Fiscal Decentralisation, the Knowledge Economy and School Teachers’ Wages in Urban China

Yi Long\textsuperscript{a}, Chris Nyland\textsuperscript{a} and Russell Smyth\textsuperscript{b}

Abstract:
We examine how fiscal decentralisation and progress towards the development of a knowledge-intensive economy has impacted on teachers’ wages in China, utilising a panel dataset of 31 provincial administrations from 2001 to 2013. We find that fiscal decentralisation has a negative impact on teachers’ wages and this effect is further enhanced by a deepening of the knowledge intensity of the economy, while knowledge economy itself has no significant impact on teachers’ wages. The findings suggest that incentives being offered to local administrators need to be revisited if the national government is convinced of the need to increase teacher quality in ways suited to the knowledge economy China wishes to construct.

Keywords: fiscal decentralisation, knowledge economy, teachers, wages, human capital, China

JEL Classification Numbers: H73, J31, J45

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Introduction

China is undergoing a fundamental structural transformation from a low skilled, surplus-labour economy to a more capital-intensive, and technology-intensive, economy (Garnaut, 2011). To complement this shift, China’s government accepts that it needs to increase the nation’s investment in human capital accumulation (World Bank, 2013). This is a development that is evidenced by the marked increase in resources now directed to education and by the increased emphasis on the need to build a workforce that is both innovative and creative (Pang & Plucker, 2013). What China’s national government also recognises is that socio-economic diversity influences the extent to which regional administrations need to subsidise education provision. This is evidenced by the fact that the national government has embraced a regime that entails the specification of a common national minimum teacher wage schedule and permits local authorities to decide whether, and to what extent, they will supplement this minimum. For example, Zeng and Yu (2015) find that in 2010 regional supplements for teachers in Shanghai, Beijing, Zhejiang and Tibet were almost four times higher than the national minimum. Regional supplements introduce a degree of competition for teachers between provinces, although the level of regional competition for teachers should not be overstated. While teachers are free to move across provinces, regional administrators retain market power because teachers are unable to transfer highly desired permanent positions across provinces.

Despite the increased value accorded to human capital development through
education, whether China can build a workforce suited to the utilisation of sophisticated technology remains an open question. Heckman (2005) has charged that China underinvested in human capital in the 1990s and that this resulted in a shortage of workers with the cognitive capacities required to master the skills demanded by new technologies. Consequently, there was a relatively low rate of return to the capital that was invested in the upgraded technologies. A number of researchers have posited that the underinvestment in education Heckman underscores was due to the system of fiscal decentralisation that permits local governments, that tend to favour investments that generate short term returns, to determine precisely how much will be invested in social service provision (Fu, 2010; Luo & Chen, 2010; Wang et al., 2012).

Fiscal decentralisation is a concept that captures the extent to which national governments permit local administrators to retain a share of their locally generated revenue and/or decide how resources are allocated (Porcelli, 2009; Zhang & Zou, 1998). Focusing on the effect of this institutional factor on human capital formation, this paper examines how fiscal decentralisation, and progress towards the development of a knowledge-intensive economy, influences teachers’ wages in China.

Locating the analysis in the foregoing context, this paper makes two contributions to teacher wage determination theory and the Chinese teacher wage determination literature. First, it enriches our knowledge of the teacher wage determination process by examining the role that fiscal decentralisation, and its interaction with the knowledge economy, play as institutional determinants of teachers’ wages. Fiscal
decentralisation, to different degrees, is observed in many countries and is held to influence government behaviours (OECD & Korea Institute of Public Finance, 2013). The impact of labour market institutions, such as unions and collective bargaining, on teacher wages has been extensively studied (Goldhaber, 2009; Hoxby, 1996). However, although the government is a key player in the teacher wage determination process, we really know little about the effect of the institutional incentives faced by governments in this process. China provides the ideal setting in which to address this issue because its fiscal reforms provide us with an opportunity to examine how institutional incentives that governments face influence teachers’ wages.

Second, incorporating the knowledge economy into wage determination theories also underscores the fact that the wage determination process is evolutionary. That this is the case has been recognised by scholars who have documented how changing attitudes to gender and race have influenced wages (Blau & Kahn, 2000; Podgursky & Springer, 2007). But what has gone unexplored is the possibility that the changing knowledge intensity of economies may change the context in which teachers work and that it may be necessary to introduce wage adjustments when the labour market increasingly rewards high skills (Acemoglu, 1998; Katz & Margo, 2014). Whether this general trend has been reflected in a specific skill-intensive occupation, such as teachers, is of interest and has far-reaching implications for the recruitment and retention of high quality workers in the education sector.

To examine whether, and to what extent, fiscal decentralisation, knowledge economy
and their interaction affects teacher wages, we focus on China for two reasons. First, fiscal decentralisation has been a prominent feature of China’s intergovernmental fiscal system (Jin, et al., 2005; Zhang & Zou, 1998). While China is not unique in experimenting with fiscal decentralisation, the fiscal reforms that China has implemented have accentuated regional differences in the incentives faced by governments. This provides an excellent setting in which to examine the role that the institutional incentives faced by government play in determining the wages that teachers receive.

