The Impact of Hosting the Summer Olympic Games on Economic Growth in Developing Countries: A Case Study of the 2008 Beijing Games

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Presented in partial fulfillment of the requirements for completion of the Bachelor of Arts degree in International Studies at the Croft Institute for International Studies
Sally McDonnell Barksdale Honors College
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University, Mississippi
December 2014

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Acknowledgements

I would like to thank my thesis advisor, Dr. Joshua Hendrickson, for his above and beyond devotion of time and energy into guiding me through the writing process; not even my yearlong writing hiatus could cause him to lose interest in my work. Dr. Hendrickson's insight on regression modeling techniques and his merciless editing pen made invaluable contributions to the completion of this thesis.

I would also like to thank Dr. Gang Guo for inspiring me to pursue further study in quantitative research; his research methods class helped me to thresh out the initial concept for this paper and his insightful comments on my initial drafts were critical to polishing the final version presented in this text.

Finally, I want to thank Dr. Kees Gispen, Dr. William Schenck, The Croft Institute for International Studies, and The Sally McDonnell Honors College at the University of Mississippi for providing me with the resources, motivation, and support that enabled me to take full advantage of my undergraduate experience and emerge with a better understanding of the world around us.

Introduction

In recent years, the global media and the governments of developing countries have begun to regard hosting the Olympic Games as a viable means by which to achieve strengthened international political influence. More and more developing countries view a successful Olympic bid as an opportunity to announce their arrival as major players on the economic and diplomatic world stage. Often included in such rhetoric is the idea that hosting the games has a positive impact on economic growth in the host city, as well as the host country. While this claim has been tested, and widely rejected, in developed countries, little research exists concerning how hosting the games in developing countries will impact the host economy.

The 2008 Beijing Olympics is among a select group of Olympic Games ever hosted in a developing country (joining Seoul, South Korea in 1988 and Mexico City, Mexico in 1968). In the past, conducting research on the effects of the Olympics on these countries' economies was made nearly impossible by limited data collection technology and limited resources and incentives for governments to collect data. However, because of the availability of reliable economic indicators in China over the past 15 years, at both the municipal and national level, the 2008 Beijing Games offers a unique opportunity to investigate the Olympic impact on economic growth in developing countries.

Economic Growth Background

With the collapse of the Soviet Union in 1991, the struggle between capitalism and socialism for preeminence as the global economic system of choice officially came to an end; capitalism had seemingly become the only legitimate method of economic organization available to state actors. As such, governments across the developing world enthusiastically implemented policies designed to increase free trade, privatize state-run industries, improve banking transparency, and stabilize currencies, among other such pro-growth initiatives (de Soto 2000). While similar strategies had been ineffectively employed before, most notably with the International Monetary Fund-led round of neoliberal reforms in 1980s Latin America, the switch to a common worldwide capitalist system was expected to remove many of the barriers to economic growth facing developing countries. However, the first post-Soviet decade was characterized not by a surge of growth throughout the developing world, but rather by the continued economic triumphs of developed countries.

As it became increasingly clear that the unification of the world economy under the capitalist system was not the panacea it was thought to be for developing countries, the field of economic growth once again sprung to the forefront of economic thought. In recent years, researchers have begun to delve deeper in their questioning of why, under the same economic system, some countries succeed while others languish in perpetual economic stagnation. The drive to explain phenomena like income differences across countries and the persistence of poverty in certain regions has led current economists to make significant strides in understanding the

mechanisms that promote growth and the underlying conditions that make growth possible. Thus, before we analyze the effects of the 2008 Beijing Olympics on economic growth in China, it is important to understand these underlying conditions and factors.

Although theories ranging from nations' geographical locations to their endowment with certain cultural traits have long dominated the discussion on economic growth, empirical evidence compiled over the last few decades does not support these hypotheses. (Acemoglu, Johnson, and Robinson 2001). The legal origins theory, perhaps most notably supported by Engerman and Solokoff (2000), argued that the legal institutions set up in a country during colonialism (English common law, French code law, etc.) have been the primary determinants in countries' growth since the start of the 20th century. Despite the valuable contributions of this hypothesis to the field of economics, Jones (2011), among many others, has found major theoretical flaws in Engerman and Solokoff's argument. Notably, these critics point to the economies of the colonial British Caribbean islands as evidence against the legal origins hypothesis. While countries like the Bahamas use the British common law system (associated with positive growth according to legal origins theory), they have not experienced sustainable growth. Jones (2011) instead emphasizes the importance of factor endowments in giving rise to specific institutions, which determine growth.

The institutional framework described in Acemoglu and Robinson's *Why Nations Fail (2012)*, which proposes that the political and economic institutions of a nation are responsible for the economic growth of that nation, has been the first to

successfully integrate theory and empirical research to explain growth. Institutions are the "rules of the game" that describe how decisions are made in a country, who gets to make them, and why these people make the decisions they do (North, 1990). Institutions are therefore the basis for the economic incentives to become educated, to invest, and to innovate. Hence, Acemoglu and Robinson argue that the type of institutions in a nation, either *inclusive* (broad distribution of political rights, secure property rights, unbiased legal processes, quality public services, etc…) or *extractive (*designed for the enrichment of a country's elite) establish that nation's ability to grow (Acemoglu, Johnson and Robinson 2005). Essentially, inclusive economic and political institutions are associated with economic prosperity and growth while extractive institutions are tied to poverty and stagnation.

This conclusion gives us a framework with which to analyze growth. Any shocks to the economic or political system of a country that broaden political or economic participation, increase incentives to invest and innovate, stimulate trust throughout the nation's working population, or promote economic efficiency could all contribute to the inclusivity of a nation's institutions and hence the creation of sustainable economic growth. Such shocks include the creation of a sophisticated, large, and inclusive financial market, the fostering of competition, the creation and enforcement of property protection laws, suitable allocation of resources, and the development of an efficient public infrastructure system.

To go into a bit more detail, one major means by which to achieve growth is through financial sector development. The ease and cost with which people can lend and borrow money determines the amount of investment in an economy. In

countries with underdeveloped financial systems, lack of access to credit discourages investment with positive potential returns. Therefore this investment is foregone and no growth is created. More specifically, banks in underdeveloped systems face high monitoring and screening costs (Aghion, Howitt 2009). Screening costs are those associated with conducting background checks to make sure that the proposed investment opportunity has a realistic potential to bring returns to the investment and that potential innovators (the debtors) are trustworthy. Monitoring costs are described by the amount of resources necessary to ensure that the credit is being put towards the use for which it was intended. If these two costs are significantly high, loan interest rates will be correspondingly elevated, and therefore many potential innovators will be unable to afford to take out a loan for their projects. Banerjee and Duflo (2005) explain that because the rates lenders charge borrowers include the cost of monitoring and screening, these rates could end up being considerably higher than the opportunity cost of capital, discouraging potential investment. Additional benefits of financial development include lowering transaction costs (Greenwood and Smith 1996), boosting corporate governance (Bencivenga and Smith 1993), and facilitating the trading and hedging of risk with positive implications for growth (Acemoglu and Zilibotti 1997). Therefore, developing a larger, more integrated, and more transparent financial system will increase the efficiency of background checks and monitoring, cutting costs significantly. Thus, more people are able to take out loans and the percentage of "good" investments will increase.

Another factor that can contribute to sustained economic growth is the fostering of competition amongst firms. Aghion, Blundell, Griffith, Howitt, and Prantl (2006) conclude that the closer firms are to the world's technological frontier (the industry leading technology), the more responsive these firms are to increased entry in their respective industries. The closer to this technological frontier, the more productivity growth will result from increased entry. However, firms that are relatively far behind the frontier are actually negatively affected by increased entry, implying that barriers to entry are helpful to a country's less technologically advanced firms (at least for a short period of time). Aghion, Burgess, Redding, and Zilibotti (2006) show that delicensing has a positive effect on productivity growth in India, but only when the threat of increased entry into the industry is already credible before government intervention.

Thirdly, nations can apply stricter enforcement of property protection laws to create conditions favorable to economic growth. Without the enforcement of property rights laws, there exists little incentive to invest. Potential investors will forgo investment opportunities when there is nothing stopping the government or competitors from confiscating potential investments before the returns are captured. Do and Iyer (2003) show that the implementation of land reforms policies allowing farmers to sell, transfer, or inherit their land usage rights increased agricultural investment, especially sustainable investment such as the planting of multi-year crops.

Efficient resource allocation is another important driver of economic growth.

Recent literature has focused on resource misallocation to explain the income and productivity gaps across the world's nation, implying that efficient resource allocation can also contribute to economic growth. Banerjee and Duflo (2005) point to a list of factors that can contribute to misallocation. One such factor is that government under-regulation or overregulation can both contribute to misallocation. Under-regulation contributes for the same reason as lack of property protection, distorting incentives to invest because of an increased risk of property confiscation. Thus, both capital and human resources are not used in their most productive capacity. Overregulation or over-taxation can stymie innovation and risk taking by decreasing or in some cases, eliminating the incentive to invest (Jones 2011, Banerjee and Duflo). In fact, Aghion, Algan, and Cahuc (2008) as well as Zak and Knack (2001) show that there exists a strong, negative causal relationship between regulation and trust: the more regulatory a country is (i.e. more government controls on market entry, prices, wages, etc.), the lower level of trust exists between citizens of that country. Knack and Keefer (1997) show that mutual trust among individuals is positively correlated with growth. Therefore, building trust (which implies resisting overregulation) is a key indicator of conditions suitable for economic growth.

