 2010
Rhode Island	State	July 15, 2013

Source: National Employment Law Project (2016) and local legislation.

Table 3: Effects on Employment for Men Ages 25-35 with No College Degree

Table 3 : Effects on Employment for Men Ages 25 to 35 with No College Degree

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ban the Box	0.000031	-0.000183	-0.005066	-0.001475	0.000401	-0.005137	0.003650	-0.001958
	-0.003480	-0.003420	-0.005264	-0.008109	-0.008027	-0.007165	-0.005701	-0.006230
Ban the Box*black				0.015616	0.016392	0.015808	0.007124	0.0354439***
				-0.021743	-0.020624	-0.020630	-0.012060	-0.011961
Ban the Box*hispanic				-0.000290	-0.005673	-0.002990	-0.012171*	-0.003633
				-0.013988	-0.014608	-0.014540	-0.006630	-0.008051
Pre Ban the Box Baseline								
Non-black	0.7821	0.7821	0.7821	0.7821	0.7821	0.7821	0.7821	0.7821
Black	0.6043	0.6043	0.6043	0.6043	0.6043	0.6043	0.6043	0.6043
Hispanic	0.8374	0.8374	0.8374	0.8374	0.8374	0.8374	0.8374	0.8374
Controls:								
Year fixed effect	X	X	X	X	X	X	X	X
State fixed effect	X	X	X	X	X	X	X	X
Demographics		X	X		X	X	X	X
State linear trend			X			X		X
Black*demographics							X	X
Black*year							X	X
Black*state							X	X
Black*state linear trend								X
Hispanic*demographics							X	X
Hispanic*year							X	X
Hispanic*state							X	X
Hispanic*state linear trend								X
Observations	822,428	822,428	822,428	822,428	822,428	822,428	822,428	822,428
R squared	0.0110	0.0140	0.0140	0.0376	0.0441	0.0445	0.0576	0.0584

Note: The data are from the American Community Survey from 2006 t o2015 for non-institutionalized men between 25 to 35 years old and without college education. Dependent variable is individual's employment status which equals to 1 if employed and 0 otherwise. Demographics include age and education. Standard errors are clustered by state. ***p<0.001, **p<0.05, *p<0.1

Table 4: Effects on Employment for Men Ages 25-35 with No High School Degree

Table 4 : Effects on Employment for Men Ages 25 to 35 with no High School Degree

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ban the Box	-0.004720	-0.006610	-0.018200	-0.039160	-0.028260	-0.043740	-0.005320	-0.037770
	-0.011520	-0.011090	-0.014510	-0.032950	-0.029840	-0.034060	-0.024360	-0.030800
Ban the Box*black				0.17384***	0.15110***	0.14448**	0.12346**	0.097875
				-0.050440	-0.054120	-0.054180	-0.058870	-0.094930
Ban the Box*hispanic				0.030660	0.017090	-0.002990	-0.006300	0.018607
				-0.036060	-0.033230	-0.014540	-0.026100	-0.033920
Pre Ban the Box Baseline								
Non-black	0.5938	0.5938	0.5938	0.5938	0.5938	0.5938	0.5938	0.5938
Black	0.4117	0.4117	0.4117	0.4117	0.4117	0.4117	0.4117	0.4117
Hispanic	0.8627	0.8627	0.8627	0.8627	0.8627	0.8627	0.8627	0.8627
Controls:								
Year fixed effect	X	X	X	X	X	X	X	X
State fixed effect	X	X	X	X	X	X	X	X
Demographics		X	X		X	X	X	X
State linear trend			X			X		X
Black*demographics							X	X
Black*year							X	X
Black*state							X	X
Black*state linear trend								X
Hispanic*demographics							X	X
Hispanic*year							X	X
Hispanic*state							X	X
Hispanic*state linear trend								X
Observations	72724	72724	72724	72724	72724	72724	72724	72724
R squared	0.0305	0.0560	0.0583	0.1266	0.1363	0.1381	0.1456	0.1499

Note: The data are from the American Community Survey from 2006 t o2015 for non-institutionalized men between 25 to 35 years old and have never attended high school. Dependent variable is individual's employment status which equals to 1 if employed and 0 otherwise. Demographics include age and education. Standard errors are clustered by state. ***p<0.001, **p<0.05, *p<0.1

Table 5: Effects on State Level Employment Rate for Men Ages 25-35

Table 5: Effects on State Level Employment Rate for Men ages 25 to 35

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ban the Box	0.0105	0.0102	0.0107	0.0116	0.0137	0.0152	0.00506	0.00713*	0.00600*	0.00217	0.00442	0.00247
	(0.0103)	(0.0187)	(0.0185)	(0.0104)	(0.0203)	(0.0204)	(0.00335)	(0.00402)	(0.00318)	(0.00377)	(0.00362)	(0.00284)
Trend		5.65e-05	0.000231		-0.000375	0.000151		-0.000401	-0.000736		-0.000437	-0.000968
		(0.00225)	(0.00256)		(0.00229)	(0.00246)		(0.000866)	(0.000994)		(0.000868)	(0.000988)
Post trend			-0.000447			-0.00135			0.000993			0.00157
			(0.00191)			-0.00145			(0.000971)			(0.00105)
Controls:												
State fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Year fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Demographics				X	X	X				X	X	X
Sample:												
25-35 black men	X	X	X	X	X	X						
25-35 white men							X	X	X	X	X	X
Observations	500	500	500	500	500	500	500	500	500	500	500	500
R-squared	0.846	0.846	0.846	0.865	0.865	0.865	0.909	0.909	0.910	0.915	0.915	0.915

Note: Data are from American Community Survey 2005 -2015 for non institutionalized individuals, restricted to men ages 25 to 35. Dependent variable is state level employment rate. Demographics include education and age. Standard error is clustered by state. Person weight is used.

Table 6: Effects on State Level Employment Rate for Men Ages 25-35 with No College Degree

Table 6: Effects on State Level Employment Rate for Men ages 25 to 35 with No College Degree

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ban the Box	0.0156*	0.00570	0.00931	0.0154*	0.00383	0.00766	0.00105	0.00233	0.00162	0.00225	0.00251	0.00295
	(0.00848)	(0.0150)	(0.0137)	(0.00825)	(0.0132)	(0.0121)	(0.00524)	(0.00599)	(0.00572)	(0.00614)	(0.00633)	(0.00661)
Trend		0.00173	0.00289		0.00202	0.00325		-0.000247	-0.000397		-5.12e-05	4.91e-05
		(0.00242)	(0.00274)		(0.00228)	(0.00265)		(0.000975)	(0.00108)		(0.00104)	(0.00133)
Post trend			-0.00305			-0.00320			0.000543			-0.000330
			(0.00233)			(0.00240)			(0.00141)			(0.00178)
Controls:												
State fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Year fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Underlying trend		X	X		X	X		X	X		X	X
Post trend			X			X			X			X
Demographics				X	X	X				X	X	X
Sample:												
25-35 black men	X	X	X	X	X	X						
25-35 white men							X	X	X	X	X	X
Observations	493	493	493	493	493	493	344	344	344	344	344	344
R-squared	0.786	0.787	0.787	0.794	0.795	0.795	0.886	0.886	0.886	0.887	0.887	0.887

Note: Data are from American Community Survey 2005 -2015 for non institutionalized individuals, restricted to men ages 25 to 35 with no college degree. Dependent variable is state level employment rate. Demographics include education and age. Standard error is clustered by state. Person weight is used.

Table 7: Event Study of Effect of "Ban the Box" on Employment Rate

Table 7: Event study of Effect of "Ban the Box" on Employment Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
before_4	-0.00197	-0.00173	-0.00293	-0.00214	0.00174	0.00192	0.00751*	0.00744*
	(0.00665)	(0.00663)	(0.0144)	(0.0145)	(0.00270)	(0.00313)	(0.00425)	(0.00412)
before_3	-0.00670	-0.00675	-0.00836	-0.00870	-0.00906***	-0.00900***	-0.00431	-0.00431
	(0.0135)	(0.0136)	(0.0154)	(0.0154)	(0.00303)	(0.00304)	(0.00635)	(0.00645)
before_2	0.00483	0.00443	0.0125	0.0106	-0.00744*	-0.00755*	0.00390	0.00399
	(0.0254)	(0.0250)	(0.0249)	(0.0241)	(0.00433)	(0.00428)	(0.00682)	(0.00743)
before_1	0.00151	0.000791	-0.0139	-0.0170	-0.00174	-0.00201	0.00372	0.00390
	(0.0126)	(0.0121)	(0.0146)	(0.0137)	(0.00406)	(0.00436)	(0.00909)	(0.0103)
after_1	0.00196	0.000568	0.00930	0.00337	0.000194	-0.000388	0.00297	0.00333
	(0.00806)	(0.00753)	(0.0110)	(0.0111)	(0.00294)	(0.00292)	(0.00408)	(0.00594)
after_2	0.0170	0.0154	0.0213	0.0146	0.00128	0.000606	0.00234	0.00275
	(0.0148)	(0.0153)	(0.0138)	(0.0148)	(0.00337)	(0.00443)	(0.00886)	(0.0116)
after_3	0.0299	0.0285	0.0345	0.0282	0.00427	0.00360	0.00144	0.00184
	(0.0264)	(0.0259)	(0.0307)	(0.0298)	(0.00622)	(0.00590)	(0.00763)	(0.00641)
after_4	0.0130	0.0112	0.0407	0.0332	0.00608	0.00530	-0.00266	-0.00219
	(0.0240)	(0.0233)	(0.0470)	(0.0475)	(0.00617)	(0.00575)	(0.0110)	(0.0102)
Underlying trend		0.000356		0.00146		0.000175		-9.50e-05
		(0.00119)		(0.00156)		(0.000736)		(0.00108)
Controls								
State fiexed effect	X	X	X	X	X	X	X	X
Year fixed effect	X	X	X	X	X	X	X	X
Sample								
25-35 black men	X	X						
25-35 black men with no collge educ			X	X				
25-35 white men					X	X		
25-35 white men with no college educ							X	X
Observations	500	500	493	493	500	500	500	500
R-squared	0.365	0.367	0.789	0.789	0.911	0.911	0.887	0.887

Note: The data are from the American Community Survey from 2006 t o2015 for non-institutionalized individuals. Dependent variable is the employment rate in state *s* and year *t*. Person weight is used. Demographics include age and education. Standard errors are clustered by state. ***p<0.001, **p<0.05, *p<0.1

Table 8: Effects on State Level Incarceration Rate for Men Ages 25-35

Table 8: Effects on State Level Incarceration Rate for Men Ages 25 to 35

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ban the Box	-0.00733	0.00604	0.000198	-0.00729	0.00417	-0.00193	-0.00566**	-0.00364	-0.00441**	-0.00421*	-0.00228	-0.00267
	(0.00847)	(0.0153)	(0.0144)	(0.00826)	(0.0154)	(0.0148)	(0.00215)	(0.00235)	(0.00211)	(0.00217)	(0.00247)	(0.00225)
Trend		-0.00237	-0.00443**		-0.00203	-0.00415**		-0.000391	-0.000618		-0.000376	-0.000484
		(0.00251)	(0.00212)		(0.00239)	(0.00193)		(0.000393)	(0.000456)		(0.000353)	(0.000437)
Post trend			0.00528**			0.00542***			0.000671			0.000317
			(0.00199)			(0.00150)			(0.000406)			(0.000410)
Controls:												
State fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Year fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Demographics				X	X	X				X	X	X
Sample:												
25-35 black men	X	X	X	X	X	X						
25-35 white men							X	X	X	X	X	X
Observations	500	500	500	500	500	500	500	500	500	500	500	500
R-squared	0.828	0.829	0.831	0.843	0.844	0.846	0.865	0.865	0.866	0.872	0.872	0.872

Note: Data are from American Community Survey 2006 -2015 for non institutionalized individuals, restricted to men ages 25 to 35. Dependent variable is state level incarceration rate. Demographics include education and age. Standard error is clustered by state. Person weight is used.

Table 9: Effects on State Level Incarceration Rate for Men Ages 25-35 with No College Degree

Table 9: Effects on State Level Incarceration Rate for Men ages 25 to 35 with No College Degree

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ban the Box	-0.0148	0.0179	0.00850	-0.0132	0.0199	0.0109	-0.00770*	-0.00637	-0.00673*	-0.00787*	-0.00639	-0.00716*
	(0.0105)	(0.0216)	(0.0202)	(0.0104)	(0.0201)	(0.0189)	(0.00394)	(0.00429)	(0.00345)	(0.00447)	(0.00432)	(0.00368)
Trend		-0.00572	-0.00877***		-0.00578*	-0.00868***		-0.000256	-0.000332		-0.000296	-0.000471
		(0.00363)	(0.00279)		(0.00342)	(0.00274)		(0.000772)	(0.000963)		(0.000833)	(0.00111)
Post trend			0.00797***			0.00750***			0.000274			0.000576
			(0.00235)			(0.00238)			(0.000984)			(0.00115)
Controls:												
State fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Year fixed effect	X	X	X	X	X	X	X	X	X	X	X	X
Demographics				X	X	X				X	X	X
Sample:												
25-35 black men	X	X	X	X	X	X						
25-35 white men							X	X	X	X	X	X
Observations	500	500	500	500	500	500	500	500	500	500	500	500
R-squared	0.779	0.783	0.786	0.785	0.789	0.792	0.833	0.833	0.833	0.833	0.833	0.833

Note: Data are from American Community Survey 2006 -2015 for non institutionalized individuals, restricted to men ages 25 to 35 with no high school degree. Dependent variable is state level incarceration rate. Demographics include education and age. Standard error is clustered by state. Person weight is used.

Table 10: Event Study of Effect of "Ban the Box" on Incarceration Rate

Table 10: Event study of Effect of "Ban the Box" on Incarceration Rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
before_4	-0.00465	-0.00507	-0.00360	-0.00479	0.00160	0.00107	0.00266	0.00235*
	(0.0109)	(0.0109)	(0.0208)	(0.0211)	(0.00114)	(0.000644)	(0.00186)	(0.00132)
before_3	0.00472	0.00479	-0.00226	-0.00174	0.00215	0.00197**	0.000413	0.000418
	(0.00782)	(0.00822)	(0.0131)	(0.0141)	(0.00135)	(0.000885)	(0.00264)	(0.00223)
before_2	-0.0144	-0.0137	-0.0379*	-0.0351*	-0.00278	-0.00246	-0.00774	-0.00731
	(0.0141)	(0.0141)	(0.0214)	(0.0208)	(0.00281)	(0.00238)	(0.00508)	(0.00507)
before_1	-0.00776	-0.00649	-0.0226	-0.0178	-0.00200	-0.00123	-0.00253	-0.00173
	(0.0106)	(0.00962)	(0.0140)	(0.0108)	(0.00329)	(0.00293)	(0.00719)	(0.00715)
after_1	-0.00477	-0.00230	-0.0142	-0.00526	-0.00533**	-0.00365**	-0.00609	-0.00449
	(0.00926)	(0.00956)	(0.0131)	(0.0152)	(0.00209)	(0.00160)	(0.00374)	(0.00330)
after_2	-0.0232**	-0.0204	-0.0366**	-0.0264	-0.00597***	-0.00403**	-0.0112**	-0.00932
	(0.0103)	(0.0133)	(0.0140)	(0.0203)	(0.00178)	(0.00154)	(0.00430)	(0.00559)
after_3	-0.0360*	-0.0334	-0.0672*	-0.0577	-0.00438	-0.00245	-0.00536	-0.00356
	(0.0198)	(0.0212)	(0.0342)	(0.0356)	(0.00282)	(0.00239)	(0.00698)	(0.00583)
after_4	-0.0252***	-0.0221*	-0.0813***	-0.0700***	-0.00387	-0.00160	-0.00590	-0.00380
	(0.00831)	(0.0110)	(0.0147)	(0.0191)	(0.00316)	(0.00253)	(0.00794)	(0.00667)
Underlying trend		-0.000474		-0.00221		-0.000507		-0.000429
		(0.00176)		(0.00244)		(0.000325)		(0.000711)
Controls								
State fiexed effect	X	X	X	X	X	X	X	X
Year fixed effect	X	X	X	X	X	X	X	X
Sample								
25-35 black men	X	X						
25-35 black men with no college educ			X	X				
25-35 white men					X	X		
25-35 white men with no college educ							X	X
Observations	500	500	500	500	500	500	500	500
R-squared	0.847	0.847	0.787	0.788	0.865	0.867	0.834	0.835

Note: The data are from the American Community Survey from 2006 t o2015 for non-institutionalized individuals. Dependent variable is the incarceration rate in state *s* and year *t*. Person weight is used. Demographics include age and education. Standard errors are clustered by state. ***p<0.001, **p<0.05, *p<0.1

AN APPLICATION OF THE PHILLIPS CURVE TO THE INDIAN ECONOMY

BY: Shambhavi Tiwari (Columbia University)


WHEN

An Application of the Phillips Curve to the Indian Economy

Shambhavi Tiwari
Department of Economics
Columbia University

Advisor: Professor Jushan Bai

Abstract

Using data from the Indian economy spanning January 1980 to August 2016, I find that the tradeoff between inflation and unemployment implied by the Phillips Curve is nonexistent. Using supply shock variables for liberalization, droughts, and oil prices, I fit a New-Keynesian Phillips Curve (NKPC) to the Indian economy. The NKPC proves to be of little applicability to the Indian case, despite the inclusion of supply shocks and despite the application of both OLS and GMM estimators.

