

UCD CENTRE FOR ECONOMIC RESEARCH

WORKING PAPER SERIES

2012

**Estimating the External Returns to Education:
Evidence from China**

Wen Fan and Yuanyuan Ma, University College Dublin

WP12/20

August 2012

**UCD SCHOOL OF ECONOMICS
UNIVERSITY COLLEGE DUBLIN
BELFIELD DUBLIN 4**

Estimating the External Returns to Education: Evidence from China ^{*}

Wen Fan [†]

Yuanyuan Ma [‡]

School of Economics and Geary Institute

School of Economics and Geary Institute

University College Dublin

University College Dublin

August 2012

Abstract

Good understanding on the human capital externalities is important for both policy makers and social science researchers. Economists have speculated for at least a century that the social returns to education may exceed the private returns. In this paper, using the longitudinal data from China Health and Nutrition Survey (CHNS), we examine how individual wage changes associated with the share of college graduates in the same province across years for a person who has never moved by implementing individual fixed effects estimates. The individual fixed effect model shows that the external returns to education in China appear to be negative and on the order of -2%, which might be biased by potential endogeneity. Concerned with this problem, we then implement the IV fixed effect estimates and find positive external returns to education at about 10%. We also find this returns differ across individual heterogeneity.

Keywords: Education, Externalities, Spillover, Signalling, China

JEL classification: J0; J24; O15

^{*}The authors acknowledge the UNC California Population Center for granting access to the CHNS data. We also thank the participants in the Development Roundtable in Geary Institute for helpful comments. We are responsible for all remaining errors.

[†]Email address: wen.e.fan@gmail.com.

[‡]Email address: yoyo.yuanyuanma@gmail.com.

1 Introduction

Good understanding on the human capital externalities is important for both policy makers and social science researchers. Amongst existing research, while much attention has been devoted to the empirical investigation on the role of human capital in the process of economic growth and development at the aggregate level, the relevant work at the individual level seems to be inadequate. Education, one measure of human capital in empirical work, is usually used for such study. We have at least two reasons why people care about the effect of human capital externality, i.e. external returns to education in this case. Firstly, current education policies are often justified on the basis of at least modest human-capital externalities, better understanding of which would produce important implications or even guidelines for policy making. Secondly, the magnitude of the external return to education is important for assessing the efficiency of public investment in education.

Economists have speculated for at least a century that the social returns to education may exceed the private return. However, most of these studies on education externality look at the developed countries. In this paper, we attempt to contribute some evidence on the external returns to education from China, which may also be helpful to understand the across-country income differential via human capital externality perspective.

Since the Reform and Opening-up policy implemented in the year 1978, China has gradually altered the attitude towards education through learning the importance of education for the economic growth and social development. Figure 1 shows the nation's total investment in education and educational investment from government in China from the year 1980 to 2009. From 1980 onwards, the total investment on education and government's investment on education kept increasing drastically. Although the investment from other sources (charity, social donation, etc.) became more and more important, government's investment is still the dominant body for education investment.

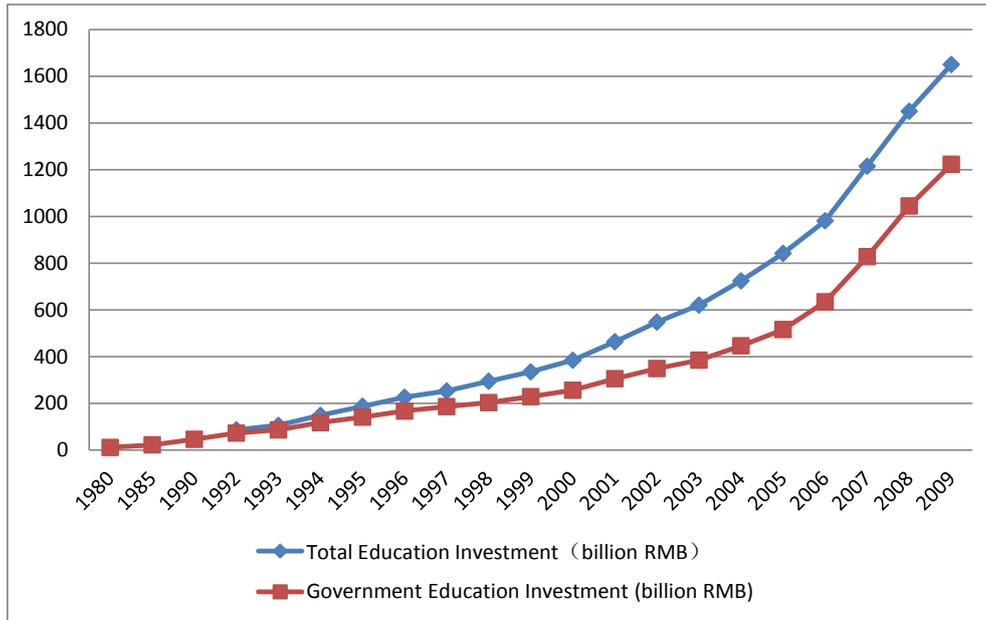


Figure 1: Total and Government Education Investment in China (1980-2009)

However, when turning to the striking GDP growth, it is not surprising that there is also criticism that Chinese government’s investment on education is far from satisfaction. Heckman (2003) argues that China has invested too little in human capital relative to its investment in physical capital. Figure 2 shows the GDP and the nation’s total investment in education in China during the same period. Figure 3 shows the proportion of government’s education investment in GDP from 1980 to 2009. Compared with the rapid growth of the absolute value of investment, the proportion is relatively stable, typically in a cross-country comparison with the developed countries. We argue that it may be quite hasty to judge whether the government’s investment on education is enough or not before fully understanding the essence of education. Education is a semi-public good. It has both private returns and external returns. Although there is a large literature investigating the private returns to education in China, little has focused on the education externalities. As mentioned before, we are trying to answer a handful of questions related to the external returns to education such as “Does education in China has positive or negative externalities?”, “ How large are the externalities?” and most importantly, "what would we learn from questioning so?"

