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Analysis of the Temporary Immigrant Labor Market on  
Information Technology Occupations

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**ABSTRACT**

An important recent labor market trend is the rapid increase in the number of immigrants employed in the information technology sector who have temporary worker status. The dual labor market theory suggests that temporary immigrant workers will be affected more adversely than native workers during a recession. This study uses OLS regression models to predict wages and employment levels (through usual hours worked) in information technology (IT) occupations as a function of immigration status, education level, age, gender, the recession and a set of interactive terms. The results from this study unexpectedly show that employment of native workers in IT occupations fell during the recession while the employment of temporary immigrant workers in IT occupations rose. Also surprising is that wages of temporary immigrant workers in IT occupations do not appear to be significantly different from their native counterparts in those occupations even during the recession. This suggests that employers retained temporary immigrants and even added to their employment to maximize productivity and fill a skills gap rather than realize alternative benefits of retaining native workers in long-term positions.

## I. INTRODUCTION

Outsourcing is typically viewed as the process of shipping jobs overseas to another country so workers at overseas companies can do the job for a lower cost. However, there are many types of corporate restructuring that can fall under the broad scope of outsourcing. Wooster and Paul (2010) define outsourcing as sending in-house production to another company, which can achieve the same results at a cheaper price, whether domestic or overseas. One of the new facets of corporate restructuring is bringing in immigrant workers to fill skills gaps. This is often accomplished through the H-1B non-immigrant visa program, or the L-1 or B-1 visa programs. All these programs allow immigrants to temporarily immigrate to the U.S. to work in a skilled job. Temporary immigration defined by Das et al. is “the temporary movement of persons from one country to another to provide on-site services, when immigrants do not get the right to dwell permanently in the host country” (2012, p. 110).

The present study specifically examines the Information Technology (IT) jobs and their use of temporary immigrants. The H-1B visa program was originally designed with the IT industry in mind because of persistent labor shortages in that industry, and over 60% of H-1B immigrants are employed in IT related jobs (Kerr & Lincoln, 2010). There are multiple other visa programs that aim to bring in skilled workers to the U.S. workforce, including the B-1 visa and the L-1 visa programs, but none with as strong of a history with IT occupations as the H-1B visa program.

There are a significant number of H-1B immigrants who are employed through specific outsourcing companies, and U.S. companies contract with those outsourcing companies for labor. According to Thibodeau & Machlis (2012), the top companies that

employ H-1B immigrants are “offshore outsourcing companies”, including Cognizant and Infosys, which each employ approximately 5000 H-1B immigrants who are then contracted out to U.S. companies for specific jobs. In a report by Moria Herbst (2009), in 2008 the top four companies employing the most H-1B immigrants were subsidiaries of Indian outsourcing companies, with the fifth largest company being Microsoft. Only a fraction of the temporary immigrants working in the IT sector are hired by companies other than the Indian outsourcing companies.

The H-1B labor market is unique in that often two firms are involved in the labor transaction, a contracting firm that pays the temporary immigrant and the firm that contracts for the services of the temporary immigrant. Since there are often two firms involved, we expect some discrepancy between the temporary immigrant workers and the native workers in terms of wages and hours worked. Therefore, this paper aims to study how temporary immigrant earnings performance differs from natives in the information technology sector. It is expected that the temporary status of H-1B visa holders and the fact that they are often employed by contracting firms, should lead to a wage disadvantage compared to natives. In addition, the paper examines how these differentials are influenced by the business cycle.

The rest of the paper proceeds as follows: Section II reviews the previous literature on the topic of temporary immigrants; Section III describes the theoretical model which is the underlying theory driving the empirical model; Section IV describes the data and utilize descriptive statistics to begin to tell the story of the IT workers; Section V explains the empirical model and the results; and Section VI presents the conclusions.

## II. LITERATURE REVIEW

The literature on immigration in the labor market is vast and typically focuses on both lower skilled workers and higher skilled workers. For the purpose of this study, I focus on the literature concerning higher skilled immigrants because that is one of the qualifications for the H-1B visa (Zavodny 2003). Since the H-1B visa was designed to fill a skills gap in the IT sector, I focus on research articles about the H-1B visa program.

The H-1B visa program was developed in 1990 and was a refinement of the H-1 immigration program. The H-1 program was created to allow individuals who show special merit or ability to perform temporary services to immigrate for a period of time. The H-1B program specified the requirements of these types of visas more definitely to ensure the immigrants in this program were considered “highly skilled immigrants”. This program places a cap on the number of new visas accepted each year. As of 2008, the cap is at 65,000 visas approved each year. Additionally, there is a six-year limit on the length an H-1B visa can be in effect. Many companies, specifically in the IT industry, have lobbied the government to expand the quota of H-1B visas every year since the cap was put into effect (Watts, 2001).

The other types of visa programs that could have workers in the IT sector include the B-1 visa and the L-1 visa. These two types of visas are the next largest temporary work visa programs. The B-1 visa is designed for the purpose of business visitors coming to the U.S. for a short period of time to participate in certain business activities. The duration of this visa is up to six months. There are two types of L-1 visas: intra-company transfers of managers and intra-company transfers of employees with specialized knowledge. This visa has a maximum stay of seven years, but the majority of

L-1 holders initially stay for only a year or two, then return to their own country. These two types of visas could easily be used in lieu of the H-1B visa; especially since a large number of H-1B visas are obtained through India based outsourcing companies.

