Appendix to “Factor Market Distortions Across Time, Space and Sectors in China”

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Proof of Propositions

Proposition 1. See the proof of Proposition 2 below. The optimal allocation in this proposition is a special case of the competitive equilibrium when all wedges are set to one.

Proposition 2. For any set of positive wedges $\{\tau_i^y, \tau_{ij}^l, \tau_{ij}^k\}_{i=1,\ldots,m; j=n,s}$, we now show that there is a unique allocation that solves firm's profit maximization problems. Let

$$\widetilde{A}_{ij} = A_{ij} / \left(\tau_{ij}^{la} \tau_{ij}^{k1-a}\right),$$

$$\widetilde{A}_i = \left(\widetilde{A}_{is}^{\frac{1-\phi}{\phi}} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}}\right)^{\frac{\phi}{1-\phi}},$$

and

$$\widetilde{\tau}_i^l = \left(\frac{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}} \tau_{is}^{l-1} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}} \tau_{in}^{l-1}}{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}}}\right)^{-1}, \quad \widetilde{\tau}_i^k = \left(\frac{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}} \tau_{is}^{k-1} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}} \tau_{in}^{k-1}}{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}}}\right)^{-1}.$$

Remember the stand-in firm's profit maximization problem in province i and sector j is

$$\max_{K_{ij}, L_{ij}} \left\{P_{ij} A_{ij} L_{ij}^a K_{ij}^{1-a} - \tau_{ij}^l w L_{ij} - \tau_{ij}^k r K_{ij}\right\}$$

which implies the following standard first-order conditions:

$$aP_{ij}A_{ij}L_{ij}^{a-1}K_{ij}^{1-a} = \tau_{ij}^l w \tag{1}$$

$$(1-a)P_{ij}A_{ij}L_{ij}^a K_{ij}^{-a} = \tau_{ij}^k r \tag{2}$$

Taking the ratio of the two equations yields the following:

$$\frac{K_{ij}}{L_{ij}} = \left(\frac{\tau_{ij}^l w}{a}\right)\left(\frac{\tau_{ij}^k r}{1-a}\right)^{-1} \tag{3}$$

Substituting it into (1), we have

$$aP_{ij}A_{ij}\left[\frac{\tau_{ij}^l w}{a}\frac{1-a}{\tau_{ij}^k r}\right]^{1-a} = \tau_{ij}^l w.$$

Solving for P_{ij} yields

$$P_{ij} = A_{ij}^{-1}\left(\frac{\tau_{ij}^{l} w}{a}\right)^{a}\left(\frac{\tau_{ij}^{k} r}{1-a}\right)^{1-a} = A_{ij}^{-1}\tau_{ij}^{la}\tau_{ij}^{k1-a}\lambda_p,$$

where

$$\lambda_p = \left(\frac{w}{a}\right)^{a}\left(\frac{r}{1-a}\right)^{1-a}.$$

By the definition of $\widetilde{A}_{ij}$ in the proposition, we have

$$P_{ij} = \widetilde{A}_{ij}^{-1}\tau_y^{-1}\lambda_p, \tag{4}$$

Thus,

$$P_i = \left(P_{is}^{\frac{\phi-1}{\phi}} + P_{in}^{\frac{\phi-1}{\phi}}\right)^{\frac{\phi}{\phi-1}} = \widetilde{A}_i^{-1}\tau_y^{-1}\lambda_p.$$

Note that

$$Y_{ij} = A_{ij}L_{ij}^{a}K_{ij}^{1-a} = A_{ij}\left(\frac{K_{ij}}{L_{ij}}\right)^{1-a}L_{ij}.$$