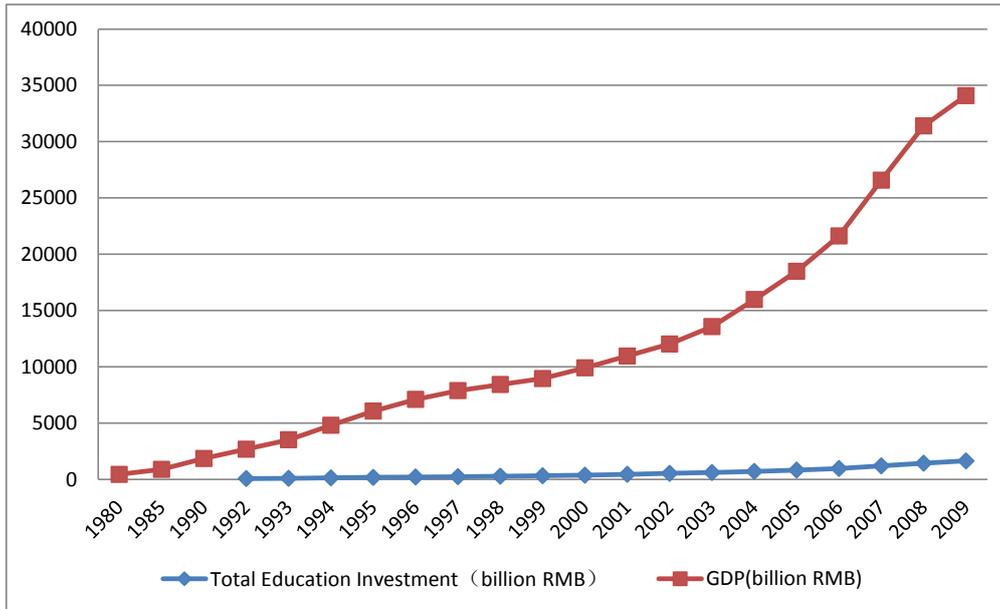


Figure 2: GDP and Total Education Investment in China (1980-2009)

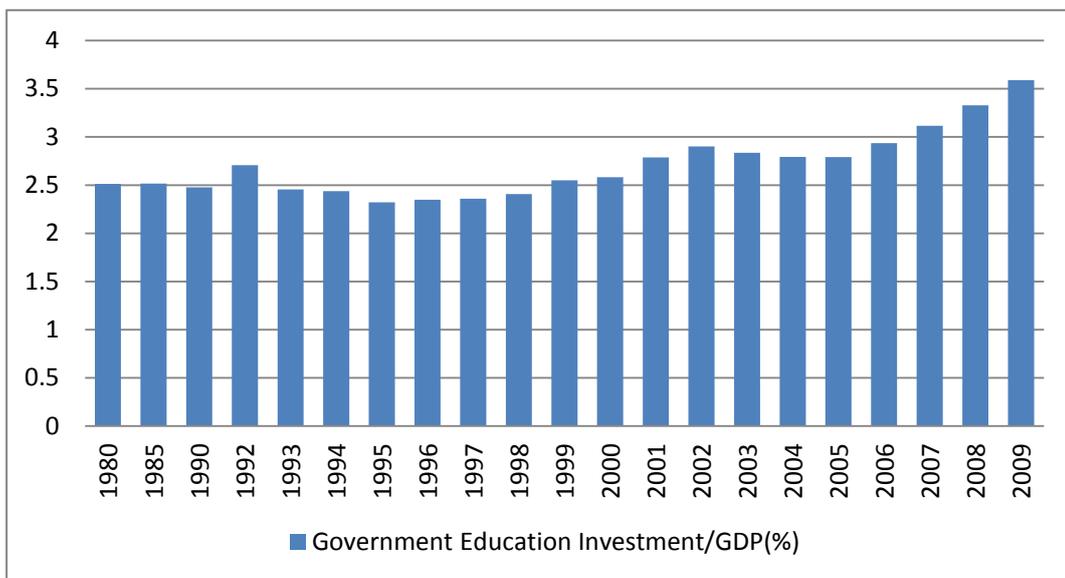


Figure 3: The Proportion of Government Education Investment in GDP(1980-2009)

Using China Health and Nutrition Survey (CHNS) ¹ data, we obtained figure 4 and 5 showing the correlation between individual's wage (Log monthly wage) and the share of college graduates in local province in 1991 and 2009, respectively. While the relation between the natural logarithm of individuals' monthly wage and the share of college graduates in provinces under study appears to be very flat-sloping in 1991, it turns out to be evidently positive 20 years later. This straightforward figure comparison suggests that the wages are higher in areas where the labour force is better educated. However, it is not clear whether this documented association is causal. In other words, the sign and size of external returns to education are ambiguous due to underlying mechanisms.

Marshall (1961) argues that increasing the geographic concentration of specialized inputs increases productivity, since the matching between factor inputs and industries is improved. Firms find it profitable to invest in new technologies only when there is a sufficient supply of trained workers to replace employees who quit. Greater human capital encourages more investment by firms and raises other workers' wages via this channel.

If we believe the knowledge spillover story that the sharing of knowledge and skills through formal and informal interaction may generate positive externality across workers, living with more educated people would make you earn more. In contrast, if school could teach you nothing but identify your ability in labour market, signalling theory tells us that the external returns to education tend to be very low, even zero (Acemoglu and Angrist (2000)).

In addition, people would expect to find negative external returns to education if labour supply extremely exceeds demand and then crucial competition may induce a decrease in individual wages when they have to face much stronger competitors (Moretti (2004)).

Theoretically speaking, it is still not clear whether the social returns to education may exceed the private return. Despite the significant policy implications and a large theoretical literature, the empirical evidence is limited.

¹We describe this dataset in details in section 2.1.