The economics literature specifically researching the H-1B program is minimal, although what has been done focuses mainly on the IT industry. The literature on H-1B immigrants is varied. Some of the articles, such as Das et al. (2012), look specifically at a comparison of immigrant labor and outsourcing jobs, while other papers, such as Zavodny (2003), focus more on the effects of the H-1B workers on wages of the native workers. Other articles, such as Fulmer (2009), look at ways the U.S. can improve the H-1B visa program to fix the problems with wages and unemployment in the IT industry. My research is different in that I am focusing on very recent data surrounding the most recent recession.

According to a study by Borjas (1999), “the economic gains from immigration are largest when the skills of immigrants most complement those of natives” (p.32). One of the most argued segments of the literature on immigration is whether the immigrants are complements or substitutes to the native workers. Two sides have emerged on the debate of the H-1B visa program. Proponents to the program argue that the temporary immigrants are complements to the native workers, while the opponents to the H-1B visa program, argue the immigrants are substitutes. Robert Atkinson, for example, asserts that H-1B workers are substitutes, stating “the H-1B program is used by companies as a way to lower the wages they have to pay to American workers and that additional H-1B visa slots come at the expense of American jobs” (2010, p.1).

There have been many studies done in the past few years to determine whether H-1B workers are complements or substitutes to the native workers. Mithas & Lucas (2010) specifically look at this relationship in their study, and in fact conclude that “American and foreign IT professionals are not perfect substitutes and may in fact be complements of each other. These findings may be a result of the unique human capital possessed by foreign IT professionals” (p. 760). Along the same lines, Atkinson (2010) found that H-1B visas are not being used as a way to undercut native workers, but are rather “complement[ing] them so that hiring foreign workers increases demand for domestic workers” (p. 2). Luthra (2009) asserts that the jobs H-1B workers are working in are more ‘flexible’ in terms of length of job, and in terms of benefits. Thus, the temporary immigrants seem to be more complementary to the native workers than substitutes.

One of the aspects of the H-1B visa is that an applicant’s possession of a bachelor’s degree is a requirement (Mithas & Lucas, 2010). This education qualification means that a good number of H-1B immigrants have a fairly good grasp on speaking English, which could be extremely helpful in terms of their jobs. Borjas (1999) asserts “a great deal of evidence shows that immigrants who understand and speak English earn more than those who do not” (pg. 33). This is just another example of how the H-1B visa program is beneficial to the U.S., not just to the immigrants.

According to many studies focusing on the early 2000’s (Fulmer 2009, Mithas & Lucas 2010, Mann 2006), the wage disparity that is expected through theoretical models and many anecdotal reports appears to be insignificant through statistical analysis. Temporary immigrants are to be paid at least 95 percent of the premium wage for the job

they were hired to do (Mann 2006). However, many anecdotal reports claim there are other ways around this rule. Fulmer (2009) finds that the prevailing wage is calculated based on the job description, not on the qualifications of the applicant. So if the job only requires a bachelor's degree, but the worker has a doctorate, then they will only be paid at the bachelor's degree wage.

For the purposes of this study, the outstanding factor not taken into account in the previous studies is the recent influx of outsourcing companies hiring the H-1B workers and contracting their labor out to other firms. Since the employing outsourcing firm pays the H-1B worker, not the company where the H-1B worker is actually working, there is little reason to expect that the wages of workers hired directly by the company and those contracted out would be equal.

Many studies attempt to study the wage disparity between the temporary immigrants and the native workers with the thought that temporary immigrants are being paid less than the native workers (Luthra 2009 & Zavodny 2003). The majority of the studies that look at the wage disparity focus on the early 2000's and look specifically at the effect on the IT sector. Recently, the system seems to have shifted (Fulmer, 2009) because of the large increase in Indian outsourcing companies hiring the H-1B immigrants. Since the temporary immigrant workers are hired by outsourcing companies who then contract the workers out to another company to work, the native workers and the temporary workers are being paid by different sources. Thus, this suggests that a wage disparity between native IT workers and the IT workers hired from outsourcing companies could exist.

In the previous literature, it does not appear that contract labor has been studied in relation to the H-1B visa. However, it appears that within the last six years or so, outsourcing companies hiring H-1B immigrants have increased substantially. As is evident through Fulmer's study, 19,512 out of the 65,000 H-1B visas approved in 2006 were through Indian outsourcing firms (2009, p. 844). H-1B immigrants are not being hired directly by U.S. companies; rather they are sub-contracted out by the outsourcing firms to do work for the U.S. companies. Therefore, I believe this new path for H-1B immigrants needs to be addressed and it is my assertion that the wages of more recent H-1B immigrants is impacted in a different way than found in previous studies.

As is evident from the literature reviewed, the debate regarding temporary immigration and the H-1B visa program specifically covers a range of topics and occasionally reaches contradictory conclusions. While some studies find insignificant wage differences (Zavodny 2003, Mithas & Lucas 2010, & Luthra 2009) there are reasons to think that differences may now exist between natives in the IT industry and temporary immigrants. This topic, I believe is extremely important in this era of globalization especially in the IT sector, as those H-1B immigrants are seen as the best and the brightest to keep up with technological advances.

My study aims to contribute to this body of research by specifically looking at the effect the business cycle has on both wages and employment in regard to temporary immigrants and native workers in the IT sector. The majority of the studies reviewed focus on what was occurring in the early 2000's; my study will look at the years surrounding the recession of 2008, which have not previously been studied. Since these are years in which sub-contracting of temporary immigrant labor became more important,

I expect temporary immigrant workers to experience different wage and employment patterns than suggested by earlier research. The paper also seeks to determine how wage and employment performance of temporary immigrant labor in the IT sector changed relative to natives during the recent recession.