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Contents

I. Introduction

In their book *Poor Economics*, Esther Duflo and Abhijit V. Banerjee explain how economists often encounter problems when attempting to apply models tailor-made for advanced economies to the developing world. The Phillips Curve is a classic example of an empirical relationship between two macroeconomic variables (inflation and unemployment) that was originally devised for a post-modern nation, namely the United Kingdom (Phillips, 1958). The curve has proved applicable other advanced economies, such as that of the United States in the period from 1960-1979 (Fuhrer, 1995). Using Duflo and Banerjee's narrative as a prompt, my research is motivated by the question: Is the Phillips Curve applicable to developing economies, specifically the Indian economy? Although applying the Phillips Curve to multiple developing countries is beyond the

scope of my research, I believe that its application to the Indian economy can be insightful for the case of developing economies as a whole. Although the Indian economy is growing faster than most, it continues to share many characteristics with other developing economies.[1]

The Phillips Curve is often used as a macroeconomic rule and helps shape policy decisions made by many countries' central banks. Can the Reserve Bank of India (RBI), India's central bank, use this macroeconomic rule as a policy determinant? The relationship between inflation and unemployment is particularly important considering that RBI considers price stability to be one of its major goals. If the curve is not applicable, can modifications like the addition of supply shocks make it specific to the Indian economy?

My paper is organized as follows. The next section will cover the theoretical foundations of the Phillips Curve. Section 3 is a brief literature review. Section 4 covers data-related issues. Section 5 provides the results of my estimation, and Section 6 concludes.

[1] See: "Is India still a developing country?" *The Guardian*, 6 April 2014, https://goo.gl/KLLCio

II. Theoretical Foundations

In its broadest application, the Phillips Curve provides a basis for the existence of a tradeoff between inflation and unemployment. Okun's Law, which suggests a negative relationship between unemployment and economic growth, also implies a positive relationship between inflation and total output (Paul, 2009). As a result, empirical applications of the Phillips Curve often examine the relationship between inflation and the 'output gap,' which is the difference between actual and potential output. A positive output gap implies excess production. As has been found in many economies, including the American and British economies, the relationship between inflation and output gap is expected to remain positive as a direct result of the Phillips Curve and Okun's Law.

Further work on the Phillips Curve helped derive it from its microeconomic foundations in the product market. As explained by Sahu (2013), this specific model of the Phillips Curve, known as the New Keynesian Phillips Curve (NKPC), assumes that individual firms are monopolistically competitive and set prices by accounting for their current marginal costs and maximizing their expected future profits. This feature makes prices sticky in the NKPC; firms set prices based on expectations of future prices as well as their current marginal costs. Since marginal costs for individual firms are hard to measure, conventional estimates of the NKPC substitute marginal costs for the deviations from the natural rate of unemployment. The logic behind this substitution is that firms which experience high marginal costs will reduce the number of workers they employ. Thus, the NKPC is modeled as below:

$$\pi_t = -\theta(u_a - u_n) + E_t\pi_{t+1}$$

Where π_t is inflation at time *t*, u_a is actual unemployment at time *t*, and u_n is the natural rate of unemployment at time *t*. Thus θ measures the effect of cyclical unemployment on inflation π_t. $E_t\pi_{t+1}$ is the agents' expectation of inflation at time $t+1$ when they are in time t.

Using Okun's Law, one can substitute the term $u_a - u_n$ with the output gap. This is also a relevant transformation for my problem because monthly unemployment data for the Indian economy is rarely found in freely available datasets online. The above equation is transformed to the following:

$$\pi_t = \beta(y_a - y_n) + E_t\pi_{t+1}$$

Where y_a denotes actual output, y_n denotes potential output, and thus β becomes the coefficient for the output gap.

Paul (2009) points to the inadequacy of past literature on including supply shocks in their estimations of the Phillips Curve. However, the work of Gordon (1984) points to the usefulness of this addition. Supply shocks, which exogenously cause shifts in the aggregate supply curve, affect both inflation and output levels. They are included in the NKPC as below:

$$\pi_t = \beta y_t + E_t\pi_{t+1} + S_t$$

Where y_t denotes the output gap and S_t represents the various country-specific supply shocks.

III. Literature Review

Literature on the Indian Phillips Curve previous to Paul (2009), finds that the curve is nonexistent to the Indian economy. For example, Dholakia (1990) attributes the curve's nonexistence to the "underutilized potential" of developing economies. However, using annual data, Paul finds that the tradeoff between inflation and unemployment holds even for the Indian case. Paul makes a breakthrough by using a whole range of supply shocks that continue to be used by following literature, such as Mazumder (2011) and Jain (2015). I adopted the techniques of these authors amongst others, as below, when choosing the data to use for my application to the Indian NKPC. I reference techniques from past literature with regards to the NKPC in the next section.

IV. Data

My data spans from January 1980 till August 2016, and is significantly more recent than the data used by previous literature, most of which extends only until the late 2000s.

Although the Reserve Bank of India (RBI) has recently started publishing information on households' inflationary expectations, this data is inconsistently found and only available for the most recent years. Due to this data availability problem, I assume rational expectations. With rational expectations, agents have perfect foresight and thus I replace $E_t \pi_{t+1}$ in equation (1) above with $E_t \pi_{t+1} = \pi_{t+1}$.

However, as explained by Jain (2015), the rational expectations-based NKPC has been heavily criticized because it does not factor in past inflation. In response, Galí and Gertler (1999) and Galí and Lopez-Salido (2005) proposed a hybrid NKPC in which present inflation is dependent on both future and past inflation. This proposal is sensible considering that the New Keynesian model assume prices to be sticky and firms to have

imperfect information, which leads firms to set prices based on future expectations of profits as well. Like Sahu (2013), I estimate the equation above using the following specification:

$$\pi_t = b_o + \beta(L^k)y_t + \alpha(L^p)\pi_{t-1} + \mu(L^n)S_t + \upsilon\pi_{t+1} + \varepsilon_t \quad \textbf{(1)}$$

Where *(L)* represents lags of order *k, p, n* on output gap, past inflation, and supply shocks respectively.

The inclusion of the term π_{t+1} is contentious in literature on the Phillips Curve. Some authors, like Dua and Gaur (2009) find that the forward-looking hybrid NKPC is a better estimate of inflationary levels in developing countries. Other authors, like Kapur (2013), point to the fact that the hybrid NKPC has received criticism and proves to be weak when tested on its potential for forecasting. Most importantly, Gordon (2013) establishes the "triangle model" of inflation π_t, which assumes three main determinants for inflation: expectations, demand-side factors, and supply-side factors. In fact, my hybrid NKPC specification of equation (2) includes both demand-side factors of inflation, proxied by the output gap, as well as supply-side factors of inflation, proxied by supply side shocks. Although I choose to make a deviation from the triangle model by including π_{t+1} in my specification, I will also make estimates in my results section omitting the term π_{t+1} in equation (2), making my new estimation of the form:

$$\pi_t = b_o + \beta(L^k)y_t + \alpha(L^p)\pi_{t-1} + \mu(L^n)S_t + \varepsilon_t \quad \textbf{(2)}$$

In addition, the output gap y_t is modeled using different specifications in Sahu (2013), Paul (2009) and Dua and Gaur (2009). Sahu has a legitimate concern particular to developing countries: modeling only $y_t$is faulty because agriculture is a significant

portion of the Indian GDP (17% of the 2015 Indian GDP according to World Bank estimates). As a result, he recommends estimating industrial output y_t^i and agricultural output y_t^a separately in equation (2), as specified below:

$$\pi_t = b_o + \beta(L^k)y_t^i + \gamma(L^q)y_t^a + \alpha(L^p)\pi_{t-1} + \mu(L^n)S_t + \upsilon\pi_{t+1} + \varepsilon_t \quad \textbf{(3)}$$

However, Paul explains that specification (4) would be lead to multicollinearity as industrial and agricultural outputs are highly correlated. Instead, he suggests instrumenting agricultural output by using droughts as supply shocks, since a nationwide drought would be most harmful in reducing agricultural output. Although droughts are an imperfect proxy for agricultural output, due to the multicollinearity issue above and the lack of monthly agricultural output data for India, I choose to include droughts. I will discuss the additional supply side shocks that I use in my model below.

Dua and Gaur claim that using output gap for demand side factors is insufficient for developing countries, and propose using both the industrial production output gap and the real money output gap in the hybrid NKPC. This is because monetary policy in developing countries has a more autonomous effect on inflation than in developed countries. In theory, money supply affects interest rates, which in turn affects aggregate demand and thus indirectly has an effect on inflation. It can be argued, however, that interest rates in developing countries do not affect aggregate demand as strongly as expected due to weak financial markets. In other words, the NKPC can be estimated in developed countries using the industrial production output gap alone, as the effect of monetary policy is sufficiently reflected in this output gap. But including only the industrial production output gap will not suffice in developing countries. Thus the NKPC can be modified as below:

$$\pi_t = b_o + \beta(L^k)y_t + \lambda(L^m)m_t + \alpha(L^p)\pi_{t-1} + \mu(L^n)S_t + \upsilon\pi_{t+1} + \varepsilon_t \quad (4)$$

Where y_t denotes the IIP (Index of Industrial Production) output gap, m_t is the real money output gap, calculated as the difference between actual and potential monetary aggregate (using M3 measures of money in the economy). I further evaluate Dua and Gaur's argument in Appendix (A).

As Jain (2015) recognizes, data on inflation in India is found in the Wholesale Price Index (WPI) and the Consumer Price Index (CPI). The WPI mainly measures inflation of goods in the manufactured sector, although food and primary articles also account for a significant portion of the measure. CPI measures in India are historically divided into four categories: CPI for industrial workers, rural laborers, agricultural laborers and urban non-manual employees. However, since 2011, the RBI has created a new CPI that combines all four sector-specific historical measurements. Although conventional Phillips Curve estimations rely on CPI measures to calculate inflation, due to the very recent nature of aggregated CPI estimates for the Indian economy, I will use WPI data in my regressions.

I choose to use monthly data so I can record the effect of month-on-month changes in the regressors included in my NKPC estimation, as opposed to year-on-year changes. My calculations help me avoid the base effect, which Hayashi et al. (2015) recognize as distortions to inflationary levels. The base effect specifies that if year-on-year data is used, a permanent or temporary shock to the inflation in one month will cause a continuous decrease for the next year of inflationary data. On the other hand, with month-on-month data the shock will be reflected in that month alone. To avoid this problem, I choose to use monthly data.

Data for the WPI is collected from the Office of the Economic Advisor's website. However, the data is not unified according to one base year, ranging from data with the

base years of 1970-71, 1981-82, 1993-94, and 2004-05. Using the 'arithmetic conversion' method recommended by the Indian government, I rebase all the WPI to the base year of 2004-05. The details of my rebasing calculations are provided in Appendix (B).

Kapur (2013) recommends using Non-Food Manufactured Products (NFMP) inflation instead of WPI inflation. NFMP inflation is a measure created and provided by the Reserve Bank of India. Kapur points to several advantages of using NFMP inflation, most importantly that this specific measure of inflation is more reflective of core underlying trends in the economy, and that it is more reflective of demand-side shocks to the Indian economy. Indeed, the NFMP and other core measures of inflation take headline inflation and subtract the more volatile components of energy and food prices. Hayashi et al. (2015) also choose to exclude food and beverage prices from their WPI when estimating the Phillips Curve for the Sri Lankan economy. Their rationale for doing so is that both food and beverage prices reflect supply and demand-side factors which are difficult to separate from each other.

However, I choose to include headline WPI inflation as opposed to core for three main reasons. First, monthly data on NFMP inflation is not freely available on the Web. It is also tricky to manually calculate core WPI inflation from headline WPI because different years of the Indian WPI are comprised of different baskets of wholesale products. Thus it is difficult to determine which exact components should be consistently removed from these baskets. Third, I contend that it can be erroneous to use core inflation when making policy decisions with the Phillips Curve due to the nature of the Indian economy. Former RBI governor D. Subbarao has also recognized the pitfalls of using core WPI inflation. Typical to a developing country, food and energy prices comprise of 65% of the Indian inflation basket, and inflation has been persistent in these sectors. Components of inflation baskets that are so significant and persistent should not be excluded from analysis in the NKPC. It is also easier to use

core inflation for developed economies, since "[the] relevance of core inflation is much higher in advanced economies as food constitutes a lesser portion of the consumption basket, unlike India," according D.K. Joshi, chief economist at Crisil Ltd.[2]

I proxy output using monthly industrial production data, found from the Index of Industrial Production (IIP) from the International Monetary Fund's International Finance Statistics (IFS) database. All data is based on the year 2010. To calculate the output gap I transform IIP data, as recommended by Mazumder (2011), Sahu (2013), Kapur (2013), and the majority of the literature on the Indian Phillips Curve. To accurately calculate potential output, I first deseasonalize IIP data using the Stata moving average filter with weights [2 1 2]. Most literature, including Hayashi et al. (2015), deseasonalize their data using governmental deseasonalizing software, such as the X-12 ARIMA software created by the U.S. Census Bureau. However, Baum (2006, p178) points out that these more complex software filtering techniques can be replaced by the Stata moving average filter. I cannot omit deseasonalizing my data because I next use the Hodrick-Prescot (HP) filter to find a trend for the IIP data, and as explained by Alexandrov et al. (2008, p10), the HP filter requires seasonally adjusted data. This is because the trend of the HP filter is calculated using:

$$\min_{\tau}\left(\sum_{t=1}^{T}(y_t-\tau_t)^2+\lambda\sum_{t=2}^{T-1}[(\tau_{t+1}-\tau_t)-(\tau_t-\tau_{t-1})]^2\right) \quad (5)$$

Where I assume $IIP = y_t = \tau_t + c_t + \varepsilon_t$ where c_t is the cyclical component of y_t and τ_t is the trend component of y_t, and ε_t the error. In addition, $\lambda = 14{,}400$ is adopted by Hayashi et al. (2015) and advised for the HP filter when using monthly data. Equation

[2] See: "Core inflation may not be a true indicator: Subbarao" Livemint, 18 July 2012, https://goo.gl/mVHg2p

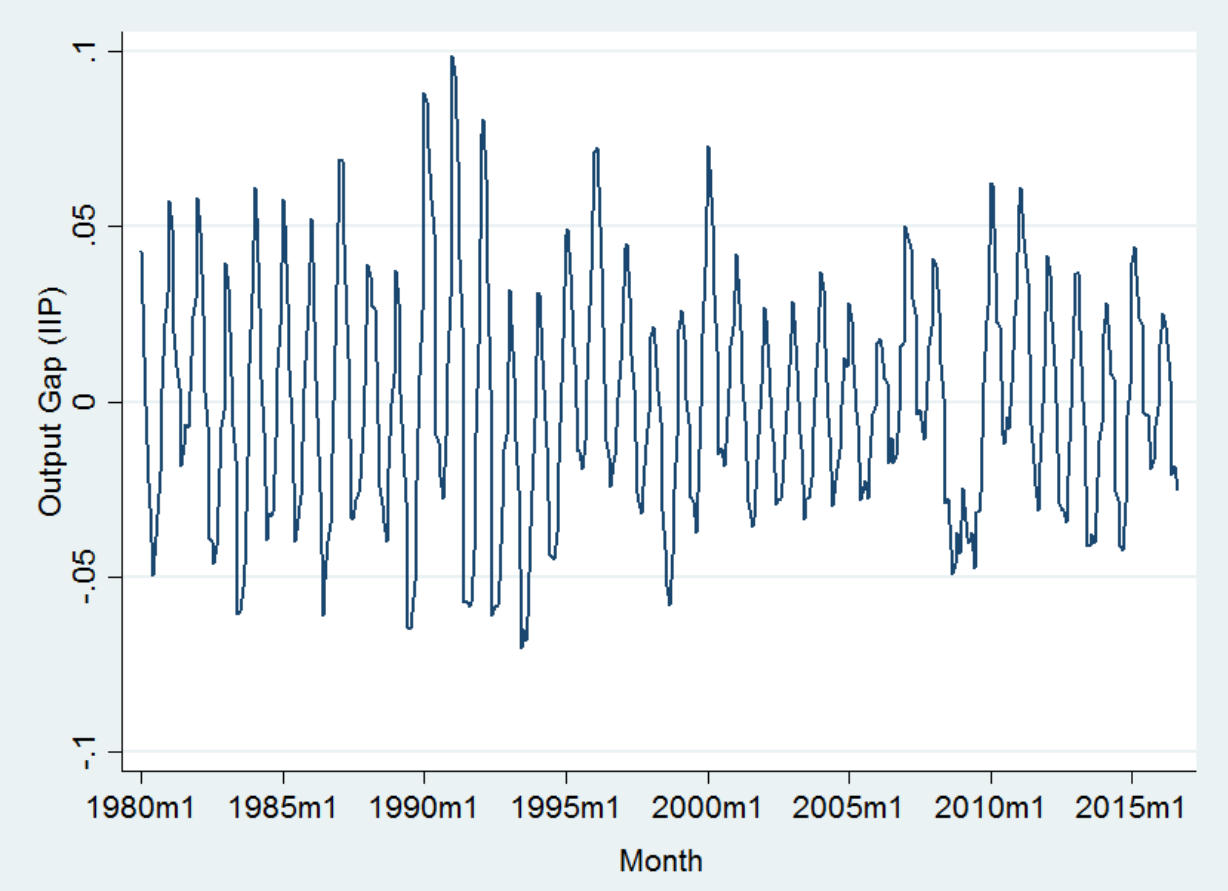
(6) above shows that the HP filter requires that the series y_t be comprised of a cyclical and trend component only, not a seasonal component.