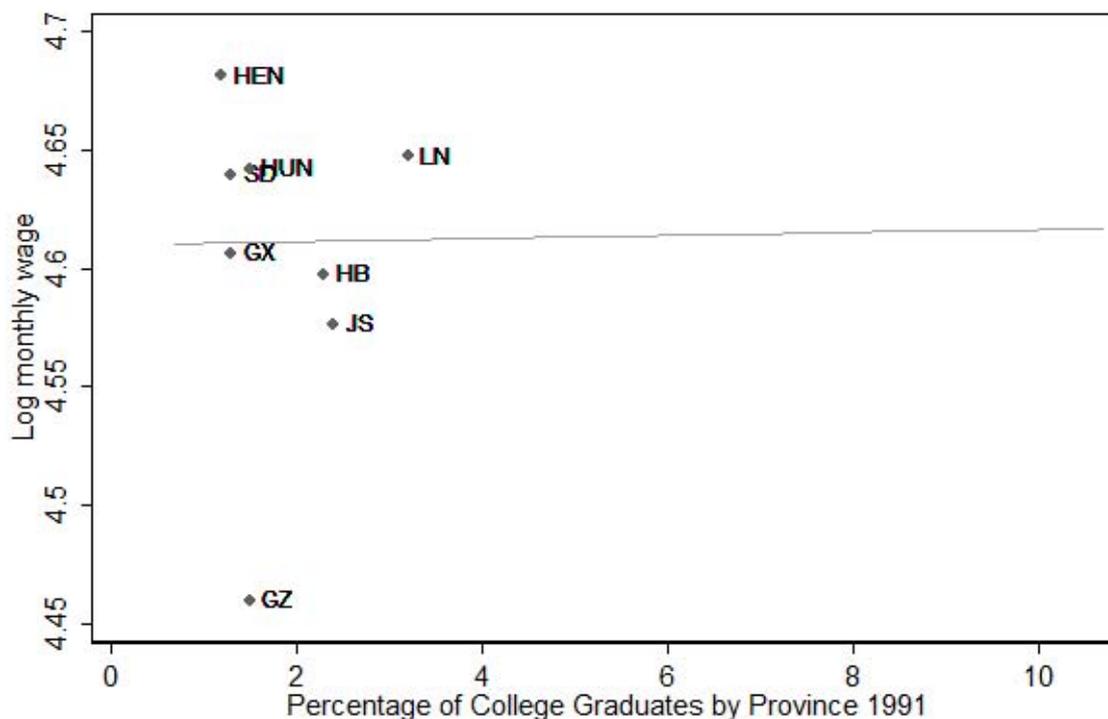


Figure 4: Correlation between log monthly wage and share of college graduates (1991)

Rauch (1993) is the first attempt to estimate human-capital externalities. His results suggest that there are externalities on the order of 3% to 5%. Moretti (2004) finds sizable human-capital externalities with longitudinal data from American National Longitudinal Survey of Youths and American Census data. Acemoglu and Angrist (2000) find little evidence for sizable external returns to education with 1950-1990 American Census data. Liu (2007) provides the first set of estimates of the external returns to education in Chinese cities. He finds that the external returns are at least as high as the private returns to education, with the order of 4.9% to 6.7%. What's more, the 2SLS estimates indicate that a one-year increase in city average education could increase individual earnings by between 11% to 13%.

To our knowledge, our paper is the first paper to estimate the external returns to education in China using longitudinal data. To this purpose, we examine how individual wage changes associated with the share of college graduates in the same province across years for a person who has never moved by implementing individual fixed effects estimates.

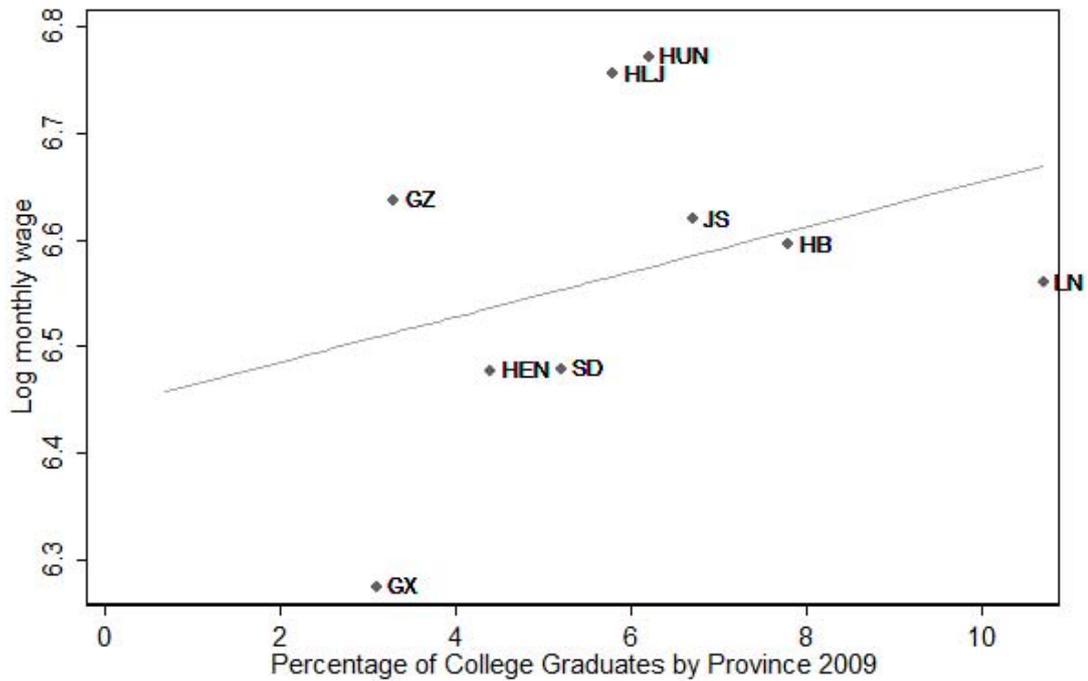


Figure 5: Correlation between log monthly wage and share of college graduates (2009)

In the first set of estimates, we find significantly negative relationship between college graduates share and individual wages, suggesting the external returns to education are negative. However, when we account for endogeneity problem and then turn to instrumental variable fixed effect estimates, we find positive external returns to education for full sample. This finding suggests the previous fixed effect estimates are likely biased downwards due to supply factors, which could be partly explained by the Chinese higher education expansion that took place in later 1990s.

Taking individual heterogeneity into consideration, we split our sample by region, gender and education levels. Our results speak to different stories and shed some light on policy implication. We find zero external returns in urban areas but significantly positive ones in rural areas, indicating that on one hand, there is strong motivation for us to increase education level and improve education quality in rural China, that on the other hand, huge higher education expansion seems leading to the problem of over-education, which means that the students may not be able to accumulate human capital through college education

and therefore gain zero external returns to education. For gender difference, men, rather than women, benefit from being around educated people. It is probably more plausible to understand this from the psychological perspective. In addition, we do find the external returns to education vary across education levels. Low skilled people tend to earn more associated with an increase in college graduates share, which is consistent with existing prediction (Moretti 2004). Null benefit for high skilled workers implies that the spillover is not strong enough to exceed the supply effect.