Thus, from (3), we have

$$Y_{ij} = A_{ij}\left(\frac{\tau_{ij}^{l} w}{a}\right)^{1-a}\left(\frac{\tau_{ij}^{k} r}{1-a}\right)^{a-1}L_{ij} = \widetilde{A}_{ij}\widetilde{\tau}_{ij}^{l}\lambda_L L_{ij}, \tag{5}$$

where

$$\lambda_L = \left(\frac{w}{a}\right)^{1-a}\left(\frac{r}{1-a}\right)^{a-1}.$$

Let

$$u_i = \left[\left(\widetilde{A}_{is}\widetilde{\tau}_{is}^{l} l_{s|i}\right)^{1-\phi} + \left(\widetilde{A}_{in}\widetilde{\tau}_{in}^{l} l_{n|i}\right)^{1-\phi}\right]^{\frac{1}{1-\phi}}$$

then, substituting (5) into equation (2) in the main text yields the following

$$Y_i = u_i\lambda_L L_i \tag{6}$$

From (7) in the main text, (5) and (6) we have

$$\frac{P_{ij}}{P_i} = \frac{\widetilde{A}_i}{\widetilde{A}_{ij}} = \left(\frac{\widetilde{A}_{ij}\widetilde{\tau}^l_{ij}L_{ij}}{u_iL_i}\right)^{-\phi} = \left(\frac{\widetilde{A}_{ij}\widetilde{\tau}^l_{ij}l_{j|i}}{u_i}\right)^{-\phi}$$

Solving for $l_{j|i}$

$$l_{j|i} = u_i\widetilde{A}_i^{-\frac{1}{\phi}}\widetilde{A}_{ij}^{\frac{1-\phi}{\phi}}\widetilde{\tau}_{ij}^{l-1}.$$

By definition,

$$1 = l_{s|i} + l_{n|i} = u_i\widetilde{A}_i^{-\frac{1}{\phi}}\left(\widetilde{A}_{is}^{\frac{1-\phi}{\phi}}\widetilde{\tau}_{is}^{l-1} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}}\widetilde{\tau}_{in}^{l-1}\right),$$

which implies that

$$u_i = \frac{\widetilde{A}_i^{\frac{1}{\phi}}}{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}}\widetilde{\tau}_{is}^{l-1} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}}\widetilde{\tau}_{in}^{l-1}} = \widetilde{A}_i\widetilde{\tau}_i^l,$$

$$Y_i = \widetilde{A}_i\widetilde{\tau}_i^l\lambda_L L_i,$$

and

$$l_{j|i} = \frac{\widetilde{A}_{ij}^{\frac{1-\phi}{\phi}}\tau_{ij}^{l-1}}{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}}\tau_{is}^{l-1} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}}\tau_{in}^{l-1}}. \tag{7}$$

From equation (6) in the main text, we have

$$\frac{P_i}{P} = \frac{\widetilde{A}_i^{-1}\tau_y^{-1}\lambda_p}{P} = \frac{\omega_i}{\tau_i^y}\left(\frac{Yi}{Y}\right)^{-\sigma} = \frac{\omega_i}{\tau_i^y}\left(\frac{\widetilde{A}_i\widetilde{\tau}_i^l l_i}{\left[\sum_{i=1}^m \omega_{i'}\left(\widetilde{A}_{i'}\widetilde{\tau}_{i'}^l l_{i'}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}}\right)^{-\sigma}$$

Let

$$u = \left[\sum_{i=1}^m \omega_{i'}\left(\widetilde{A}_{i'}\widetilde{\tau}_{i'}^l l_{i'}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}},$$

then, we have

$$\frac{\widetilde{A}_i^{-1}\lambda_p}{P} = \omega_i\left(\frac{\widetilde{A}_i\widetilde{\tau}_i^l}{u}l_i\right)^{-\sigma}$$

or

$$l_i = u\left(\frac{P}{\lambda_p}\right)^{\frac{1}{\sigma}} \widetilde{A}_i^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_i^{l-1} \omega_i^{\frac{1}{\sigma}}$$

By definition,

$$1 = \sum_{i=1}^{m} l_i = u\left(\frac{P}{\lambda_p}\right)^{\frac{1}{\sigma}} \sum_{i=1}^{m} \widetilde{A}_i^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_i^{l-1} \omega_i^{\frac{1}{\sigma}}$$

which implies that

$$u\left(\frac{P}{\lambda_p}\right)^{\frac{1}{\sigma}} = \left(\sum_{i=1}^{m} \widetilde{A}_i^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_i^{l-1} \omega_i^{\frac{1}{\sigma}}\right)^{-1}$$

and

$$l_i = \frac{\omega_i^{\frac{1}{\sigma}} \widetilde{A}_i^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_i^{l-1}}{\sum_{i'=1}^{m} \omega_i^{\frac{1}{\sigma}} \widetilde{A}_{i'}^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_{i'}^{l-1}} \tag{8}$$

Equation (7) and (8) provide the expression for the equilibrium labour allocation for the given set of taxes.