I next take the natural log of the seasonally adjusted series $\ln(iip_{ma})$, where *ma* is the moving average filter used for seasonal adjustment. I obtain the output gap using:

$$IIPoutput\_gap = \ln(iip_{ma}) - HP_{trend}[\ln(iip_{ma})] \quad (6)$$

Where iip_{ma} is the moving average filter applied to the monthly IIP data, and HP_{trend} is the trend component of the HP filter as calculated in equation (6) above. I plot $IIPoutput\_gap$ below:

Figure 1: Output gap calculated using monthly IIP data



Source: IMF *IFS*

Further discussion on the need for detrending and deseasonalizing my data can be found in Appendix (C).

Data for money supply, used in the output gap in equation (5), is collected from the OECD. I use data for broad money (M3) and calculate the output gap identical to the calculation for the IIP output gap above. Although the OECD data is seasonally adjusted, I still use the moving average filter on the M3 to have an identical calculation method to IIP output gap.

$$M3output\_gap = \ln(M3_{ma}) - HP_{trend}[\ln(M3_{ma})] \quad (8)$$

Where $M3_{ma}$ is the moving average filter applied to the monthly IIP data, and HP_{trend} is the trend component of the HP filter as calculated in equation (6) above.

The majority of literature after Paul (2009) focusing on the Indian Phillips Curve is quite unanimously in favor of including supply shocks in the NKPC. Supply shocks are recognized to have a multiplier effect, in which shocks that mainly affect agricultural or primary-sector economies are multiplied throughout other sectors as well. In addition, India's status as an open economy makes it even more vulnerable to shocks in the economies of its trade partners. Paul recommends using three dummy variables as supply side shocks: for the liberalization of the Indian economy in 1992, for nation-wide droughts, and for shocks to global crude oil prices. Sahu (2013) also includes in his supply side shocks specification the price levels of the top twenty import partners of India, as well as the nominal exchange rate of the U.S. dollar to the Indian rupee.

In accordance with the NKPC estimations of Mazumder (2011), which augment Paul's, I use the supply shock of global oil price levels in Indian Rupees (INR) instead of global oil price dummies. I do so by multiplying crude oil prices by the US dollar to Indian rupee exchange rate. This particular calculation allows my supply shock of global

price levels to also reflect any shocks to the US Dollar/INR exchange rate, which is a significant supply shock in both Sahu and Kapur's estimations (2013). It is important to note that crude oil prices are indexed in the Federal Reserve datasets according to their suppliers. Thus, there are three indices of global oil: the BRENT, Dubai, and WTI (Texas) crude oils.

India is known to export only from BRENT and Dubai crude, in a fixed ratio between the two that has only been published from the year 2000-01 onwards. Therefore, I use only the global crude oil prices of BRENT and Dubai, making the assumption that in the years before 2000-01, the Indian government maintained the ratio of BRENT to Dubai imports that it had been using in 2000-01. Data for the ratio of the oil imports for the Indian economy is obtained from the Petroleum Planning and Analysis Cell (PPAC) of the Indian government. With this assumption, I calculate the unified monthly data for crude oil prices from January 1980 to August 2016, in US dollars per barrel, doing a weighted average between the BRENT and Dubai crude oil prices, weighed by the ratio provided by the PPAC. I then multiply these prices by the monthly US dollar/INR exchange rate, which I obtain from the IMF's International Financial Statistics (IFS).

Although the Nominal Effective Exchange Rate (NEER) would have been a better measure of exchange rate-related supply-side shocks to the Indian NKPC, I am faced with the classic problem of data availability. The NEER would provide me with the "weighted average of bilateral nominal exchange rates of the...[Rupee] in terms of foreign currencies," according to the Open Government Data Platform for India. The NEER is often measured in terms of trading partners' currencies and so any fluctuations in this measure would be a better reflection of supply shocks than just the US dollar/INR exchange rate. However, since monthly NEER data is unavailable, I use the latter.

Using Paul's specification of the liberalization dummy variable, I create a dummy variable lib_t that takes the value of 1 for the years 1992-95 and 0 otherwise. During this period, the Indian economy underwent "industrial delicensing, exchange rate reform, partly liberalizing capital flows, and current account convertibility," according to Paul. One cannot expect the shock of lib_t to be represented through the other variables included in the NKPC specification (2). This is because the shocks that the economy experienced during this liberalization period were multiple and widespread through the economy. For example, liberalization led to both financial crises and increases in agricultural prices, which are both best represented through the dummy variable lib_t.

Paul explains that instrumenting agricultural output using a dummy variable for droughts is a complicated process because only a certain level of drought will harm agricultural output. Paul finds significant effects with rainfall deficiencies higher than 18% of the long period average of rainfall (89 cm, as estimated by the Indian government). Along with other data on droughts in India, Paul uses his findings to assign the dummy variable $drought_t$ the value of 1 for the years 1972-4, 1979-81, 1982-4, 1987-9, and 2002-4, and 0 otherwise. Media reports show that India has been experiencing severe droughts after 2002 as well, something that has not been captured by past literature.[3] Since monthly Indian agricultural output data is difficult to find in freely available formats on the Web, I take a more rudimentary approach to investigate recent rainfall deficiencies. I calculate the average of annual rainfall levels from 1901-2013 with data obtained from the Indian Meteorological Department. I then calculate the percentage deviation of each

[3] See: "Crops in India wilt in a weak monsoon season," New York Times, 3 September 2012, https://goo.gl/kNCZI

See: "India is suffering one of its worst droughts in decades," Bloomberg, May 3, 2016, https://goo.gl/rlSS9r

year's rainfall from its average value. I find that the percentage deviations of rainfall in the years 2009 and 2012 are just as excessively negative as the ones in the drought years of 1982, 1987, and 2002. I thus extend the dummy and also assign it the value 1 for the years 2009 and 2012. My calculations can be found in Appendix (D).

Although I have followed similar data collection and processing methods to past literature, my data still has several shortcomings. First, the WPI does not account for any services provided. This is a major shortfall, since Jain (2015) recognizes the services sector to be the largest in the Indian economy. The calculation of the WPI according to base year 2004-05 is also faulty, as this base year is dated. And with new technologies and changing markets, the basket of wholesale goods needs to be updated, a fact recognized by the Mid-Year Economic Report of 2015.

Mohanty and Klau (2001) have critiqued the HP filter. It has conventionally been used to de-trend data, but its selection of an arbitrary (the selection of which has little theoretical foundation), its end-sample bias, and its inability to capture supply-side shocks and rapid structural changes make the HP filter an imperfect tool for de-trending data.

Finally, the assumption of perfect foresight and rational expectations is very unlikely to be true in most economies. This is especially the case in developing countries, where literacy rates are low and the majority of the population is poorly educated in comparison to their counterparts in developed economies. It is difficult to make adequate estimations of inflationary expectations in the case of developing economies, but it is important to be aware that rational expectations can be a fallacious assumption.

V. Estimation Results

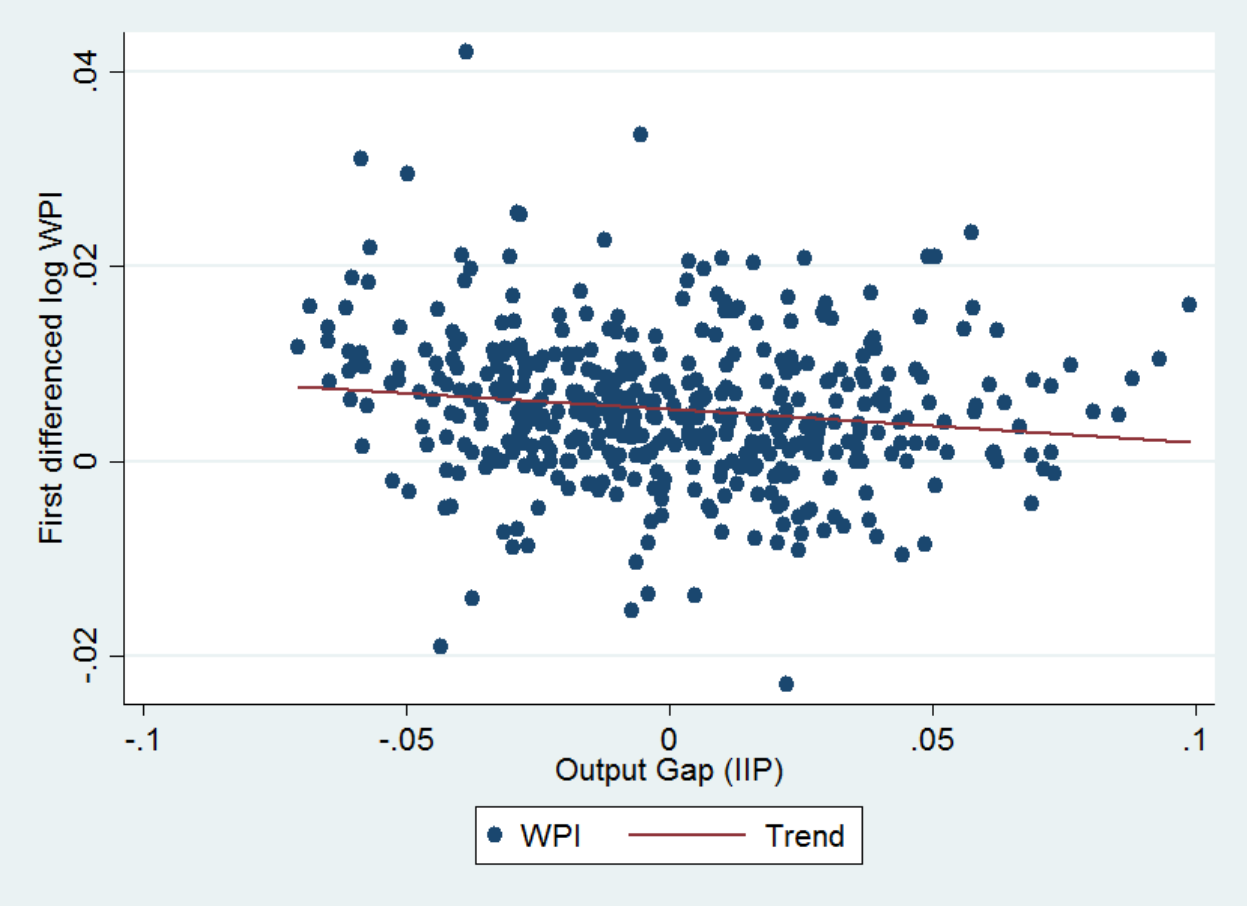
Before estimation, I ensure the stationarity of all my data. I also estimate the ideal number of lags using the AIC criterion (using a maximum lags specification of 12, as I am using monthly data). The results of my estimation can be found in Table 1 below. I use both the Augmented Dickey-Fuller and the Phillips Perron unit root tests, testing with and without a trend component to be assured of my variables' stationarity. Since I found π_t and the price of oil, in INR, to be non-stationary, I take the first difference of their natural logs. This transformation makes both variables stationary.

Table 1: Augmented Dickey-Fuller and Phillips-Perron unit root test statistics

Regressor	Number of lags from AIC criterion (max. lags 12)	ADF		PP	
		Trend	No trend	Trend	No Trend
π_t WPI inflation	10	-1.578	1.885	-1.277	2.766*
$D.\log(\pi_t)$ = First differenced log WPI inflation	12	-5.089***	-4.779***	-13.254***	-13.172***
Output gap (IIP)	12	-8.556***	-8.566***	-4.293***	-4.304 ***
Output gap (Monetary aggregate M3)	11	-5.762***	-5.768***	-4.799***	-4.803***
Price of Oil, INR	11	-2.468	-1.358	-2.299	-1.279
***dlpoilinr* = First differenced log price of oil, INR**	6	-9.495***	-9.505***	-14.731***	-14.750 ***
$Drought_t$ (Drought years dummy)	1	-3.518**	-3.531***	-3.519**	-3.531***
Lib_t (Liberalization dummy)	1	-2.344	-2.283	-2.347	-2.287
D. Lib_t	0	-20.860***	-20.881***	-20.860***	-20.881***
π_t- WPI inflation	10	-1.578	1.885	-1.277	2.766*
$D.\log(\pi_t)$ = First differenced log WPI inflation	12	-5.089***	-4.779***	-13.254***	-13.172***
Output gap (IIP)	12	-8.556***	-8.566***	-4.293***	-4.304 ***
p<0.10, ** p<0.05, *** p<0.010					

Before doing the estimation, I also do a preliminary plot of the Indian Phillips Curve in a model that does not account for any supply shocks. It is evident from Figure 2 below that supply shocks are necessary since the original Phillips Curve does not seem to hold, given the negative relationship between IIP output gap and WPI inflation:

Figure 2: Plotting WPI vs IIP output gap for India, 1980m1-2016m8



Source: IMF IFS and Office of the Economic Advisor, Govt. of India

Mazumder (2011) adopts an OLS estimation of the Indian NKPC, with heteroskedasticity autocorrelation robust (HAC) standard errors. The results of my estimation are provided in Table 2 below and, in order to be concise, I choose to provide only the significant coefficients. I estimate the backwards-looking NKPC, consistent with equation (2) above, using only IIP output gap in specification 1 and using both IIP and M3 output gap in specification 3. In specification 2 and 4, I estimate the hybrid NKPC that is consistent with equation 1 above.

My results are surprising given the consistency of past literature after Paul in finding evidence for the Phillips Curve for the Indian case. All of my OLS regressions show a negative relationship between the output gap (both M3 and IIP) and WPI with certain lags. Looking specifically at the twice-lagged IIP output gap, specifications 1-4 tell me that the effect of a percentage increase in the output gap (which implies that actual output is above its potential) would cause a decrease in the WPI two periods later ranging between 0.08-0.14 percent. This result is counterintuitive to economic theory.

