Introduction
A 2010 poll conducted by UW-Madison Professor Ken Foldstein found that 62 percent of Wisconsinites agreed with the statement that Wisconsin’s brightest college graduates are leaving their home state for opportunities outside Wisconsin, and that “brain drain” is a statewide concern. Additionally, a speaker at the governor’s conference on economic development in February pointed out that combatting “brain drain” is the key to Wisconsin’s growth, with neighboring states like Illinois and Minnesota gaining college graduates. These inquiries raise several questions. Is “brain drain” a problem for Wisconsin? If so, what are the causes? How serious is the problem?

So exactly what is “brain drain”? In economics, “brain drain” is defined as a situation in which educated or professional people leave a particular place for one that gives them better pay or living conditions. More generally, brain drain is also called human capital flight, with human capital being the knowledge, skills, competencies, and attributes of individuals that facilitate the creation of personal, social and economic well-being. Differences in human capital among workers can be explained by various worker attributes, such as education, health conditions, experience, and training. Improving individual human capital can help alleviate the severity of social inequality in a society. Moreover, human capital has been shown to exhibit positive externalities because well-trained individuals tend to spread their knowledge to others, thus benefitting less skilled individuals (Lucas, 1988). In sum, human capital is a driving force for the growth of the economy (Barro and Sala-i-Martin 2004).

Any loss of human capital from the exit of skilled workers will lead to lower education levels, lower per capita income and fewer opportunities for economic development. Brain drain is a comprehensive term that encompasses the emigration of all highly trained or educated people of all age groups, not only the out-migration of young (aged 25-29), single, and college educated. Brain drain will be worse if human capital flight is associated with the net loss of young college-educated individuals because of the negative impact of lost tax revenues and diminished economic prospects. Without a skilled and highly educated workforce, our economy will experience slower growth, because of lost productivity. Studies have shown that more “qualified job applicants” mean more jobs because companies tend to move to states where they know they can hire an educated workforce.

The loss of human capital from brain drain is usually regarded as an economic cost. Investment in education by local governments may not lead to faster local economic growth if a large number of its highly educated workers leave the home state. “Brain drain” thus often leads to arguments that question the effectiveness of public investments in education. Though Wisconsin’s population is increasing, most of the growth is occurring in people 65 or older. Over the past five years, Wisconsin has lost 9,000 college educated residents, aged between 21 and 29. This, however, has been the experience of every state. For highly educated young people, the whole world is their job market. This is not so much brain drain, but brain redistribution. Mobility in our society has increased because of new technologies. Similar to the importance of human capital, mobility is also the key factor in the success of the local economy. The influence of migration can be treated as an equilibrating mechanism in change economy (Sjaastad, 1962). Economists have shown that migration is a method of promoting better resource allocation. We could treat migration as an investment in increasing the productivity of human resource, and thus, a very important factor for the growth of the local economy. While we pay close attention to the number of people leaving the state, we should not ignore the number of people coming to Wisconsin, and the quality of human capital carried by immigrants.
Since “brain drain” involves the loss of human capital, if we really want to check the severity of the brain drain in Wisconsin, we should not simply count the number of migrants, (the number of the inflow and the number of the outflow). We should also carefully examine the human capital of migrants both leaving and arriving in Wisconsin, to assess changes in labor productivity of the state. A relatively higher rate of in-migration of talented people and a relatively lower rate of out-migration of talent overtime can increase the level of human capital in the local economy. So we need to consider ways to measure the quantity of human capital carried by migrants. Such measurements and data sources are described in the second section. The third section gives the results of our study. A comparison of brain drain among regional and neighboring states will also be explored. Policy implications and conclusions are discussed in the last section.

**Method and Data**

There is no a perfect way to identify exactly how much human capital each person possesses because each person is different. We adopt a general measurement that takes into consideration shared characteristics that influence human capital stocks, including education attainment, work experience, health status, marital status, and other variables.

**Basic Model**

Persons with greater human capital are more productive than those with less human capital. As the amount of time a person spends in an activity grows, that person is likely to develop some method, either a new technique or simply muscle memory, to increase proficiency, thereby increasing output and income. Hence, the amount of human capital within a state is crucial to its competitiveness and gross state product. This begs the question: What exactly contributes to human capital development? Certainly there are formal measurements such as education and experience. However, other attributes also contribute to the formation and accumulation of human capital in any given trade. As economist Alfred Marshall put it, this happens as if “it were in the air, and [people] may learn them unconsciously” (Marshall, 1890).