Next, the lack of insurance in a country can disrupt efficient allocation. Banerjee and Newman (1991) demonstrate that in India, where insurance is often available in villages but not in the city, some individuals with greater economic potential in the city decide not to migrate, preferring to stay insured in the village despite the lack of economic opportunities there. According to Rozenweig and

Wolpin (1993), uninsured households also use productive resources as "buffer stocks" to smooth out consumption or prevent against unforeseen future economic troubles.

Additionally, Banerjee (1992) shows that local externalities can lead to misallocation of resources. He argues that people often rely too much on other people's behavior rather than their own information when investing, leading to "herd behavior" and underinvestment or overinvestment depending on the trend of the herd.

Finally, a dramatic push towards a more efficient infrastructure can also results in sustained growth. Wang (2002) argues that the externality effects between a nation's infrastructure establishment and private real production are strong enough to bring about "substantial" economic growth, a conclusion supported by a near consensus of growth economists. Pradhan and Bagchi (2013) show that infrastructure, in particular transportation infrastructure, expands the productive capacity of a nation by increasing the ease with which resources can be mobilized and boosting the productivity of those resources. They conclude there exists "bidirectional causality" between road transport infrastructure and economic growth, meaning that improved infrastructure has a statistically significant positive effect on growth while economic growth also has a significant positive effect on infrastructure efficiency.

According to Acemoglu and Robinson (2012), these variables associated with growth will develop naturally from the incentives created by inclusive institutions. However, nations with extractive institutions can only hope to achieve growth by

very specific means, namely increased government centralization and the promotion of efficiency.

Chinese Institutions

Acemoglu and Robinson (2012) argue that Chinese economic institutions have achieved significant strides towards inclusive economic institutions over the past three decades, beginning with Deng Xiaoping's "four modernizations" reforms. However, Chinese growth thus far has rested predominantly upon "catching up" to developed nations through the import of foreign technology and export of low-end manufacturing products. Griffith, Redding, and Van Reenen (2003) propose that research and development becomes more important to a country's growth prospects as that country moves closer to the technological frontier. Because China's economy has grown steadily closer to the economies of developed countries, continued economic growth will rely on whether or not China makes the shift to innovative (as opposed to imitative) business and economic policies.

Acemoglu, Aghion, and Zilibotti (2006) build on this idea by arguing that countries unable or unwilling to make the shift towards inclusive institutions (a shift that would promote innovation and stimulate R&D expenditures through an increase in the legislation and enforcement of property rights) will be caught in a "poverty trap." Thus, a country cannot hope to achieve sustainable economic growth through imitative policies like those that have driven Chinese growth in recent years.

Acemoglu and Robinson (2012) contend that while China's economic institutions have become decidedly more inclusive, its political institutions have remained extractive, posing a threat to the country's ability to make the switch to innovation driven economic growth. McGregor (2012) argues that China's primary goal and interest is to maintain its fundamental system of state security. Despite all the recent economic reforms, McGregor declares that the "3 pillars of communism" (control of personnel, propaganda, and The People's Liberation Army) are still extremely robust and supported by party leadership. Lu and Tao (2009) describe Chinese courts as being influenced by opinions and direction from local government officials, implying a lack of autonomy and hence a lack of trust in the legal system. Furthermore Zhao (1989) reveals that local courts rely on local government organizations for funding, a clear infringement on autonomy.

In regard to the protection of property rights, China's constitution made no mention of private property rights until 2004 (Lu, Png, and Tao 2012). Therefore, while property protection has made marginal improvements over the past decade, property rights legislation and enforcement has remained sporadic at best, resulting in significant regional differences in areas like patent protection (Lu, Png, Tao 2012).

Due to the state's heavy influence in the financial market, state-owned enterprises are at a natural advantage in areas like access to credit and cost of borrowing. Hence, China will be unable to achieve economic growth through its financial system. It runs into the same problem with competition-driven and property protection-driven economic growth. In both cases the government has

little incentive to reform policies favoring limited competition or limited patent protection because state run companies can benefit from these extractive laws.

The elimination of three of the five potential drivers of growth discussed in the previous section leads us to an important insight that forms the basis for this paper. Despite possessing extractive political institutions (which rule out most potential drivers of growth), China can theoretically still achieve economic growth through the last two drivers mentioned in the previous section: more efficient resource allocation and the development and maintenance of infrastructure. The potential for these two drivers to generate growth exists regardless of the nature of a country's institutions. Thus, any exogenous shock to China's economy that pushes the economy to equilibrium with more efficiently allocated resources and a more efficient infrastructure system could result in the creation of sustained economic growth. In the next section, this paper examines if hosting the Olympics could constitute one such shock.

The Olympics and Growth

There is a wide consensus among economists that the economic benefits of hosting "mega events" such as the Summer Olympics are dramatically overstated for developed countries. Baade and Matheson (2003) argue that this overstatement follows from the fact that hosting the Olympic games necessitates considerable expenditures on infrastructure, organization, and security. This means that the host city must depend on significant levels of public subsidization to host, implying that

event promoters have an incentive to exaggerate economic benefits to convince the public to fund the games.

Further factors contributing to this inflation of predicted economic value include the failure of studies to capture the substitution and crowding out effect of hosting the Olympics (Matheson 2002). The substitution effect is the idea that people who spend money at the Olympics spend it on attendance at sporting events rather than on other activities in the local economy. The crowding out effect addresses the concept that while tourists to the games will bring in a certain amount of spending during the games, in the long run total spending will be re-allocated but unchanged. For instance, many people end up diverting their spending from old firms (restaurants, bars, etc…) that they frequented before the Olympics to new firms in the part of town developed during the preparations for hosting the games. The increase in overall spending is likely minimal or nonexistent.

Other academics question that hosting the Olympics has any economic benefit at all. Siegfreid and Zimbalist (2000) show empirically that no statistically significant relationship exists between sport stadium construction and economic development, a hypothesis also supported by Coates and Humphreys (2003). Hotchkiss, Moore, and Zobay (2002) failed to find a significant impact of the 1996 Atlanta Games on wages in the region. This same study did find some evidence that employment in the Atlanta area increased as a result of the Olympics, but it is not clear whether this increased employment was temporary or permanent.

In fact, Baade and Matheson (1999) found that of the 42,448 jobs estimated to have been created by the Atlanta Olympics, at least 40% disappeared by 1997,

just one year after the games. They also show that there was no significant increase in employment in Los Angeles as a result of the 1984 games. Hence, Baade and Matheson argue that much of the economic effects on developed countries are transitory rather than steady state increases in growth rates. Humphreys and Plummer (1995) showed that only 31 percent of expenditures on the Atlanta games were in areas that could potentially created lasting economic impacts ("transportation", "communication", "electric", and "new construction"). The rest was spent on business services and salary disbursements.

Essentially, scholars have been unable to find significant data to validate the belief that hosting the Olympics has a positive effect on economic growth in developed countries.

Until recently, studies of games hosted in developing countries were infeasible due to the lack of available data. Hence, little work has been completed on this topic. Li, Blake, and Thomas (2013) are among the first to empirically investigate this issue, but their research focuses exclusively upon the economic impact of the Beijing Olympics on the tourism industry in Beijing, leaving out critical factors that could leave a lasting economic impact upon the city and the country as a whole. Their study did find that the Olympics had a positive impact on tourism in Beijing, but the increase has been around only 1%, which is relatively insignificant compared to Beijing's whole economy.

What are these factors? The exogenous shocks toward efficient allocation of resources and infrastructure system described in the previous section. Hosting the Olympics brings an international spotlight on the city and country hosting the

games. Hence, there is significant international pressure to ensure that the games are run smoothly. To accomplish this, a number of infrastructure improvements must be made, particularly in transportation infrastructure. The benefits of transportation infrastructure on economic growth were discussed above. However, it is important that these infrastructure improvements are created with post-Olympics use in mind. For growth to occur, a large percentage of development and construction must be put to use after the Games are over. Beijing spent $1.1 billion on building and extending the subway system, completing the light rail system, constructing over 300 kilometers of city streets, implementing high-tech traffic control systems, improving access to the Beijing International Airport, and constructing a new airport terminal (Business Today). Beijing also focused on transforming the city into a "digital" city by spending $3.6 billion on digital and broadband telecommunications, wireless transmission and networking technologies. This spending on infrastructure is a small fraction of the total amount spent on the games, but it is still significant enough to have a potential effect on growth.