Table 2: OLS with HAC standard errors estimation of the Indian NKPC

Regressor	Coefficient (Standard Error)		
	Specification 1: Backwards looking NKPC	Specification 2: Hybrid NKPC	Specification 3: Backwards looking NKPC with IIP + M3 output gap
$\mathbf{WPI_{t+1}}$	-	0.31*** (0.04)	-
$\mathbf{WPI_{t-1}}$	0.32*** (0.05)	0.30*** (0.05)	0.32*** (0.05)
$\mathbf{WPI_{t-3}}$	0.10* (0.05)	0.14** (0.06)	0.10* (0.05)
$\mathbf{WPI_{t-4}}$	-0.13*** (0.05)	-0.13*** (0.05)	-0.13*** (0.05)
$\mathbf{WPI_{t-7}}$	0.11* (0.06)	0.14** (0.06)	-
$\mathbf{WPI_{t-8}}$	-0.13** (0.05)	-0.14*** (0.05)	-0.13** (0.05)
$\mathbf{WPI_{t-10}}$	0.08* (0.05)	-	0.09** (0.04)
$\mathbf{IIP\ Output\ gap_{t-2}}$	-0.08* (0.05)	-0.14*** (0.05)	-0.08* (0.05)
$\mathbf{IIP\ Output\ gap_{t-3}}$	0.20*** (0.06)	0.23*** (0.06)	0.20*** (0.06)

IIP Output gap$_{t-4}$	-0.18***	-0.19***	-0.19***
	(0.05)	(0.05)	(0.05)
IIP Output gap$_{t-5}$	0.12**	-	0.12**
	(0.05)		(0.05)
IIP Output gap$_{t-6}$	-	0.10**	0.05
		(0.05)	(0.05)
IIP Output gap$_{t-7}$	-0.12***	-0.15***	-0.13***
	(0.04)	(0.05)	(0.04)
IIP Output gap$_{t-8}$	0.11**	0.14***	0.11**
	(0.05)	(0.06)	(0.05)
IIP Output gap$_{t-9}$	-0.16***	-0.17***	-0.16***
	(0.06)	(0.06)	(0.05)
Liberalization$_{t}$	0.01***	0.00***	0.00**
	(0.00)	(0.00)	(0.00)
Price of oil in INR$_{t-1}$	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)
Price of oil in INR$_{t-3}$	0.01**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)
Price of oil in INR$_{t-5}$	0.01*	-	-
	(0.00)		
M3 output gap$_{t-5}$	-	-	2.89*
			(1.68)
M3 output gap$_{t-6}$	-	-	-4.48**
			(1.74)
M3 output gap$_{t-7}$	-	-	5.17***
			(1.76)
M3 output gap$_{t-8}$	-	-	-4.52***
			(1.69)
M3 output gap$_{t-9}$	-	-	3.30**
			(1.51)
M3 output gap$_{t-10}$	-	-	-1.85*
			(1.05)

p<0.10, ** p<0.05, *** p<0.010

However, the usage of OLS estimation for the NKPC is problematic, as explained by Baum (2006, p200), "since both variables [inflation and unemployment] are determined within the macroeconomic environment, we cannot consider either as exogenous." Indeed, the endogeneity of both inflation and output gap make Hayashi et al. (2015) and Dua and Gaur (2009) adopt the usage of instrumental variables for their estimations.

Conventionally, the Phillips Curve is estimated using the Generalized Method of Moments (GMM) technique. GMM presents several advantages for estimating the NKPC over OLS. More specifically, the OLS assumption of $E(u|x)=0$, that the error term and the regressors are uncorrelated, is violated by the existence of endogenous regressors. With the GMM estimation, I can specify which of my regressors are endogenous and how they will be instrumented, even when faced with heteroskedasticity of unknown form. Valid instruments, of course, have to be significantly correlated with the endogenous regressors and uncorrelated with the error process.

The results of my GMM estimations with HAC standard errors are presented in tables 3 and 4 below. In Table 3, I estimate specification 5, with the assumption that once-lagged WPI and IIP output gap are endogenous and instrumented by their lags, oil prices, and the drought variable. I leave the dummy variable for liberalization as an additional exogenous variable. In specification 6, I assume the hybrid NKPC and instrument π_{t+1}WPI inflation and IIP output gap on their lags, oil prices, and the drought dummy variable. Like before, I leave the dummy variable for liberalization as an additional exogenous variable. In specification 7, I assume the hybrid NKPC and instrument π_{t+1} WPI inflation and IIP output gap on their lags only, leaving oil prices, the drought and liberalization dummy variables as additional exogenous variables in the regression. As seen below, due to collinearity issues, Stata chooses to drop a certain number of variables for each regression.

Table 3: GMM estimation with HAC standard errors of the Indian NKPC

Regressor	Coefficient (Standard Error)		
	Specification 5	Specification 6	Specification 7
$\mathbf{WPI}_{t+1}$	-	0.44*** (0.06)	0.47*** (0.07)
$\mathbf{WPI}_{t-1}$	0.35*** (0.07)	-	-
$\mathbf{IIP\ Output\ gap}_t$	-0.02 (0.01)	-0.04*** (0.01)	-0.04*** (0.01)
$\boldsymbol{Price\ of\ oil\ in\ INR}_t$	-	-	-0.01* (0.00)
$\boldsymbol{Price\ of\ oil\ in\ INR}_{t-1}$	-	-	0.01*** (0.00)
$\boldsymbol{Price\ of\ oil\ in\ INR}_{t-3}$	-	-	0.01** (0.00)
$\mathbf{Liberalization}_t$	0.00*** (0.00)	0.00** (0.00)	0.01** (0.00)
$\mathbf{Liberalization}_{t-1}$	0.00 (0.00)	0.00** (0.00)	0.00** (0.00)
Constant	0.00*** (0.00)	0.00** (0.00)	0.00** (0.00)
R-squared	0.15	0.15	0.18
Underidentification test (LM statistic)	86.525 Chi-sq. P-val = 0.0000	104.387 Chi-sq. P-val = 0.0000	95.286 Chi-sq. P-val = 0.0000
Hansen J statistic	101.619 Chi-sq. P-val = 0.0000	85.642 Chi-sq. P-val = 0.0000	83.976 Chi-sq. P-val = 0.0000

p<0.10, ** p<0.05, *** p<0.010

Although the results for the IIP output gap are insignificant for specification 5, for specifications 6 and 7 I find that a percentage increase in the output gap corresponds to a 0.04 percentage decrease in WPI inflation, which is a significant coefficient. Once again, this result is counterintuitive, and the fact that the one-step forward lagged WPI

inflation accounts for the majority of this regression is alarming because it suggests that the Indian WPI is unpredictable using this specification.

Although the under identification test reveals that my endogenous regressors are adequately correlated with their instruments, the strong rejection of the Hansen J-statistic also tells me that the instruments are not uncorrelated with the error process, a key requirement for an appropriate instrument. This suggests that my model still remains unspecified and the instruments I have used are weak. In addition, the R-squared of 0.15-0.18 suggests that my regressors have little explanatory power for WPI.

In Table 4 below, I estimate the GMM NKPC with HAC standard errors for specifications 8-10. In the specifications below, I choose to include M3 output gap as suggested by Dua and Gaur (2009) in an attempt to achieve a better-specified model. In specification 8, I assume that once-lagged WPI inflation, IIP and M3 output gaps are endogenous and instrumented by their lags only. I leave oil prices, the drought, and liberalization dummy variables as additional exogenous variables in the regression. In specification 9, I assume the hybrid NKPC and instrument π_{t+1} WPI inflation, IIP output gap and M3 output gap on their lags. Finally, in specification 10, I assume the hybrid NKPC and instrument π_{t+1} WPI inflation and IIP output gap on their lags and oil prices. I assume the drought and liberalization dummy variables as additional exogenous variables in the specification.

Disappointingly, my results continue to show a negative coefficient for the output gap. The rejection of the Hansen J-statistic along with the low R-squared show that I still have weak instruments which do not satisfy the exogeneity requirement, although the model's rejection of the underidentification test shows that my endogenous regressors continue to be adequately correlated with the instruments.

It is also surprising that with GMM estimation none of M3 output gap coefficients are significant, suggesting that the addition of that variable was unnecessary.

Table 4: GMM estimation with HAC standard errors of the Indian NKPC

Regressor	Coefficient (Standard Error)		
	Specification 8	Specification 9	Specification 10
$\mathbf{WPI}_{t+1}$	-	0.47*** (0.07)	0.44*** (0.06)
$\mathbf{WPI}_{t-1}$	0.38*** (0.07)	-	-
$\mathbf{IIP\ Output\ gap}_t$	-0.01 (0.01)	-0.04*** (0.01)	-0.04*** (0.01)
$\boldsymbol{Price\ of\ oil\ in\ INR}_t$	-	0.01*** (0.00)	-
$\boldsymbol{Price\ of\ oil\ in\ INR}_{t-1}$	0.02*** (0.00)	-	-
$\boldsymbol{Price\ of\ oil\ in\ INR}_{t-3}$	-	0.01** (0.00)	-
$\mathbf{Liberalization}_t$	0.01*** (0.00)	0.01*** (0.00)	0.00** (0.00)
$\mathbf{Liberalization}_{t-1}$	-	0.00** (0.00)	-
Constant	0.00*** (0.00)	0.00*** (0.00)	0.00** (0.00)
R-squared	0.18	0.18	0.15
Underidentification test (LM statistic)	92.967 Chi-sq. P-val = 0.0000	102.122 Chi-sq. P-val = 0.0000	105.690 Chi-sq. P-val = 0.0000
Hansen J statistic	90.029 Chi-sq. P-val = 0.0000	88.434 Chi-sq. P-val = 0.0000	90.650 Chi-sq. P-val = 0.0000

p<0.10, ** p<0.05, *** p<0.010

With the consistent misspecification of the model as explained by the rejection of the Hansen J-statistic, I consider testing whether my endogenous regressors of WPI inflation and IIP and M3 output gap are indeed endogenous. I estimate the C-Statistic of 0.434 for specification 5, which means that I cannot reject the null that IIP output gap and WPI inflation are exogenous variables. As explained by Baum (2006), this suggests that a linear OLS regression cannot be considered a worse option than GMM. Indeed, since Baum also explains that using GMM estimation methods results in a loss of efficiency (since the asymptotic variance of the instrumental variables estimator is often much larger than that of the OLS estimator), perhaps OLS is a better estimation. Although I cannot reject the claim that the OLS specifications of Table 2 were the best estimations of the Indian NKPC, the question of the negative coefficient on the output gap still remains.

VI. Conclusion

My OLS and GMM estimations for the NKPC in the Indian case found that the relationship between output gap and WPI inflation is, counterintuitively, negative. Although my results are not in line with previous literature on the Indian NKPC, namely Dua and Gaur (2009), Sahu (2013), and Kapur (2013), my usage of monthly and more recent data that extends from January 1980 till August 2016 represents a different approach to the data than previous authors. However, the usage of monthly data should not negatively affect NKPC estimations, since Hayashi et al. (2015) also used monthly data in their more successful estimations of the NKPC in the Sri Lankan economy.

Indeed, my estimations' rejections of the unemployment-inflation tradeoff, the low R-squared of my GMM estimations, and the rejection of the Hansen J-Statistic provide insight to some serious misspecification issues. I can now ask whether lagged effects of recent events such as the financial crisis of 2007-09 have put the existence of the NKPC tradeoff in jeopardy for the Indian economy. Indeed, literature previous to Paul, such as Dholakia (1990), found that the NKPC tradeoff does not apply to the Indian economy. In line with historical trends, it is plausible that the Indian WPI inflation has returned to its previous unpredictability. With this view, the NKPC can no longer be used as a component of policy analysis and the RBI must evaluate new models for usage. The inapplicability of the NKPC to the Indian economy as shown in my research may imply the unemployment-inflation tradeoff only applies to advanced economies, although further application to developing economies is necessary before reaching this conclusion.

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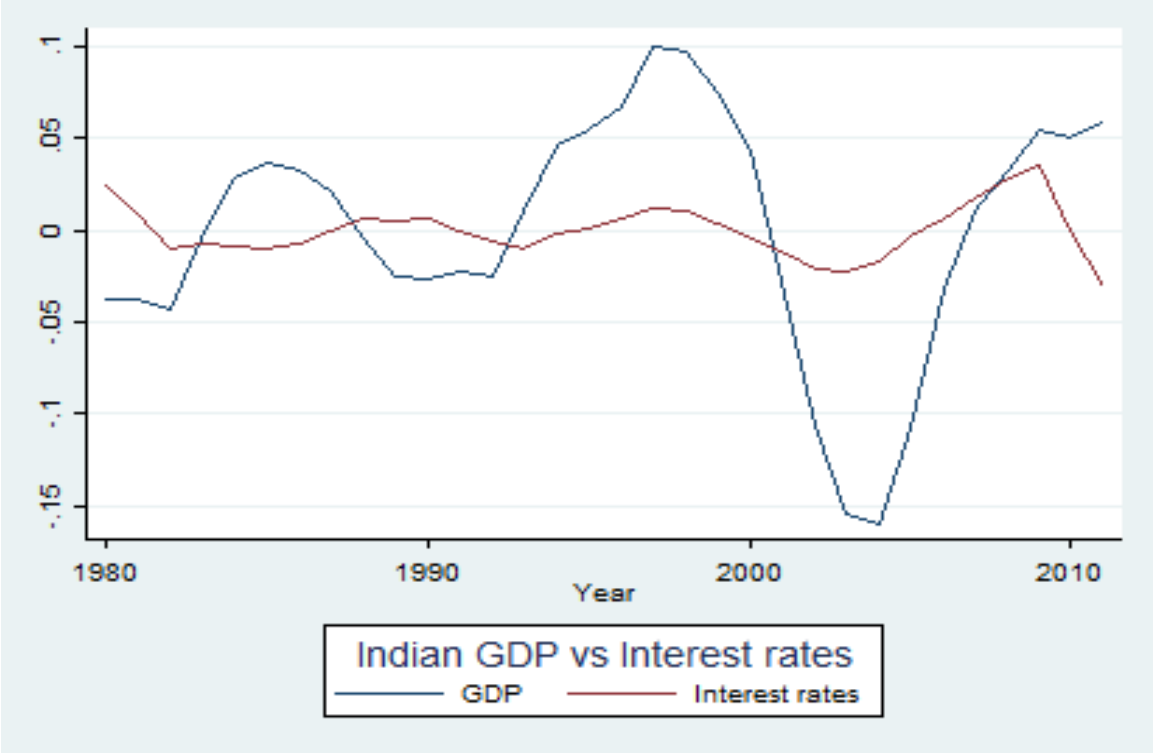
IX. Appendices

9.1 Appendix A

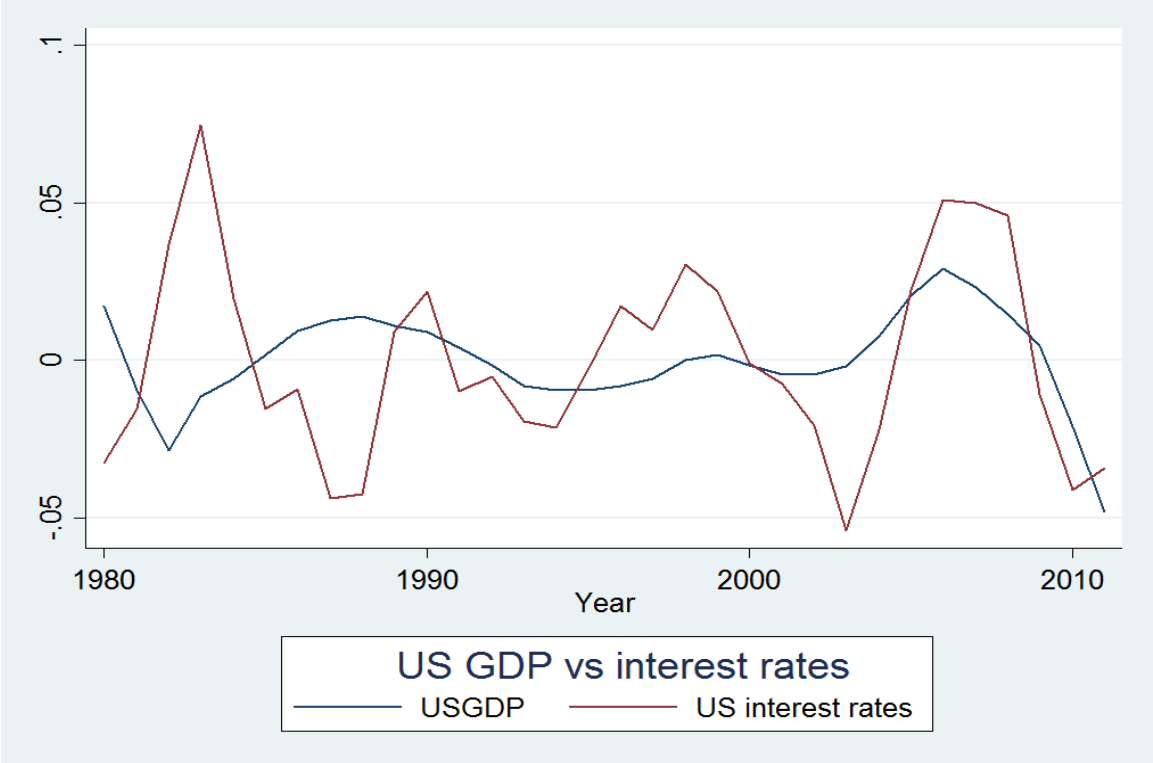
I attempt to visualize Dua and Gaur's (2009) argument that interest rates are more correlated with output in developed economies rather than developing ones. I compare the plots of US GDP and interest rates on government securities for both countries; however, to make my comparisons more effective, I use the seasonally adjusted HP-filtered cyclical components of both interest rates and GDP. It is difficult to see Dua and Gaur's argument using this analysis since the two graphs appear quite similar in the relationship between interest rates and GDP for the years 1980-2011. Indeed, the insignificance of M3 output gap in my GMM specifications shows that Dua and Gaur's argument is of little significance with regards to the Indian economy.