To estimate the movement of human capital stocks, we adopt a method known as the “Labor-Income-Based measure of Human Capital” (LIBHC). Economist Jacob Mincer formulated the LIBHC to determine how much income an individual may command relative to the amount of their human capital. The following equation shows that income is equal to the contributions of various characteristics of an individual:

\[
\text{Lnhourlywage} = \beta_0 + \beta_1 \text{Edu} + \beta_2 \text{Exp} + \beta_3 \text{Sex} + \beta_4 \text{Race} + \beta_5 \text{Mar} + \beta_6 \text{Union} + \beta_7 \text{Dis} + \epsilon.
\]

In the equation, Lnhourlywage is the natural logarithm of an individual’s hourly wage. Edu is the level of education attainment. Studies have shown that higher education level, would dramatically boost the probability of finding a job as well as the probability of finding a better job, and thus increase earning levels. Exp refers to work experience, which constitutes another key component of human capital. Work experience permits an individual to become more productive and therefore earn a higher income. Mar is a dummy variable for marital status that helps to explain the power of family obligations, which in general, can motivate people to take on extra responsibilities at work and gain extra experience that translate into greater human capital. Further, Sex is another dummy variable used for gender, as there are gender specific jobs that restrict labor participation of certain group and thus affects the ability to accumulate human capital. In addition, we also control for other factors that may affect individual’s human capital. Race is a dummy variable for ethnicity, Dis refers to the disability status and Union represents the union affiliation. \(\epsilon\) is the error term.

All these factors can distort the link between human capital and the wage rate. The intercept term, \(\beta_0\), shows the extent to which hourly wages resulted from the characteristics of their local economy, such as the amount of machinery and equipment per worker, the amount of roads or other public capital per worker. Other coefficients (\(\beta_1-\beta_7\)) show the influence of human capital characteristics on hourly wages of individuals.

With the above equations, we can take a close look at the brain drain problem in Wisconsin. We can consider how much human capital on average each out-migrant removes from a state by relocating, resulting in the “brain drain” effect or human capital flight. Alternatively, “brain gain” is the result of the inflow of persons to the state with human capital. The data sources are described in detail below.

**Data Sources**

The U.S. Census Bureau sends a monthly survey to households called the American Community Survey (ACS) to estimate characteristics of the U.S. population and households based on the twelve months leading up to the issue of the survey.
Individual responses are weighted to indicate the amount of people each respondent represents. The Mincer equation used in our study looks at ACS data to determine the hourly rate or return on human capital of in-migrants and out-migrants. This information is used to calculate the human capital transferred when migrants leave one state for another. We define the net flow of workers as the difference between outflow of migrants and inflow of migrants. And similarly, the net flow of human capital is the difference between total human capital stocks carried by the out-flow of workers and the human capital carried by the in-flow of workers.

As mentioned previously, education attainment is the most important variable influencing the human capital. The ACS samples span from no years of schooling to 20 years (the presumed amount of time from first grade to attainment of a doctorate degree). Work experience constitutes another key component of individual’s human capital stock. More years of work experience permit an individual to be more productive than the average greenhorn, and therefore earn a higher income. In our analysis, we utilize age as a proxy for “potential experience” because the ACS survey does not directly ask respondents about their years of work. Experience should rise with the age of workers who remain in the workforce. The link between potential experience and actual experience may be more tenuous for women than for men because women are more likely to spend time out of the formal labor force to attend to family responsibilities. We therefore control for gender in our equation.

Familial obligations may motivate an individual to want to out-perform peers and, thereby contribute to an individual’s human capital accumulation. Health problems can reduce the human capital for workers if illness causes workers to miss work for extended periods or if it leads to a loss of coordination or knowledge. We therefore include a variable for disability status in our estimation. Finally, we know that unions protect workers from unfair labor practices and create job security. While comforting for the worker, unions create disincentives to seek better opportunities elsewhere, thereby constraining human capital accumulation. The ACS survey however has not collected union affiliation data. In response, we developed a variable to estimate the probability of union affiliation for each migrant. To be considered a union member, an individual must be over 18 years of age, currently working, and earn a weekly wage within $150 of the average wage of union members of the industry.

Given our emphasis on the comprehensiveness of “brain drain”, we limited our sample to working migrants between the age of 16 and 70 who have relocated within the past year and have resided in their new states more than three months. Those without wage earnings are not taken into consideration. Hourly wages were converted to annual income assuming a 2,000 hour work year, and annual incomes are assumed to persist in the future. Future returns are then used to estimate the migrant’s human capital stock, using 10% annual discount rate.

Results

Brain Drain in Wisconsin

Let’s see if our state has a brain drain problem. Figure 1 shows flow patterns of migrants. We know from 2000 to 2010, 64,334 workers left Wisconsin per year on average and the average inflow of workers per year was 64,793. For that 11 years period, 5,040 more workers entered Wisconsin than left the state. However, Wisconsin has experienced a net loss of 40,726 workers from 2006 to 2010. This trend, if continued, will have a negative effect on Wisconsin’s future economic growth. States that have more workers enter than leave will be in a much better labor market position than states that face a net outflow of workers.