The equilibrium capital allocation $k_{j|i}$ and k_i can be solved in a similar way:

$$k_{j|i} = \frac{\widetilde{A}_{ij}^{\frac{1-\phi}{\phi}} \widetilde{\tau}_{ij}^{k-1}}{\widetilde{A}_{is}^{\frac{1-\phi}{\phi}} \widetilde{\tau}_{is}^{k-1} + \widetilde{A}_{in}^{\frac{1-\phi}{\phi}} \widetilde{\tau}_{in}^{k-1}}, \tag{9}$$

$$k_i = \frac{\omega_i^{\frac{1}{\sigma}} \widetilde{A}_i^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_i^{k-1}}{\sum_{i'=1}^{m} \omega_i^{\frac{1}{\sigma}} \widetilde{A}_{i'}^{\frac{1-\sigma}{\sigma}} \widetilde{\tau}_{i'}^{k-1}}. \tag{10}$$

From these expressions it is clear that multiplying taxes in all provinces and sectors by a positive constant will not change the resulting equilibrium allocation of labour and capital.

Proposition 3. Next, we show, for any given allocation and a vector of provincial prices, how we can identify the set of taxes that implement the competitive equilibrium. First, note that

$$L_{ij} \propto l_{j|i} l_i \qquad K_{ij} \propto k_{j|i} k_i$$

So,

$$Y_{ij} \propto \widetilde{Y}_{ij} \equiv A_{ij} \left(l_{j|i} l_i\right)^a \left(k_{j|i} k_i\right)^{1-a}$$

and

$$Y_i \propto \widetilde{Y}_i \equiv \left(\widetilde{Y}_{in}^{1-\phi} + \widetilde{Y}_{is}^{1-\phi}\right)^{\frac{1}{1-\phi}}$$

From equation (7) in the main text, then, we have

$$P_{ij} = P_i Y_{ij}^{-\phi} Y_i^{\phi} \propto P_i \widetilde{Y}_{ij}^{-\phi} \widetilde{Y}_i^{\phi}.$$

From (1) and (2), we have

$$\tau_{ij}^{l} \propto \frac{P_i \widetilde{Y}_{ij}^{-\phi} \widetilde{Y}_i^{\phi}}{l_{j|i} l_i} \quad \text{and} \quad \tau_{ij}^{k} \propto \frac{P_i \widetilde{Y}_{ij}^{-\phi} \widetilde{Y}_i^{\phi}}{k_{j|i} k_i}.$$

Finally, from (6) in the main text, we have

$$\tau_i^{y} = P_i^{-1} \omega_i P \left(\frac{Y_i}{Y}\right)^{-\sigma} \propto P_i^{-1} \omega_i \widetilde{Y}_i^{-\sigma}$$

Provincial Real Non-Agricultural GDP, 1978-2007

China's NBS annually reports nominal non-agricultural GDP levels and real non-agricultural GDP growth (but not levels) for each province. To construct real non-agricultural GDP for each of China's provinces between 1978 and 2007, we use information on nominal GDP, real GDP growth rates, and price level differences in 1990. We first proportionately re-scale reported nominal non-agricultural GDP values in every year such that the sum across provinces equals the national total. Reported year-over-year real growth rates for each province are used to construct the growth rate of each province's deflator. Specifically, this is given by the ratio of the gross nominal non-agricultural GDP growth to the reported real growth rate. To capture level differences in our base year (1990), the 1990 GDP deflator is set equal to each provinces' CPI relative to the national average.

We report the GDP deflator, for each province and for selected years, in the following table. The complete dataset is available upon request.