Figure 3: GDP vs Interest Rates on Government Securities (India)



Source: Reserve Bank of India

Figure 4: GDP vs Interest Rates on Government Securities (United States)



Source: St. Louis Federal Reserve (FRED)

9.1 Appendix B

I rebase WPI data using the 'arithmetic conversion' method recommended by the Office of the Economic Advisor. I take guidance on this method using *Economic Developments in India: Volume 29,* Academic Foundation. The book provides specific calculations for the linking factor, which will be multiplied to old WPI series to convert it to the new 2004-05 base year. For example, to rebase the 1971-1982 series (which are based on the year 1970-71) to the base year of 1982-1991, I would calculate the linking factor as follows:

$$linking\ factor_{from\ 1970-71\ by\ to\ 1981-82\ by} = \frac{Average\ of\ 1981-82\ WPI\ for\ 1981-82\ based\ index}{Average\ of\ 1981-82\ WPI\ for\ 1970-71\ based\ index}$$

$$= \frac{100}{278.3917} = 0.359206$$

I was thus able to multiply this linking factor to all WPI data based on the years 1970-71 to obtain new data based on the years 1981-82. I used a similar method to rebase all my data to the year 2004-05.

9.2 Appendix C

Plotting oil prices in INR, WPI, and IIP without doing any data manipulation, I obtain Figures 5 and 6 below:

Figure 5: WPI, IIP, and Crude Oil Prices in INR for 1980m1-2016m8

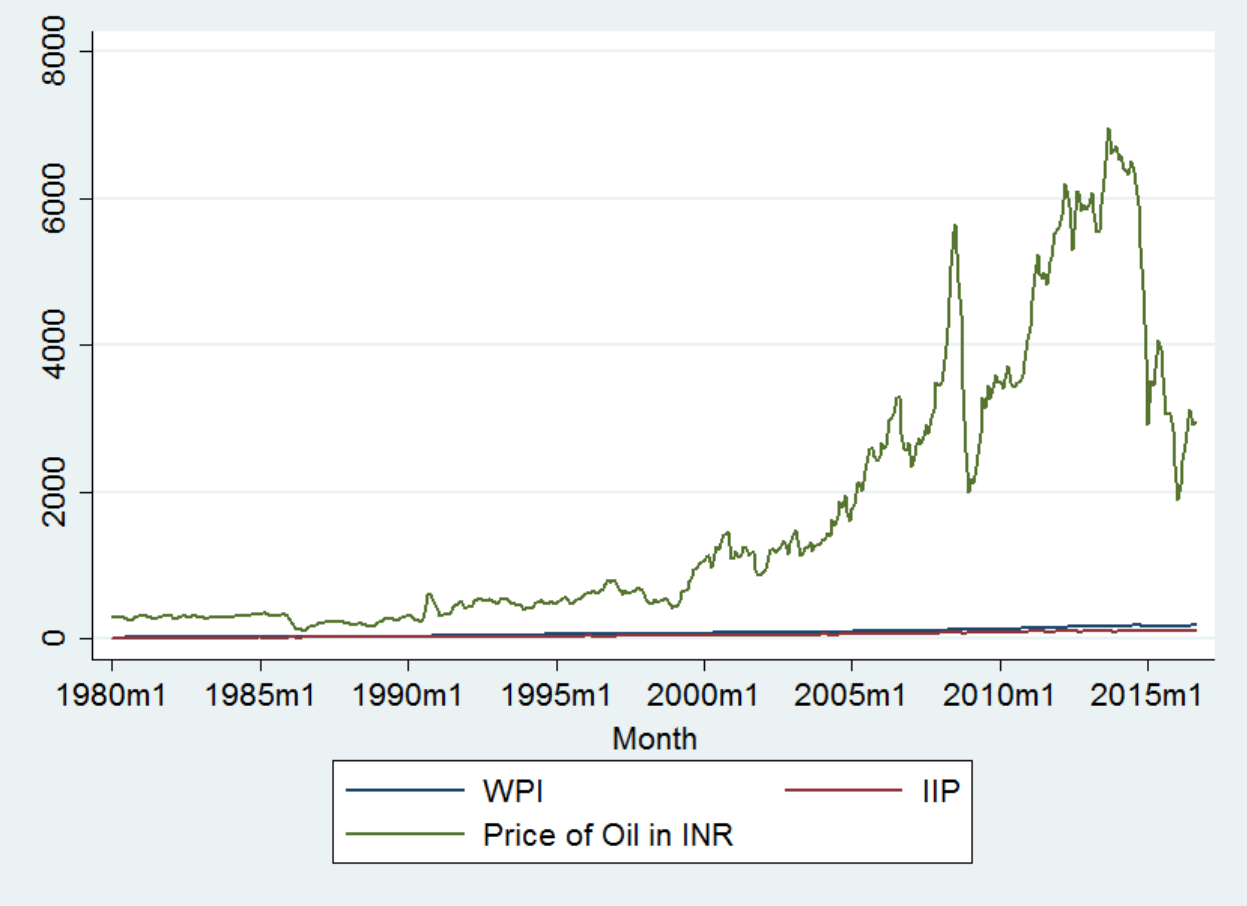
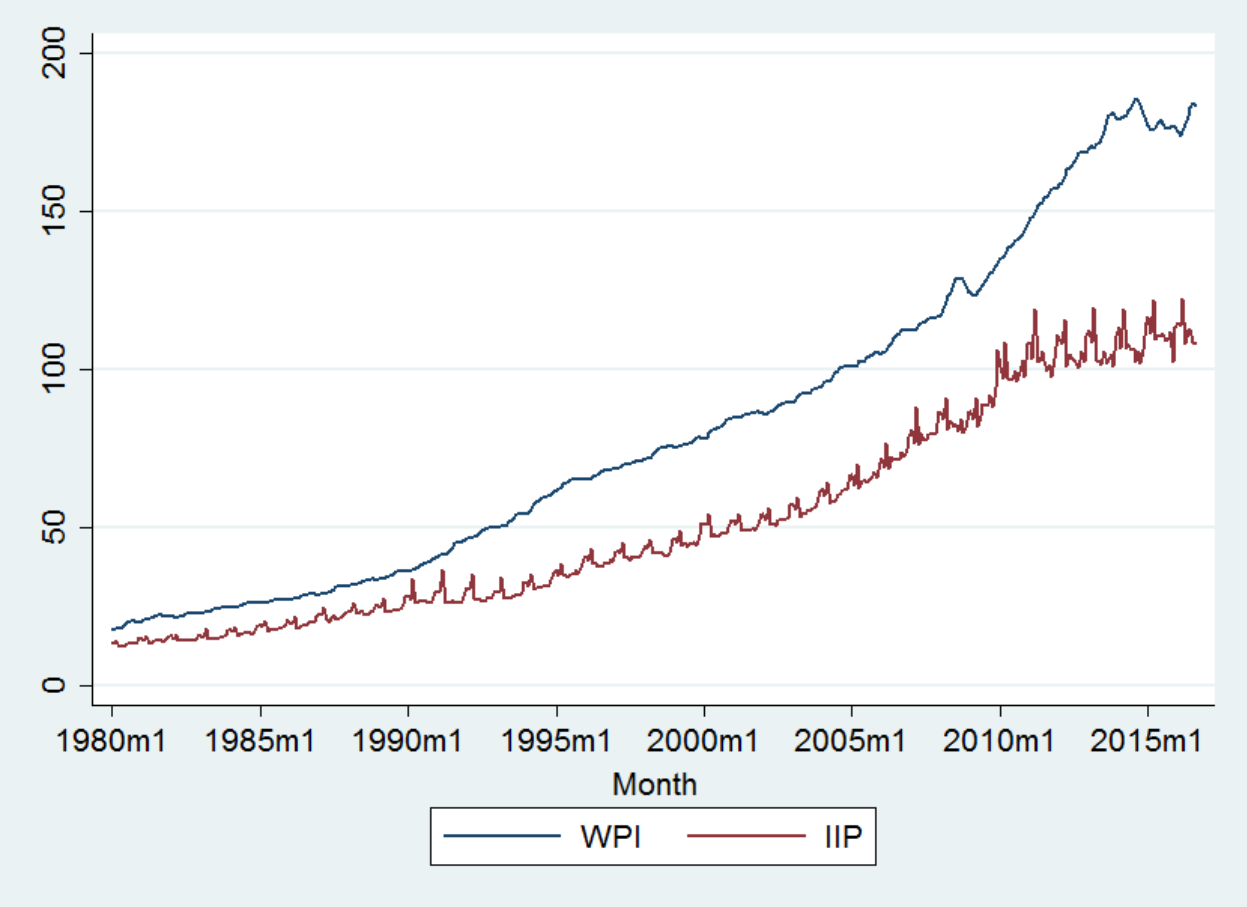


Figure 6: WPI, IIP, and Crude Oil Prices in INR for 1980m1-2016m8



It is evident from these graphs that all three measures consist of trend and seasonal components that make data comparisons very difficult. Thus, the need for data stationarity using methods like the HP filter and first-differencing is also evident, in order to extract the core fluctuations in these three measures.

9.3 Appendix D

Table 4: Percentage Deviations of Indian Annual Rainfall from its 1901-2013 Average

Year	Annual rainfall	Percentage deviation
1980	1182.3	0.4
1981	1170.7	-0.6
1982	1084.4	-7.9
1983	1320.9	12.2
1984	1160.8	-1.4
1985	1144.9	-2.8
1986	1137.6	-3.4
1987	1088.9	-7.5
1988	1342.1	14.0
1989	1127.4	-4.3
1990	1401.4	19.0
1991	1170.2	-0.6
1992	1102.7	-6.4
1993	1207.8	2.6
1994	1295.3	10.0
1995	1242.4	5.5
1996	1182.9	0.5
1997	1183.1	0.5
1998	1208.8	2.7
1999	1116.6	-5.2
2000	1035.4	-12.1
2001	1105.2	-6.1
2002	981.9	-16.6
2003	1243.6	5.6
2004	1080.5	-8.2
2005	1208.3	2.6
2006	1161.6	-1.3
2007	1179.3	0.2
2008	1118	-5.1
2009	953.7	-19.0
2010	1215.5	3.2
2011	1116.3	-5.2
2012	1054.7	-10.4
2013	1092.5	-7.2

Source: Indian Meteorological Department, found in the Open Government Data Platform India

Note: The highlighted columns show the years that I have assigned a value of $drought_t = 1$.

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MACROPRUDENTIAL POLICY AND NON-BANK FINANCE IMPLICATIONS FOR COMMERCIAL REAL ESTATE CREDIT

BY: Aidan T. Thornton (University of Pennsylvania)

Macroprudential Policy and Non-bank Finance: Implications for Commercial Real Estate Credit

Aidan T. Thornton
Department of Real Estate
The Wharton School, University of Pennsylvania
Spring 2017

Advisor: Professor Susan M. Wachter

Abstract

Recent discussions of financial supervision amongst economists and regulatory authorities have been dedicated to risk emanating from the financial system as a whole—beyond focusing on individual firm risk. This 'macroprudential' approach to financial supervision has already been deployed, particularly in the ongoing implementation of a global framework for bank capital adequacy and access to liquidity established under Basel III. This paper aims to clarify the impact that this new supervisory framework will have on the banking system and the consequences for liquidity in credit markets. Due to the unique nature of commercial real estate credit as an asset class, this paper specifically focuses on the potential for constrained liquidity in this market. The role of non-bank financial institutions in alleviating that constraint is also considered. This paper finds that the implementation of macroprudential supervisory measures may restrict bank-supplied credit, particularly to the commercial real estate sector, thereby resulting in unmet demand. On the other hand, unfettered by major capital regulation and encouraged by the unique procyclicality between credit and real estate, non-bank financial institutions appear poised to meet this demand. The paper concludes by providing suggestions for future macroprudential policy design.

Contents

I. Introduction

1.1 Context

In the aftermath of the 2007-2009 Global Financial Crisis (GFC), financial supervisory authorities have prioritized the adoption of a policy framework that considers not only institution-specific risk, but also the risk emanating from the financial system as a whole—a major contributor to systemic instability. International bodies have already begun implementing policies with this aim, mostly focused on ensuring the capital adequacy and access to liquidity of the banking system. In response to this change in the regulatory regime, there has been meaningful research regarding the impact of this framework on the banking system and the broader economy.

Given the importance of residential mortgage markets as a source of the GFC, much of this research has understandably focused on risks emanating from housing finance systems. This focus has also translated to considerable examination of the effect that post-crisis regulatory reforms might have on housing finance systems. Substantial research has also examined institutions outside of the traditional banking system as a means of circumventing regulation and their role fueling the GFC. However, there has been considerably less attention paid to commercial real estate credit markets and how they might be impacted by the implementation of this new policy framework. Additionally, very little work focuses on the role of non-bank financial institutions in the commercial real estate credit markets. Finally, there is little research considering the nexus between newly-implemented financial regulation, commercial real estate credit, and non-bank financial institutions. This paper aims to contribute to this body of literature.

Established and newly created supervisory authorities have increasingly favored a framework that integrates regulation of individual institutions' risk management practices with supervision intended to ensure that these institutions are adequately

prepared to sustain systemic shocks. Perhaps the most significant recent development in macroprudential policy is the implementation of new capital adequacy standards established by the Basel III Capital Accord. These standards are scheduled to be fully implemented by 2019. They have already had effects on the financial system, particularly in the form of modified capital planning and lending activities by banking institutions. However, the impact of increased capital regulation on the broader financial system, particularly within credit markets, has yet to be fully understood. Given that these reforms are motivated by concerns for systemic stability, it is prudent to evaluate their impact on systemically significant markets, namely real estate credit markets. Since the 1990s, there have been substantial structural developments in the commercial real estate credit market. Many of these developments could have significant effects on the financial system and its stability. Within this market, the increasing importance of financial institutions outside of the traditional banking system also raises questions of systemic stability.

This paper has several objectives. First, it will establish a basis for understanding the impact of macroprudential policy measures, particularly capital adequacy standards, on the traditional banking system. This paper also aims to add to the understanding of how these structural changes within the banking system influence banking institutions' activities in credit markets. I will also consider the role of non-bank financial institutions within this context. Finally, this paper seeks to develop a framework for policy design that considers commercial real estate credit provision by non-bank financial institutions in an environment in which traditional banking institutions are subject to increased capital constraints.

1.2 Key Concerns

The newly adopted global framework for supervisory authorities is considered 'macroprudential' in an attempt to distinguish it from the largely firm-specific or 'microprudential' framework that prevailed preceding the GFC. A macroprudential approach to financial supervision emphasizes the implementation of measures to ensure capital adequacy and access to liquidity of banking institutions. As such, these measures have ramifications for the financing structure and credit provision activities of these institutions.

Financial institutions are active in a variety of credit markets. However, the market for commercial real estate credit can be distinguished from broader credit markets for several reasons. First, in commercial real estate, the asset against which the credit is provided is inherently prone to price cyclicality. The cyclicality of the underlying assets has considerable influence on the corresponding credit. This produces complexity beyond the standard macroeconomic relationship between asset prices and credit availability. Second, the term structure of most commercial real estate credit instruments is rarely fully-amortizing, is subject to interest rate variability, and generally has a maturity of ten years—all factors that contribute to a need for periodic refinancing. Finally, the relatively high value of commercial real estate assets and the associated credit means that commercial real estate credit investments can represent a significant portion of an institution's total assets. These distinct characteristics of commercial real estate credit demonstrate the importance of the asset class in any discussion of systemic stability.