Our paper may call into question by the following caveats. Firstly, a lot of wage information is missing. To show that there is no sample bias issue raised, we split the whole sample into wage-earners and non-wage-earners and find that most variables are not significantly different between those two groups. Secondly, although IV methods were used to help deal with endogeneity problem, we are not able to rule out the possibility that unobserved time-varying variable would also bias our estimates. For this concern, we consider two types of time-varying factors. One is referred as migration effects, educated people move in and out due to unobservables. To control for this, we add lag of adjacent provincial wage by assuming people are more likely to move to province with similar economic and cultural backgrounds to where they used to live. The other one is known as “catch-up” effect, referring that new-developing regions would attract more skilled people. We introduce GDP per capita on province level to capture such effect.

The layout of this paper is as follows. Section 2 presents data and methodology. Section 3 shows main empirical results and Section 4 provides further discussion. Section 5 concludes.

2 Data and Methodology

2.1 Data

The data used in this paper comes from the China Health and Nutrition Survey (CHNS), the largest micro-level survey for current China. Started in 1989, CHNS is an ongoing open

cohort, international collaborative project between the Carolina Population Centre at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Centre for Disease Control and Prevention.

CHNS covers nine provinces (GUANGXI, GUIZHOU, HEILONGJIANG, HENAN, HUBEI, HUNAN, JIANGSU, LIAONING and SHANDONG), which vary considerably in the geographic characteristics and economic development levels. A multistage, random cluster process was used to draw the sample surveyed in each of the province.

Some macro level information (eg. the provincial share of college graduates, GDP per capita and lag adjacent provincial wage) is obtained from China Statistical Year Books.

Started in 1989, the survey took place every 2-4 years. Based on the original longitudinal dataset, we extract an unbalanced panel covering the years 1991, 1997, 2000, 2004, 2006 and 2009. ²

2.2 Baseline Model

In this paper, we examine how individual wage changes associated with the share of college graduates in that province across years for a person who has never moved ³ using individual fixed effects estimates.

The regression equation looks like following:

$$\ln W_{ijt} = \delta_{ij} + \lambda_t + \sigma * X_{ijt} + \gamma * P_{jt} + \rho * Z_{jt} + \mu_{jt} + \epsilon_{ijt} \quad (1)$$

where $\ln W_{ijt}$ is the log monthly wage of individual i in province j in year t , μ_{jt} is a province-year error component, and ϵ_{ijt} is an individual error term. The controls δ_{ij} and λ_t are individual and year effects. The coefficient σ is the parameter for individual characteristics,

²Year 1989 and 1994 are excluded, because no information on the provincial share of college graduates can be matched for these two years.

³A unique ID identifier can be calculated for each person according to their residence code.

while the coefficient γ is meant to capture the effect of the percentage of college graduated workers, P_{jt} in province j and year t . Z_{jt} is a vector of province characteristics which may be correlated with P_{jt} . In practice, we also allow for the private return to schooling to vary over time by including the interaction of individual years of schooling and year dummies.

There are two major methodological concerns. Firstly, there may be unobserved factors that are correlated with both wages and education. We use longitudinal data and individual fixed effect model to deal with this problem. A benefit of using longitudinal individual-level data is that we can deal with some of the most relevant endogeneity and selectivity issues, which might bias a simpler cross-sectional specification. In our case, when the non-mover sample are used, individual fixed effect estimates enable us to control for permanent unobserved characteristics of individuals as well as provinces where individual reside. Taking ability for instance, we can eliminate any unobservables that may correlate with individual education and wage by assuming the unobserved ability is equally valued over time. ⁴

Secondly, time-varying factors that are correlated with overall level of human capital and wage in an area could also bias our estimates. ⁵ In other words, we have to circumvent the potential endogeneity problem of provincial share of college graduates.

To deal with this problem, we use instrument variable (IV) fixed effect estimates. Ideally, we need an instrumental variable that is correlated with college share in a province and uncorrelated with unobserved time-varying factors that affect wage directly. In our case, we instrument the share of college graduates with the number of “211” universities in each province in each year. ⁶ Given only universities with long historical reputation ⁷were

⁴Given the respondent has never moved our assumption is weaker than standard individual fixed effects model where unobserved abilities are assumed to be equally valued everywhere as well.

⁵In theory people might think to absorb such shocks by adding province*year effect; however, which would not work in empirical as model would be perfectly saturated then.

⁶“211” denotes Project 211. Project 211 is a project of National Key Universities and Colleges initiated in 1995 by the Ministry of Education of the People’s Republic of China, aiming to raise the research standards of high-level universities and cultivate strategies for socio-economic development. The fact that universities were conferred “211” title in different years depending on their quality offers us natural variation on region*year level. We will introduce it more in section 3.2.1.

⁷The establishment year is 50 years ago at least; many universities are over 100 years old. Among 100 universities only two universities were established on 1960.

considered to be listed in Project 211, one might expect that the number of “211” universities in each province is more likely to be correlated with historical and accumulative factors than contemporary market condition. ⁸ With regard to individual characteristics, we avoid including any variables which could be endogenous to the share of college graduates, say, occupations, marital status and so on.

Table 1 presents the summary statistics. Given there is a large proportion of missing values on individual wage, Table A.1 in the appendix reports summary statistics for people with and without wage information. It is clear to see that our wage earner sample is basically similar to non-wage earners in terms of most variables, suggesting our results would not severely be impacted by sample selection bias.

Table 1: **Summary Statistics**

Variable	N	Mean	Std. Dev.
Log(monthly wages)	12772	6.09	1.06
Individual years of schooling	38931	8.78	3.54
Age	40488	38.63	10.54
Female	40491	0.52	0.50
Share of college graduates (%) per province	40560	3.73	2.27
Number of 211 Universities per province	40560	2.54	2.93
Lag log(annual wage) of adjacent province	40560	8.88	0.81
GDP per capita (in 1000 RMB)) of adjacent province	40560	9.71	8.44
Survey year	39345	2000.93	6.00

3 Empirical Results

3.1 Fixed Effects

Table 2 presents individual fixed effects estimates. We find a significant negative effect of provincial college graduates share – one percentage point increase in the share of college graduates will reduce individual wages by about 2%.

⁸The other concern might be the underlying correlation between the education feature and economy development in a given province. The estimates would be biased upwards if provinces with more 211universities are also rich areas so tend to have higher wages. As addressed before, individual fixed effects help to deal with this problem. We will discuss it more in section 3.2.1.

Column 1 reports the individual fixed effect estimates without any provincial characteristics controls. To further consider other relevant factors, we add one period lag of wage in adjacent province ⁹ and provincial GDP per capita as controls in Column 2. Comparing the two columns, we find the coefficients of college graduates share are not significantly different from each other, a little bit smaller with controls though.