Table 1: Province-Specific GDP Deflators

Province	1980	1985	1990	1995	2000	2005
Anhui	0.53	0.64	0.93	1.52	1.37	1.33
Beijing	0.76	0.91	1.15	1.90	2.04	2.92
Chongqing	0.56	0.64	0.88	1.67	1.62	1.70
Fujian	0.55	0.69	1.10	1.97	1.98	1.80
Gansu	0.71	0.81	0.98	1.46	1.62	1.74
Guangdong	0.75	0.99	1.38	2.19	2.19	2.47
Guangxi	0.46	0.58	1.03	1.76	1.59	1.72
Guizhou	0.60	0.69	1.01	1.68	1.70	1.89
Hainan	0.75	0.88	1.29	2.09	2.03	1.97
Hebei	0.59	0.67	0.98	1.64	1.68	1.78
Heilongjiang	0.61	0.71	1.00	2.00	2.05	1.90
Henan	0.62	0.71	0.98	1.78	1.83	2.00
Hubei	0.55	0.63	0.93	1.53	1.59	1.35
Hunan	0.55	0.66	0.98	1.78	1.81	1.78
Inner Mongolia	0.58	0.71	0.96	1.64	1.67	1.92
Jiangsu	0.73	0.81	1.06	1.83	1.74	1.83
Jiangxi	0.62	0.72	1.00	1.58	1.55	1.65
Jilin	0.61	0.75	1.03	1.69	1.66	1.80
Liaoning	0.62	0.74	1.02	1.71	1.84	1.69
Ningxia	0.62	0.69	0.98	1.80	1.66	2.05
Qinghai	0.50	0.61	0.96	1.64	1.67	1.76
Shaanxi	0.63	0.72	1.01	1.67	1.73	2.00
Shandong	0.51	0.69	0.99	1.57	1.55	1.64
Shanghai	1.03	1.01	1.20	2.20	2.31	2.41
Shanxi	0.61	0.72	1.02	1.67	1.61	2.00
Sichuan	0.50	0.58	0.88	1.52	1.55	1.53
Tianjin	0.73	0.81	1.07	1.88	1.91	2.03
Xinjiang	0.53	0.63	0.93	1.69	1.84	1.98
Yunnan	0.54	0.61	1.04	1.78	1.87	1.96
Zhejiang	0.60	0.73	1.03	1.75	1.73	1.90

Construction of Infrastructure Capital Stock

This outlines the procedures used to adjust the state-sector capital stock data. The period 1981-2007 is analyzed, using data from the Statistical Yearbook of China and Fixed Asset Investment Yearbooks for various years. Different investment categories are listed by the statistical yearbooks for different time periods. The various categories from each source, with bold categories representing a close approximation to infrastructure, are as follows:

- 1981-1984, Statistical Yearbook of China (State-Sector Capital Construction Only)
  - Industry; Construction; and resources prospecting (with subcategory for ***resource prospecting***); Agriculture, forestry, water conservancy and meteorology (with subcategory for ***water conservancy***); ***Transport, posts and telecommunications*** (with subcategory for railways); Commerce, catering, and service trades and materials supply and marketing; banking and insurance; scientific researches culture, education, public health and social welfare; ***civil public utilities***; ***government agencies, public organizations, and others***.
- 1985-1992, Statistical Yearbook of China (State-Sector Only)
  - Farming, forestry, animal husbandry, fishery, ***water conservancy***; Industry; ***Geological survey and prospecting***; Construction; ***Transportation, postal, telecommunication***; Commerce, food service, material supply, marketing, storage; Real estate, public services, residential and consultancy services; health care, sports, social welfare; education, culture, art, radio, TV; Scientific research, polytechnical service; banking, insurance; ***government agencies, parties, social organizations***; Other.
  - Subindustry: ***Power generation, steam and hot water production and supply*** (1985-1988).
- 1993-2002, Statistical Yearbook of China (94-02 All Sectors, 93 State)
  - Agr; Mining; Mfg; ***Elec, Gas and Water***; Construction; ***Geological prospecting and water conservancy***; ***Transportation, Storage, postal and telecommunication services***; wholesale and retail, catering; Banking and insurance; real estate; social services; health care, sports, and social welfare; education, culture, and arts, radio, film, TV; R&D, polytechnical services; ***government,parties, social organizations***; other.