### **III. THEORY**

The theoretical model for this paper is a modified version of the dual labor market model that is common in labor economics (Reich, et. al., 1973). The qualifications of the H-1B visa program limit the ability of movement of temporary immigrants through the labor market. H-1B workers are hired and sponsored by the firm they will work for in the U.S., furthermore “[t]o an H-1B worker, termination of employment means loss of H-1B status” (Fulmer 2009, p. 855). Therefore, it seems clear from the literature that the H-1B workers and the native workers are not in the same labor market, and that H-1B workers are more vulnerable to employment discrimination.

Zavodny’s (2003) research in conjunction with the fact that the majority of H-1B visa immigrants are hired by outsourcing companies rather than directly by U.S. companies, as well as the temporary status of the immigrant workers, all lead to the conclusion that there seems to be a segmentation of the labor market between the temporary immigrants and the native workers. Therefore, the theory of a dual labor market appears to be a reasonable conceptual representation.

A dual labor market means that there are two labor markets that are separated by some barrier (Reich et al., 1973). In this case, the temporary immigrants are in their own labor market, which is segmented from the labor market of the natives in the IT industry.

These two labor markets have a barrier between them, which prevents mobility of labor; specifically, the temporary immigrant workers are hired by different companies (outsourcing companies) and are unlikely to become permanent employees like the native workers in IT occupations. This allows for a different equilibrium for wages and quantity of labor in each of the labor markets.

This theory assumes that if there is a change in one of these labor markets, there will be little effect on the other labor market. In the native workers' market, we assume supply and demand is derived based on the economy and the available workers in the field. In the temporary immigrant workers market, there currently appears to be excess demand, as the number of applicants for the H-1B visa exceeds the quota of available visas (Atkinson 2010), and supply is derived up until the point of the quota for the H-1B visas. Reich et al. identifies this as a dual labor market, where one market is the primary market, which is more stable and tends to have higher wages. The other market is the secondary market, which typically does not encourage a stable working environment, and generally has lower wages.

The idea of a dual labor market is the main theory of this paper, and was originally introduced into the topic of immigration by Piore (1979). His interpretation of the dual labor market is somewhat different than mine. Piore (1979) makes the assumption that in the primary market the workers are higher skilled and not easily replaceable. The secondary market, is more generally inclusive of immigrants in general, who are perceived to be lesser skilled, and thus, have lower wages.

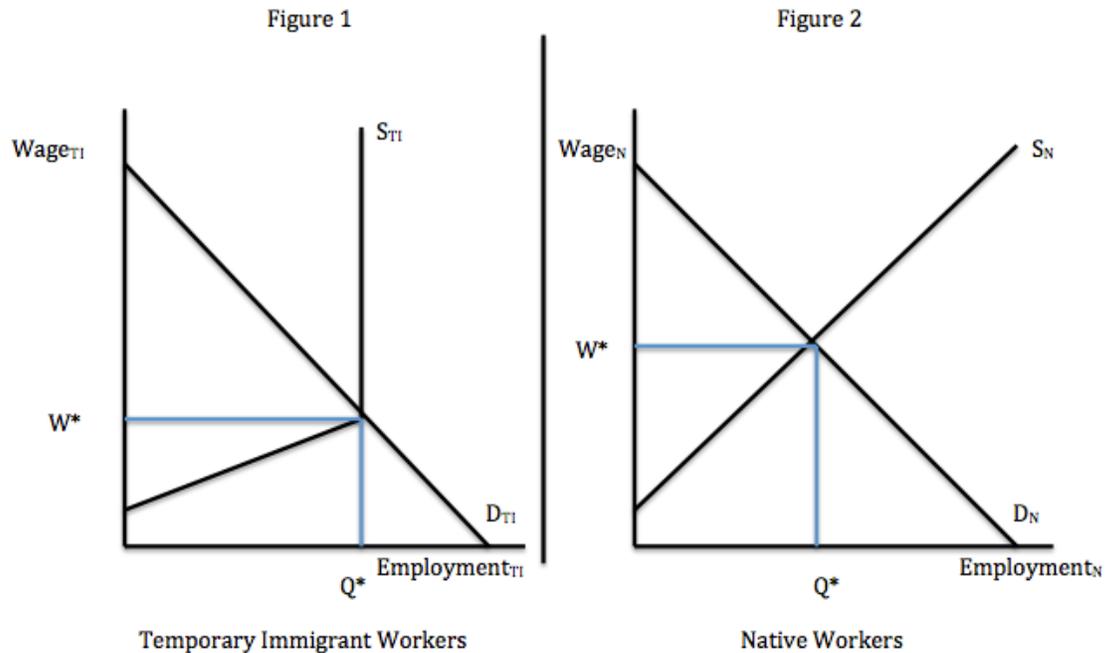
Dual markets are somewhat different in the context of the current study. When taking this framework into account concerning the H-1B visa, the primary market

consists of the native workers, and the secondary market consists of the temporary immigrant workers. The temporary immigrant workers, while not separated from the natives by being lower skilled, as was the case with Piore's (1979) interpretation, do have many disadvantages in the labor market. For example, the stipulations of the H-1B visa, such as the limitation on the duration of stay in the U.S. and the fact that the temporary immigrants are totally dependent on the employer who helped sponsor their visa all lead to the conclusion that temporary immigrant workers are not in the same labor market as the native workers.