A second reason for situating our study in China is that its education system has recently been at the centre of international debates about the best way to develop a high-performing education system. Shanghai topped the league table in the 2009 and 2012 Programme for International Student Assessment organised by the OECD, generating considerable international attention in its approach to education. This has also initiated fierce public debate about the average level of academic achievement and the quality of education in China (OECD, 2011; Tucker, 2012; Zhao, 2014). There is a need to examine how the evolution of the knowledge economy that China desires, has effected the incentives offered to governments to attract the best people into the education sector, not just in Shanghai, but across the country.

Teachers’ compensation includes both wages and fringe benefits. While, in the past, many fringe benefits have not been totally transparent, recent reforms have incorporated fringe benefits into the wage bill. For example, free housing has been
replaced with the housing provident fund, which is clearly listed on the wage bill. In the past, like all civil servants, teachers did not have to contribute to social insurance, even though they received better pensions on retirement than did employees working in the private sector or state-owned enterprises. The pension reforms in 2014 and 2015, however, mandated that teachers now have to pay the same proportion of their wages to the social insurance program and that the base wage should be increased to compensate for wages contributed to social insurance. Hence, pensions are also visible on the wage bill. These reforms suggest that differences in teachers’ wages are the main drivers of differences in total remuneration across provinces.\(^1\)

We find that fiscal decentralisation has a negative influence on teacher wages. A one percent increase in fiscal decentralisation reduces the average annual primary school teacher’s wages by 0.87% to 0.92% and the average annual secondary school teacher’s wages by 0.47% to 0.52%. Finding that there is a negative link between decentralisation and wages is important because it is commonly assumed that devolution will enhance the extent to which wages reflect the needs of local economies, but this may not be the case if long-term development requires a high rate of human capital accumulation and local administrators have shorter term priorities.\(^2\)

We find that progression toward a knowledge-intensive economy has no significant

\(^1\) As discussed below our measure of teachers’ remuneration covers the total wage bill, including base and supplement wages and salaries as well as other payments both in kind and in cash.

\(^2\) One might be concerned that the negative link between fiscal decentralisation and wages is being driven by differences in teacher quality where better qualified teachers are migrating to wealthier, higher paying, provinces leaving less well qualified teachers in the poorer provinces. If this was the case, we would observe that wages of teachers would be falling not because the government is paying less, but because the remaining pool are less qualified. However, as we note above, interprovincial competition for teachers should not be overstated and, in our modelling below, we at least partly control for differences in teacher quality through including teachers’ education and professional rank as control variables, although neither are perfect proxies for teacher quality.
influence on school teacher wages. The upward pressure on teacher wages exerted by the knowledge economy through increasing demand for skilled workers may be offset by the rise in the supply of college graduates in China since the expansion of the higher education sector in 1999. This explanation is in line with the observation that the skill wage premium may not increase if the supply of educated workers outpaces skill demand that is induced by an upgrading of technology as Goldin and Katz (2007) find occurred in the United States through 1915-1980.

Despite finding no significant direct effect of the knowledge economy on teacher wages, we find that progression to a knowledge-intensive economy strengthens the negative association between fiscal decentralisation and teachers’ wages. Conditioning on the average level of knowledge economy, a one percent increase in fiscal decentralisation reduces the average annual primary school teacher wages by 0.94% to 1.27% and the average annual secondary school teacher wages by 0.55% to 0.92%.

While the findings generated by the study are derived from China’s experience they have wider relevance to ongoing debates being sustained in many nations on how to improve the quality of the teaching workforce. Giving more local and school autonomy in wage determination have been advanced as strategies to improve the quality of teaching (OECD, 2005; Propper & Britton, 2012). Our finding regarding China’s experience suggests localised determination may not lead to the desired outcome if autonomy is not balanced by appropriate incentives and accountability
systems.

**Conceptual model**

*Fiscal decentralisation and teachers’ wages*

That fiscal decentralisation may impact on teachers’ wages is suggested by two strands of literature. The first argues that fiscal decentralisation tends to diminish public services. It stems from theories of fiscal federalism which study the incentives embedded in institutions and the types of decentralisation that best support economic prosperity (Jin et al., 2005; Oates, 2008). China’s national government provides strong economic and personal promotion incentives that are designed to encourage local governments to promote economic growth and development (Chen et al., 2005; Li & Zhou, 2005).

With autonomy to make fiscal decisions, these incentives motivate administrators to prioritise items that contribute to short-term economic growth, which tends to mean directing resources to build physical infrastructure that attracts investment inflow (Cheung, 2008) and encouraging firms to take advantage of China’s abundance of cheap labour (Gaulier et al., 2007).

In the period in which China’s development strategy focussed on low value-added production only, basic literacy was required to complement this approach. Research for the 1990s found that providing the population with a primary school education had a positive effect on GDP growth, but the effect of higher levels of education was statistically insignificant (Qian & Smyth, 2006). Given this was the case and given
local governments were encouraged to focus on growth, it is not surprising that local officials discounted the importance of human capital accumulation and the need to invest in education (Gordon & Li, 2011; Li et al., 2012; Qian & Roland, 1998). This downplayed the need to raise teachers’ wages for recruiting and retaining high skilled staff.