The mechanisms by which infrastructure can influence growth revolve around providing a greater percentage of the population with the opportunity to engage in the modern economy. For instance, building a new highway to a town outside of Beijing enables residents of that town to commute into Beijing, thus giving these workers a greater variety of employment opportunities while bolstering the Beijing economy. The greater variety of employment opportunities enables workers to better utilize their knowledge and skill sets, making the overall

economy more efficient. Increasing the efficiency of transportation infrastructure also benefits those residents already commuting to work within Beijing. Faster travel times may mean that workers can either devote more time to working or to sleeping (the latter of which could possibly promote efficiency at the workplace, resulting in higher levels of production).

An efficiency improvement of all varieties of infrastructure (electrical, transportation, physical) can promote increased growth by cutting costs associated with time delays and the unpredictability and instability of weak infrastructure systems. Increasing efficiency allows businesses to shift resources from the transportation of goods, information, and employees to the production process or distribution of services (depending on the type of industry). This shift can result in either a higher quality or quantity of products and services, both of which can stimulate economic growth.

Perhaps a more lasting effect on growth is the positive effect that hosting the Olympics can potentially have on eliminating government corruption, thereby promoting efficiency. The deadlines set during the preparation process force the government to delegate tasks to privately-owned organizations and companies, which because of their profit incentive, typically have lower costs associated with the production or distribution of their product or service. At the same time, the international media spotlight on the host country's government can encourage the government to cut back on known methods of corruption and close legal loopholes that allow for continued financial dishonesty.

Of course, hosting the Olympics also offers ample opportunities for increased corruption (the granting of Olympic construction contracts to family members, bribes to speed up the regulatory process to meet strict IOC deadlines, et cetera). Therefore, while it is beyond the scope of this paper to determine whether corruption increased or decreased in China because of the Olympic Games, it is important to note that if this paper were to find a significant positive effect of hosting the Olympics on growth in China, the reduction of official-level corruption could be one of the contributing factors.

The literature discussed above demonstrates that China, as with most developing countries, is not characterized by the inclusive institutions praised by Acemoglu and Robinson as the key to growth. Nevertheless, with a strong, efficient state government, a nation such as China (which is politically exclusive but possesses some degree of economic inclusivity) can theoretically achieve growth by improving infrastructure and decreasing corruption. Hosting the Olympics puts pressure on host countries to provide a smoothly run games and thrusts the country's politics into the forefront of global awareness. Hence, the host country has a strong incentive to improve infrastructure and cut down on government corruption, which can both have positive effects on economic growth.

Data

Using data from the China Bureau of Statistics, I have built a Panel Data set consisting of variables from 31 Chinese regions and municipalities between the years 1998-2011. To model the effects of hosting the Olympics on economic growth,

I employ two variables, real gross regional product level and real per capita wage growth, to serve as indicators of economic growth. Hence, these GRP level and wage growth variables operate as dependent variables in my regression equations. Because more than one dependent variable is included in the model, multiple regressions are required to test this paper's hypothesis.

In terms of independent variables, it is important to include as many relevant variables as possible to form the most complete explanation for the impact of the Olympic Games on growth. In this case, I have added thirteen independent variables: Infrastructure, Education, Construction, Commercial Traffic, Passenger Traffic, Competition, Patent Protection, Investment, Time, a variable to control for the 2008 financial crisis, a dummy variable to control for the Olympics, an interaction variable between the Olympics dummy and time to isolate the rate of GRP change effect of the Olympics, and an interaction variable included to isolate the effect of the Olympics on the municipality of Beijing. (see Appendix A for explanation of variables and methods of collection and Appendix B for a discussion of the use of similar variables in previous economic literature).

Descriptive Statistics

Before performing regression analysis, it is always useful to calculate descriptive statistics to observe general trends present in the data. Keeping in mind that these trends should be used simply to motivate more rigorous analysis and not to explain true relationships between variables, we can use the following statistics to familiarize ourselves with the data.

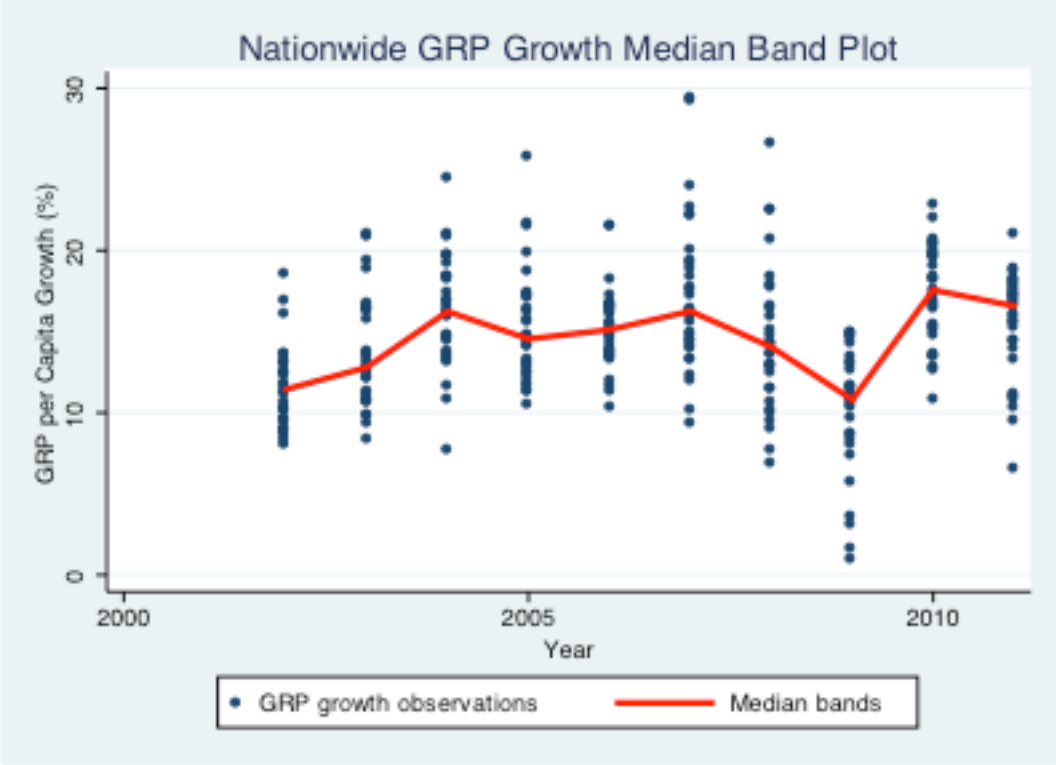

Figure 1

Figure 1 is a scatter plot of real gross regional product growth rates across all of China, with each point of the graph representing the growth rate of a given region for a given year. Although our dependent variable in the regression is GRP level, Figure 1 depicts GRP growth rate to offer a better visual representation of the variable. The median bands line is a trend line connecting the median values of GRP growth at each yearly interval. The figure presents us with an idea of both the general time trends for GRP as well as the range of growth rates exhibited across China. However, an examination of Figure 1 does not offer convincing evidence of a

growth rate trend. The median trend line fluctuates between 10-15% throughout the 2000s, with no evidence of significant long-term increases or decreases in growth rate. When examining this chart, it is important to note the graph measures growth *rate* and not levels of GRP. Thus, an increase or decrease in growth rate does not imply a negative growth rate; it simply implies that the rate of positive growth in China was faster or slower during those years.

To capture a different angle in describing the data, the calculated means for nationwide real gross regional product per capita growth and the growth rate trend for the municipality of Beijing are depicted in the chart below.

Mean Gross Regional Product per Capita Growth Comparison

Year	Mean Nationwide GRP per Capita Growth (%)	Mean Beijing GRP per Capita Growth (%)
2002	11.616	18.481
2003	13.742	15.787
2004	16.297	19.604
2005	15.244	12.01
2006	15.176	13.362
2007	17.257	22.677
2008	14.389	7.742
2009	10.017	10.805
2010	17.345	13.612
2011	15.449	9.521

Table 1

A comparison of the above growth rate yearly mean values suggests that in general, from 2002 to 2007, Beijing experienced higher levels of growth than the country average. In 2007, the year preceding the Olympics, Beijing dramatically outperformed the nationwide average (22.7 percent compared to 17.3 percent).

While Beijing experienced a growth leap of over 9 percentage points from 2006 to 2007, the nationwide mean increased by only 2 percentage points. This large difference would imply that the Olympic preparations did in fact give a boost to the Beijing economy. Even if this increase is attributable to the Olympics, we must also ask whether this boost was sustained. These descriptive statistics indicate that the answer is no. In 2008, Beijing's growth rate plummeted from 22.7% to 7.7% (a drop of an incredible 15%). The national mean fell by approximately 4%. This drop in growth rate is, at least in part, likely attributable to the economic downturn that followed the 2007-2008 financial and banking crisis. Thus, the statistics suggest that while the worldwide financial crisis played a role in the sharp drop in Beijing's growth rate from 2007 to 2008, the dramatic decrease in Beijing growth when compared to the national mean implies that there were other factors involved. What could these factors be? One possibility is that leading up to the Olympics, the Chinese government could have shifted resources towards building the Beijing economy. Then, when the games ended, they shifted these same resources away from Beijing, partially contributing to the huge drop in Beijing's growth rate.