The figures below represent graphically the situation of a dual labor market. Figure 1 represents the secondary labor market for the temporary immigrant workers, and Figure 2 represents the primary labor market for the native workers. The line drawn between the two graphs represents the barrier where no worker can cross from one market to the other. As is shown by  $W^*$  and  $Q^*$  in both graphs, it is clear that the secondary market, Figure 1, temporary workers have a lower wage than that of the native workers in Figure 2. One reason to expect that temporary immigrants will have lower wages is because many of these immigrants work for outsourcing companies; the temporary workers are being treated as such, temporary. Thus it follows that they would be paid lower wages because they are not expected to be working for the company for an extended period of time as the natives are.

The figures also represent how the equilibrium is derived. In Figure 1, the  $Q^*$  is forced because there is a quota for the number of H-1B visas allowed in the country each year; therefore, there is a maximum number of temporary workers that can be accounted

for. While in Figure 2, the native workers equilibrium is derived from the market where supply of native workers equals demand of native workers.



We can conclude that the temporary immigrant workers will be more subject to fluctuations in the business cycle than the native workers; therefore, we would expect a decrease in both the wages and the number of temporary immigrants working in the IT sector during tough economic times. It is expected that since the temporary immigrant workers are in the secondary labor market, they are the most expendable and, thus, will be the first to be let go in times of economic struggle. Similarly, because of the temporary nature of immigrant workers in the secondary labor market, dual labor market theory implies that in general the temporary immigrants will have lower wages, and that temporary immigrant wages may fall sharply relative to native wages during times of a

recession. Also, since the native workers are seen as more permanent workers, there is less of a chance they will be let go or have their hours cut before the temporary immigrant workers.

One reason to expect temporary immigrant workers to be more sensitive to recessions is that the cost of turnover is much lower for them than for permanent workers. Because of their temporary nature, employers are less likely to invest in a great deal of on the job training. Employers know that their commitment is generally constrained by the six-year length of an H-1B visa. On the other hand, hours worked may not decline much for a temporary immigrant during a recession if the cost to the employer is largely determined by the fixed terms of the contract with an outsourcing firm. All things considered, I expect that during the 2008 recession, the temporary immigrants in the IT industry will have lower wages and will work fewer hours than native workers.

#### **IV. DATA**

The primary database used in this study is iPums-USA American Community Survey. There is no data currently available to look at the effect on H-1B immigrants specifically, but I am able to select a large sample of college-educated immigrants who are working in the IT sector on a short-term basis. Many of these workers are likely holders of H-1B visas. There is no certain way to ensure that all members of the sample of temporary workers in my study have the H-1B visa, but I do know that the immigrants in my study meet the qualifications, so I will assume that the data I receive will be similar to that which I would get if there was a database of H-1B immigrants. However, there

are likely to be some individuals in my sample who have other types of temporary visas such as the B-2 and L-1 visas.

My sample consists of adult IT workers who are working at least 35 hours per week, 48 weeks per year and are between the ages of 25 and 65. The sample consists of three groups that can be identified for analysis. The individuals in all three groups will be similar in terms of age, education status, occupation, and industry in which they work.

The three groups are:

1. Citizens of the U.S. who were born in the U.S. or born by U.S. parents abroad.
2. Long-term immigrants, who were not born in the U.S., but have either become U.S. citizens or have lived in the U.S. longer than six years. Those in the group of long-term immigrants are very likely to be citizens or to have a green card, which assures permanent residency.
3. Temporary immigrants in IT occupations that have been in the United States less than six years. Many of these individuals are likely in the U.S. to work for a specified period of time under temporary visa programs and do not have permanent residency.

The theoretical assumption of the dual labor market theory is that there are two markets, the primary and the secondary market. For this reason, the group labeled long-term immigrants is considered to be part of the primary job market along with the group of natives.

In my dataset, I only extract data of individuals with age parameters from 25 to 65 to collect data from working age adults. I also only extracted data of individuals in IT type occupations defined by the 1990 occupation code as:

- Computer systems analysts and computer scientists
- Operations and systems researchers and analysts
- Computer software developers
- Programmers of numerically controlled machine tools
- Computer and peripheral equipment operators

The reason for looking at these types of jobs is to obtain a sample of workers in IT type occupations.

Furthermore, in my study, I analyze temporary immigrant workers and native workers in three specific years. The first year, 2006, is during relatively good economic times. The second year, 2008, is during the recession with relatively bad economic times. The third year, 2010, is during the recovery of the recession where the economy is thought to have recovered some, but was by no means completely recovered.

### **1. Descriptive Statistics**

The sample of temporary immigrants has high levels of educational attainment. In the temporary immigrant group, 47.4% have a bachelor's degree, 40.8% have a master's degree, and 2.5% have a doctorate degree. Those in the sample who are not temporary immigrants (long-term immigrants plus natives) have educational attainment that is much more diverse. The percentage of this group with a bachelor's degree is 41.9%. The numbers then drop off compared to the temporary immigrant group. There are 16.6% of permanent workers who have a master's degree and only 1.6% of this group has a doctorate degree. These statistics begin to suggest that perhaps there is a skills gap present in the IT sector, with the temporary immigrant group possessing more education.

The literature previously discussed also suggested that a majority of the H-1B visa holders would be from India as a result of the vast majority of Indian outsourcing companies who hire many H-1B immigrants. In fact, in my sample 57.5% of the temporary workers were born in India. The next largest percent of temporary workers born in one country is China with 7.3% of temporary workers. Both in terms of country

of origin and educational attainment it appears that my sample fits extremely well in terms of the literature and what is expected.