In summary, this strand of thought holds that the higher the level of fiscal decentralisation and the consequent greater fiscal autonomy, the more likely administrators will align expenditure with fiscal and political incentives (Fu & Zhang, 2007). With a higher level of fiscal decentralisation, local government officials who are rewarded for accelerating growth are more likely to underinvest in public service provision and overinvest in infrastructure construction that has a significant and immediate impact on growth.

The second strand of literature that has examined the impact of fiscal decentralisation on local administrators suggests the priorities of the party-state have shifted over time. In brief, it is posited that the national government has expanded its agenda and now seeks to promote economic development and expand public service provision (Liu, 2011; Yang, 2013). Given this new mix of priorities, if incentives to encourage the long-term development of human capital are greater than the incentives to promote short-term growth, fiscal decentralisation will exert a positive impact on public goods provision and, vice versa.

The overwhelming majority of empirical studies continue to find economic growth is
being prioritised over human capital accumulation (Fu, 2010; Jia et al., 2014; Li, 2007; Luo & Chen, 2010; Qiao et al., 2006). It is possible that this is because most studies use historical data even though China is continuing to change rapidly. But given the current weight of evidence we posit the following hypothesis:

Hypothesis 1: When the level of fiscal decentralisation is higher, teachers’ wages will be lower.

Knowledge economy and teacher wages

The possibility that progression towards a knowledge economy will have a positive impact on teachers’ wages is suggested by Heckman’s (2005) claim that as more sophisticated technology was introduced into Chinese industry it became necessary to increase investment in human capital accumulation, that this was not done at a commensurate rate, and as a consequence the return to physical capital was diminished.

The global nature of this transformation has also been highlighted by the OECD (1996). It has observed repeatedly that knowledge has become a primary driver of productivity, economic growth, and competitiveness. In so doing the OECD (2008) has also stressed that as technology becomes more sophisticated so too does the need both for workers who can learn sophisticated skills and for teachers who have the capacity to graduate students who have the requisite capacity to learn (see also, Tucker, 2012).
Teachers’ contribution to students’ learning capacities has been evidenced by the finding that a one standard deviation increase in teacher quality raises test scores of a national standardised test by almost 0.1 standard deviation in reading and mathematics in the United States (Rockoff, 2004, see also Aaronson et al., 2007; Chetty et al., 2014a; Hanushek & Rivkin, 2010). In addition, Chetty et al. (2014b) find students taught by high value-added teachers in primary school are more likely to attend college and earn higher salaries. Outside the United States, research for Australia (Leigh, 2010), Brazil (Harbison & Hanushek, 1992), the United Kingdom (Slater et al., 2012), and Peru (Metzler & Woessmann, 2012) has confirmed that teacher quality has a positive impact on students’ academic achievement. Thus, high quality teachers are a prerequisite for cultivating the knowledge economy workforce.

Skill-biased technological progress increases the demand for high skilled workers and raises their wages (Acemoglu, 1998; Katz & Margo, 2014). Thus, there is the need to recompense teachers that will induce high quality students to become teachers and ensure high quality teachers remain in this profession (OECD, 2008; Schleicher, 2011).

In China skill requirements have risen in line with industrial upgrading occurring at different rates in accordance with the extent to which regions have developed a knowledge-intensive economy (Cai & Wang, 2014; Heckman & Yi, 2012). We suggest that given the evidenced link between the quality of teachers and wages there will also be a positive association between wages and the extent to which regions
have been able to develop a knowledge intensive economy. This suggests our second hypothesis.

Hypothesis 2: When the level of knowledge economy is higher, teacher wages will be higher.

The moderating role of the knowledge economy on the relationship between fiscal decentralisation and teachers’ wages

That local government fiscal independence arguably induces local administrators to curtail teachers’ wages begs the question: is this tendency mitigated by the advance of the knowledge economy? In the early stages of the transition to a knowledge-intensive economy this mitigation effect is likely to occur only at the level of primary school education given that a primary school education is sufficient for the overwhelming majority of workers to undertake their employment. As the level of technology within the economy increases, along with increased demand for more skilled workers and for higher quality teachers, this effect will tend to become pronounced at higher levels of education and local administrators will come under mounting pressure to increase the proportion of their expenditure that they apportion to education and to the employment of ever higher quality teachers.

The OECD (2015) and the National Centre on Education and the Economy in the United States (Tucker, 2012) has observed that high-performing education systems are inclined to prioritise higher teacher salaries over other forms of education
expenditure. Dolton and Marcenaro-Gutierrez (2011) have lent support to this claim by evidencing that teachers’ wages, both measured in absolute terms and relative to the average wages in a country, are positively associated with student performance even after controlling for country fixed effects.

The development of a knowledge economy in China creates an imperative for governments to accept the policy implications drawn from the experience of high-performance education systems. Ramesh (2013) argues that progression towards a knowledge-based economy is the product of a cumulative and overlapping set of reforms which over 30 years have embedded knowledge creation in coastal regions with the process progressively diffusing to the rest of China. Central to this process, Ramesh (2013) adds, is education policy and more specifically the government’s effort to raise the quality of the nation’s education workforce. If local governments embrace this insight, we can expect the knowledge economy to moderate the negative impact of fiscal decentralisation on teachers’ wages.