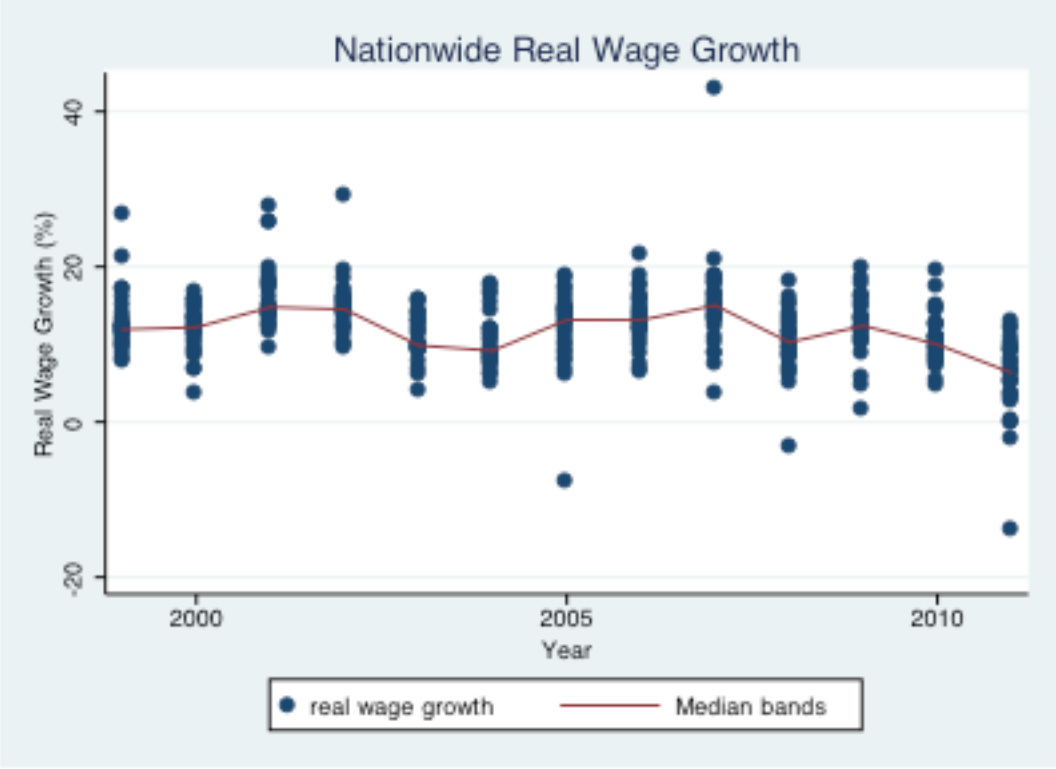

Figure 2

Figure 2 displays a median trend line for real wage growth overlaid on a scatter plot of the dependent variable, in this case the real wage growth in China. Figure 2 doesn't provide any indication of the existence of any particular trends in the data. If anything, Figure 2 and Table 2 (see below) indicate that real wage growth actually decreases from 2001 to 2008 (wage growth means were the highest in 2001 [16.105%]). At the same time, there appears to be an upward trend in wage growth in Beijing until 2008. This trend would seem to support the idea that the Olympics generated growth in Beijing but failed to do so in the rest of the country. However, to know for sure, we must move on to more complex methods of analysis.

Before continuing on, it is important to note the post-2007 growth rate decline suggested by Figure 2 and Table 2. This steep drop off likely indicates the negative affects of a global economic recession on the Chinese economy. Following

the financial crisis and subsequent government bailouts of investment and commercial banks across the United States and Europe in 2007 and 2008, international trade and global commodity prices fell sharply while unemployment rose. Considering these effects of the global recession, the post-2007 wage growth decrease indicated by Table 2 falls in line with our expectations.

Mean Real Wage Growth Comparison

Year	Nationwide Real Wage Growth (%)	Beijing Real Wage Growth (%)
1999	12.699	12.27
2000	11.968	12.84
2001	16.106	14.06
2002	14.811	15.88
2003	10.842	15.63
2004	10.279	16.23
2005	12.169	13.72
2006	13.202	16.43
2007	15.198	13.53
2008	10.294	16.02
2009	12.451	4.72
2010	10.525	10.57
2011	5.624	9.32

Table 2

Descriptive Statistics for the independent variables are presented in Appendix C.

Statistical Methods

This paper attempts to capture the effect of hosting the 2008 Beijing Olympic Games on economic growth in China. Using Gross Regional Product Levels and Real Wage Growth Rate to measure economic growth, we can estimate this effect using a two-stage least squares model with instrumental variables, depicted by the two regression equations below.

$$GRP = \beta_0 + \beta_1 Patent\_Protection + \beta_2 Construction + \beta_3 Commercial\_Traffic + \beta_4 Population + \beta_5 Olympic\_Dummy + \beta_6 Financial\_Crisis\_Control + \beta_7 Investment + \beta_8 Beijing\_Olympics\_Interaction + \beta_9 Beijing\_Time\_Interaction + \beta_{10} Fitted\_Value\_Infrastructure + \beta_{11} Fitted\_Value\_Education + \nu \quad (1)$$

$$wage\_growth = \beta_0 + \beta_1 Patent\_Protection + \beta_2 Construction + \beta_3 Commercial\_Traffic + \beta_4 Population + \beta_5 Olympic\_Dummy + \beta_6 Crisis\_Control\_Dummy + \beta_7 Investment + \beta_8 Beijing\_Olympics\_Interaction + \beta_9 Beijing\_Time\_Interaction + \beta_{10} Fitted\_Value\_Infrastructure + \beta_{11} Fitted\_Value\_Education + \nu \quad (2)$$

Fitted values for the infrastructure and education variables are obtained through the linear regressions (3) and (4), respectively.

$$Fitted\_Value\_Infrastructure = \gamma_0 + \gamma_1 Patent + \gamma_2 Construction + \gamma_3 Commercial\_Traffic + \gamma_4 Population + \gamma_5 Olympic\_Dummy + \gamma_6 Crisis\_Control\_Dummy + \gamma_7 Investment + \gamma_8 infra\_control + \gamma_9 Education + \mu \quad (3)$$

$$Fitted\_Value\_Education = \gamma_0 + \gamma_1 Patent + \gamma_2 Construction + \gamma_3 Commercial\_Traffic + \gamma_4 Population + \gamma_5 Olympic\_Dummy + \gamma_6 Crisis\_Control\_Dummy + \gamma_7 Investment + \gamma_8 Infrastructure + \gamma_9 \ edu\_control + \mu \quad (4)$$

**Note: μ is a composite error term that is uncorrelated with the independent variables in the two equations

This model takes the same form as a typical panel data regression equation with one major difference—the inclusion of instrumental variables. Our growth model needs these instrumental variables to address the problem of endogeneity we face with the variables *Education* and *Infrastructure*. Endogeneity occurs when a dependent variable can influence an independent variable while that independent variable simultaneously influences the dependent variable. An example of such bi-directionality is one of the variables in our model—education. It is widely regarded that increased quality and access to formal education has a positive effect on

economic growth. Conversely, it is likely that higher levels of growth lead to higher levels and greater quality of education.

Instrumental variables can address this issue because they are variables that are associated with the endogenous independent variable but not the dependent variable. More precisely, the instrumental variables can only influence the dependent variable by influencing the independent variable. Thus, employing instrumental variables allows us to isolate the effect of an endogenous independent variable on the dependent variable. If we fail to address the endogeneity problem, then our least squares estimates would be both biased and inconsistent, which would give us no reason to trust these estimates.

In the regressions used in this paper, there are two variables whose endogeneity warrants consideration: *Education* and *Infrastructure*. The instrument for the endogenous *Education* variable is defined by data describing the regional sales of children's books over time.[1] Children's book sales are directly related to the independent variable (as children's book sales increase, the quality of education likely increases as well). While children's book sales are related to GRP as well, they represent such a small percentage of GRP that they are unlikely to have a significant effect on it. Children's book sales thus can be considered a good instrumental variable to control for the endogeneity problem that exists in the *Education* variable. I use another instrument, forest coverage rate (*infra_control)*, to control for my *Infrastructure* variable's endogenous nature. The *Infrastructure* variable is defined by the area of paved roads in each region in China. Forest coverage rate is related to

[1] This variable is called *edu_control*. Refer to Appendix A for further explanation

this variable in that more remote regions of China on average have greater coverage rates and fewer square kilometers of paved roads. However, forest coverage rate is likely not related to economic growth in any manner other than the effect that being remote could have on growth. Hence, this too, satisfies the requirement for instrumental variables.

Carrying out a two-stage least squares regression consists of a two-part process, from which the model derives its name. During the first stage, we regress the endogenous independent variable (e.g. *Education* or *Infrastructure*) on the corresponding instrumental variable (*educ_control* or *infra_control*) and the other independent variables to create fitted values for the endogenous explanatory variables.[2]

The second step is reminiscent of a typical panel data regression. First, the fitted values for the endogenous independent variables are substituted in to the regression equation. Then, the dependent variable is regressed on the independent variables (including the newly substituted fitted values). [3] This process leads to unbiased and consistent coefficient estimates..