Descriptive Statistics were run on the data for each year separately to determine how the IT employment numbers changed from year to year. Table 1 below represents the breakdown of the data collected, to determine the dispersion throughout the five IT sector jobs through the three years. This table includes full-time, year round workers who worked at least 48 weeks last year and work at least 35 hours each week. Table 1 shows that the total number of workers in each of the five IT occupations increased between 2006 and 2008. Then looking from 2008 to 2010, the total number in the sample has decreased in every occupation except operations and systems researchers and analysts. When looking at the total number of workers in the sample, employment in the IT sector increased from 2006 to 2008, and then decreased from 2008 to 2010. This shows that the recession affected the IT sector less than the rest of the economy since the IT occupations in the sample actually experienced job growth from 2006 to 2010 when most other sectors experienced job loss.

Table 1: Number Employed in IT Occupations

Census Year				
Occupation, 1990 basis	2006	2008	2010	Total
Computer systems analysts and computer scientists	14235	16140	15562	45937
Operations and systems researchers and analysts	1463	1592	1787	4842
Computer software developers	10976	11692	11329	33997
Programmers of numerically controlled machine tools	544	643	524	1711
Computer and peripheral equipment operators	1169	1062	991	3222
Total	28387	31129	30193	89709

Table 2 shows the percent distribution of IT workers in the three groups in this sample, natives, temporary immigrants, and long-term immigrants over the three years. According to the table, the number of natives employed in the IT sector decreased significantly from 2008 to 2010, with a -4.1 percent change, and long-term immigrants also experienced a small decline in employment during this period. Surprisingly, temporary immigrants had a significant increase in employment from 2008 to 2010, with a 5.1 percent change in employment. These results are unexpected and suggest that employers are reducing employment of the native workers rather than the temporary immigrant workers during the 2008 to 2010 time period. Although it is not possible to know the exact reason that employers are favoring employment of temporary workers over permanent workers during this period, one possible explanation is that employers could decide to let go of the native workers instead of the temporary workers because typically the native workers are paid more, and thus, the employers would save more money as a result of reducing their employment.

Table 2: Number of Individuals Employed in IT in 2006, 2008, and 2010

Number of:	2006	2008	2010	Total Employed	% Change (2006-2008)	% Change (2008-2010)
Natives	22758	24708	23702	71168	8.6%	-4.1%
Temporary Immigrants	1026	1096	1152	3274	6.8%	5.1%
Long-term Immigrants	4459	5188	5187	14834	16.3%	-.02%
Total	28243	30992	30041	89276		

Tables 3 and 4 show the average hours worked and the average real wages by immigrant status. Table 3 shows that the average hours worked are pretty consistent throughout the three years. It appears from these statistics that temporary immigrants work the least hours per week, and the natives work the most. However, the differences in hours are not that large. Table 4 suggests that long-term immigrants on average make

more money than either temporary immigrants or natives. Surprisingly, temporary immigrants are making more money on average than natives are in both 2006 and 2010. This is the opposite of what is expected as a result of the theoretical evidence of the dual labor market.

Table 3: Average Hours Worked by Immigrant Status

Immigrant Status	Census Year		
	2006	2008	2010
Temporary Immigrants	42.62	42.44	42.14
Long-term Immigrants	42.94	42.98	42.77
Natives	43.59	43.59	43.34

Table 4: Average Real Wage by Immigrant Status

Immigration Status	Census Year		
	2006	2008	2010
Temporary Immigrants	66735.24	70209.04	76912.15
Long-term Immigrants	71015.25	84243.47	88275.30
Natives	62329.18	70933.35	74029.61

Table 5 shows the distribution of employment in IT occupations by industry in the three different groups, temporary immigrants, long-term immigrants, and natives. The reason for controlling for industry is important in order to control for the differences between IT jobs in different industries. It appears that temporary immigrants are overrepresented in the business and repair services industry compared to the other two groups, with 52% of temporary immigrants, 35.6% of long-term immigrants, and 25.5% of natives. It is important to control for industry of employment in the two regressions to be presented below because there are rather large differences in the employment distributions of temporary immigrant IT workers compared to other IT workers.

Table 5: Industry of Employment by Immigrant Status for 2008

Industry Dummy Variable	Temporary	Long-term	Natives	Total
Construction Dummy	0.3%	0.4%	0.6%	0.6%
Manufacturing Dummy	12.7%	16.1%	16.6%	16.4%
Communications Dummy	6.1%	9.4%	9.7%	9.6%
Finance Dummy	10.4%	13.2%	11.6%	11.8%
Business Dummy	52.0%	35.6%	25.5%	28.2%
Professional Dummy	10.1%	14.4%	18.5%	17.5%
Administration Dummy	1.1%	4.3%	9.2%	8.1%
Trade Dummy	5.1%	5.6%	6.5%	6.3%
Other	2.2%	1.0%	1.8%	1.5%
Total	100%	100%	100%	100%

## V. EMPIRICAL MODEL & RESULTS

The main purpose of the empirical model is to use an OLS regression to determine whether temporary immigrant workers are more adversely affected by the recent recession compared to native workers. The same basic model is run to predict two variables: the natural log of wages (LnWages) and usual hours worked per week (HOURS). LnWages is the proxy for individual wages and is yearly data. HOURS is a proxy for individual employment and is the usual hours worked per week. Table 6, provides definitions of all the dependent and independent variables included in the regression model along with the expected signs. The dependent variable in Regression 1 will be LnWages. The wages are controlled for inflation by using the CPI with 2010 as the base year, collected from the Worldbank database.