Hypothesis 3: The level of knowledge economy moderates the relationship between the degree of fiscal decentralisation and teacher wages, such that when the level of knowledge economy increases, the negative impact of fiscal decentralisation on teacher wages is weakened.

Model specification, measurement of variables and dataset

The basic specification of the model can be represented by:
\[ W_{it} = \alpha_i + \beta_1 FD_{it} + \beta_2 KE_{it} + \sum \beta X_{it} + \epsilon_{it} \]

This unconditional model will be employed to test the first and second hypothesis. The dependent variable \( W_{it} \) is the average teacher wages in region \( i \) in year \( t \). The major explanatory variables are \( FD_{it} \), representing fiscal decentralisation, and \( KE_{it} \) denoting knowledge economy. In addition, we also control for variables that have been deemed important in the extant teacher wage determination literature. The set of control variables \( X_{it} \) include local government’s fiscal capacity, teachers’ human capital and other demographic attributes, job attributes, changes in student enrolments, cost of living (COL) and local unemployment rate. The intercept \( \alpha_i \) may be the same or varying across regions. The error term \( \epsilon_{it} \) is assumed to have a zero mean, and to be independent and identically distributed across observations.

To test whether the knowledge economy moderates the effect of fiscal decentralisation on teachers’ wages, the interaction term of the two independent variables \( FD_{it} \times KE_{it} \) is added to the basic model. Below shows the conditional model:

\[ W_{it} = \alpha_i + \beta_1 FD_{it} + \beta_2 KE_{it} + \beta_3 FD_{it} \times KE_{it} + \sum \beta X_{it} + \mu_{it} \]

Fiscal decentralisation has been measured using various approaches (Martinez-Vazquez & Timofeev, 2010). The most commonly used measurement in studies for China since the mid-1990s has been the ratio of subnational government expenditure to national government expenditure (Fu & Zhang, 2007; Li, 2007; Zhang & Zou, 1998; Zheng, 2008). A similar measure that has been employed is the ratio of
subnational government revenue to national government revenue (Guo & Jia, 2010; Li, 2007; Liang, 2009; Shen & Fu, 2005). Another often utilised measurement is the fiscal autonomy indicator or self-reliance ratio, which is derived by dividing total subnational fiscal revenue by subnational fiscal expenditure (Chen, 2010; Gong & Lu, 2009; Xing & Deng, 2012).

Despite their widespread usage, the first two measures are problematic since a common denominator across provinces for any given year merely captures the amount of provinces’ public revenue or expenditure, instead of the level of fiscal decentralisation (Chen & Gao, 2012; Niu, 2013; Zhang, 2011). Chen and Gao (2012) and Zhang (2011) point out the choice of fiscal decentralisation measurement is dependent on the time period covered in the study and fiscal autonomy is a better indicator to reflect regional fiscal decentralisation variation after 1994 compared to revenue and expenditure measurement. Thus, we use the third measure in this study.

We focus on three dimensions of the knowledge economy, based on the work of Ramesh (2013); namely, research and development (R&D), size of the knowledge economy workforce and knowledge creation, measured by full-time equivalent R&D personnel per 10,000 people, population with a college or above education as a percentage of the working age population and certified patent applications.

The dataset consists of a 13-year panel for the 31 provinces and municipalities directly under the national government in Mainland China from 2001 to 2013. School teachers’ average wages are obtained from the China Labour Statistical Yearbook,
which only has data for those working in urban areas. As the average wage of teachers in primary education and secondary education are given separately, we consider these groups independently. Table A1 in the appendix contains details of measurement and data sources. The descriptive statistics are given in Table 1.

Table 1. Descriptive statistics for all variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages (P)</td>
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<td>31145</td>
<td>16469</td>
<td>9448</td>
<td>90950</td>
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<td>Wages (S)</td>
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<td>33764</td>
<td>16572</td>
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<tr>
<td>FD</td>
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<td>47.96</td>
<td>18.67</td>
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<td>R&amp;D</td>
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<td>114.50</td>
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<td>Size of KE workforce</td>
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<td>6.72</td>
<td>0.36</td>
<td>48.22</td>
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<tr>
<td>Knowledge creation</td>
<td>403</td>
<td>14564</td>
<td>32123</td>
<td>7</td>
<td>269944</td>
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<tr>
<td>Fiscal capacity</td>
<td>403</td>
<td>2803</td>
<td>3048</td>
<td>319</td>
<td>17501</td>
</tr>
<tr>
<td>Female (P)</td>
<td>403</td>
<td>70.45</td>
<td>7.53</td>
<td>50.21</td>
<td>83.14</td>
</tr>
<tr>
<td>Female (S)</td>
<td>403</td>
<td>50.04</td>
<td>10.86</td>
<td>30.74</td>
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<td>Education (P)</td>
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<td>Education (S)</td>
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<td>Senior rank (P)</td>
<td>403</td>
<td>49.84</td>
<td>12.24</td>
<td>14.62</td>
<td>80.46</td>
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<td>Senior rank (S)</td>
<td>403</td>
<td>53.95</td>
<td>11.30</td>
<td>16.47</td>
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<td>Ratio (P)</td>
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<tr>
<td>Ratio (S)</td>
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<td>Enrolment growth (P)</td>
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<td>-17.55</td>
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<td>Enrolment growth (S)</td>
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<td>COL</td>
<td>403</td>
<td>3289</td>
<td>447</td>
<td>2430</td>
<td>4614</td>
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<td>Unemployment rate</td>
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<td>3.70</td>
<td>0.71</td>
<td>1.2</td>
<td>7.1</td>
</tr>
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</table>