In order to assess the seriousness of brain drain, we need to evaluate the human capital flow patterns for Wisconsin. As shown in Figure 2, the total net loss of human capital to Wisconsin from 2000 to 2010 was about $309,137,167, despite the net gain of 5,040 workers during the same period. This tells us that the workers leaving Wisconsin were significantly more skilled and educated than the workers coming in. Although 5,040 more workers entered Wisconsin than
left, there was a net loss in human capital. Wisconsin’s GDP grew each year from 2000 to 2010 (even during the recession in 2008), so the net loss of human capital is not preventing Wisconsin from growing. It may however be preventing Wisconsin from growing at a faster rate. Figure 2 shows that, since 2010, Wisconsin has experienced an increase in net human capital inflow at $2,768,479,479, despite 17,779 more workers leaving Wisconsin than entering the state in 2010. This change may indicate that Wisconsin has had some success in attracting the highly skilled and educated workers. We need to continue this trend line to promote our economic growth, especially growth into the future.

Figure 2- Flow Patterns of Wisconsin Human Capital

Wisconsin and its Neighbor States

In order to have a better understanding of our brain drain problem, we also need to examine the experience of surrounding states. Figures 3 and 4 show how net flows of migrants and human capital in Wisconsin compare to its neighbor states. Of the 4 states surrounding Wisconsin, we can clearly see that most of our neighbors lost workers from 2000 to 2010, except for Iowa which gained more workers than it lost. Iowa far exceeded Wisconsin’s total net gain in workers, while the other 3 states experienced net losses. The net inflow of workers to Iowa during the period is 11,087, while Illinois’s net loss was 381,262 workers, Michigan’s net loss was 284,648, and Minnesota’s net loss was 45,190. It is surprising that Illinois lost workers given that Chicago has been a magnet for workers in the past.

It is also necessary to check the flow pattern of human capital carried by these migrants in our bordering states. In Figure 4, we see that most of our neighbor states lost human capital from 2000 to 2010, except Illinois which gained over $100 billion in income from the net inflow of by highly skilled and educated workers. This result is consistent with the expectations of economists. Larger and more interesting cities are especially attractive for the highly skilled and educated workers who prefer communities that have the amenities they desire, such as education and job opportunities. The only neighbor state that really enjoyed “brain gain” is Illinois. The proximity of Chicago is also one reason why Wisconsin loses many of its young and highly educated workers.

Relatively speaking, Wisconsin’s brain problem may not be as dire as initially thought. While Wisconsin lost $309,137,167 in income in the 11 year period, Iowa lost $10,132,194,003, Michigan $41,692,937,461, and Minnesota $22,286,727,435. Wisconsin has managed to recover the lost human capital since 2010 with a
surge in highly skilled and educated in-migration of workers, despite the U.S. trend of human capital moving south. Compared with Minnesota, Iowa and Michigan, Wisconsin has been a magnet for highly skilled and educated workers. Among all our neighbors, Iowa is most like Wisconsin. Though Iowa performed better than Wisconsin in attracting workers overall, the state lost more human capital than Wisconsin because it was losing educated and skilled workers while attracting unskilled workers during the period.

The other 2 states – Michigan and Minnesota, experienced a net loss both in the number of workers and the level of human capital. Despite the long term economic stagnation in Michigan, it seems that Minnesota has more problems in attracting people, especially skilled and educated workers. Minnesota has a higher GSP level, larger metropolitan areas, and much higher per capita income than Wisconsin. Why then has Wisconsin performed better in terms of net migration and human capital? Some clues to this come from the data collected by the National Center for Education Statistics. Wisconsin is an annual net importer of college-bound students due to the good reputation of college and universities in Wisconsin, while Minnesota and Michigan are annual net exporter of young high school graduates. Tornatzky, et.al. (2001) found that college reputation was the most important factor determining choices of high school graduates, and students in general tended to stay where they earned college degrees. Their findings are supported by a report from the University of Wisconsin System, which looked at the number of graduates who remain in the state. Of all 13 four-year institutions, 81 percent of Wisconsin residents remained in the state after graduation from a UW System institution. Overall – including non-residents- 67% of alumni remained in Wisconsin. At UW-Madison, 69% of Wisconsin residents stayed in the state. At UW-Stevens Point, 76% of UW-Stevens Point graduates remained in the state, with 31% living in the North Central region. In total, 81% of Wisconsin residents who graduated from UW-Stevens Point remained in the state.