- 2003-2006, Fixed Asset Investment Yearbook (All Sectors, 2006=Urban); 2007 Statistical Yearbook of China
  - Agr; Mining; Mfg; ***Elec, Gas and Water***; Construction; ***Transport***; Information tech; Wholesale and Retail Trade; Hotels and Catering; Financial Intermediation; Real Estate; Leasing; R&D; ***Water Mgmt, Env and Public Facilities***; Hshld Services; Education; Health and Welfare; Culture and sports; ***Public mgmt and social org***; Int org; Other.

These infrastructure categories are associated with capital intensive activities that are mainly state activities.

There are some important details that one must consider in addition to the above. The previous table outlines many categories of fixed asset investment but certain years are missing important breakdowns. The following adjustments are made to the categorical data prior to beginning the analysis.

1. For 1985-1992 water does not exist as a separate category. Aggregate level data suggests that such investment is approximately 10% of overall agricultural investment in the 90s. However, 1981-1984 data, which does provide provincial-level data on the matter, points to a 50% rate. So, for the 1985-1992 period, water investment is assumed to equal 25% of total agricultural ("Farming, forestry, animal husbandry, fishery, water conservancy") investment.

2. Pre-1992 electricity and gas is also not provided for years except between 1985-1988 as a subcategory of industry fixed investment. Consistent with data from these four available years, we generate a power generation estimate equal to the 85-88 province-specific average share of industry investment to power generation. This ranges from 68% in Tibet, 34% in Fujian, to 9% in Beijing, Tianjin, and Shanghai. This share is then use to infer values for 81-84 and 89-92.

3. 1993-2002 transportation also appears to be far higher than surrounding years. This is likely due to the broader definition of transportation including all telecommunications investment during this period. The fraction of the transport category of the total investment is 10% in the post-2002 period while it often exceeds 20% between 1997 and 2002, and is approximately 14% between 1993 and 1997. We correct this additional investment by deflating the size of this category to be included as state-social investment to 2/3 of its original value (a figure that makes 2002 more consistent with 2003.

4. Only 2003-2007 and 1996 reports provincial breakdowns of fixed asset investment by category for all classes of investment, while other dates provide only capital construction, technical updates, real estate, and so on. Thus, the 2003-2007 and 1996 data provides a full breakdown by sector while the remaining years usually account for 2/3 of overall investment since 1985 and approximately 50% for the 1981-1984 period. We make no adjustment for this, which implies we assume the state social investment share is identical across reporting categories. This is assumption is proved false in 1998, a year with all investment types available, with a 31% social share implied when using all data, but 40% when using the capital, real estate, and innovation categories. As a robustness check, we analyze the time series implied by adjusting pre-2003 shares downward by a factor of 1.2. All conclusions are robust.

The next issue to consider is the various investment types reported in the statistical and investment yearbooks, such as Capital Construction and Real Estate, for instance. Innovative Activities and Technical Updates likely reflect the same activity, but merely represent a series-name change. For years in which the total fixed investment by sector and province are not available, we estimate that total using a sum of the capital, innovative, real estate, and technical investment types for that year. For 1998 we ignore the "All" type and do calculations consistent to the entire 1997-2002 set. Thus, 1996 and 2003-2007 have the "All" type used exclusively. Table 2 provides the number of provinces, cross tabulated by year and type, for which data is available.

A final adjustment is crude, but recognizes that some portion of the social investment categories is nonstate. From the 2007 data, approximately 75% of the highlighted sectors (varying from 65% for culture to 81% for transport) are in the state sector. Given that sectors change through time, and no provincial data is available for the ownership/sector breakdown, we apply a uniform deflation of the social investment data by 0.75 prior to determining its share of overall investment. Next, given that 1994-onwards includes all ownership types within the total, we adjust the social investment share by the inverse of the observed state share of fixed investment, by province, from the China Data Online dataset (Statistical Yearbook sources).