In addition to endogeneity, there are a number of other factors that must be taken into account when specifying our growth model. The obvious problem that emerges while attempting to run a regression on this data is how to separate the effects of exogenous variables on GRP and wage growth from the effects derived from hosting the Olympics. This is where the *Olympic_Dummy* variable, which

[2] See equations (3) and (4) from the statistical methods section for an illustration of this first step
[3] See equations (1) and (2) for an illustration of the second step

captures only data from the years in which Beijing was preparing for the Olympics (2001-2008), becomes beneficial. This variable takes on one of only two values, 1 and 0. Any year between 2001 (the year in which Beijing was awarded the Olympic Games), and 2008 (the start of the games) takes on the value of 1, while all other years are labeled 0. Thus, this variable captures any additional economic growth that took place while China was preparing for the Olympics (as opposed to the growth that it would have achieved without the games). A significant *Olympic_Dummy* variable with a positive coefficient would indicate that hosting the Olympics did increase the GRP level across China. As a result, this variable is central to the conclusions of this paper.

As explained in the previous research section of this paper, the viable means through which hosting the Olympics could possibly impact growth are limited to improvements in infrastructure and resource allocation efficiency. Hence, such improvements, if made, would be completed during the time period starting when China was awarded the games and ending by the opening ceremonies in 2008. If improvements in efficiency were in fact completed during this time, their effect on growth would show up in the regressions through the coefficients of this Olympic Dummy independent variable. Non-Olympic driven growth effects from infrastructure and resource allocation improvements are captured by variables such as *infrastructure, construction, commercial traffic*, and *passenger traffic.* The remaining independent variables represent control variables for outside factors that might influence growth (i.e. the *2008_Financial_Crisis* Variable controls for the downward spike in economic growth in China in the midst of the worldwide

economic downturn, doing so by estimating the degree of participation in the global economy by various regions in China).[4]

Next, it is important to consider how to control for the effects of unobserved heterogeneity when this heterogeneity is correlated with our independent variables and remains constant over time. In this paper's model, region-specific effects that are left uncontrolled by the independent variables (e.g. If Beijing's landscape is somehow naturally more conducive to economic growth than the landscape of Shanghai) could potentially be mistakenly captured by the regression as an effect of the Olympics on growth. Addressing this issue is achieved by treating our independent variables as non-random using the fixed effects model.

This model captures all factors affecting our dependent variable that do not change over time using the independent variable term a_i, where the subscript (i) represents each different region in our study (Beijing, Shanghai, et cetera). Thus, when we add a_i and dummy variables for each time period (in our case, for each year) to the regression equation as explanatory variables, we are able to separate out these "fixed effects" from effects on the dependent variable that change with time.

Finally, during the process of the specification of this paper's regression model, the presence of serial correlation (the relationship between a given variable and itself over various time intervals) remained, even after treating these variables as non-random. Thus, this paper took the approach of clustering to solve the correlation problem. When discussing serial correlation of the errors in panel data, I

[4] See Appendix A for an explanation of these variables and Appendix B for a description of their use in previous literature

am referring to correlation within the panel i.d. variables (in this case, the regional variables) rather than between the i.d. variables. Such correlation is problematic because it implies Ordinary Least Squared approach will not result in the best linear unbiased estimate of the population parameters and standard errors will likely be underestimated. Thankfully, the method of clustering can be employed to adjust the standard errors to correlation within the i.d. variables, which eliminates the issue.

Regression Results

Using the Natural Log of Gross Regional Product as the Dependent Variable

In this regression, our dependent variable is the natural log of GRP level, represented by the variable *log_real_gross_regional_product.* Our excluded instruments are the variables *log_edu_control* and *infra_control* while the instrumented variables are *log_education and log_infra.* Finally, our included instruments are *log_patent, log_pop, log_construction, log_comm, log_pass, olympicdummy, crisis_cont, log_invest, time_trend, beijing_olympics, and Olympic_time_interact.*

2SLS Model Summary

Observations	274
Number of Clusters	31
F-Statistic (13, 30)	1408.42
Centered R-Squared	.98
Un-centered R-Squared	.98
Total Sum of Squares	35.18
Residual Sum of Squares	.60

Table 3

Independent Variable Significance Results

Independent Variables	Coefficient	Robust Std. Error	Z Statistic	P > l Z l
log_education	.30	.51	0.60	0.55
log_infra	.00	.33	0.01	0.99
log_patent	.04	.07	0.61	0.54
log_pop	.74	.40	1.85	0.06
log_construct	-.04	.14	-0.27	0.79
log_comm	.18	.11	1.55	0.12
log_pass	-.03	.05	-0.52	0.60
olympicdummy	.58	.26	2.18	0.03
crisis_control	-.09	.07	-1.20	0.23
log_invest	.19	.16	1.21	0.23
time_trend	.12	.02	6.65	0.00
beijing_olympics	-.11	.07	-1.65	0.10
olympic_time_interact	-.04	.02	-1.69	0.09

Table 4

There are two independent variables that are found to have a significant effect on real GRP per capita at the 5% level: our Olympic Games dummy variable and the time trend.

To begin, the significance of the *time_trend* variable is unsurprising given that China achieved positive economic growth rates throughout the test period. Thus, as time moves from 1998 to 2011, GRP levels are on average, expected to increase. In fact, a time increase of one year is associated with an expected 12% increase in gross regional product. The interpretation of our *Olympic_dummy* variable is more nuanced. It can be understood as "holding all other independent variables constant,

Olympics-investment years (2001-2008) are associated with a 78.6% higher gross regional product in China than years falling outside the Olympics-investment period."[5] Essentially, this suggests that, given China's economy is growing at a pre-determined rate of growth, GRP *levels* increased by approximately 79% due to variables associated with hosting the 2008 Beijing Olympic Games. While the 79% statistic (a result with a magnitude much larger than expected) certainly provides strong evidence that hosting the Olympics positively influenced GRP levels in China, we must use caution when making conclusions from it. The effect on GRP seems almost implausibly large, which could be a result of a lack of non-Olympic preparation year GRP data. While the regression uses eight years of Olympic preparation data (2001-2008), we employ only three years of non-Olympic preparation data on GRP (2009-2011). The small sample size of the latter period could have contributed to the larger than expected coefficient on the *Olympic_dummy* variable.

Nevertheless, regardless of the *level* effect of the Olympics on GRP, the more interesting analysis is of the effect of the Olympic Games on economic *growth*. To achieve a positive effect on economic growth in China, hosting the Olympics must have increased the *slope* of that pre-determined trend. To determine whether such an alteration of the growth rate occurred, we must examine the *olympic_time_interact* variable. This interaction between the Olympics dummy variable and the time trend is found to be weakly significant (5% < p-value < 10%), but with a negative coefficient. This suggests that while there is evidence that

[5] when dependent variable is logged, we calculate the percentage change as 100*[exp(coefficient)-1], which in this case is, 100*[exp(.58)-1] = 78.6

hosting the Olympics increased GRP levels between 2001 and 2008, the games actually had a negative effect on *growth* in China. Thus, we have some evidence (albeit not very strong evidence) supporting the idea that hosting the Olympics could have actually impede growth in China.

Before we move on to an examination of the results of our wage growth regression, a brief discussion of the GRP regression's other weakly significant variable is warranted. Interestingly, the interaction between our Beijing dummy variable and the Olympic dummy is shown to be significant at the 10% level with a negative coefficient. The purpose of including this variable in the regression model was to capture the effects of hosting the Olympics on the municipality of Beijing, as opposed to the effects on the entirety of China. Because China is such a large and economically diverse country, a reasonable assumption is that the Olympics would not alter the growth rate of the entire country, but could do so in the host city. The weak significance of the Beijing interaction variable indicates we have some evidence (again, weak evidence) that hosting the Olympics altered the growth rate in the city of Beijing in the negative direction. Such a result implies that hosting the Olympics, in addition to impeding growth across China, might have actually dampened GRP growth within the municipality of the host city as well. This is certainly a surprising result.

No other independent variable interpretations are noteworthy, apart from the fact that most of the coefficients of the regression's independent variables have signs in line with expectations (e.g. the variable controlling for the negative effects of the financial crisis has a negative coefficient and variables like education that are

expected to be positively associated with gross regional product have positive coefficients). A regression model generating coefficients whose signs fall in line with logical economic expectations is generally a mark of a well-specified model. However, the limitations of our model should also be noted.