As mentioned before, we also allow for the private return to schooling to vary over time by including the interaction of individual years of schooling and year dummies. The private returns to schooling increased year by year from 1997 to 2009, which is in accordance with previous literature.

However, time-varying factors that are correlated with the overall level of human capital and wage in an area could still bias this conventional fixed effect estimates. For example, any transitory unobserved factors that affect both changes in college graduates share and changes in wages. If higher education expansion (which indeed occurred in China since late 1990s) generates huge increase in college graduates supply in the labour market, such unobserved supply factors will bias our estimates downward. In other words, estimated negative effect of college share in table 2 might be spurious. As mentioned above, to address this issue we turn to IV fixed effect model.

3.2 IV Fixed Effects

3.2.1 Project 211

Project 211 is a project of National Key Universities and Colleges initiated in 1995 by the Ministry of Education of the People’s Republic of China, aiming to raise the research standards of high-level universities and cultivate strategies for socio-economic development.

⁹Given our samples vary across geographically, 9 provinces can be basically classified into four regions — north eastern (LIAONING and HEILONGJIANG), south eastern (SHANDONG and JIANGSU), middle areas (HENAN, HUBEI and HUNAN) and south western (GUANGXI and GUIZHOU). Similar economic and cultural backgrounds and close distance make labour migrations more likely across provinces within region. As a result, skilled workers are likely to move to the adjacent province when there exists better job offers. To control for this migration effects, we enter the wages level of adjacent province in last year.

Table 2: Fixed Effect Estimates of External Returns to Education (1991-2009)

<i>Y=LOG(MONTHLY WAGE)</i>	[1]	[2]
Share of College Graduates	-.024*** (.009)	-.019** (.009)
Age	.368*** (.088)	.358*** (.088)
Age sq./100	-0.013 (.009)	-0.014 (.009)
Years of edu*1997	0.007 (.006)	0.007 (.006)
Years of edu*2000	.034*** (.006)	.034*** (.006)
Years of edu*2004	.067*** (.007)	.066*** (.007)
Years of edu*2006	.082*** (.007)	.081*** (.007)
Years of edu*2009	.095*** (.007)	.094*** (.007)
<i>Provincial Characteristics</i>		
<i>Lag adjacent province wage</i>		yes
<i>GDP per capita</i>		yes
Observations	11,893	11,893

Note: (1) All specifications also include year dummies. (2) Robust standard errors in parentheses allowing for clustering by individual. (3) * denotes the significance level, with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

It is envisaged that after several years' of efforts in the 21st century, about 100 universities and institutions of higher education would have greatly improved their quality of education, scientific research, management and institutional efficiency. In addition, these universities and institutions will also have made remarkable progress in reforming the management system and consequently become the bases for training high-level professional manpower and solving major problems for the country's economic construction and social development. The name for the project comes from an abbreviation of the 21st century and approximately 100 universities.

There are over 2,000 standard universities and higher education institutions in China, among which, 112 are 211 universities. Those 211 universities could receive extensive financial and policy support from central government. This project has been ceased in 2009 so there is no new university entitled since then.

Our instrument is hoped to be valid due to the following features. Firstly, the instrument is strongly correlated with the endogeneous variable. As the province with more 211 universities is always a more attractive place to study and work, it is quite natural that more college graduates would enter the labour market over there than otherwise. The assumption making here is that the provincial number of 211 universities would impact the individual wages through its effect on the share of college graduates in that province while others are equal.

Secondly, the instrument is exogenous to the outcome variable. Given only universities with long historical reputation have been considered, one might expect the number of "211" universities is more likely to be correlated with historical and accumulative factors rather than contemporary conditions.

Even so, one might still question about the possible underlying correlation between the education feature and economic development in a given province. That is, provinces with more more 211 universities are also richer areas, and thus tend to have higher wages. If this is the case, our estimates would be biased upwards. As addressed before, individual fixed

effects help to deal with this problem. What’s more, we can show in our data that it is not the case that provinces with more 211 universities are also richer in China. Figure 6 shows the number of 211 universities in each province from 1991 to 2009. Jiangsu has the most 211 universities, reaching nine in 2000 and staying at nine since then. Hubei has the second most, with seven universities entitled as 211 universities. Liaoning, Heilongjiang and Hunan have four, while Henan, Guangxi and Guizhou only have one each. Figure 7 shows the GDP per capita, indicating the economic development level in those provinces. As we can see from the figure, Jiangsu has the highest GDP per capita almost through the whole period. But Hubei only ranked the fifth, after Shandong, Liaoning and Heilongjiang, with huge decrease of GDP per capita. Although Hunan has the same number of 211 universities as Liaoning and Heilongjiang, its GDP per capita is much lower.

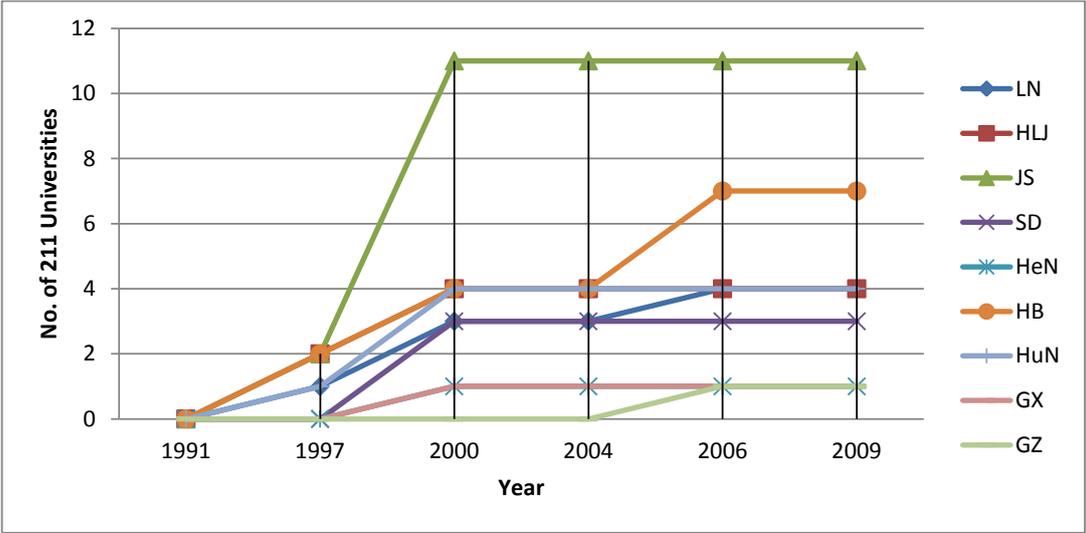


Figure 6: The Number of 211 Universities in Each Province (1991-2009)

3.2.2 IV estimates results

Table 3 reports the IV fixed effects estimates. The first stage estimates are statistically positive significant with and without additional provincial controls. And the magnitudes of the coefficients are quite similar. As one might expect, the more 211 universities one province has, the higher college graduates share will be in that province.