If a state loses high school graduates who obtain a college degree in another state, it will result in fewer individuals contributing to the home state’s future economy. These facts go against the argument that “brain drain” phenomenon should discourage investment in education. Our better university and community college system actually curbs brain drain. States that attract more college enrollees from other states than they lose will be in a much better economic position in the future. Instead of investing less in the education in Wisconsin, we should invest more here to attract more educated and young people.

Brain Drains in Great Lakes and Midwest Region
Regional comparisons of domestic migrations are illustrated in Figure 5 which shows the net regional flow patterns of workers in average in the Great Lakes and Midwest from 2000 to 2010. When we do the all the regional comparisons of domestic migrations for the whole United States from 2005 to 2010, the biggest loser of workers is the Great Lakes regions, while the greatest gains go to states in the Southeast region. We know that many workers leave the northern part of the country for southern states, so it is not surprising to see that the Midwest experienced a net loss of workers. The situation is even worse in the Great lakes region. We can also observe from Figure 5, there is more in-migration before the financial crisis in 2008 than afterwards, supporting the idea that people are
more mobile when they have money. With regards to the net flow of human capital in the two regions shown in Figure 6, we can see that the whole Midwest area lost human capital at a $201,193,186 on average every year from 2001 to 2010, while the Great Lakes gained $701,769,370. The Great Lakes is doing better in attracting skilled and educated workers than the rest of the states in the Midwest. Despite this, we should not ignore the problem of a consistent net loss of the human capital since 2003 for the Great Lakes region.

Figure 6 - Net Flows of Human Capitals in the Great Lakes and Midwest Region

Policy Implications and Conclusion
A lack of qualified workers undermine economic stability and growth in the future so policy and business leaders need to have a clearer picture of our flow pattern of workers, and human capital especially. We have shown that Wisconsin experienced a net in-migration of workers and brain drain during the period of 2000 to 2010. The real problem is that the skill level of out-migrants is higher than in-migrants. Several factors have contributed to the net loss of human capitals in our state. Wisconsin has a lower per capita income level than other states-$37,623 compared to $39,626 nationally. Good paying jobs and career opportunities are the most important criteria to migrants in choosing where to live. Another significant factor contributing to Wisconsin’s brain drain is the national trend toward urban areas which typically have more job opportunities and higher wages. Though we have a major metropolis in Milwaukee, larger cities like Chicago and Minneapolis can attract a lot of Wisconsin’s educated and skilled workers. It is very important for workers, especially for the skilled and educated young people to find a place that is “active, exciting and fun” (Thomas B. Fordham Institute, 2009).

Contrary to conventional wisdom, the so-called “brain drain” may not be as dire as is often portrayed in Wisconsin. Compared with Minnesota, Iowa and Michigan, Wisconsin is a more attractive place for educated and skilled workers. Wisconsin did manage to recover much of the lost human capital in 2010 with a huge surge in highly skilled in-migration of workers. We find that our well-regarded university and community college system has attracted out-of-state school graduates, many who stay in Wisconsin after earning their college degree.

Long-range comprehensive initiatives should be developed to try to combat the drain in human capital. First of all, we need to create jobs that pay competitive wages. Other researchers have emphasized the need to implement policies, such as tax credits, to promote growth in industries with “technological intensity”, which tend to grow faster, create more jobs, and lead to higher incomes. Like other states in the Midwest, Wisconsin’s traditional manufacturing industries have not been able to compete with the high-tech industries in Silicon Valley and Chicago for highly skilled workers. Increasing the share of Wisconsin firms with technological intensity will help combat brain drain, making our state more attractive for the future
workers. Boosting Wisconsin’s economy will take more than just adding jobs and attracting workers. The state needs to foster high growth industries which lure highly talented workers.

Secondly, the state should invest more in education instead of worrying that college graduates will leave for other states. It is true that we lose some of our college graduates during their early 20s. However, the mobility of workers, especially young people is something that cannot be “curbed” or controlled. While there is little to stop young people from leaving, we can do a lot to encourage educated and highly skilled people to come, live and stay in Wisconsin. Evidence from neighboring states like Minnesota indicate that college education is important in curbing brain drain and that college reputation is the most important factor in attracting young high school graduates. The state should also provide incentives such as specified tuition reduction programs, loan forgiveness, grant aid and/or offer more graduate school scholarships to keep local talent in-state and to attract out-of-state talent. Expanding social opportunities and the cultural diversity of the state can also help as well as fostering ties between colleges/universities and local businesses. In sum, keeping and attracting workers with higher human capital requires us to engage in long-range comprehensive planning.
References


Tornatzky, Louis G., Denis O. Gray et al. (2001).“ Who Will Stay and Who Will Leave?” Southern Technology Council, a division of the Southern Growth Policies Board. skilled and educated young people to find a place that is “active, exciting and fun” (Thomas B. Fordham Institute, 2009).