a. Wages and fiscal capacity data are adjusted for inflation by converting the figures to 2013 RMB constant prices using the national consumer price index (CPI) as the deflator. The reason that we did not use provincial CPI is that COL as measured by the spatial price index has captured the regional price variation. So we only have to adjust for inflation over time.
b. P and S in the parentheses refer to primary schools and secondary schools respectively.
c. KE refers to knowledge economy

3 According to the explanatory notes in the *China Labour Statistical Yearbook*, “the average wage of employees refers to the average wage level in monetary terms per employee in a certain period of time, which is calculated by dividing the total wage bill for employees in that period by the average number of employees in that period. The calculation of the total wage bill is based on the total remuneration payment, including wages, salaries and other payments to employees, regardless of its source or category, both in kind and in cash”.
Results

The estimated direct effect of fiscal decentralisation and knowledge economy on teachers’ wages in primary schools and secondary schools are reported in column 1 to 3 and column 4 to 6 in Table 2 respectively. As the results are similar across the two sub-sectors in education, we discuss these two sets of results together.

Table 2. The direct effect of fiscal decentralisation and knowledge economy on teachers’ wages

<table>
<thead>
<tr>
<th>VARIABLES</th>
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<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<tbody>
<tr>
<td>FD</td>
<td>-274.6***</td>
<td>-287.6***</td>
<td>-270.1***</td>
<td>-165.4***</td>
<td>-175.7***</td>
<td>-160.1***</td>
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<tr>
<td></td>
<td>(47.87)</td>
<td>(50.58)</td>
<td>(47.08)</td>
<td>(55.24)</td>
<td>(52.51)</td>
<td>(57.02)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>64.21</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(82.86)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of KE workforce</td>
<td></td>
<td>-174.3</td>
<td></td>
<td>-115.7</td>
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<td></td>
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<td>Knowledge creation</td>
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<td></td>
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<td></td>
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<td>(0.0104)</td>
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<tr>
<td>Observations</td>
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<td>488.85</td>
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<td>306.84</td>
</tr>
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</table>

a. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
b. The Breusch and Pagan LM test rejects the pooled OLS estimator as being unbiased and efficient and suggests the existence of individual effects. We select the fixed effect model over the random effect model to address the individual effects. When the unit of observation is a large geographical unit such as state or province, we cannot treat our sample as a random sample from a large population (Wooldridge, 2012).
c. Modified Wald test for groupwise heteroscedasticity and Wooldridge test for autocorrelation in panel data suggest the existence of heteroscedasticity and autocorrelation in the residuals. Thus, we clustered the standard error on the panel variable (province), producing an estimator robust to cross-sectional heteroscedasticity and serial correlation.

Fiscal decentralisation has a negative impact on primary and secondary school teachers’ wages, consistent with our first hypothesis. It suggests that where the level of fiscal decentralisation is higher, teacher’s wages tends to be lower, confirming the theoretical argument that fiscal decentralisation will underplay investment in human
capital (Gordon & Li, 2011; Li et al., 2012; Qian & Roland, 1998).

In addition, the absolute value of the coefficients on fiscal decentralisation for primary school teachers in all three equations are uniformly higher than those for secondary school teachers, implying that while local governments undermine teacher wages, they set even lower value on primary school teachers. The regression coefficient suggests that for a one percent increase in fiscal decentralisation, the reduction of average primary school teachers’ wages per year ranges between 270.1 RMB and 287.6 RMB and that of average secondary school teachers’ wages ranges between 160.1 RMB and 175.7 RMB depending on the measurement of the knowledge economy, which account for 0.87% to 0.92% of the average annual primary school teacher’s wages and 0.47% to 0.52% of the average annual secondary school teacher’s wages. While we do not report the results of the controls, this is equivalent to a decrease in years of schooling of primary school and secondary school teachers of 0.058 to 0.062 years and 0.011 to 0.013 years. In other words, the impact of a one standard deviation increase in fiscal decentralisation on teachers’ wages is equal to that of a 1.50 to 1.60 standard deviation decrease and a 0.76 to 0.89 standard deviation decrease in years of schooling of primary school and secondary school teachers, respectively.

However, the level of knowledge economy is found to have no significant influence on primary and secondary school teacher wages, consistent across all three measures of knowledge economy. The results reject our second hypothesis which posits a
positive relationship between the knowledge economy and school teacher wages.