Table 6: Variables and Descriptions

Variable Name	Description	Expected Sign
<b>Dependent</b>		
LnWages	Regression 1	
HOURS	Regression 2	
<b>Independent</b>		
Native	1=native, 0=immigrant	Omitted
Temporary	1=temporary status, 0=does not have temporary status	Negative
Long-term	1=immigrant, 0=non immigrant	Positive
Female	1=female, 0=male	Unknown
Age	Number 25 through 65	Unknown
<i>Year Dummy Variables</i>		
D2006	1=2006, 0=any other year	Omitted
D2008	1=2008, 0=any other year	Negative
D2010	1=2010, 0=any other year	Positive
<i>Educational Attainment</i>		
SomeCollege	1=some college, 0=attended more schooling	Omitted
AssociateDegree	1=associate degree, 0=no associate degree	Positive
BachelorsDegree	1=bachelors degree, 0=no bachelors degree or more schooling	Positive
MastersDegree	1=masters degree, 0=no masters degree or more schooling	Positive
ProfessionalDegree	1=professional degree, 0=no professional degree or more schooling	Positive
DoctoralDegree	1=doctoral degree, 0=no doctoral degree	Positive
<i>Language Proficiency</i>		
LimitedEnglish	1=speaks little to no English, 0=speaks English reasonably well	Negative
SomeEnglish	1=speaks some English, 0=speaks no English or speaks English fluently	Positive
<i>Industry Dummy Variables</i>		
ConstructionDummy	1=employed in construction, 0=not employed in construction	Unknown
ManufacturingDummy	1=employed in manufacturing, 0=not employed in manufacturing	Unknown
CommunicationsDummy	1=employed in communications, 0=not employed in communications	Unknown
FinanceDummy	1=employed in finance, 0=not employed in finance	Unknown
BusinessDummy	1=employed in business services, 0=not employed in business services	Unknown
ProfessionalDummy	1=employed in professional services, 0=not employed in professional services	Unknown
AdministrationDummy	1=employed in public administration, 0=not employed in public administration	Unknown
TradeDummy	1=employed in a trade occupation, 0=not employed in a trade occupation	Unknown

We are using LnWages instead of wages to follow standard practice in the labor market literature to deal with non-linearities in age-earnings profiles and heteroscedasticity of the error term.

### 1. Empirical Model

The equations below are what are being estimated.

Regression 1:

$$\begin{aligned} \text{LnWages} = & \alpha + \beta_1(\text{Temporary}) + \beta_2(\text{Long-term}) + \beta_3(\text{D2008}) + \beta_4(\text{D2010}) + \\ & \beta_5(\text{D2008*Temporary}) + \beta_6(\text{D2010*Temporary}) + \beta_7(\text{Age}) + \beta_8(\text{Female}) + \\ & \beta_9(\text{LimitedEnglish}) + \beta_{10}(\text{SomeEnglish}) + \beta_{11}(\text{AssociateDegree}) + \beta_{12}(\text{BachelorsDegree}) \\ & + \beta_{13}(\text{MastersDegree}) + \beta_{14}(\text{ProfessionalDegree}) + \beta_{15}(\text{DoctoralDegree}) + \\ & \beta_{16}(\text{ConstructionDummy}) + \beta_{17}(\text{ManufacturingDummy}) + \beta_{18}(\text{CommunicationsDummy}) \\ & \beta_{19}(\text{FinanceDummy}) + \beta_{20}(\text{BusinessDummy}) + \beta_{21}(\text{ProfessionalDummy}) + \\ & \beta_{22}(\text{AdministrationDummy}) + \beta_{23}(\text{TradeDummy}) \end{aligned}$$

Regression 2:

$$\begin{aligned} \text{HOURS} = & \alpha + \beta_1(\text{Temporary}) + \beta_2(\text{Long-term}) + \beta_3(\text{D2008}) + \beta_4(\text{D2010}) + \\ & \beta_5(\text{D2008*Temporary}) + \beta_6(\text{D2010*Temporary}) + \beta_7(\text{Age}) + \beta_8(\text{Female}) + \\ & \beta_9(\text{LimitedEnglish}) + \beta_{10}(\text{SomeEnglish}) + \beta_{11}(\text{AssociateDegree}) + \beta_{12}(\text{BachelorsDegree}) \\ & + \beta_{13}(\text{MastersDegree}) + \beta_{14}(\text{ProfessionalDegree}) + \beta_{15}(\text{DoctoralDegree}) + \\ & \beta_{16}(\text{ConstructionDummy}) + \beta_{17}(\text{ManufacturingDummy}) + \beta_{18}(\text{CommunicationsDummy}) \\ & \beta_{19}(\text{FinanceDummy}) + \beta_{20}(\text{BusinessDummy}) + \beta_{21}(\text{ProfessionalDummy}) + \\ & \beta_{22}(\text{AdministrationDummy}) + \beta_{23}(\text{TradeDummy}) \end{aligned}$$

There are multiple independent variables to measure human capital and demographic determinants of LnWages and HOURS. The main focus of this paper is on variables that measure temporary immigration status and a time variable that measures whether or not the economy is in recession. The main variable that we are focusing on is a dummy variable indicating temporary status (Temporary), where Temporary equals one

if the respondent is in the United States for less than 6 years and is not a citizen. I expect temporary status to be negatively related to LnWages for reasons suggested by the dual labor market theory. The reference group in the regression is native workers. There is also one last dummy variable that captures long-term immigrants (Long-term), where Long-term equals one if the respondent is in the United States for 6 or more years, but was born outside of the United States. In both of the regressions we will use interactive terms to capture the effect of both a recession and temporary status. The interactive terms are computed by interacting temporary immigration status with the survey year. The interactive terms will allow us to test the hypothesis that temporary workers in the IT sector will be more adversely affected by the recession compared with native workers.