While it is well understood that macroprudential regulatory measures have a profound impact on the banking system, there are also indirect effects on non-bank financial institutions. These entities operate largely outside of the scope of traditional banking regulation. They are of considerable importance to the financial system,

particularly due to their activities in the market for commercial real estate credit. This market has demonstrated a unique relevance to systemic stability; therefore the role of non-bank financial institutions within the macroprudential regulatory regime demands consideration.

1.3 Central Dynamic

In addition to developing a framework for understanding the nexus between macroprudential policy, commercial real estate credit and the role of non-bank financial institutions, this paper makes several claims. First, I find that the implementation of macroprudential capital adequacy standards can restrict banking institutions' provision of commercial real estate credit. Given sustained growth in the commercial real estate market, this trend will result in unmet demand. Second, I find that, encouraged by credit and real estate procyclicality, non-bank financial institutions largely unaffected by macroprudential measures are uniquely poised to meet this demand. Finally, I consider the implications of this dynamic for policy design.

The rest of the paper is organized as follows: Section II reviews macroprudential policy measures, specifically capital adequacy standards and their impact on the financial system. Section III considers the market for commercial real estate credit, focusing specifically on historical developments and the market structure. Section IV discusses the emergence of non-bank financial institutions, their role in commercial real estate credit markets and the implications for policy design. Section V provides concluding remarks.

II. Macroprudential Policy & Capital Regulation

2.1 Overview of Macroprudential Policy

A macroprudential approach to financial supervision is characterized by a consideration of risk factors emanating from the entire financial system—systemic risk. This approach is broader than 'microprudential' regulation, which seeks only to ensure sufficient risk management by individual institutions. Microprudential regulation is somewhat systemically focused in that it aims to prevent institutional failures and, implicitly, their effects on the broader financial system. However, this perspective largely considers these institutions on an individual basis. In contrast, the basis of macroprudential policy is the interconnectedness of financial institutions, and the risk to financial markets and the economy that this presents. As Hanson et al. (2011) explain, a macroprudential approach considers general equilibrium dynamics and focuses on protecting the entire financial system. Specifically, macroprudential policy considers the potential for a systemic shock to weaken access to financially-intermediated credit (Yellen, 2011). Macroprudential policy measures have largely centered on the banking system, given the role of banking institutions financial intermediaries and providers of credit to the economy.

A macroprudential approach does not simply constitute enhanced financial oversight, but rather emphasizes preparation for inevitable systemic shocks. As such, regulatory bodies attempt to minimize external costs derived from systemic shocks to institutions' balance sheets (Hanson et al., 2011). Ensuring this degree of protection requires mechanisms by which supervisory authorities can compel banking institutions to modulate their structure and activities in accordance with stated policy goals. Broadly speaking, macroprudential policies aim to produce more resilient banking systems by providing supervisory authorities with 'policy tools' designed to mitigate systemic risk (Calem et al., 2016). These tools consider both cyclicality and instability

in financial markets. As such, they are specifically aimed at "countering the procyclical nature of credit and leverage, leaning against the wind when systemic risk is accumulating" (Yellen, 2011, p. 8). After the GFC, the instability of the banking system motivated renewed discussion of macroprudential policy. It also led to the creation of powerful policy tools that increased standards for capital adequacy and liquidity access for banking institutions. In comparison to other supervisory measures, macroprudential policy is distinct in its singular focus on systemic risk. While significant financial supervision existed previously, the GFC demonstrated that traditional stabilization policy and microprudential financial supervision were insufficient for the management of systemic risk.

Yellen (2011) asserts the insufficiency of traditional stabilization policy in addressing systemic risk, observing that "monetary policy cannot be a primary instrument for systemic risk management. First, it has its own macroeconomic goals on which it must maintain a sharp focus. Second, it is too blunt an instrument for dealing with systemic risk" (p. 5). The unfeasibility of cross-country monetary policy coordination, combined with the increasing interconnectedness of financial markets and banking institutions, renders monetary policy an ineffective approach to managing systemic stability. These difficulties also hinder other policy approaches.

Although broad-based risk management policies were already in place before the crisis (most notably Basel II), their purview was largely limited to the supervision of individual banking institutions' risk management practices. In terms of risk endogenous to individual institutions' balance sheets, capital adequacy standards for individual banking institutions may have been sufficient. However, as demonstrated by impairment of bank capital positions, these standards were insufficient in their consideration of exogenous risk. As demonstrated during the GFC, much of this exogenous risk is derived from overly inflated valuations in specific markets. These bubbles, even "in the presence

of arbitrage, occur pro-cyclically, and the result is the production of systemic risk as liquidity providers increase their lending based on current above-market fundamentals pricing of these assets" (Pavlov and Wachter, 2009, p. 453). Thus over-inflated asset prices, particularly of real estate-related securities, misrepresented the overall bank balance sheet, driving banking institutions to further extend credit. On an individual basis, most banks appeared to be well-capitalized, but not sufficiently in the face of systemic risk emanating from the inflation of asset prices beyond fundamental values. Additionally, as collateralized lending was expanded on the basis of this inflated pricing, management of credit exposure was clearly insufficient.

As with any shift in the regulatory regime, the macroprudential policy proposals necessitate an evaluation of their relative costs and benefits. On a microeconomic basis, banking institutions are distinct from other firms in their heavy reliance on short-term debt to meet their financing needs (Kashyap et al., 2008). From a systemic perspective, higher capitalization can be substantially beneficial, as the marginal cost of higher capital ratios is far outweighed by the total cost of financial crises (Schanz et al., 2011). However, it is difficult to determine the total effect of the costs of higher capital ratios on the overall financial system. In designing a macroprudential policy framework, it is therefore important to achieve a balance between systemic stability and an environment that encourages financial innovation—ultimately resulting in greater financial efficiency.

2.2 Basel III Framework

Of the array of macroprudential policy measures available to supervisory authorities, standards for capital adequacy and access to liquidity are the most prominent. This is understandable, as a change in capital or liquidity requirements has a sizable impact on banking institutions' funding strategies and level of financial intermediation. The most prominent iteration of macroprudential supervision has been through Basel III, which emphasizes standards for institutions of systemic significance. As such, the structure of these requirements will have an important impact on overall financial markets. With respect to capital adequacy standards, the Basel III regime requires banks to retain high quality capital that will allow them to absorb losses in the event of a systemic shock (Noss and Toffano, 2014). The required level of regulatory capital is calculated on the basis of an institution's assets and their relative risk (a measure that is also mandated by Basel III). Requiring more high quality capital can influence banking institutions via two channels: funding structure decisions and changes in the risk profile of assets (this paper is primarily focused on the latter, although the channels are interconnected). As such, any increase in capital requirements will have a profound impact on overall credit markets, in which the banking system plays a major role.

Capital adequacy concerns have always existed in some form in fractional reserve banking systems. However, the degree to which these concerns are codified in policy has fluctuated over time. Moreover, using capital adequacy standards to protect against systemic risk is also a relatively new development in the scope of historical financial supervision. Basel III capital adequacy standards seek to reduce the overall procyclicality of credit supply and the leverage of banking institutions (Yellen, 2011). This framework represents a shift away from views on capital adequacy that are largely risk-invariant.

Under Basel III, several new policy tools will establish standards for capital adequacy and access to liquidity in the banking system. To ensure that a banking institution's balance sheet is sufficiently liquid, supervisory authorities have developed two key measures. The Liquidity Coverage Ratio (LCR) ensures sufficient access to liquidity to meet short-term demand, and the Net Stable Funding Ratio (NSFR) attempts to decrease reliance on unstable short-term liabilities to finance long-term assets. In terms of capital adequacy, the Basel III framework is far more nuanced than its predecessor. Specifically, it includes increases in total required capital, an additional capital requirement for banking institutions deemed 'systemically important,' and the ability to impose additional 'countercyclical' capital requirements during a credit expansion. The process for calculating risk exposure has also been extended to account for financial innovations (Basel Committee on Banking Supervision, 2010/2011). This paper discusses both Basel III's increased required capital and its introduction of a more robust system of determining the risk of assets.

2.3 Impact of Capital Requirements on the Financial System

Although the entirety of the Basel III regulations will not be fully implemented until 2019, its effects have already been felt within the banking and broader financial systems. Banking institutions fund their activities through greater leverage than typical firms. Additionally, supervisory authorities and banking institutions tend to disagree on the optimal level of capital, as well as the precise definition of 'high quality capital.' In the absence of regulatory pressures, banking institutions have little incentive to retain capital beyond the amount needed to ensure the viability of their day to day operations. This is largely due to the relatively high cost of equity financing for banking institutions. For most firms, funding through debt is generally less costly than funding through equity. This differential is particularly true for banks due to structural issues in

corporate governance. Even during periods of market stability, investors demand a premium for supplying banking institutions with large amounts of equity capital for fear of poor governance practices (Kashyap et al., 2008, p. 434). As a result, banks rely heavily on debt to finance their balance sheets—which has profound systemic effects. If equity financing is costlier than financing through short-term debt, banking institutions will take on high levels of leverage—while internalizing the benefits but externalizing some of the costs (Hanson et al., 2011). Naturally, bank funding structures utilizing excessive short-term debt can greatly contribute to systemic risk.

Banking institutions have gone to great lengths to avoid retaining capital beyond the amount required by regulation. This was particularly evident between 2003 and 2007, when banking institutions explicitly engaged in off-balance sheet transactions, in part, to reduce the burden of capital requirements (Acharya and Richardson, 2009).

Required regulatory capital generally exceeds the amount of capital that banking institutions deem economically efficient to hold in the absence of regulation. As such, it is necessary to understand the impact of capital regulation on the cost of financing. Noss and Toffano (2014) observe that, particularly during a credit boom, increases in required capital can lead to increases in the cost of financing for banks. This dynamic can be understood in the context of the 'irrelevance principle' in the decision to finance a firm through debt or equity (Modigliani and Miller, 1958). As is the case with any firm, the value of a banking institution is influenced by its capital structure. The degree of the impact of capital requirements on financing costs depends on the composition of both assets and liabilities (Schanz et al., 2011). Banking institutions, therefore, are incentivized to decrease financing costs by modifying the composition of their balance sheets. This can be achieved, in part, through changes in the banking institution's revenue-generating activities—particularly the provision of credit.

Considering the impact of this dynamic on credit markets, Thompson (2016) anticipates that even highly capitalized banking institutions will be affected by Basel III, which will reduce the supply and increase the cost of bank-intermediated credit. But there is another method by which banks can minimize the impact of required capital. Under the Basel III framework, capital requirements depend upon the risk exposure of a banking institution's assets. Because Basel III emphasizes risk weighting, banking institutions will be incentivized to reduce financing costs by increasing the cost and decreasing the supply of credit provided (Noss and Toffano. 2014). The emphasis on risk-weighting of assets under Basel III also particularly incentivizes banking institutions to minimize their provision of credit products considered 'high-risk.'

Commercial real estate is considered a 'leveraged asset class' (i.e. transactions inherently require leverage). Therefore, any change in costs and liquidity in credit markets would have significant effects on the commercial real estate market. Specifically, the development and acquisition of commercial real estate almost always requires some form of debt financing, and is therefore uniquely reliant on credit markets, particularly bank-intermediated credit. The availability of credit "is a key factor in each stage of CRE activity. Builders, owners, and users depend on the smooth functioning of the financial markets to bridge the gaps between expenses and income" (Meeks, 2008, p. 5). The importance of bank-intermediated credit to commercial real estate has also been historically documented. For example, Jackson et al. (1999) observed that, in the early 1990s, real estate was particularly affected by pressure on banking institutions' capital. The state of the commercial real estate market is therefore inextricably linked to the state of credit markets, and distortions in bank-intermediated credit, specifically to the commercial real estate sector, could have significant consequences.

As discussed earlier, Basel III incentivizes banking institutions to shed assets considered by supervisory authorities to be particularly risky, such as commercial real

estate credit. Basel III establishes a new methodology to determine assets' relative risk and corresponding capital requirements. High volatility commercial real estate loans are mandated a 150% capital reserve requirement, relative to 100% for most commercial loans and 50% for residential mortgages (Thompson, 2016). The Basel III framework views commercial real estate credit as highly risky. In the United States, authorities warned banks to reduce exposure to commercial real estate or increase capital reserves (Thompson, 2016). This view of the risk of commercial real estate credit is not without basis. For example, Calem and LaCour-Little (2004) find that, for commercial real estate debt instruments, even small differences in the loan-to-value ratio can have significant impacts on the prudent amount of capital to be held. Additional risks emanate from the term structure of these credit instruments and the inherently cyclicality of the collateral's value.

Increased capital requirements for commercial real estate increase the cost of financing investment for these assets. Barring a substantial increase in the yields for underlying commercial real estate assets, many banking institutions will be discouraged to provide credit to the commercial real estate sector, reducing liquidity within these markets. Idzelis and Torres (2015) observe that increased capital requirements have reduced profitability in this sector. Even the partial implementation of Basel III capital requirements has already had discernible effects on the participation of banking institutions in the commercial real estate credit markets.

In late 2016, banking institutions represented only 31% of commercial real estate lending, compared to previous highs in excess of 40% (CBRE Research, 2016b)—a trend is expected to continue (CBRE Research, 2016a). Reduced provision of credit by increasingly capital-constrained banking institutions, particularly to commercial real estate markets, will undoubtedly result in costlier commercial real estate credit.

Increases in interest rates could further exacerbate this dynamic. As Peng (2010) demonstrates, changes in the credit spread are positively correlated with the commercial real estate risk premium. Increasingly costly commercial real estate credit may be seen as an opportunity for some market participants. CBRE Research (2015) observes that capital-constrained banking institutions are being prompted to increase costs and reduce the supply of credit provided to commercial real estate. This dynamic presents an opportunity for non-bank financial institutions. These institutions, unfettered by Basel III capital regulations, could respond to the decreasing competitiveness of banking institutions and increasing yields on commercial real estate credit by beginning to engage or increasing their engagement in the market.

III. The Commercial Real Estate Credit Market

3.1 Market Innovation in Commercial Real Estate

In the United States, the market for commercial real estate credit, as it is currently structured, began to emerge in the 1970s. This emergence included increasing integration between the market for commercial real estate credit and global capital markets. Beginning in the 1970s, financial institutions began to determine commercial real estate lending rates relative to bond yields, which represented a "very crude but effective method of creating a proxy rate for real estate. From this and other instances, capital market linkages to real estate were born" (McCoy, 2011, p. 47-8). Although commercial real estate markets, like all real estate markets, are still characterized by structural inefficiency, this integration represented access to the liquidity and efficiency of broader credit markets.

This was furthered by the increasing role of securitization in commercial real estate credit markets. Between 1976 and 2003, financial markets experienced a rise in securitization as well as deregulation. Partially as a result of these developments, large

banking institutions increased their credit exposure to real estate markets, particularly commercial real estate (Zarutskie, 2013). Commercial mortgage-backed securities (CMBS) were the primary vehicle for private securitization of commercial real estate credit instruments (Antoniades, 2016). However, this shift in financing for commercial real estate would have substantial consequences for global financial stability.

Securitization of commercial real estate financing was accompanied by rapid price appreciation of commercial real estate assets beyond fundamentals in the period preceding the GFC (Levitin and Wachter, 2013). However, it is important to note that securitization, in its own right, cannot be held as the sole factor that drove the GFC. Although the GFC was largely blamed on the housing finance system in the United States, the role of commercial real estate raises important questions about the similarities and differences between the markets for residential and commercial real estate credit. Both markets are significant due to their relative size (although the market for residential real estate credit is much larger than the market for commercial real estate credit). In addition, as both commercial and residential real estate are 'leveraged assets,' their heavy reliance on debt financing inextricably links them to the financial system.

Analysis of borrower decision making in commercial real estate is complicated by the sheer number of entities involved. Relative to residential real estate, "where a property most often has one equity player (the mortgage holder) and one debt player (the mortgage bank), commercial real estate properties are often financed by multiple debt and equity players" (Steering and Advisory Committee — Asset Price Dynamics Initiative, 2016, p. 23). The structure of commercial real estate credit instruments is also often complex. Consider the nature of defaults on these instruments. In contrast to "residential defaults that result from failure to maintain monthly mortgage payments, commercial real estate defaults are most often "'maturity defaults' in which the

borrower is unable to borrow a large enough sum to pay off an expiring loan. The difference between the balloon payment owed on the maturing loan and the amount that can be borrowed today is the 'equity gap.' The equity gap is caused by two factors: falling valuations of commercial real estate and lack of liquidity" (Marsh, 2011, p. 35). Default structure presents evidence of considerable risk. This is due, in part, to the perspective of credit providers in commercial real estate.