Thus, our measure of state infrastructure investment expenditures is given by the following:

$$\text{State Infra Invest}_{it} = 0.75\left(\frac{\text{Total Infra Invest}_{it}}{\text{State Invest}_{it}}\right)$$

Table 2: Provincial Data Availability, by Investment Type and Year

Year	All	Capital Construction	Innovative Activities	Real Estate	Technical Updates
1981	0	29	0	0	0
1982	0	29	0	0	0
1983	0	29	0	0	0
1984	0	29	0	0	0
1985	0	29	0	0	29
1986	0	29	0	0	29
1987	0	29	0	0	29
1988	0	30	0	0	30
1989	0	30	0	0	30
1990	0	30	0	0	30
1991	0	30	0	0	30
1992	0	30	0	0	30
1993	0	30	0	0	30
1994	0	30	0	30	30
1995	0	30	0	30	30
1996	30	0	0	0	0
1997	0	31	31	31	0
1998	31	31	31	31	0
1999	0	31	31	31	0
2000	0	31	31	31	0
2001	0	31	31	31	0
2002	0	31	31	31	0
2003	31	0	0	0	0
2004	31	0	0	0	0
2005	31	0	0	0	0
2006	31 (urban)	0	0	0	0
2007	31	0	0	0	0

Labour Shares, National and Provincial, for State and Non-state Sectors

To construct estimates of labour-intensity for state and non-state output in a manner that avoids using direct labour compensation in China, we use labour's share of value-added for corresponding sectors of the United States. That is, given the product and factor markets are more competitive in the United States, the US shares should more closely correspond to technical factor-elasticities of output. This exercise will determine if the sectoral-composition of state and non-state output differs systematically in a manner that invalidates our baseline assumption of equal factor shares.

We use data from China's National Statistical Yearbooks for 1985, 1990, 1995, and 2000, which report employment for 16 sectors separately for state and non-state firms. We match sectors to US data reported in the BEA's GDP-by-industry accounts publicly available through their web-site. This match is done by name, which admittedly is rough. Applying these shares to both the state and non-state sectors in China, we can determine the implied employment-weighted average of labour's share between state and non-state sectors for each year. For 2007, we perform the same exercise using a different set of 19 sectors reported in the more recent Statistical Yearbooks.

The results suggest that since the mid-1990s the state sector has become more labour intensive. They also suggest the non-state sectors are slightly less labour intensive and are roughly stable over time. We present the implied state and non-state shares for each sector below.

Table 3: Labour Shares of Output, by Sector

	Non-state	State
1985	56.21%	59.94%
1990	55.70%	60.27%
1995	57.07%	60.40%
2000	56.30%	65.05%
2007	53.38%	68.13%

It is important to note the source of the higher labour share in the state sector. In the US, the health and education sectors both have labour shares in excess of 80%. The state employment of China is significantly concentrated in these sectors, and this concentration is increasing over time. For example, in 2007, 30% of state employment was in health, education, and welfare sectors. In 1985, this was just over 10%. Also extremely labour-intensive is the so-called Public Management and Social Organizations sector (which we map to the government sector of the US), which also has a labour share over 80%. The fraction of total state employment in this sector of China in 2007 was 20%. So, half of state employment is concentrated in highly labour intensive service sector areas. This accounts for the higher state sector labour share overall and the growing share over time.

To determine the variation in labour shares across provinces, we carry out a similar exercise as above for 1985 and 1996 using region-specific employment information by sector and by state and non-state. We find the cross-province variation is minor. We also confirm with this alternative data that the state sector is slightly more labour intensive than the non-state sectors. We report the implied shares in the following table.