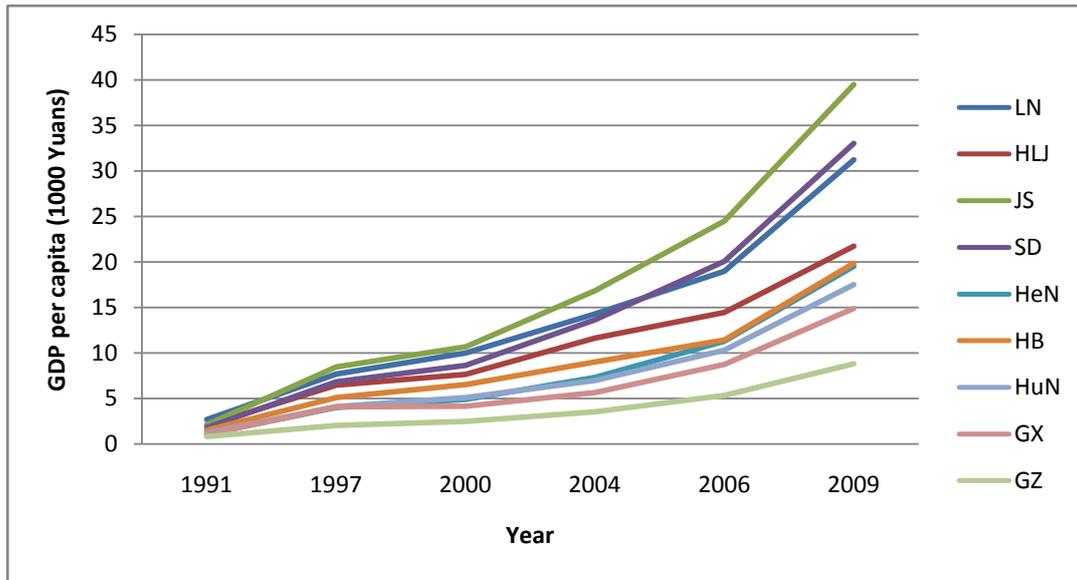


Figure 7: GDP per capita in Each Province (1991-2009)

The coefficient of college graduates share turns out to be positively significant with and without province controls, suggesting that the conventional fixed effect estimate is biased downwards. One percentage point increase in the share of college graduates will increase individual wages by about 6.7% to 12.9%. This is different from the fixed effects estimates, indicating that the variation in college graduates share across province captured before is probably driven by unobserved supply factors, which could be explained by the Chinese higher education expansion that took place in late 1990s.

Table 3: IV Fixed Effect Estimates of the External Returns to Education (1991-2009)

	FIRST STAGE:		IV	
	Y= college share	Y= log(monthly wage)	Y= college share	Y= log(monthly wage)
Instrument: Number of 211 Universities	.177*** (.004)	.124*** (.004)		
Share of College Graduates			.067** (.033)	.129*** (.048)
Observations	38,867	38,867	11,893	11,893
<i>Provincial Characteristics</i>				
<i>Lag adjacent province wage</i>			yes	yes
<i>GDP per capita</i>			yes	yes

Note: (1) All specifications also include age, age-squared, year dummies, interactions between individual education and year dummies and provincial characteristics mentioned in text. (2) Robust standard errors in parentheses allow for clustering by individual in FE and first stage estimates. (3) * denotes the significance level, with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4 Further Discussion

The above analysis estimates the external returns to education using the representative sample for the whole China. In the following context, we try to split the population sample into different groups to see whether the external returns to education may differ in those different groups. In section 4.1, we split the sample into urban and rural areas. In section 4.2 and 4.3, we split the sample by gender and education levels, respectively.

4.1 Education Externalities in Urban and Rural China

Are the external returns to education different in urban and rural areas? Table 4 reports the results. Liu(2007) find that a one-year increase in city average education could increase individual earnings by between 11% and 13% in China. Li, Chen and Zhang (2010) find that from 1989 to 2000, the external returns to education in urban China is about 0.0064, while after 2004, it increased to about 0.01, meaning that if the share of high education graduates increase by one percentage point, individual wages would increase by 1%. While here, we find no significant evidence for either positive or negative education externalities in urban areas in China. It seems that the signalling story suits here well. Instead of positive spill-over or negative competition effect, receiving higher education may simply help you stand out in the screening process in the labour market.

To date and our knowledge, there is no previous work on the external returns to education in rural China subject to data limitation. Thereby, our estimates are hoped to provide some new evidence. One percentage point increase in the share of college graduates in a given province would increase the rural people's wages by about 21%. Given education level is extraordinarily low for rural China, people might expect the increase in proportion of educated people would bring a larger spillover relative to what would happen for urban areas. Additionally, while signalling theory explains the zero external returns for urban areas, significant positive spillovers found in rural areas are supportive evidence for standard human capital theory, implying it is necessary to further improve the education investment and education quality in rural areas in China.

Table 4: IV Fixed Effect Estimates of External Returns to Education by Region (1991-2009)

	Urban		Rural	
	FE	IV FE	FE	IV FE
<i>FIRST STAGE</i>				
Number of 211 Universities		.121*** (.008)		.125*** (.005)
Observations		12,460		26,407
Share of College Graduates	-.036*** (.012)	0.024 (.067)	0.004 (.015)	.211*** (.063)
Observations	5,799	5,799	6,094	6,094

Note: (1) All specifications also include age, age-squared, year dummies, interactions between individual education and year dummies and provincial characteristics mentioned in text. (2) Robust standard errors in parentheses allow for clustering by individual in FE and first stage estimates. (3) * denotes the significance level, with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2 Education Externalities for Male and Female

The discrimination literature has an emphasis on investigating the gender difference in labour market. As for education, researchers focused on comparing the private returns to education for males and females. For China case, Yao (2007), Zhang (2005), Yuan (2005), Chen (2004) and Li (2003) find that females' private returns to education stayed higher than males'. Except Li (2003), all the others use data collected from urban areas.