A high R-squared value of .98 means that approximately 98% of the variation in real gross regional product is explained by the independent variables in the model, where this variation is simply the difference between the actual values of real GRP per capita observed and the values predicted by the regression model. The relatively high coefficient of determination suggests that our error term in the model (unknown factors' effect on real GRP per capita) is sufficiently small to make our model a viable predictor of growth. Unfortunately, the regression does not actually explain a whole lot other than the fact that GRP growth is trend stationary and that the Olympics had a level effect on GRP (i.e. none of the other explanatory variables are significant). Thus, the regression's high R-squared coefficient combined with a lack of significant variables could mean that the independent variables have a more complicated effect on GRP than is suggested by this paper's model specification (for instance, a model with more interaction terms between the independent variables could potentially offer a more precise explanation of the variance in the dependent variable). This issue by no means invalidates the conclusions mentioned earlier in the results section of this paper; it simply offers a potential explanation for the high significance of the overall model, despite the lack of significance of individual variables included in the model.

Using Wage Growth as the Dependent Variable

Now, we turn our analysis towards the regression of these same independent variables on a different proxy for economic growth—wage. Specifically, our variable refers to the real wage growth throughout the 31 measured regions in China. The value of employing two different economic indicators in our examination of the 2008 Olympics is that we can isolate any errors attributable to irregularities in the data of one of our dependent variables.

When specifying the wage growth rate regression equation, we use all but two of the independent variables we employed in the previous GRP level regression equation. *Olympic_time_interact* and *time_trend* are not included here because our dependent variable is a growth, not level, variable. Therefore, we are already measuring rate of change; we do not need time-related explanatory variables to capture the rate of change effects on the dependent variable. Otherwise, all instruments, excluded and included instrumented variables, and explanatory variables are the same as in the GRP model.

2SLS Model Summary

Observations	272
Number of Clusters	31
F-Statistic (11, 30)	2.26
Prob > F	.04

Table 5

Independent Variable Significance Results

Independent Variables	Coefficient	Robust Std. Error	Z Statistic	P > l Z l
log_education	9.59	41.87	0.23	0.82
log_infra	56.45	57.11	0.99	0.32
log_patent	-5.27	6.04	-.87	0.38
log_pop	5.97	61.86	0.10	0.92
log_construct	2.59	14.82	0.18	0.86
log_comm	-18.89	10.39	-1.82	0.07
log_pass	-0.045	7.75	-0.01	0.99
olympicdummy	-0.73	1.89	-0.38	0.70
crisis_control	-0.06	9.35	-0.01	0.99
log_invest	-16.54	15.68	-1.06	0.29
beijing_olympics	-6.49	12.56	-0.52	0.60

Table 6

In this regression, none of the explanatory variables are significant at the 5% level. Thus, this regression suggests that hosting the Olympics had no effect on wage growth in China and no effect on wage growth in Beijing. Thus, while the results of regressions with our two dependent variables have a few differences (most notably the weak significance of the *Beijing_olympics* variable in the GRP regression), neither result provides any evidence that hosting the 2008 Beijing Olympics had a positive effect on economic growth throughout China or in Beijing.

Chinese Expectations and Public Discourse

Now that we can describe with some degree of certainty the effects that hosting the 2008 Olympics had upon the economies of Beijing and China, we can compare these results to the way in which Chinese officials framed the Olympic games in an economic context, in terms of both expectations prior to the games and public discourse after the completion of the games.

In respect to economic expectations, leading up to the Olympics, officials and media alike stressed the importance of building a system of highways and high-speed railways that would connect Beijing with 2 surrounding metropolitan areas (Tianjin and Tangshan), cutting travel time between the cities to less than 30 minutes. Constructed in preparation for the Olympics, the stated benefits of these projects was to create a mega municipal community, which would allow for the "optimization of factors of production allocation" as well as the "promotion of technological, commercial, and talent exchange" in the region, which are precisely the factors outlined in this papers necessary for China to achieve Olympic-driven economic growth. According to Beijing's Olympic Bid Budget Report, over 64% of the total Olympic Budget was spent on infrastructure improvements, with half of those expenditures devoted to the road and railway construction mentioned above, or similar projects like airport construction and expansion, all of which have the potential to contribute to growth creation.

With such a large portion of funds allocated towards efforts to improve infrastructure in ways that could lead to increased efficiency in the Beijing municipal region, it appears that China's leaders were aware of the potential for

infrastructure and efficiency improvement-driven economic growth and committed themselves to carrying out these improvements. Thus, we would expect the results of my regression to provide evidence of a positive significant effect of the Olympics on economic growth. Considering the negative coefficient on the Olympics_time_interaction variable, this was clearly not the case.

How can we explain this negative (or at best, neutral) relationship between the Olympics and growth, given China's focus on infrastructure improvement? First, it is important to note the role of the unique budgeting methods used for Beijing Olympics expenditures. The Chinese government reported approximately $6.2 billion in direct Olympic costs (venue construction, operating costs, et cetera) but estimated over $40 billion in "indirect" Olympic costs (i.e. infrastructure and telecommunication improvements as well as the "greenification" of the municipality) conducted between 2001 and 2008. Thus, hosting the games did not necessitate these infrastructure expenditures. Instead, government officials chose to allocate this spending to improve the Beijing metropolitan area. We can reasonably infer that had Beijing not hosted the 2008 games, China's capital city would still have invested considerably in infrastructure improvement. Therefore, the 64% of Olympic funds outlaid towards infrastructure improvement may simply represent a typical infrastructure improvement budget for the years between 2001 and 2008. In this case, the Olympic Games would not represent a shock that pushed Beijing towards more efficient infrastructure. We would thus not expect the infrastructure improvements that took place between 2001 and 2008 to contribute to any Olympics-driven growth during these Olympics preparation years.

A second reason for the ineffectiveness infrastructure improvements to contribute to increased economic growth can be inferred from widespread reports of excessive spending on non-practical aspects of infrastructure (i.e. improvements that do not increase efficiency or access). For instance, the Beijing government spent $30 million to renovate a secondary access road to the Beijing airport, with costs consisting primarily of ornamentation (planting flowers and trees, installing an ornamental wall, et cetera) and compensation to residents forced to move from the road's edge to make room for the upgrades (Fowler). Such expenditures are wealth transfers, and although it is difficult to state with precision the ability of a specific infrastructure project to positively influence growth, wealth transfers certainly will not.

The differentiation between "direct" and "indirect" Olympic costs also gives insight into the validity of the Chinese government's claims of making Olympic profits. Just prior to the games, Chinese media reported enthusiastic statements from officials like those of the vice minister of the Beijing Olympic Organizing Committee Finance Department, Shen Yu Yun, who stated "Although we've made adjustments and increases [from the initial budget], the current budget is still balanced, with a slight profit" (Wang). Mr. Shen could make these claims only because of the way in which the Olympic budget was constructed. The referred to profit was, in reality, simply a small surplus in the final Olympic operating budget (approximately $2 billion in revenue versus slightly less than that in operating costs). While state media circulated the "profit" numbers from The Beijing Organizing Committee for the Games of the XXIX Olympiad (which amounted to

about $146.4 million) (Chief Auditor), the $46 billion combined direct and indirect cost of the games was either left unmentioned or explained away as contributing to future economic growth.

This raises an interesting point. Between its Olympic operating profit claim and the fact that China and Beijing did see growth (but not an increase in growth rate) during the Olympic investment period of 2001-2008, the Chinese government can make a convincing public argument that hosting the Olympic games had a positive effect on China's economy. However this paper, supported by the results of the regression reported above, argues that China's growth trend over the past decade remained relatively unchanged by factors associated with hosting the 2008 Olympics.

Conclusion

The recent wave of successful mega event bids (2016 Summer Olympics in Rio De Janeiro and the 2014, 2018, 2022 FIFA World Cups in Brazil, Russia, and Qatar respectively) has inspired curiosity as to the reasons for international sporting organizations' pivot towards the developing world. As mentioned in the discussion of the regression results above, the conclusions presented by this paper do not offer any evidence suggesting that hosting the Olympic Games can positively influence growth in a developing country like China. Thus, it is implied from this result that the Olympics likely will not do any more for a developing country than it can for a developed country. Why then, have we witnessed this developing host country trend in recent years? This is a question for future research, the answer to which must address the social, political, and economic motivations of politicians across in the developing world in pitching bids to host mega events like the Olympic Games. In the following paragraphs, I list a number of plausible ideas, which I hope will be further developed by future research.

One major potential factor is that Chinese politicians were able to convincingly sell a costly Olympics as "profitable" through innovative budgeting techniques while simultaneously funneling millions of dollars into inefficient city development projects that would be resisted by the general public in a non-Olympic setting. This method could be attractive to politicians in many developing countries, regardless of political structure or the plausibility of hosting a debt-free Olympics in their city. On one hand, the politicians in charge of the city's Olympic planning

commission can demonstrate their efficacy by keeping operating income above operating costs. On the other, they have the responsibility of allocating of billions of dollars of "indirect" Olympic investment money. This means that politicians can dole out funds and contracts to the agencies and firms of their choosing, a responsibility that at a minimum, can be used to reward political supporters and solidify allegiances, and in extreme cases, can attract large bribes or political favors. From an individual utility-maximizing standpoint, hosting a mega event has obvious benefits for politicians, which might explain why politicians in Brazil and Russia have so enthusiastically embraced recent bid campaigns.