The LnWages and HOURS regressions also include a number of control variables that are commonly found in empirical studies of wages. The human capital variables are defined in Table 6, and include many dummy variables to determine levels of educational attainment. There are also two dummy variables to determine how well the individuals speak English, the first one captures if the immigrant speaks little to no English (LimitedEnglish) and the other variable captures if the immigrant speaks English fairly well but is not fluent (SomeEnglish). There are also dummy variables for age (Age) and gender (Female). Finally, there are dummy variables to control for industry the worker has an IT job in. The independent variables are defined in Table 6.

The other regression that will be run, Regression 2, will have the same independent variables, but will have usual hours worked per week (HOURS) as the dependent variable to determine if employees during the recession had their hours worked per week cut back. This dependent variable is used as a proxy for employment.

Please note that since the sample consists of those IT workers that work more than 35 hours per week, the HOURS variable applies to variation in usual hours worked of the pool of workers who work more than 35 hours per week.

These two regressions will be able to tell us the effect of both temporary status and the business cycle on both LnWages and HOURS. When both regressions are run, the expected signs that are most important are Temporary, which I expect will be negative in both regressions because of the “dual labor market” theory discussed above. This would mean that temporary worker status would have a negative effect on both wages and usual hours worked per week. One problem that might occur with the regression model that is worth noting is the idea of endogeneity, which essentially is the question of whether the number of hours a worker works cause their wages to be higher, or whether a higher wage causes the worker to either work more or fewer hours per week.

The next important variable is D2008, which I expect to be negative as well because I believe the recession would have a negative impact on both wages and usual hours worked per week for all IT workers in the sample. The next important variable is the interactive term for (D2008\*Temporary); I would expect its coefficient to be negative because the combined effect of being a temporary worker during the recession should have a negative effect on both wages and usual hours worked. That is, I expect temporary immigrant workers in the IT sector to be more adversely affected by the recession than all other workers in the IT sector.

Although the main focus of this study is on immigration status and survey year, there are a number of control variables included in the empirical model. For example, I expect higher levels of educational attainment to have a positive effect on LnWage and

HOURS, because the more human capital an individual has, the higher their wages should be, thus, the more hours they should work. Educational attainment is proxied by a set of dummy variables with the omitted reference variable being those who have not completed any college. The other control variables in the model included measures of age, sex, English language ability, and industry of employment.

## **2. OLS Regression Results**

This section discusses the regression results that are used to test two research hypotheses: first, temporary immigrant IT workers are at an economic disadvantage compared to native IT workers, and second, temporary IT workers are more adversely affected by the 2008 recession compared with their native counterparts. Table 7 below shows the results of both regressions. Regression 1 predicts LnWages, and Regression 2 predicts HOURS.

In terms of the coefficients that are most important for what I am studying, the variable Temporary is negative like I expected, however, it is not significant, which suggests that being a temporary immigrant does not have a significant effect on the workers' wages in the short-run. The variable Long-term has a positive and a significant effect on LnWages, which is consistent with the descriptive statistics in Table 4, as long-term immigrants had the highest wage of immigrant group in all three years. Both of the interactive terms in Regression 1 are also not significant, but the interactive term (D2008\*Temporary) is negative, as was predicted. The fact that the interactive terms were not significant suggests that temporary workers are not more adversely affected by the recession than natives. This is surprising because it suggests that possibly there is not a disadvantage to temporary immigrants in the IT sector. In fact, the positive coefficients

Table 7: Regression Results

	Regression 1 (Dependent: LnWages)	Regression 2 (Dependent: HOURS)
Constant	10.327*** (696.442)	44.449*** (218.000)
Temporary	-.012 (-.774)	-1.941*** (-9.215)
Long-term	.083*** (17.533)	-0.880*** (-13.562)
D2008	.121*** (30.498)	-0.020 (-.363)
D2010	.159*** (39.782)	-0.232*** (-4.229)
Interactive2008	-.014 (-.670)	0.282 (.983)
Interactive2010	.028 (1.373)	0.176 (.620)
Age	.010*** (62.281)	0.002 (1.067)
Female	-.167*** (-46.644)	-1.197*** (-24.263)
LimitedEnglish	-.207*** (-10.331)	-0.220 (-.801)
SomeEnglish	-.105*** (-12.180)	-0.875*** (-7.349)
AssociateDegree	.039*** (6.868)	-0.313*** (-3.991)
BachelorsDegree	.283*** (71.059)	0.227*** (4.155)
MastersDegree	.428*** (83.954)	0.665*** (9.519)
ProfessionalDegree	.349*** (17.368)	0.950*** (3.444)
DoctoralDegree	.538*** (41.718)	1.703*** (9.662)
ConstructionDummy	-.040 (-1.602)	-.578* (-1.683)
ManufacturingDummy	.042*** (3.165)	-.316* (-1.734)
CommunicationsDummy	.043*** (3.148)	-.556*** (-2.962)
FinanceDummy	.106*** (7.875)	-.835*** (-4.514)
BusinessDummy	.082*** (6.264)	-.099 (-.554)
ProfessionalDummy	-.051*** (-3.907)	-1.532*** (-8.448)
AdministrationDummy	.018 (1.278)	-2.552*** (-13.480)
TradeDummy	-.012 (-.885)	-.373** (-1.933)
Adjusted R-Square	.192	0.027
Sample Size	89709	89709

Numbers in parentheses are t-statistics

\*Significance at the .10 level

\*\*Significance at the .05 level

\*\*\*Significance at the .01 level

to D2008 and D2010 suggest that wages in the IT sector increased after 2006, a result that suggests that labor demand remained high in that occupational sector. So, all three groups (temporary immigrants, long-term immigrants and natives) seem to have shared in the upward trend in wages over this time period and no one group benefitted over another.