As far as we are concerned, there is no paper comparing the education externalities between men and women in China. So here, we split the sample into males and females and try to compare the education externalities in these two groups. Table 5 shows the results. While there are strong positive externalities among men, there are nearly no externalities among women.

4.3 Education Externalities for Different Education Groups

Existing research usually finds that the marginal returns to private education decreases along with the improvement of education level. It is naturally to question how the external returns to education may vary across educational levels. Table 6 gives the estimates. We split the

sample into individuals with college education or higher, who tend to be high-skilled workers, and individuals with only junior high school education experience or even below, who are otherwise seen as low-skilled workers in labour market.

We may argue that the change in share of college graduates in certain areas may affect workers with different skill levels differently. Moretti (2004) summarizes these with two effects: the standard imperfect substitution effect associated with a shift in college share and the spillover effect. The spillover effect is a positive effect that has been addressed extensively. The standard imperfect substitution effect related to the labour supply change has different impact on skilled and non-skilled workers.

Theoretically speaking, irrespective of the magnitude of spillover, the increase in the share of college graduates would help to increase low-skilled worker's wages. For the high-skilled workers, the final effect depends on the comparison of those two effects. If the spillover effect is stronger than the imperfect substitution effect related to labor supply, the externality coefficient would be positive. Otherwise, if the supply effect is stronger than the spillover effect, the coefficient would be negative.

As we can see from table 6, there are strong positive externalities among low-skilled workers, while there is no significant externalities among high-skilled workers. The possible explanation could be that the substitution effect associated with labour supply and the spillover effect cancel out each other for high-skilled workers. Given that the increase in college graduates share is largely due to the higher education expansion policy, our results suggest that such policy could in some sense help to decrease the wage differentials between high-skilled workers and low-skilled workers.

Table 5: IV Fixed Effect Estimates of External Returns to Education by Gender (1991-2009)

	Men		Women	
	FE	IV FE	FE	IV FE
<i>FIRST STAGE</i>				
Number of 211 Universities		.126*** (.006)		.123*** (.006)
Observations		18,849		20,018
Share of College Graduates	-0.004 (.012)	.175*** (.063)	-.044*** (.013)	0.046 (.072)
Observations	6,941	6,941	4,952	4,952

Note: (1)All specifications also include age, age-squared, year dummies, interactions between individual education and year dummies and provincial characteristics mentioned in text. (2) Robust standard errors in parentheses allow for clustering by individual in FE and first stage estimates. (3) * denotes the significance level, with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6: IV Fixed Effect Estimates of External Returns to Education by Education Levels (1991-2009)

	Compulsory schooling or below		Some college and College +	
	FE	IV FE	FE	IV FE
<i>FIRST STAGE</i>				
Number of 211 Universities		.113*** (.005)		.142*** (.015)
Observations		27,192		3,995
Share of College Graduates	0.015 (.015)	.174** (.086)	-.045*** (.014)	-0.069 (.067)
Observations	5,642	5,642	3,020	3,020

Note: (1)All specifications also include age, age-squared, year dummies, interactions between individual education and year dummies and provincial characteristics mentioned in text. (2) Robust standard errors in parentheses allow for clustering by individual in FE and first stage estimates. (3) * denotes the significance level, with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5 Conclusion

This paper provides the first set of estimates on the external returns to education in China using panel data. Using longitudinal data from CHNS, we examine how individual wage changes associated with the share of college graduates in the same province in China across years for a person who has never moved by implementing individual fixed effect estimates. The fixed effect estimates of external returns to education in China range from -0.019 to -0.024, which are severely biased downwards due to the endogeneity problem.

Then, we used the number of 211 universities and colleges to instrument the share of college graduates in that province, and obtained sizable positive external returns to education in China. One percentage point increase in the share of college graduates would increase individual wage by about 12%. This finding provides justification for governments' (central and local) policy and financial investment in higher education in China. Increasing the overall education level would also help to increase individuals' earnings in China.

Besides the main findings, we also have three further important insights into the role of education. Firstly, we find nearly zero education externalities in urban area, but large positive externalities in rural area, providing evidence for further improving the education investment and education quality in rural areas in China and also implying that urban people have to face severe competition in labour market where college would teach you nothing but just identify yourself from less capable people. Secondly, there are also gender differences in the external returns to education in China as well. Men workers gain from networking with other educated ones whereas women do not. Last but not the least important, there are strong positive externalities among low-skilled workers, while no significant externalities among high-skilled workers. The higher education externalities can help to decrease the wage differentials between high-skilled and low-skilled workers. Our sample only covers those who have never moved during survey periods. This is a common issue with many longitudinal studies. We hope to see empirical solution in the future work.

REFERENCES

- [1]Acemoglu, Daron. "A Microfoundation for Social Increasing Returns in Human Capital Accumulation." *Quarterly Journal of Economics*, 1996, 111(3), pp. 779-804.
- [2]Acemoglu, Daron and Angrist, Joshua. "How Large Are Human-Capital Externalities? Evidence from Compulsory Schooling Laws." *NBER/Macroeconomics Annual* (MIT Press), 2000, 15(1), pp. 9-59.
- [3]Bils, Mark. "[How Large Are Human-Capital Externalities? Evidence from Compulsory Schooling Laws]: Comment." *NBER Macroeconomics Annual*, 2000, 15, pp. 59-68.
- [4]Fleisher, Belton M. and Wang, Xiaojun. "Skill Differentials, Return to Schooling, and Market Segmentation in a Transition Economy: The Case of Mainland China." *Journal of Development Economics*, 2004, 73(1), pp. 315-28.
- [5]Heckman, James. "China's Human Capital Investment." *Economic Development and Cultural Change*, 2003, (51), pp. 795-804.
- [6]Huang, Zhiling and Yao, Xianguo. "The Gender difference on the Returns to Education" *World Economy*, 2009, (7).
- [7]Joshua D. Angrist, Jorn-Steffen Pischke. *Mostly Harmless Econometrics—an Empiricist's Companion*. Princeton University Press, 2009.
- [8]Kirby, Simon and Riley, Rebecca. "The External Returns to Education: Uk Evidence Using Repeated Cross-Sections." *Labour Economics*, 2008, 15(4), pp. 619-30.
- [9]Li, Haizheng. "Economic Transition and Returns to Education in China." *Economics of Education Review*, 2003, 22(3), pp. 317-28.
- [10]Li, Xiaoying and Chen, Guanghan and Zhang Yingwu. "Estimating the External Returns to Higher Education in Urban China" *World Economic Paper*, 2010, (1).
- [10]Liu, Zhiqiang. "The External Returns to Education: Evidence from Chinese Cities." *Journal of Urban Economics*, 2007, 61(3), pp. 542-64.
- [12]Lucas Jr, Robert E. "On the Mechanics of Economic Development." *Journal of Monetary Economics*, 1988, 22(1), pp. 3-42.
- [13]Marshall, Alfred. *Principles of Economics*. London: MacMillan, 1961.
- [14]Maurer-Fazio, Margaret. "Earnings and Education in China's Transition to a Market

Economy Survey Evidence from 1989 and 1992." *China Economic Review*, 1999, 10(1), pp. 17-40.