Nevertheless, to organize a successful bid for the Olympics or World Cup, politicians in general must rely on support from both the general public and from the corresponding international sporting association. The Chinese government pitched the 2008 Beijing Games as the arrival of China on the world stage, which appeared to spawn a wave of national pride and motivate residents of the host city "buy in", both literally (financially) and figuratively, to the task of hosting. The marketing strategy was two-pronged. Officials led marketing efforts geared towards Beijing residents with the slogan: "New Beijing, Great Olympics" and created informal nicknames for the games like the "Green Olympics", the "High-tech Olympics" and "The People's Olympics," all of which implied that the Beijing people would benefit from and play an integral role in the games. At the same time, the marketing to the rest of the world revolved around celebrating Chinese culture and uniting the world under the banner "One World, One Dream," a campaign that was widely applauded by the International Olympic Committee. This paper argues there

was no evidence that hosting the 2008 Beijing Games positively increased growth in China, but because we also do not offer conclusive evidence that hosting has a negative impact, it seems possible or even likely that politicians in developing countries will continue to mount successful marketing campaigns to bring the Olympics to their respective countries, potentially employing methods similar to those used by Chinese officials for the Beijing games. Research into the marketing campaigns of future host countries like Brazil would be very informative as to the plausibility of employing these methods.

Conjecturing on this point, it seems as if it would be exceedingly difficult for politicians in other countries to re-create the conditions that allowed China to successfully market its own games. Principally, the Beijing Olympics appeared able to survive the drag of a massive budget that exceeded $40 billion because of two unique factors—its political structure and its financial support. First, China's status as a single party state gives its government the ability to allocate funds as it sees fit without strong opposition. As a result, when Beijing ran into budget increases, officials could simply temporarily divert investment from other projects or cities into Beijing's Olympic development. This paper offers no evidence that such a divergence of funds took place, but the ability to pull off such a political maneuver is important to note. In a more inclusive (i.e. democratic) political environment like Brazil, such a move would be implausible. Interest groups from different cities and projects would probably not allow their funds to be diverted to the host city. A study of the political factors surrounding funding for both the 2008 Beijing and 2016 Rio de Janeiro Games would be very enlightening.

In terms of financial support, China claimed that half of its budget was supported through taxation while the other half consisted of donations from "overseas Chinese" (ethnic Chinese who live abroad and often hold foreign passports). From the taxation point of view, other developing countries do not have the enormous tax base enjoyed by China. When $40 billion of Olympic costs are dispersed over more than a billion people, the resulting per capita costs are very minimal. However, in a country like Brazil or Russia (which have populations a fraction of the size of China's), taxes for a mega event would likely be drawn mostly from the local residents instead of being culled from the entire population, resulting in a huge financial burden for residents of the host city.

Additionally, Brazil, Russia, Qatar (and really almost any country) cannot count on Olympic financial support from citizens of other countries. Chinese immigrants are well known for maintaining strong ties to China, which means the Chinese government was apparently able to leverage these ties, along with the excitement surrounding the games, to solicit a considerable portion of the budget from residents not even included in China's tax base. An examination of the contributions of these overseas Chinese and the motivations behind these contributions would certainly be a worthwhile study to pursue.

The final potential reason future host countries may encounter more obstacles than China did in 2008 concerns the notion that China's government is heavily involved in its media industry. In fact, many of the reported statistics regarding funding and budgeting for the games originated from state sponsored media institutions like the People's Daily Newspaper. Consequently, both the Olympic

investment and auditing processes were conducted in a closed, private environment. Without interference from independent media investigators and journalists, hiding any potential inefficiency or corruption would be relatively easy. Countries with more journalistic freedom would likely not have the opportunity to shield the processes (legal or otherwise) necessary to prepare for the Olympics from the public eye.

This paper focuses almost exclusively on the economic effects of hosting the Olympics, but a brief discussion of the non-economic costs and benefits of hosting is warranted here. I hope that by incorporating these issues into the conversation, future researchers can delve more deeply into these aspects to form a more comprehensive picture of the costs and benefits faced by developing country hosts of the Olympic games. The potential benefits are relatively intangible: a heightened sense of national pride, increased media attention, and a surge in interest in sporting and exercise in the host country are among the most prominent. The potential costs are somewhat more concrete. First, there is the inconvenience that hosting the games brings to residents of the host city. At a minimum, residents face constant construction projects (which carries with it noise and light pollution, in addition to actual air pollution) for more than half a decade as the city prepares for the games. At worst, residents have been forced to abandon their homes to make room for new highways, stadiums, et cetera. In fact, government forced eviction has been a common theme for Olympic preparation in both China and Brazil. The former has already been mentioned earlier in this paper. The latter has ignited media backlash for bulldozing entire *favelas* (neighborhoods) to make way for new

stadiums or simply to transform Rio De Janeiro's public image. Forcing long-term residents from their homes for the sake of a sporting event, no matter how large or important, is a disturbing trend that merits a more in depth examination.

Another issue that has cropped up recently is the visibility that the games bring to a host city and country. As the world turns its attention to a country, groups of people view the games as an opportunity to make a statement and bring attention to their respective causes. Such statements could take the form of terrorism or, more likely, protest movements. China was able to successfully minimize these events in 2008 due to the employment of unprecedented numbers of security personnel, but one has to wonder if they would be similarly successful in 2014. The previous year has seen a number of large-scale pro-separatist movement terrorist attacks in Kunming, Xinjiang, and even the heart of Beijing itself—Tiananmen Square. At the same time, simmering pro-democracy protests in Hong Kong have ignited, spreading throughout the city and spanning over multiple months. With these politically sensitive issues grabbing headlines, the Chinese government would likely prefer not to solicit another mega-event (and the media spotlight it would draw) over the next few years. Consequently, before applying for the chance to host the Olympic Games or the World Cup, political leaders in developing countries should consider the current political environment. Hosting a mega event will draw attention not only to a country's burgeoning economy and unique culture, but also to any present instability, corruption, inequality, or other problems that afflict the country.

The key insight of the case study of the 2008 Olympic Games presented in this paper is that hosting the Olympics offers at best uncertain temporary economic benefits, no long term economic benefits, and a small number of positive intangible effects. However, the disadvantages of hosting discussed above (large expenditures, inconvenience to host city residents, security threats, etc) are certain and unavoidable. Therefore, while this paper does not conclude that hosting the Olympics or another mega event is necessarily a poor choice for developing countries and their economies, it does suggest that in the majority of cases the costs (economic, social, and political) may outweigh any potential benefits. Continued research into the outcomes of upcoming developing country hosted mega events will be essential to reaching more definite conclusions.

Appendix A: Explanation of Variables

Variable Chart

sources: China Bureau of Statistics, St. Louis Federal Reserve FRED Database
note: type of variable (Independent, Dependent, or Instrumental) denoted inside the brackets[ ]

Variable	Abbreviation	Actual Variable Name (unit)	Description of Measurement Technique
Annual Real Wage Growth (yuan) [Dep]	wage_growth	Average Wage of Staff and Workers (Yuan)	Staff and Workers refer to persons working in, and receiving payment from units of state ownership, collective ownership, joint ownership, share holding ownership, foreign ownership, and ownership by entrepreneurs from Hong Kong, Macao, and Taiwan, and other types of ownership and their affiliated units. They do not include persons employed in township enterprises, persons employed in private enterprises, urban self-employed persons, retirees, re-employed retirees, teachers in schools runs by locals, foreigners and persons from Hong Kong, Macao, and Taiwan who work in urban units. Note: Data refers to fully employed staff and workers. Wage growth calculation equation: $wage\_growth_i = ((wage_i - wage_{i-1})/wage_{i-1})*100$
Domestic Passenger Traffic Volume [Ind]	DP_Traff	Passenger Traffic (10,000)	Refers to volume of passenger traffic through various means of transportation. Regardless of the traveling distance and ticket price, the passenger traffic is calculated by the principle that one person can be counted only once per one travel (i.e. passengers that travel with a half price ticket or child ticket are calculated as a full person)
Commercial Traffic [Ind]	Comm_Traff	Freight Traffic (10,000)	Freight Traffic refers to the volume of freight transported with various means. Freight transport is calculated in tons. Regardless the type of freight and traveling distance, freight transport is calculated in the actual weight of the goods.
Investment [Ind]	TFI	Total Fixed Investment (100 million Yuan)	Total Fixed Investment Includes: the investment by state-owned units, collective units, individuals, joint ownership units, share-holding units, as well as investment by businessmen from foreign countries and from Hong Kong, Macao, and Taiwan
Infrastructure [Ind]	Infra	Area of Paved Roads	Refers to the area of roads with paved surfaces, including bridges and tunnels connected with these roads at years end. Area of roads is measured for paved roads with a width of 3.5 meters and over, including roads in open-ended factory compounds and residential quarters
Real GRP	real_gross_regional_product	Gross Regional Product (100 million yuan)	GRP refers to the final products at market prices produced by all resident units in a region during a certain period of time. Gross Regional Product is calculated with a value added approach, i.e. total value of goods and services produced by all resident units during a certain period of time, minus the total value of the inputs of goods and services. GRP is calculated using current money prices (nominal).
Real GRP Growth Per Capita [Dep]	GRP_growth_cap	Gross Regional Product Growth per capita	Growth Rate Equation: $GRP\_growth_i = ((GRP_i - GRP_{i-1})/GRP_{i-1})*100$. GRP_growth_cap was subsequently calculated by subtracting population growth rate from GRP_growth. (See population).
Consumer Price Index [Used to create other variables]	CPI	Consumer Price Index	Reflects the trend and degree of changes in prices of consumer goods and services purchased by households from one year to the next, essentially a measure of annual inflation. To convert nominal variables into real variables, this paper converted this "CPI" into an inflation rate through the following growth rate equation. $Inflation_i = ((CPI_i - CPI_{i-1})/CPI_{i-1})*100$. The resulting inflation rate was substrated from the growth rate of nominal variables like GRP to generate real variables like real GRP growth.