Lenders for residential mortgage debt are highly concerned with the leverage of the collateral against which they are providing credit. On the other hand, commercial real estate lenders emphasize a commercial real estate asset's ability to meet operating expenditures and debt service requirements (Marsh, 2011). The lack of focus on the overall leverage of the collateral property is concerning, particularly as Kau et al. (2009) demonstrates that this leverage (in terms of the loan-to-value ratio) is a major driver of the default probability of commercial real estate debt.

The systemic significance of the market for commercial real estate credit is further fueled by the increasing interconnectedness of global credit markets (upon which commercial real estate relies for financing). This trend has, in part, drove commercial real estate to be viewed as a 'global asset' that, in the case of misalignment between prices and fundamentals, can produce systemic risk (Steering and Advisory Committee — Asset Price Dynamics Initiative, 2016). Financing of commercial real estate is a dynamic process typically including "periods of extensive refinancing and appraisals, renovations and restructurings of facilities themselves and the paper associated with these during the life of commercial properties" (Lahm et al., 2011, p. 6). The dynamic nature of commercial real estate financing and reliance on credit has resulted in constant engagement between the commercial real estate markets and the financial system.

3.2 Current Structure of the Commercial Real Estate Credit Market

Although smaller than the market for residential real estate credit, the market for commercial real estate credit is substantial. At the end of 2015, the combined outstanding debt of commercial and multifamily real estate represented approximately $3.61 trillion (Board of Governors of the Federal Reserve System, 2015). Many distinct types of institutions participate in this sizeable market. In addition to traditional commercial banks and depository institutions, participants include "asset-backed securities (CMBS) issuers, life insurance companies, government-sponsored enterprises, governmental entities, finance companies, real estate investment trusts, pension funds, and others" (Harper and Everett, 2015, p. 1). The involvement of bank and non-bank financial institutions is crucial to the commercial real estate market due to the constant reliance on credit financing, which produces what Lahm et al. (2011) term a 'mutuality of interests.' The size of the commercial real estate credit market, in addition to its integration with the financial system, raises questions of systemic risk. Specifically, within the traditional banking system, commercial real estate credit represents a sizeable portion of the total portfolio that is highly scrutinized by regulators (Woo, 2011).

Relative to residential real estate credit, commercial real estate credit instruments are often characterized by larger balances, complexity in the sources of repayment, and are very rarely structured to be fully amortizing (Levitin and Wachter, 2013). These factors contribute to the perceived risk of the instruments. However, investor perception of risk is also influenced by the underlying commercial real estate assets, the prices of which have demonstrated historical volatility (Igan and Pinheiro, 2009). Basel III accordingly designates commercial real estate credit as a highly risk-weighted asset class.

The market for commercial real estate is currently undergoing a shift in the structure of its credit supply due to capital constraints on banking institutions. However, sustained demand for commercial real estate has continued, as "sales of commercial properties excluding hotels in 2015 surpassed 2007 volumes, which drove commercial real estate loan volume to a near-record total of $504 billion" (Bennett and Cacciapaglia, 2016b, p. 2). Naturally, this demand for commercial real estate assets has led to a great deal of demand for credit financing. Because of this dislocation between supply and demand trends, CREF predicts that disparities in commercial real estate financing could emerge (Commercial Real Estate Finance Council, 2015).

In some segments of commercial real estate credit markets, these disparities in financing have already appeared, placing upward pressure on required yields. In the market for securitized products, Bisbey (2016) observes dramatic increases in risk premiums for commercial mortgage bonds. Additionally, another constraint of commercial real estate credit may occur in the CMBS market. A large number of CMBS characterized by low underwriting standards were expected to mature between 2016-2017, with approximately $92 billion expected to come to maturity in 2017 alone (Mooney, 2016). The friction between constrained supply and sustained demand for commercial real estate credit will result in higher yields, attracting institutions with deployable capital. Financial institutions outside of the scope of traditional banking regulation, unfettered by capital regulation, are well poised to take advantage of this opportunity.

IV. The Role of Non-Bank Financial Institutions

4.1 Emergence of Non-Bank Financial Institutions

Many have referred to non-bank financial institutions as part of the 'shadow finance' or 'shadow banking' system, an unnecessarily pejorative moniker that has no precise definition, academic or otherwise. However, experts agree that it refers a system of entities that perform some or all of the core functions of traditional banks while unencumbered by the regulatory oversight to which the traditional banking system is subjected. Examples of these institutions include hedge funds, private equity firms, and other institutions that do not finance operations through deposits (Thomas, 2013). Similar to traditional banks' demand deposit-funded credit intermediation, non-bank financial institutions engage in the liquidity and maturity transformation that banking institutions undertake, financed through non-deposit short-term liabilities (Unger, 2016). Individual institutions in the banking system are connected through interbank lending or other short-term financing. In contrast, non-bank financial institutions are connected via vertically-integrated intermediation, financing activities largely through securitization (Adrian et al., 2010). These non-bank financial institutions operate as an interconnected network outside of the scope of traditional banking supervision.

Although non-bank financial institutions replicate many of the functions of traditional banks, they do so largely outside of the scope of most banking regulation, particularly standards for capital adequacy and access to liquidity. This allows these institutions to take on the risks of traditional banking functions without being required to retain additional capital (Meeks et al., 2014). The process of credit securitization is perhaps the best example of this practice. England (2011) explains that, preceding the GFC, the level of mortgage securitization could be equated to the level of non-bank financial institutions in the mortgage market. Non-bank financial institutions are not entirely distinct from the traditional banking system. Institutions within the banking

system often engage in off-balance sheet financial intermediation through entities such as special purpose vehicles (SPVs), in addition to direct transactions with non-bank financial institutions. Therefore, the non-bank financial system can be broadly defined as financial intermediation by any institution that is unaffected by traditional banking supervision.

Of the market activities in which non-bank financial institutions engage, liquidity provision in the credit markets is the most concerning to supervisory authorities utilizing a macroprudential approach. This is largely due to the inherent risk (both transaction-specific and systemic) associated with credit exposure. Much of this risk is dependent upon characteristics specific to a certain class of instrument as well as the overall market for those instruments. Given the unique risk characteristics of the market for commercial real estate credit, it is understandable that supervisory authorities would be concerned about the involvement of non-bank financial institutions in this market.

Many consider the emergence of institutions that perform financial intermediation while being unencumbered by banking regulation to be an eventual consequence of the incentive for so-called 'regulatory avoidance.' Yellen (2011) recognizes a constant incentive to engage in risky activities outside of the scope of supervision. The growing significance of non-bank financial institutions is perhaps best exemplified by the rise of private-label securitization in the period preceding the GFC. The securitization process "allowed banks to transfer these risks from their balance sheets to the broader capital market, including pension funds, hedge funds, mutual funds, insurance companies and foreign-based institutions" (Acharya and Richardson, 2009, p. 199). This also demonstrates the significant systemic impact of engagement between the traditional banking system and non-bank financial institutions.

Paradoxically, it may have been traditional banks' engagement with non-bank financial institutions that contributed to the ability of non-bank financial institutions to

more competitively engage in financial intermediation. Thomas (2013) demonstrates that non-bank financial institutions' activities have accounted for a large share of the decline in traditional bank-intermediated credit. Although there is demonstrable competition between banking institutions and non-bank financial institutions, the rising influence of non-bank financial institutions has broadly contributed to the growth of the overall financial sector as a proportion of national income. Nersisyan and Wray (2010) term this process the 'financialization' of the economy. This increased exposure can also contribute to a greater degree of economic instability.

Non-bank financial institutions can only compete for market share with a traditional bank after overcoming the competitive advantage of banking institutions. Banks have access to cheap financing through insured demand deposits, discounted lending through the interbank market, and access to liquidity via the Federal Reserve as a lender of last resort. In spite of this considerable competitive advantage, non-bank financial institutions are still able to compete through financial innovation, such as accessing "sources of inexpensive funding for credit by converting opaque, risky, long-term assets into money-like and seemingly riskless short-term liabilities" (Adrian et al., 2010, p. 2). As such, the trend of 'financialization' appears set to continue, particularly via growth of the non-bank financial system. Schwarcz (2013) estimates that credit provided by non-bank financial institutions effectively rivals, if not exceeds, credit provided by banking institutions. The growth of non-bank financial institutions relative to the banking system raises questions about the advantages and disadvantages of engaging in financial intermediation outside of the scope of traditional banking regulation. It should be noted, however, that non-bank financial institutions, as banks' competitors, play a necessary and crucial role in financial markets. This contributes to greater financial efficiency and serves as a vehicle for innovation.

In the context of increasing capital adequacy standards for traditional banks, it is noteworthy that non-bank financial institutions are able to finance themselves with higher leverage than traditional banking institutions (Meeks et al., 2014). As non-bank financial institutions do not enjoy some of the competitive advantages of a traditional bank, they lack some of the support mechanisms that mitigate the risk of a run on their liabilities (Unger, 2016). This vulnerability contributes to systemic stability concerns. However, it is notable that non-bank financial institutions are not funded by deposits and do not rely on a publicly-provided safety net. Also, investors are generally more risk-tolerant. A 'run' on a non-bank financial institution's funding structure would therefore not contribute tremendously to systemic risk. However, systemic risk still exists, largely as a result of the interconnectedness between non-bank financial institutions and banking institutions, who are reliant on public support.

4.2 Non-Bank Financial Institutions and Commercial Real Estate Credit

The realm of commercial real estate credit investment provides opportunities beyond supply and demand disparities, particularly for non-bank financial institutions. Institutions with a greater degree of capital flexibility would be well suited to tolerate the risk that stems from the high leverage, cash flow instability, and asset price cyclicality endemic to the commercial real estate asset class. In addition, the potential to offload risk through off-balance sheet transactions and securitization would increase the risk-adjusted return of commercial real estate credit investments.

Non-bank financial institutions already play a significant role in the market for commercial real estate credit, particularly in the United States, where they have significantly decreased financing costs (CBRE Research, 2015). Non-bank financial institutions in commercial real estate credit, which include "debt funds, REITs, and

other private high yield sources of capital, are also more likely to invest in value-add and opportunistic commercial real estate debt instruments (CRE Finance Council, 2015). Increased activity by non-bank financial institutions has also been demonstrated to increase in tandem with regulatory capital requirements. Bedendo and Bruno (2010), in an evaluation of U.S. commercial banks' credit risk transfer strategies, demonstrate that institutions who lend to real estate, when faced with liquidity or capital constraints, are more likely to engage with non-bank financial institutions by off-loading credit risk through securitization. This indicates that future conservatism in bank-intermediated commercial real estate credit would shift financing demands to non-bank financial institutions.

The reticence of banking institutions to engage in commercial real estate credit markets has already resulted in downward pressure on credit supply. Furthermore, sustained demand for capital has already shifted to non-bank financial institutions. As of 2016, hedge funds held approximately 40% of subordinate CMBS positions (Murray and Clarke, 2016). Idzelis and Torres (2015) also explore this structural shift towards commercial real estate provided by non-bank financial institutions. They write that "U.S. private funds that target debt investments in commercial real estate raised a record $14.2 billion [in 2014], a 67 percent jump from 2013 and up from just $1.7 billion in 2010" (p. 1). However, rather than simply wresting away market share from the traditional banking system, the increasingly important role of non-bank financial institutions in commercial real estate credit has actually contributed to increasing integration between the two.

Although the newly implemented regime for capital regulation attempts to manage risk exogenous to the balance sheet, monitoring this risk is difficult. Banking institutions have been able to minimize the impact of capital regulation by engaging with non-bank financial institutions even before the implementation of Basel III capital

requirements (Thomas, 2013). In the period preceding the GFC, banking institutions used off-balance sheet structured investment vehicles (SIVs) to "increase supply of mortgage financing for housing, commercial real estate lending, and consumer lending" (Palley, 2012, p. 64). Current and future increases in capital requirements may further incentivize banking institutions to become more integrated with non-bank financial institutions through off-balance sheet methods of decreasing financing costs.

Formal engagement with non-bank financial institutions has also increased. In 2014, one of the highest growth categories of banking institutions' credit was direct lending to non-bank financial institutions (Idzelis and Torres, 2015). In that year, the change in the volume of this lending represented an increase of 36%, or $47.3 billion (von Jena, 2015, p. 1). Increasing integration between non-bank financial institutions and banking institutions raises furthers doubts about systemic stability. Direct and indirect exposure of banking institutions to non-bank financial institutions can lead to greater vulnerability to systemic shocks (Meeks et al., 2014).

The risk of systemic shocks as a result of highly-leveraged non-bank financial institutions also depends on the composition of these institutions' credit investments. With respect to commercial real estate credit instruments, Igan and Pinheiro (2009) demonstrate that institutions "with high loan-deposit ratios and large share of real estate loans in their lending activities are more likely to be among the most vulnerable" (p. 14) to systemically-based shocks. Greater interconnectedness between banks and non-bank financial institutions, in addition to increased leverage of non-bank financial institutions, raises several important concerns about macroprudential policy design.

4.3 Implications for Policy Design

Non-bank financial institutions operate, by definition, outside of the scope of traditional banking regulation. Supervision of the banking system aims to mitigate the systemic impact of 'responsibility failure'—a form of market failure that occurs when a firm successfully externalizes the risk of an activity while internalizing the benefits. Schwarcz (2013) characterizes responsibility failures and their broader impact as follows:

> *"(i) a firm profiting by issuing short-term debt to fund long-term projects, thereby taking a liquidity risk which could cause systemic and other consequences if the firm defaults on repaying its maturing short-term debt; and (ii) the limited liability of investors who manage a firm, making it more likely that they will cause the firm to take outsized risks, hoping for outsized gains" (p. 22).*

The implementation of the new macroprudential regime has resulted in far less risk of responsibility failure from traditional banking institutions as they have "been substantively regulated to maintain certain levels of financial responsibility" (p. 27-8). However, the increasing importance of non-bank financial institutions illuminates potential issues in this approach.

A macroprudential approach to financial supervision, particularly capital adequacy standards, relies heavily on the ability of supervisory authorities to monitor risk exposure across the entirety of the financial system. However, as Calem and LaCour-Little (2004) demonstrate, traditional banks' engagement in regulatory capital arbitrage and increased financial intermediation by non-bank financial institutions are problematic for macroprudential policy implementation, as they distort regulators' views of the degree of capital adequacy within the financial system. This is due to the fact that financial intermediation outside of the scope of traditional supervision, specifically off-balance sheet activities by traditional banking institutions, creates 'indirect' risk exposure that is difficult to measure, but "may turn out to be as debilitating as direct

exposure. For example, if a bank has lent heavily to non-bank financial intermediaries such as finance companies that engage in real estate lending, it may be taking on substantial additional exposure to the real estate" (Herring and Wachter, 1999, p. 22). Increases in required capital that are measured largely with respect to direct exposures are inefficient attempts to mitigate the effect of systemic risks.

Preceding the GFC, the risks of indirect exposures, particularly risks emanating from "real estate exposure and its coverage through usual capital requirements ha[d] not given any early warning signs, yet it was the exposures concentrated in off-balance sheet items that triggered problems" (Igan & Pinheiro, 2009, p. 4). The opacity of indirect exposures as a result of the rise of non-bank financial institutions is concerning. Much of this stems from "fire-sale risk associated with excessive short-term funding, [which] comes from not just insured depositories, but rather any financial intermediary whose combination of asset choice and financing structure may exacerbate a systemic fire-sale problem" (Hanson et al., 2011, p. 13). The insufficiency of traditional regulation in maintaining the goal of macroprudential policy—to control systemic risk exposures—is clearly demonstrated by the mounting role of non-bank financial institutions.

Furthermore, regulators must examine not only interaction between credit and commercial real estate markets, but the interaction between these markets across countries. Madam et al. (2013) evaluate the negative impact that the GFC had on the commercial real estate sector in India. This dynamic was also recognized well before the GFC. Peek and Rosengren (1997) connect the decline of Japanese commercial real estate prices during the 1990s with real economic activity in the United States.

Assets within the commercial real estate market are characterized by distinct leverage risk, as they are often highly leveraged.

> *"Real estate developers usually operate with a minimum of capital in order to shift as much risk as possible to the lender. Banks generally try to protect themselves by requiring low loan-to-value ratios, guarantees, takeout commitments for longer-term financing, and strict loan covenants that will protect them against risky behavior by the developer after the loan is made. But when real estate markets become overheated, underwriting standards deteriorate"* (Herring and Wachter, 1999, p. 23).