Table 3. The effect of fiscal decentralisation on teachers’ wages conditioned on the knowledge economy

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
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<tbody>
<tr>
<td>FD</td>
<td>-232.0***</td>
<td>-234.5***</td>
<td>-258.3***</td>
<td>-139.6**</td>
<td>-141.7***</td>
<td>-154.5**</td>
</tr>
<tr>
<td></td>
<td>(57.17)</td>
<td>(57.82)</td>
<td>(48.21)</td>
<td>(58.64)</td>
<td>(48.11)</td>
<td>(57.84)</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>882.5***</td>
<td>992.3***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(265.4)</td>
<td>(249.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of KE workforce</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>426.8*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(245.0)</td>
</tr>
<tr>
<td>Knowledge creation</td>
<td>0.201**</td>
<td></td>
<td></td>
<td>0.192**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0819)</td>
<td></td>
<td></td>
<td>(0.0899)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FD* R&amp;D</td>
<td>-10.23***</td>
<td>-10.68***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.396)</td>
<td>(3.166)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FD* Size of KE workforce</td>
<td></td>
<td></td>
<td>-14.62***</td>
<td>-10.32*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.366)</td>
<td>(5.301)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FD* Knowledge creation</td>
<td></td>
<td>-0.233**</td>
<td></td>
<td></td>
<td>-0.212*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.103)</td>
<td></td>
<td></td>
<td>(0.112)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>403</td>
<td>403</td>
<td>403</td>
<td>403</td>
<td>403</td>
<td>403</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.956</td>
<td>0.954</td>
<td>0.953</td>
<td>0.962</td>
<td>0.958</td>
<td>0.958</td>
</tr>
<tr>
<td>F-statistics</td>
<td>537.22</td>
<td>582.34</td>
<td>427.51</td>
<td>1145.45</td>
<td>659.91</td>
<td>334.42</td>
</tr>
</tbody>
</table>

Notes: See notes to Table 2

The interaction between fiscal decentralisation and knowledge economy has a negative impact on both primary and secondary school teachers’ wages, which means that the knowledge economy strengthens the negative influence of fiscal decentralisation on teachers’ wages, inconsistent with the third hypothesis which posits that a higher level of knowledge economy weakens the negative impact of fiscal decentralisation on teachers’ wages. As is indicated in Figures 1 and 2, when the level of knowledge economy increases⁴, the negative effect of fiscal decentralisation

⁴ Here we only show the graph with the size of the knowledge economy workforce as the measurement of knowledge economy. Other graphs are available upon request.
on both primary and secondary school teachers’ wages becomes larger.

At the average level of knowledge economy, as measured by the size of the knowledge economy workforce, a one percent increase in fiscal decentralisation reduces primary school teachers’ wages by 384.7 RMB and secondary school teachers’ wages by 247.8 RMB, which are 1.24% and 0.73% of the average annual primary and secondary school teachers’ wages, respectively. And when the level of knowledge economy decreases by one standard deviation, a one percent increase in fiscal decentralisation reduces primary school teachers’ wages by 286.5 RMB and secondary school teachers’ wages by 178.5 RMB, which are 0.92% and 0.53% of the average annual primary and secondary school teachers’ wages, respectively. When the level of knowledge economy increases by one standard deviation, a one percent increase in fiscal decentralisation reduces primary school teachers’ wages by 482.9 RMB and secondary school teachers’ wages by 317.2 RMB, which are 1.55% and 0.94% of the average annual primary and secondary school teachers’ wages, respectively.
We calculated the total effect of fiscal decentralisation which sums the coefficients on fiscal decentralisation and the interaction between fiscal decentralisation and the knowledge economy evaluated at the average level, expressed as $\beta_1 + \beta_3 \overline{KE}_{it}$. The
results are shown in Table 4. The total effect of fiscal decentralisation on primary school teachers’ wages ranges between 292.29 RMB and 394.6 RMB, which are 0.94% to 1.27% of the average annual primary school teacher wages, depending on the specification of knowledge economy. The negative effect of fiscal decentralisation on teachers’ wages is smaller in secondary schools, which are in the range 185.4-309.3 RMB, accounting for 0.55% to 0.92% of the average annual secondary school teacher wages.

| Measurement of KE | dy/dx | SE  | z    | P>|z|
|-------------------|-------|-----|------|-----|
| Primary school    | R&D   | -394.6 | 74.1 | -5.32 | 0.000 |
| Size of KE workforce | -384.7 | 50.9 | -7.56 | 0.000 |
| Knowledge creation | -292.3 | 45.0 | -6.50 | 0.000 |
| Secondary school  | R&D   | -309.3 | 68.2 | -4.53 | 0.000 |
| Size of KE workforce | -247.8 | 69.9 | -3.55 | 0.000 |
| Knowledge creation | -185.4 | 56.5 | -3.28 | 0.001 |

The national government introduced wage reform for teachers in 2009 and required subnational government to pay local supplements to teachers. Does the effect of FD and KE on wages change before and after the 2009 teacher wage reform? We created a reform dummy variable, with the value zero for the period 2001 to 2009 and 1 for the period 2010 to 2013, since Pang et al. (2010) observed that this reform was not in effect in most provinces until 2010. First, we added the reform dummy and its interaction with each independent variable in the unconditional model to ascertain whether the direct effect of FD and KE changes and then, second, to the conditional
model to check whether the interaction effect of FD and KE changes.