All of the educational attainment control variables are highly significant in predicting LnWages, this suggests that regardless of immigration status, more education has a positive effect on LnWages, which is expected based on economic theory. The control variables for industry also were all significant except construction, administration, and trade in this regression. ConstructionDummy and TradeDummy both had a negative effect on LnWages, which suggests that workers in these industries have a lower wage. The rest of the industry dummy variables had a positive effect on LnWages, which suggests that workers in these industries have a positive effect on LnWages. Age and female both appear to have a significant effect on LnWages. Age has a positive effect on LnWages, which means that the older workers have higher wages. Female has a negative effect on LnWages, showing that women IT workers, *ceteris paribus*, have 16.7% lower wages than men. The dummy control variables for English proficiency are both significant and negative on LnWages, suggesting that if workers do not speak English well, it will have a negative impact on wages.

In terms of Regression 2, the coefficients of the variables I am most concerned with, Temporary is negative and significant as was predicted. This suggests that being temporary has a negative effect on usual hours worked. Long-term immigrants also have a significant and negative effect on usual hours worked. Once again, the interactive

terms do not appear to have a significant effect on usual hours worked. These results show that both the business cycle and temporary status do not appear to negatively affect usual hours worked as the theoretical model predicted. This suggests that there is something else going on in the IT sector, which could be explained as growth in this sector despite the recession.

The educational attainment control variables are all positive and highly significant predictors of hours worked which suggests that the more education a worker has the more hours they will work each week. Both of the language variables are negative; however, only the variable `SomeEnglish` is significant. Age does not appear to be significant in determining usual hours worked. Female, however, is once again highly significant and negative, suggesting that female workers work less than male workers.

## **VI. CONCLUSION**

In conclusion, the results of this study do not completely support my hypothesis that during a recession, temporary immigrant workers will be affected by the recession more adversely than native workers in terms of both wages and usual hours worked. In terms of wages, the fact that a worker has temporary status does not significantly affect their wages, and in terms of usual hours worked, temporary status only decreases usual hours worked by about 2 hours, which is not a considerable amount. These results are surprising in the context of expectations derived from the dual labor market theory. First, perhaps there really is a skills gap in the IT sector that the temporary immigrants are filling which would suggest that the temporary immigrants are not fleeting in terms of their importance to the firms. Second, since there is a skills gap in the IT sector, the

hiring of temporary workers is most important to growing firms to fill the shortage; therefore, this causes wages of newly hired temporary immigrants to be higher.

The idea that the temporary immigrants are filling a skills gap in the IT sector could easily explain the results of this study. In much of the literature reviewed earlier in this paper, many authors argued either for or against the idea that temporary immigrant workers are either complements or substitutes to the native workers in these occupations. The results of this study suggest that temporary immigrants are complements. The shortage that many claim to exist in the IT sector does in fact exist because, if these temporary immigrants are not important to the functionality of the company, it would not make sense for the owners of the firms to continue paying the high costs of employing these workers.

The main argument of the opponents of the H-1B visa program is that the reason for this program is to hire workers at a lower wage than natives. However, the results of this study show that this is not the case. In fact it appears that the temporary immigrants are paid the same wage rate as the native workers. This suggests that the wage premium that is stipulated in the H-1B program is in fact enforced in the IT sector. This is surprising, however, given the fact that the H-1B workers tend to have higher educational attainment on average compared to the natives. It makes a certain amount of sense that the temporary workers are filling a skills gap in the IT industry.

It is also possible that the skills gap has created an inverse wage disparity that creates salary inversions within firms. This would cause firms to pay higher wages to new hires than to some existing employees, which can explain why temporary status is not significant in determining wages. The idea of an inverse wage disparity can be seen

in other industries, especially those that appear to have a shortage in workers.

Essentially, inverse wage disparity is when the new hires are being paid a higher wage rate than employees who have been working at the company for a number of years. The fact that the firms need the human capital that the temporary immigrants have suggests that they are valuable to the firm. If something is valuable to a firm, the firm is willing to pay extra for it. Therefore, the firms in the IT sector are trying to attract temporary immigrant workers by paying them a premium wage.

There are many avenues for future research on this topic, and specifically stemming from this study. One area for future research is to obtain data on the benefits awarded to workers in the IT sector to determine if temporary immigrants are at a disadvantage in terms of benefits awarded compared with native workers. Another aspect of future research could be to look at the effect regional location in the U.S. has in relation to temporary status on wages and usual hours worked in the IT sector.

The results of this paper provide surprising results that do not match my expectations for the IT labor market based on dual labor market theory. Essentially, the temporary workers seem to be more important to the success of the firms than had been originally thought. The results of this study suggest that firms are choosing to retain temporary immigrants because of the skills they bring to the company. Their wage is also not significantly different than the wage of the native workers. Therefore, it appears that the predictions from the dual labor market theory are not born out of temporary immigrants in the IT sector.

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