Competition [Ind]	Comp	Number of State-Owned and State-holding Industrial Enterprises	Number of State-owned and State-holding industrial enterprises with annual revenue from the principal business above five million yuan
Population [used to create other variables]	Pop	Population (10,000)	Refers to the total number of people alive at a certain point of time within a certain area. The annual statistics on population are taken at midnight, the 31st of December, not including overseas Chinese.
Education [Ind]	Edu	Regular Undergraduates and College Students	The estimated number of undergraduates from regular institutions of higher learning. These institutions refer to educational establishments set up according to the government evaluation and approval procedures, enrolling graduates from senior secondary schools and providing higher education courses and training for senior professionals. They include full-time universities, colleges, high professional schools, high professional vocational schools and others.
Property Rights Protection [Ind]	PRP	Three Kinds of Applications for Patents Accepted	The number of patent applications for invention, utility model, and design accepted and granted in provinces, autonomous regions, and municipalities. Note: 'Three Kinds of Applications for Domestic Patents Granted" equals the sum of "Inventions", "Utility Models", and "Industrial Designs"
Construction [Ind]	construction	Gross Output Value of Construction (10,000 yuan)	Refers to the cumulative value of construction output in a region during a given year.
Education Control [Instrument]	Edu_control	Number of Printed Copies of Books Published for Children (10,000 copies)	The absolute number of children's books published in each region
Infrastructure Control [Instrument]	Infra_control	Forest Coverage Area (%)	Refers to aggregate area covered by all varieties of forests (including but not limited to timber forests, by-product forests, protection forests, fuel forests, forests for special purpose)
2008 Financial Crisis Control [Ind]	Crisis_control	2008 Financial Crisis Control	In analyzing the descriptive statistics for this data, I realized that some regions in China (notably the developed regions with large degrees of imports and exports) experienced a sharp decline in growth rate following the year 2007 (when the world financial crisis began). Hence, to control for the effects of the financial crises on regions in China, I downloaded data from the China Bureau of Statistics on the Total Value of Imports and Exports of Foreign Funded Enterprises by Region. This variable signifies the extent to which a region or municipality is connected to the world economy, and therefore the extent to which the region or municipality would have been affected by the 2008 financial crisis. Because this variable is denominated in U.S. dollars, and all other monetary variables in this paper are denominated in renminbi, I used the St. Louis Federal Reserve's FRED database annual data on exchange rates to convert the Import-Export Data into renminbi. I then proceeded to divide total GRP by the converted Import-Export Value to create the 2008 Financial Crisis Control variable (the percentage of GDP made up by imports and exports).

Olympic Dummy Variable [Ind]	Olympic_Dummy	Olympic Dummy Variable	This variable takes on one of only two values, 1 and 0. Any year between 2001 (the year in which Beijing was awarded the Olympic Games), and 2008 (the start of the games) takes on the value of 1, while all other years are labeled 0. Thus, this variable captures any additional economic growth that took place while China was preparing for the Olympics (as opposed to the growth that it would have achieved without the games).
Olympic, Time Interaction Variable [Ind]	olympic_time_interact	The Interaction between Olympic_Dummy and time_trend	This variable is simply the result of the multiplication of the Olympic_Dummy variable and the Time Trend variable. As a result, it measures the rate of change effect of the Olympic Dummy variable on the dependent variable. This allows us to estimate growth effects when using level variables such as Gross Regional Product
Beijing Dummy Variable [Ind]	Beijing_Dummy	Beijing Dummy Variable	The municipality of Beijing takes on the value of 1 and all other identifying variables (i.e. regions) take the value of zero. This variable isolates the effects of the Olympic Games on GRP level in Beijing. It was not included in the GRP model to avoid perfect collinearity.
Beijing, Time Interaction [Ind]	Beijing_Olympics	The Interaction between Beijing_Dummy and time_trend	This variable is the result of the multiplation of the Beijing Dummy variable and the Time Trend variable. As a result, it measures the rate of change effect of the Beijing Dummy variable on the dependent variable.

Appendix B: Use of Variables in Previous Literature

Variable	Usage in Previous Literature
Real Gross Regional Product Per Capita	Used as an indicator for Economic Growth by the World Bank (Variable name = "GDP Growth per Capita"). As stated in Quah (2001), Gross Regional Product Per Capita is a viable measure of national income per capita, which is strongly correlated with a nation's economic well being
Number of Patents	Quah (2001) discusses the work of numerous economists who have used number of patents to proxy for knowledge inputs (along with R &D, number of scientists, ect…). These so-called knowledge inputs contribute to growth through the process of knowledge spillovers (i.e. an increase in patents implies an increase in innovation, which spurs additional innovation and growth).
Number of Regular Undergraduates and College Students	Quah (2001) discusses the widespread use among economists of population "expertise" variables to capture economic growth. I choose this education variable to proxy for "expertise" because the number of students enrolled in college is theoretically related to the amount of expertise the population possesses.
Number of State-Owned and State-Holding Industrial Enterprises	According to Aghion and Griffith (2008), as countries advance from basic factor accumulation strategies towards innovative strategies to promote growth, increased competition is almost always associated with higher levels of growth. China is clearly beyond this factor accumulation stage, which makes a variable that proxies for competition relevant. Because the CCP can control levels of competition in China, I considered an increase in the number of state-owned enterprises as an increase in competition, which would be associated with higher growth.
Area of Paved Roads	Esfahani and Ramirez (2003) show that investment in infrastructure can lead to significantly higher growth. Fan and Zhang (2004) use the area of paved roads per square 10,000 kilometers as an infrastructure indicator. Because my paper measures effects over time, I can use "area of paved roads" rather than taking the "area of roads per square 10,000 kilometers" like Fan and Zhang do.
Total Fixed Investment	Sanchez-Robles (1998) gives empirical evidence that shows that Direct Investment (Fixed Investment) is significantly and positively related to growth.
Commercial Traffic	Goodwin (1996) presents evidence that increasing the area of roads induces higher volumes of traffic. Hence, a higher volume of traffic, if controlled for population changes, can be used to proxy for infrastructure growth
Passenger Traffic	Same line of reasoning from Goodwin (1996)
Annual Real Wage Growth	Used by The World Bank as an Indicator of Economic Growth ("Personal Remittances Received")

Appendix C: Explanatory Variable Statistical Means Across Time

Year	education	infrastructure	patent protection	population	construction
1998	-	-	2825.516	3976.839	3245804
1999	-	-	3240.774	4007.065	3597698
2000	179383.9	-	4134.645	4066.387	4031483
2001	231956.7	-	4817.581	4089.774	4955343
2002	291407.5	-	6051.613	4113.484	5976508
2003	357601.4	10182.16	7461.032	4141.097	7446408
2004	430160.3	11385.68	8353.065	4174.677	8950121
2005	503798.9	12650.52	11609.23	4174.677	11100000
2006	560917.5	13272.55	14361.65	4165.516	13400000
2007	608030.8	13666.52	18098.84	4190.935	16500000
2008	651943.5	14594.61	22327.97	4220.226	20000000
2009	691824.8	15546.74	27549.97	4247.065	24800000
2010	719933.2	16816.97	34967.65	4302.774	31000000
2011	744679.9	18145.94	47701.97	4323.935	37800000

Year	commuter traffic	passenger traffic	investment	crisis control
1998	39111.42	44206.81	-	-
1999	40927.29	44784.55	-	-
2000	43082.39	47479	-	-
2001	44440.32	49245.23	1164.258	-
2002	47050.16	51598.55	1355.903	-
2003	49463.03	50927.06	1761.355	0.1551
2004	54035.97	56623.55	2235.313	0.1849
2005	58804.58	59135.16	2809.516	0.1919
2006	64352.61	64780.42	3485.548	0.1999
2007	71809.9	71264.03	4348.161	0.1899
2008	81704.35	91891.68	5454.645	0.1692
2009	89400.19	95285.35	7058.645	0.1311
2010	102665.3	104604.6	8753.677	0.148
2011	117139.7	112806.5	9865.613	0.145

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