When we interacted the reform dummy with FD in the unconditional model we found that the interaction term was insignificant, suggesting that our results are not affected by the reform. Moreover, the interaction of the reform and KE was insignificant as well in five out of six regressions. Only in the secondary school teacher wages regression, when KE is measured by knowledge creation, did the interaction term become significant with a negative sign. When we interacted the reform dummy with the interaction of FD and KE in the conditional model, the interaction term was insignificant in five out of six regressions; the exception being the secondary school teacher wages regression when KE is measured by R&D.

An alternative explanation for our results may be that FD has a negative impact on local government's expenditure on both infrastructure and public service provision, resulting in lower teacher wages in higher FD regions. To test this explanation, we examined whether FD influenced expenditure on infrastructure, replicating the frequently cited study by Fu and Zhang (2007). The dependent variable is the percentage of expenditure on capital construction in total government expenditure of a province, which is regressed on FD and a series of controls. The results were mixed depending on the measure of FD. Employing the measure of FD used by Fu and Zhang (2007), which is the ratio of subnational government expenditure per capita to national government expenditure per capita, we found that FD is positive, consistent with our theoretical argument that local governments with higher FD divert fiscal
resources away from public service provision and into infrastructure, and thus lower teachers’ wages. However, as discussed above, this measure of FD has been criticised on the basis that the denominator is the same for all provinces in a given year (see eg. Chen & Gao, 2012; Niu, 2013; Zhang, 2011). When we use the ratio of local fiscal revenue to local fiscal expenditure to measure FD, the coefficient on FD is insignificant. Hence, the effect of FD on infrastructure is either positive or insignificant, casting doubt on this alternative explanation for our results.

Discussion of findings

The study has found that fiscal decentralisation has a negative impact on teachers’ wages. This finding resonates with existing theoretical arguments and empirical evidence which contends that in China fiscal decentralisation commonly undermines investment in social service provision (Fu, 2010; Luo & Chen, 2010; Wang et al., 2012). The finding is a source of concern given that Heckman (2005) has shown China has a history of underinvestment in the development and accumulation of human capital. It is also disconcerting given that the national government is seeking to encourage local administrators to expand their foci to include both short term economic growth and long term development and social stability by increasing the provision of social services and the resources required to generate the accumulation of high quality human resources.

In choosing to examine the association between fiscal decentralisation and teachers’ wages and by showing that this form of decentralisation may impact wages this paper
has expanded the variables that are normally considered when theorising the teacher wage determination process. This is a contribution that has pertinence both for China and for the teacher wage determination literature more broadly as fiscal decentralisation, to varying degrees, is the norm in many nations. That the study has shown that fiscal decentralisation has a negative impact on teachers’ wages in China is also a significant finding. This revelation extends the extant literature on fiscal decentralisation and government expenditure and shows that this contingency can have a decided impact on teachers’ wages. In the study the focus has been directed to the wages of teachers, but it is highly plausible that a similar relationship may exist in relation to other public service occupations across China.

That the study finds that there is no association between teachers’ wages and the intensity of the knowledge economy across China’s regions is somewhat unexpected. The public policy literature argues consistently that increasing the knowledge intensity of a nation or a region’s economy will normally require an increase in investment in education (OECD, 2008; Schleicher, 2006; World Bank, 2003). It also argues that high wages can make an important contribution to the quality of teaching. This is not least by increasing the quality of the high school graduates who become teachers and by inducing good teachers to remain in the field (OECD, 2005). But whether the association between the knowledge intensity of economies and teachers’ wages exists has not previously been documented.

Ramesh (2013) argues that China has facilitated the development of a knowledge
intensive economy by establishing high-technology parks, encouraging research, and expanding the provision of education services. But he suggests that Confucian based methods of teaching and learning prevent innovation. Consequently, China’s government needs to find ways to produce teachers who can embrace forms of pedagogy that are better suited to the generation of graduates who are critical, innovative and able to learn the skills they will need to effectively participate in a knowledge intensive economy. This need is likely to be assisted by raising teachers’ wages as the economy becomes more knowledge intensive. We, however, do not find a positive association between the knowledge intensity of economies and teachers’ wages in China.

A possible and also reasonable explanation for this result is that an increasing demand for high skilled labour is balanced by a rising supply of such workers. According to Goldin and Katz (2007), the skill wage premium will not increase if the supply of educated workers outpaces skill demand due to the upgraded technology. They find that the wage return to education initially peaked in the United States in 1915 and did not return to this peak until the 1980s. At the latter date the increasing demand for skilled labour began to outpace the increased supply of educated workers and as this situation unfolded the wage return to knowledge began to increase. In China, the situation is similar to what occurred in the United States between 1915 and the 1980s. Li et al. (2011) argue that China intentionally prioritised the development of tertiary education over primary and secondary education and this created significant problems
of absorption and unemployment for tertiary education graduates in the labour market. As is shown in Figure 3, the number of tertiary education graduates in China increased dramatically from 2001 to 2013. This pushed up the supply of highly educated workers and put downward pressure on the wages of these workers. In this environment an increase in demand for highly skilled teachers was likely to be met by the increasing supply of graduates and consequently the growth of the knowledge economy was not associated with increases in teachers’ wages.