[15]Moretti, Enrico. "Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data." *Journal of Econometrics*, 2004, 121, pp. 175-212.

[16]Moretti, Enrico. "Workers' Education, Spillovers, and Productivity: Evidence from Plant-Level Production Functions." *The American Economic Review*, 2004, 94(3), pp. 656-90.

[17]Rauch, James E. "Productivity Gains from Geographic Concentration of Human Capital: Evidence from the Cities." *Journal of Urban Economics*, 1993, 34, pp. 380-400.

[18]Rosenzweig, Mark R. "Why Are There Returns to Schooling?" *The American Economic Review*, 1995, 85(2), pp. 153-58.

[19]Yang, Dennis Tao. "Determinants of Schooling Returns During Transition: Evidence from Chinese Cities." *Journal of Comparative Economics*, 2005, 33(2), pp. 244-64.

[20]Zhang, Junsen; Zhao, Yaohui; Park, Albert and Song, Xiaoqing. "Economic Returns to Schooling in Urban China, 1988 to 2001." *Journal of Comparative Economics*, 2005, 33(4), pp. 730-52.

Appendix

Table A.1: Summary Statistics for Wage and Non-wage Sample

	Wage Sample		Non-wage Sample	
	Mean	(SD)	Mean	(SD)
Individual years of schooling	10.73	-3.22	7.92	-3.32
Age	37.39	-9.47	39.2	-10.95
Female	0.42	-0.49	0.56	-0.5
Share of college graduates (%) per Province	3.61	-2.29	3.78	-2.26
Number of 211 Universities per Province	2.62	-3.16	2.5	-2.82
Lag log(annual wage) of adjacent province	8.77	-0.85	8.92	-0.8
GDP per capita (in 1000 yuan)	9.67	-8.88	9.73	-8.23
Sample size	12,717		27,788	

UCD CENTRE FOR ECONOMIC RESEARCH – RECENT WORKING PAPERS

- [WP11/22](#) Alan Fernihough: 'Simple Logit and Probit Marginal Effects in R' October 2011
- [WP11/23](#) Ronald B Davies and Krishna Chaitanya Vadlamannati: 'A Race to the Bottom in Labour Standards? An Empirical Investigation' November 2011
- [WP11/24](#) Wen Fan: 'School Tenure and Student Achievement' November 2011
- [WP11/25](#) Mark E McGovern: 'Still Unequal at Birth - Birth Weight, Socioeconomic Status and Outcomes at Age 9' November 2011
- [WP11/26](#) Robert Gillanders: 'The Mental Health Cost of Corruption: Evidence from Sub-Saharan Africa' November 2011
- [WP11/27](#) Brendan Walsh: 'Well-being and Economic Conditions in Ireland' December 2011
- [WP11/28](#) Cormac Ó Gráda: 'Fetal Origins, Childhood Development, and Famine: A Bibliography and Literature Review' December 2011
- [WP12/01](#) Mark E McGovern: 'A Practical Introduction to Stata' January 2012
- [WP12/02](#) Colm McCarthy: 'Ireland's European Crisis: Staying Solvent in the Eurozone' January 2012
- [WP12/03](#) Colm McCarthy: 'Improving the Eurosystem for Old and New Members' January 2012
- [WP12/04](#) Ivan Pastine and Tuvana Pastine: 'All-Pay Contests with Constraints' February 2012
- [WP12/05](#) David Madden: 'Methods for Studying Dominance and Inequality in Population Health' February 2012
- [WP12/06](#) Karl Whelan: 'ELA, Promissory Notes and All That: The Fiscal Costs of Anglo Irish Bank' February 2012
- [WP12/07](#) Olivier Bargain, Eliane El Badaoui, Prudence Kwenda, Eric Strobl and Frank Walsh: 'The Formal Sector Wage Premium and Firm Size for Self-employed Workers' March 2012
- [WP12/08](#) Brendan Walsh: 'The Influence of Macroeconomic Conditions and Institutional Quality on National Levels of Life Satisfaction' March 2012
- [WP12/09](#) Ronald B Davies and Rodolphe Desbordes: 'Greenfield FDI and Skill Upgrading' March 2012
- [WP12/10](#) Morgan Kelly and Cormac Ó Gráda: 'Change Points and Temporal Dependence in Reconstructions of Annual Temperature: Did Europe Experience a Little Ice Age?' March 2012
- [WP12/11](#) Morgan Kelly and Cormac Ó Gráda: 'The Waning of the Little Ice Age' April 2012
- [WP12/12](#) Morgan Kelly and Cormac Ó Gráda: 'Agricultural Output, Calories and Living Standards in England before and during The Industrial Revolution' April 2012
- [WP12/13](#) Arnaud Chevalier and Orla Doyle: 'Schooling and Voter Turnout - Is there an American Exception?' April 2012
- [WP12/14](#) David Madden: 'The Relationship Between Low Birthweight and Socioeconomic Status in Ireland' April 2012
- [WP12/15](#) Robert W Fairlie, Kanika Kapur and Susan Gates: 'Job Lock: Evidence from a Regression Discontinuity Design' April 2012
- [WP12/16](#) John Regan: 'Ballot Order effects: An analysis of Irish General Elections' April 2012
- [WP12/17](#) Orla Doyle: 'Breaking the Cycle of Deprivation: An Experimental Evaluation of an Early Childhood Intervention' April 2012
- [WP12/18](#) Ivan Pastine, Tuvana Pastine and Paul Redmond: 'Incumbent-Quality Advantage and Counterfactual Electoral Stagnation in the U.S. Senate' May 2012
- [WP12/19](#) Adrian Corcoran and Robert Gillanders: 'Foreign Direct Investment and The Ease of Doing Business' July 2012