Table 4: Labour Shares of Output, by Sector and Province

	1985		1996	
	Non-state	State	Non-state	State
Beijing	58.48%	64.67%	60.14%	65.90%
Tianjin	58.16%	60.68%	57.53%	62.21%
Hebei	61.78%	62.41%	59.33%	62.67%
Shanxi	60.36%	62.08%	58.62%	59.12%
Inner Mongolia	60.50%	62.65%	59.88%	60.51%
Liaoning	59.18%	59.67%	58.36%	60.21%
Jinlin	58.67%	60.54%	58.90%	59.24%
Heilongjiang	59.51%	60.21%	58.27%	55.28%
Shanghai	55.87%	59.07%	57.15%	62.65%
Jiangsu	60.28%	60.57%	58.78%	62.74%
Zhejiang	58.36%	60.92%	57.90%	65.33%
Anhui	59.85%	62.72%	60.38%	62.19%
Fujian	62.03%	62.81%	59.27%	66.78%
Jiangxi	61.31%	61.07%	59.38%	61.88%
Shandong	61.73%	61.23%	59.89%	61.64%
Henan	61.87%	61.17%	60.55%	61.92%
Hubei	59.67%	61.60%	59.34%	63.96%
Hunan	60.34%	62.40%	59.77%	63.44%
Guangdong	61.36%	62.25%	58.93%	65.95%
Guangxi	61.39%	62.92%	61.06%	66.66%
Chongqing			61.04%	66.54%
Sichuan	61.06%	62.42%	60.24%	63.10%
Guizhou	61.08%	63.38%	59.75%	65.07%
Yunnan	63.19%	64.43%	60.38%	66.57%
Tibet	60.60%	67.51%	62.93%	72.73%
Shaanxi	61.15%	62.80%	62.96%	60.63%
Gansu	62.83%	62.89%	60.62%	62.37%
Qinghai	63.62%	64.52%	60.63%	64.79%
Ningxia	63.36%	62.64%	59.15%	62.11%
Xinjiang	61.26%	64.92%	58.69%	63.92%

Constructing Human Capital by Sector and Province, 1978 and 2007

Using Census of China micro-data for 1982, 1990, 2000, and 2005 we calculate the overall average years of schooling for each province. The Census records highest degree of completed schooling in various categories. We assigned 18 years to those individuals with graduate school training, 16 to those with undergraduate, 14 for come college or vocational training, 12 for high school, 9 for middle school, and 6 for primary school. We can then determine the mean years of schooling attained by individuals employed in non-agricultural activities. We linearly interpolate for between-census years and extrapolate for the year before the 1982 Census and after the 2005 Census. For the period 1978-1982, we assume the growth rate of education is, for each province, equal to the growth in schooling between 1982 and 1983. For the period 2005-2007, we similarly assume the growth rate between years is identical to the provincial growth rate between 2004 and 2005.

The Census does not provide a breakdown of employment by ownership type (state versus non-state firms, for instance). To determine this breakdown, we must supplement the values for the overall provincial average years of school with another dataset. We use data from the China Health and Nutrition Survey (CHNS), which records years of education for individuals working in non-agricultural sectors separately by state and non-state firms. We have these data for 1991, 1993, 1997, 2000, 2004, and 2006. The average years of schooling of state sector employees is approximately 25% higher than non-state sector employees in 1991 and rises to 30% by 2000 and later. These data, however, are not available for all provinces and we assume the distribution of schooling between state and nonstate holds identically across provinces.

With these data in hand, and information on the total number of employees by sector and province we can infer for each province the number of years of schooling for state and non-state employees separately. Specifically, the years of schooling of non-state is

$$s_{int} = \frac{s_{it}}{\frac{s_{st}}{s_{nt}}\frac{L_{ist}}{L_{it}} + \frac{L_{int}}{L_{it}}},$$

where S_{it} is the overall average years of schooling for the province (from Census data), S_{st}/S_{nt} is the ratio of the state to non-state years of schooling that is identical for all provinces (from CHNS), L_{ist} is the total employment in state, L_{int} is the total employment in non-state, and L_{it} is the province's total non-agricultural employment. State sector school is similarly inferred. We construct measures of human capital (h) by assuming returns to education are 13.4% for the first four years, 10.1% for additional schooling up to eight years, and 6.8% thereafter. The human-capital adjusted level of labour input for each sector and province over time is $E_{ijt} = h_{ijt} L_{ist}$.