![Figure 3. The number of tertiary education graduates in China from 1995 to 2013 (unit, 10,000 people)](image)

Our finding that the development of a knowledge economy in China’s regions has not mitigated the negative effect of fiscal decentralisation is both surprising and disconcerting. This finding suggests that while administrators who have experienced a deepening in the knowledge intensity of their regional economy may have become prone to increase investment in human capital accumulation they may have also
gained kudos for realising a goal favoured by the national government. If this is the case they may also have gained an increase in their capacity to exercise autonomy and succumb to pressures to favour short-term growth.

It is also possible that our finding may reflect the fact that determining a wage that will balance the need to contain education expenditures while concomitantly building a teaching labour force that can graduate students with the learning capacities of a future society is bound to be difficult. So doing requires that administrators accurately forecast the attributes required of teachers in 15-20 years and pay current teachers a wage that will induce today’s high school graduates to become educators who can garner these skills. Setting teachers’ wages at a level that is commensurate with economies that are becoming more knowledge intensive requires, moreover, that local governments not succumb to the temptation to concentrate education expenditure in areas that are easily measured or are highly prestigious. That local governments are likely to fall prey to this last possibility has been underscored by Hanushek & Woessmann (2015) who have documented the marked tendency for administrators to invest in measures such as years of school attainment, class size reduction, or number of tertiary institutions established rather than on raising teacher quality. The latter possibility is disconcerting given that recent studies suggest education quality matters more than quantity and that the contribution of tertiary education to economic growth disappears when the quality of schooling is considered in growth models (Hanushek & Woessmann, 2015; OECD, 2015).
Conclusion

This paper has provided evidence that fiscal decentralisation does have a significant effect on urban school teachers’ wages in China. It finds that fiscal decentralisation has a negative impact on teachers’ wages. But unexpectedly, our research does not find that the growth of a knowledge economy in China is an important teacher wage determinant.

Although there seems no direct effect of knowledge economy on teacher wages, the negative impact of fiscal decentralisation has been strengthened by knowledge economy. We have proposed possible explanations for this finding in the discussion section. Whether this is the case awaits testing.

These findings suggest that local governments in China have not sufficiently modified their inclination to concentrate on short-term growth. Given this is the case we conclude that that if the national government is convinced of the need to increase teacher quality it will need to revisit the incentives being offered to local administrators to invest in the development of human capital and embrace wage policies that are suited to the knowledge economy China wishes to construct.
References:


Tucker, M. S. (2012). Researching other countries' education systems: Why it's
indispensable but tricky, how we did it, why this time it's different. In M. S. Tucker (Ed.), *Surpassing Shanghai: An agenda for American education built on the world’s leading systems* (pp. 1-18). Cambridge: Harvard Education Press.


## Appendix

### Table A1. Measurement and data sources of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement</th>
<th>Data sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages (P)</td>
<td>Primary school staff average wages per year (RMB)</td>
<td>China Labour Statistic Yearbook</td>
</tr>
<tr>
<td>Wages (S)</td>
<td>Secondary school staff average wages per year (RMB)</td>
<td>China Labour Statistic Yearbook</td>
</tr>
<tr>
<td>FD</td>
<td>Provincial revenue/provincial expenditure (%)</td>
<td>Finance Yearbook of China</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>R&amp;D personnel in full-time equivalent per 10,000 persons a</td>
<td>China Statistical Yearbook of Science and Technology</td>
</tr>
<tr>
<td>Size of KE workforce</td>
<td>Population with college or above education as a percentage of working age population (15 to 64)</td>
<td>China Population and Employment Statistics Yearbook/ China Population Statistics Yearbook</td>
</tr>
<tr>
<td>Knowledge creation</td>
<td>Certified patent applications per year</td>
<td>China Statistical Yearbook of Science and Technology</td>
</tr>
<tr>
<td>Fiscal capacity</td>
<td>Fiscal revenue per capita</td>
<td>Finance Yearbook of China</td>
</tr>
<tr>
<td>Female (P)</td>
<td>Proportion of female teachers in primary schools (%)</td>
<td>Educational Statistic Yearbook</td>
</tr>
<tr>
<td>Female (S)</td>
<td>Proportion of female teachers in secondary schools (%)</td>
<td>Educational Statistic Yearbook</td>
</tr>
<tr>
<td>Education (P)</td>
<td>Average years of schooling of primary school teachers</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Education (S)</td>
<td>Average years of schooling of secondary school teachers</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Senior rank (P)</td>
<td>Proportion of teachers with senior professional rank in primary schools (%)</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Senior rank (S)</td>
<td>Proportion of teachers with senior professional rank in secondary schools (%)</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Ratio (P)</td>
<td>Student-teacher ratio in primary schools</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Ratio (S)</td>
<td>Student-teacher ratio in secondary schools</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Enrolment growth (P)</td>
<td>Enrolment change rate in primary schools (%)</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>Enrolment growth (S)</td>
<td>Enrolment change rate in secondary schools (%)</td>
<td>Educational Statistical Yearbook</td>
</tr>
<tr>
<td>COL</td>
<td>Spatial price index</td>
<td>Brandt and Holz (2006) c</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>Urban registered unemployment rate (%)</td>
<td>Website of National Bureau of Statistics</td>
</tr>
</tbody>
</table>


c. Brandt and Holz (2006) computed the index up to 2004. We updated the index to 2013 following their method.