The deterioration of underwriting standards can also be fueled by increasing complexity of credit instruments and the assets against which they are lent.

This complexity contributes to systemic instability, particularly when considered in tandem with the inherent cyclicality of market for the underlying commercial real estate assets. This is also relevant to the interaction between commercial real estate and credit markets, as asset price inflation is typically associated with an underpricing of credit risk (Pavlov and Wachter, 2009). The inherent risk of commercial real estate credit, combined with the increase in difficult to monitor of exposures through participation of the shadow finance system, poses important concerns about the viability of macroprudential capital regulation.

As previously discussed, it is crucial that macroprudential policy manage systemic risk without overly encumbering financial innovation. Non-bank financial institutions are critically important to financial intermediation and play an important role in ensuring financial market efficiency. Systemic concerns only arise when the costs of risk-taking are highly externalized. On an individual level, risk-taking by non-bank financial institutions is less concerning, because firms are often financed by more risk-

tolerant private capital, as opposed to demand deposits. Non-bank financial institutions are also far less consolidated than banking institutions.

Previously designed macroprudential policy frameworks have understandably focused on the banking system because of the important role banking institutions play in the real economy. In a systemic risk framework, banking institutions raise concerns because of their funding via demand deposits (provided by risk-averse agents) and reliance on the aforementioned publicly-provided 'safety net.' Non-bank financial institutions do not present these concerns. As such, any macroprudential policy that aims to simultaneously manage overall risk and diminish the negative externalities of bank failure should address banks' exposure to non-bank financial institutions. The reasons for this are two-fold: first, banking institutions contribute more to systemic risk because of their highly consolidated nature. Second, traditional banking institutions take advantage of many 'socially-provided' benefits that mitigate their risk (deposit insurance; access to the central bank as a lender of last resort; discounted interbank lending; potential assistance from the U.S. Treasury Department). This establishes an explicit public interest in reducing the 'social cost' of these benefits, which can be achieved through supervision.

As the current supervisory regime relies on measurement of institutional risk exposure, macroprudential policy measures should be designed to more effectively measure systemic risk exogenous to banking institutions—particularly risk arising from the non-bank financial system. The framework established by Basel III does attempt to achieve this through more effective measurement of counterparty risk, but development of more effective risk measurement methodologies is needed. The improvement of these methodologies requires greater involvement and collaboration between banking institutions, non-bank financial institutions, supervisory authorities and academics.

V. Conclusion

This paper has developed a framework for understanding the nexus between macroprudential policy, commercial real estate credit, and the role of institutions outside of the traditional banking system. It demonstrates that the implementation of macroprudential capital and liquidity requirements may constrain the provision of commercial real estate credit by banking institutions.

This development, in the face of sustained demand for commercial real estate assets, and thus, credit financing, will almost certainly result in a disparity between the supply and demand of commercial real estate credit. Encouraged by this opportunity, the procyclical nature of real estate and credit markets, and the fact that they are relatively unfettered by capital adequacy standards, non-bank financial institutions will be able to meet this demand. Uncertainties in the upcoming 'Wall of Maturities' in the market for commercial mortgage-backed securities in 2017 may impact the timing of this shift. But the current situation – namely, that non-bank financial institutions are considerably more active in the market for commercial real estate credit – has the potential to become a long-term trend. Given the role of these institutions within the broader financial system, this may increase systemic risk exposure in a way that the current regulatory regime is inadequately designed to manage. Future macroprudential policy should be designed so as not to unnecessarily hinder non-bank financial institutions, but rather to develop more effective methodologies for measuring banking institutions' exposure to exogenous risk.

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PROFESSOR INTERVIEW

STEFANO DELLAVIGNA

INTERVIEWED AND
TRANSCRIBED BY ORLI ZIV
EDITED BY SUDESHNA BARMAN

CAN YOU TELL US A LITTLE BIT ABOUT YOUR BACKGROUND AND HOW YOU GOT INTERESTED IN ECONOMICS?

Actually, it has something to do with Berkeley. My parents are teachers and professors. My mom taught French in high school and my father taught computer science at a university, so the idea of teaching and research was always running in the family. But I grew up in Italy, where most students are on a very humanities-oriented path. We do history, philosophy, and literature, but not a lot of math and sciences, no engineering, no economics. So when it comes to college, there is not a very viable path. Then in my junior year of high school, I actually came to Berkeley as a summer school student. I remember the phone calls home, being so far from home, but it was an incredible experience. I remember living in the International House, in a tiny room with someone else who was studying literature. And I remember I took [Economics] 100A and 100B, because I thought economics could be an interesting combination of methodological science and human behavior. I loved that. I sat in on some classes on impressionism and the American novel. It was just an incredible experience to be here, so it always left me with the appetite to come back. And the step before that was reading the biography of Richard Feynman, a crazy individual with this beautiful mind, this Nobel prize-winning physicist. So that got me thinking what an amazing thing [it was to do] research.

CAN YOU TELL US A LITTLE ABOUT THE TYPE OF ECONOMICS YOU SPECIALIZE IN AND WHAT KIND OF RESEARCH YOU'RE DOING RIGHT NOW?

In my first year of undergraduate study in Italy, in Bocconi University in Milan, one of my very first classes exposed me to Kahneman and Tversky – somewhat ahead of the times – that was in 1992 or 1993. Behavioral economics...was completely fascinating to me. I kept that in mind throughout my undergraduate years, and then when I got to graduate school at Harvard, that is what I wanted to do. I wanted to study behavioral economics, and I was incredibly lucky to study under David Laibson there. What I have studied since then are the ways in which psychological factors play a role in economic decisions. People don't pay attention, maybe investors miss some earnings announced in the news, individuals can become aggressive and commit crime. Can violent movies increase or decrease that? Does the media persuade people to vote one way or another? How can charitable giving be explained? Is it pure generosity or societal pressure? [How can we model] gift exchanges in the workplace? One of the things I love about behavioral economics is that it has such a broad range of applications.

EACH WEEK YOU TAKE ECON 101A STUDENTS OUT TO LUNCH. LAST TIME, YOU MENTIONED A STUDY YOU DID ABOUT THE EFFECTS OF VIOLENT MOVIES ON VIOLENT ACTIONS. CAN YOU ELABORATE A LITTLE BIT ON THAT?

Yes, this was with Gordon Dahl, who is a professor at UCSD. Gordon came to give a talk at Berkeley, and he talked about this dataset on crime. Well, in psychology, there is a lot of research on what happens when you watch violent media. They have lab experiments where people watch a five-minute violent clip or a five-minute nonviolent action clip and you have them choose words that are either aggressive or not. But this is not the same as crime. So we started thinking, is there any way to get the impact of violent media on violent crime, rather than just word choice? We realized that Hollywood is running that experiment for us. On one weekend let's say Hannibal is released – which was a very clearly violent movie – that drew around 10 million people to the box office – and the weekend before that, there were maybe one or two million people watching violent movies, because they're instead watching an action movie or a Disney movie or whatever was newly released. That's what we call a natural experiment that nature or society does for us. There is data out there on crime, and you can easily get the data on the release of movies. So the idea is that, on weekends when there are big releases of violent movies, [we would expect an increase in crimes]. For a few weeks we thought there was an error, because we were finding that on [violent movie] release weekends there were significantly fewer assaults – maybe 1% or 2% fewer assaults. In the end we realized that this made sense. There was an incapacitation effect. The kind of people that might have

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been doing something violent in the streets are instead in the safe place of a movie theater. We found that those weekends have less violent crimes, and we attribute it to the fact that you're more likely to be sober come midnight if you were in the movie theater, than if you spent it doing something else – let's say hanging out at a bar. So there was an interesting parallel but also a clear difference between what you can identify in the laboratory and what you can identify in the field. I really enjoyed doing that because I learned that – this incapacitation effect, for example – neither of us had thought at all about it. But of course once you think about it, it's obvious. That's the beauty of research – it exposes things that are completely obvious, but that nobody would usually think about.

WHAT DO YOU THINK BEHAVIORAL ECONOMICS AS A FIELD CAN DO, THAT PSYCHOLOGY CANNOT?

I think [there's] a lot to study at the intersection between incentives and psychology. Here's an example: One of the big problems that we have as a country is that we keep highly polluting plants, typically coal-based, on storage for the one or three or five days a year when there is a spike in energy consumption. The alternative is that we would have an electricity shortage or ration, and in general we as a country have not gone down that path, although that does happen in many places in the world. So these plants are extremely costly for only three to five days a year. Now suppose that in those five days you could convince people to consume less energy. It would be a huge saving for society. But how do you do that? You would need to have a way to tell people "Hey, can you turn down your air conditioner just for this hour?" The psychologist would say, "Just tell people it's the right thing to do," and the economist would say, "Tell them that they would save money." In reality, you have to do the two things together. You could take the economic approach, for example by giving a rebate. But people might not be paying attention to this, and then it wouldn't matter. If it's buried in the contract, it's not going to work because people are not going to be thinking about it. You need to make it salient; you need to make it simple. How do you make it understandable, easy, almost fun? Like when you drive a [Toyota] Prius, you get this great mileage per gallon, and they have these fun graphics, but then you achieve a really important economic outcome. You have to combine simple psychology together with incentives, because that tends to go further than either of the two separately.

DO YOU HAVE ANY ADVICE THAT YOU WOULD OFFER TO UNDERGRADUATES?

I think economics is a big tent. I think one great thing is that we have a unifying framework to think about the world. But I think we are extremely broad. There is definitely not just one set of topics which we study. We have economists in this department doing great work on drugs. We have economists doing work on EITC, welfare programs. Others are studying exchange rates and the European Union. I'm studying violent movies and violent crimes. I think there is definitely not one way to do economics, and that is part of the beauty of it – it's going to fit people with different interests. Having said that, I would say that having a good understanding of econometrics [is critical]. If you understand how to analyze a dataset, and understand what the dataset is saying, that is very powerful. That is also what separates news from fake news, and that is what allows us as citizens to also form our own opinions. The second thing is modeling. How do we understand demand and supply? Why is competition good, and why is it not good to have cartels? That's what we teach in microeconomics. The third thing is, what problems do you care about? I think it is really important that each of us comes with questions that we are interested in. It shouldn't be that [we professors] are telling you what you're interested in. Economics is so broad; it covers so many things in the social sciences. If you're interested in inequality there is room for you, if you are interested in exchange rates there is room for you, if you're interested in

financial security there is room for you, if you are interested in unemployment there is room for you. So that is beauty of it. If you are interested in protons and neutrons then you won't want to do economics. But I think that there is a broad range of social phenomenon, and if you can cover the first two bases, you can do a lot with it.

YOU MENTIONED THAT THE FEYNMAN BOOK WAS PARTICULARLY INTERESTING FOR YOU, BUT DO YOU HAVE ANY OTHER BOOKS, ARTICLES, OR PAPERS THAT YOU WOULD RECOMMEND FOR UNDERGRADS?

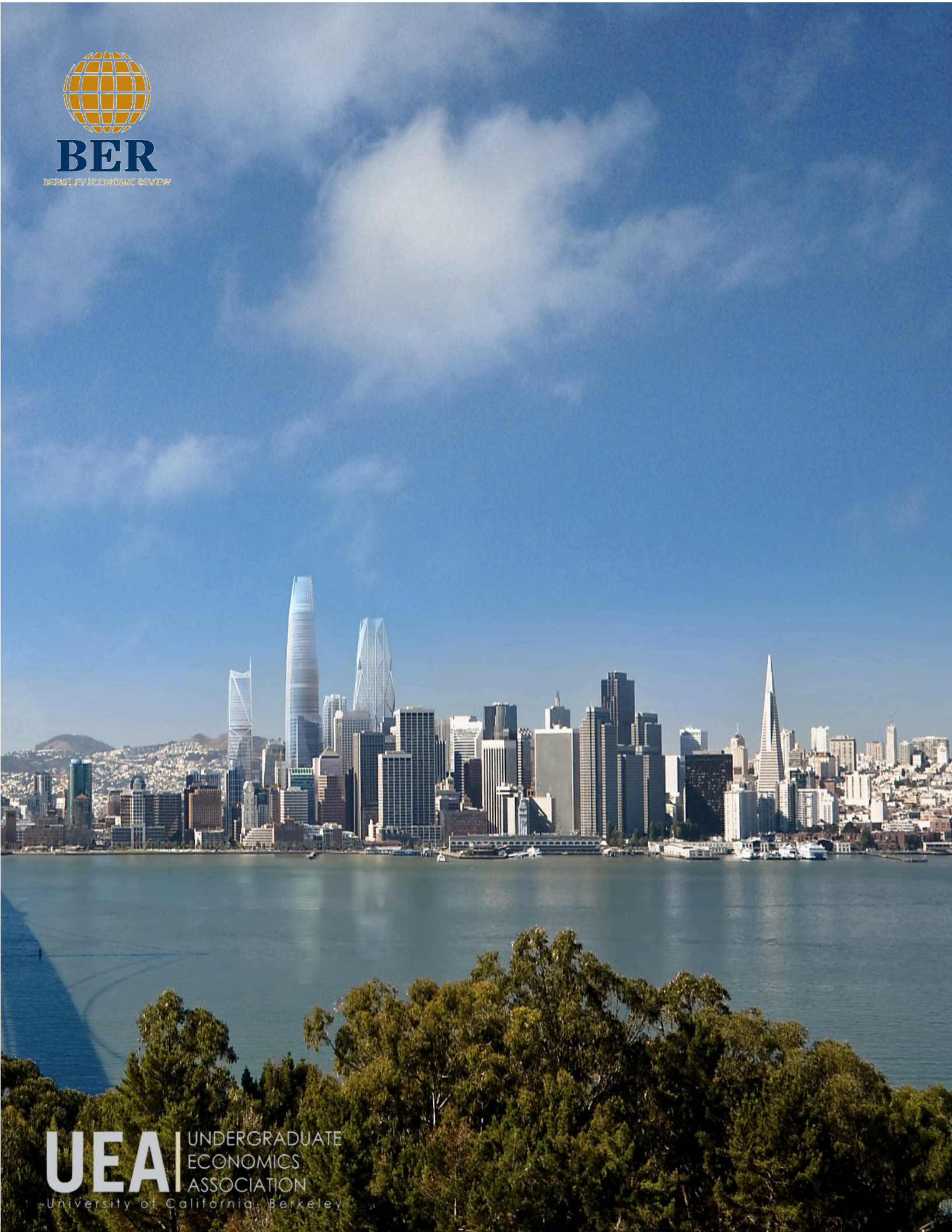
Definitely. Among the recent books, I would recommend Misbehaving by Richard Thaler. It's a beautiful and funny book. It's a mixture of autobiography and behavioral economics. I really like Super Forecasting by Philip Tetlock and Dan Gardner, which tells the story of how a bunch of individuals, recruited over the internet from various places, end up learning to collectively place forecasts on national security better than CIA agents. It analyzes the power of dispersed information. Going back a while, an early read is a beautiful book by Herbert Simon, a Nobel prize winner in economics and also a computer scientist, called Models of my Life. It's another autobiography where he goes back maybe sixty years into the early stages of computers and bounded rationality. That's two books that go back a couple of decades, and two books that were released in the past two years.

WHAT DO YOU THINK IS ONE OF THE MOST SIGNIFICANT ASPECTS OF THE ECONOMICS DEPARTMENT HERE, COMPARED TO OTHER TOP ECONOMICS DEPARTMENTS ACROSS THE COUNTRY?

I think that it is an extraordinarily cohesive department. We work as one big team, which I think makes it easier for the students. I can assure you there are places where if you go to one professor and ask about your honors thesis, they will say, "Okay, I'll talk to you, but don't talk to my colleague, because he'll tell you..." I think here there is really a common language and everyone engages in that direction. And people are also dedicated to the special mission of this public university: excellence, but at the same time a broader reach than, let's say, the Ivies and other private universities.

WE RECENTLY SENT OUT AN ESSAY CONTEST FOR UNDERGRADUATES, ASKING ABOUT THE EFFECTS OF TRUMP'S ECONOMIC POLICIES. DO YOU HAVE ANY COMMENTS?

A lot of us were really surprised at the result of the elections. We're worried about what that is going to look like in the sense that there are very different policies, and a lot of variance. We don't exactly know what's going to be implemented. A trillion dollars spent on infrastructure will create investment, but it's unclear that these health care reforms will do much other than cutting the taxes of the richest people. But the U.S. is a very strong society, and it will survive. It sounds like this is a great essay and you might be collecting opinions on both sides of the aisle, which is good.□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