Factor Prices, Population, and Productivity in Korea, 1700-1900*

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Abstract

Korean landlords and workers suffered worsening living standards in the eighteenth and nineteenth centuries. Falling land rents and real wages suggest per capita output and total factor productivity changing -0.69% and -0.54% p.a., respectively. Real wages fell faster than land rents, implying that the Korean population grew 0.28% p.a., a growth rate considerably higher than that suggested by demographic data as published by the dynastic government. The downward productivity trend stands in contrast to improvement in the English TFP, a disparity which had much to do with time preference affecting the level of investment peasants' were willing to make in soil fertility.

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In the twentieth century, colonial and South Korea did consistently better than the rest of the world in terms of per capita output growth (Cha and Kim(2009)). Little, however, is known about the growth performance of pre-colonial Korea, primarily because the aggregate data left by the dynastic government of Korea is both limited and unreliable. This article is an attempt to infer per capita output growth in pre-colonial Korea from available observations on asset and factor prices, which also allows one to estimate population and efficiency growth in Korea in eighteenth and nineteenth century.

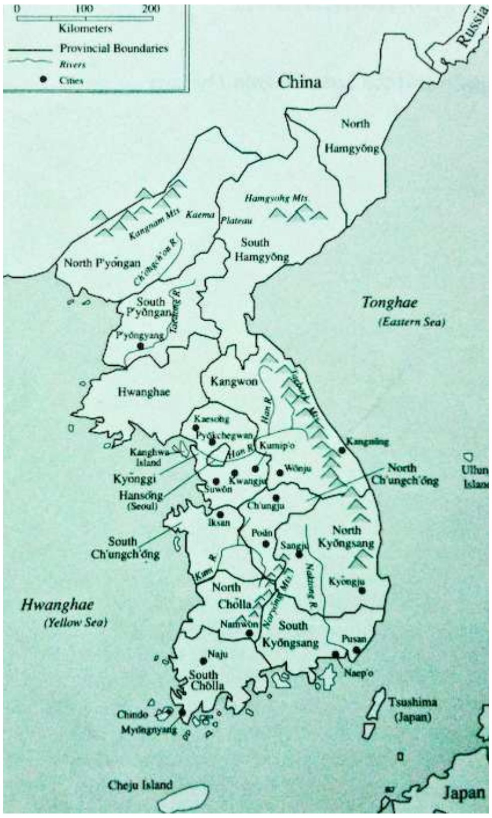
In the first two sections, I estimate the land rent and real wage in late dynastic Korea to find that the two factor incomes fell as a matter of trend in the eighteenth and nineteenth centuries, but at different speeds. From the gap in the rates of change, I infer in the third section plausible ranges of population and per capita output growth in pre-colonial Korea. The simultaneous decline in the two factor prices suggests falling total factor productivity. In the fourth section, I use the dual approach to calculate the rate of the decline and contrast the Korean deterioration with sustained productivity improvement in Britain in the eighteenth and nineteenth century. TFP drifting in opposite directions in Britain and Korea implied that the divergence between the two countries long predated the British Industrial Revolution, which I attribute to difference in time preference. Final section summarizes and concludes by offering conjectures on why in the pre-colonial Korea the future was so heavily discounted.

Land Rents

The port opening in 1876 set off transmission of modern technologies from the west, triggering proliferation of non-agricultural activities. Nevertheless, agriculture still accounted for nearly 80% of the aggregate output, when Japanese rule of Korea began in 1910. In the predominantly agrarian economy of pre-colonial Korea, land and labor were not only the two key factors of production, but also the most important sources of public revenue. Hence, the government of dynastic Korea carried out surveys on population and arable acreage on a more or less regular basis. The aggregate numbers generated by the inspections underestimated to a great extent the true size of labor force and cultivated land. Having secured Korea as a protectorate in 1905, Japanese rulers carried out a quick census to identify 12,934,282 Korean residents, a number considered by modern demographers as an underestimate, but more than twice as large as the outcome of last count by the dynastic Korea on year earlier -- 5,928,802 persons (Zensho(1925)). Similarly, the Cadastral Survey (1910-18) could locate 4.7 million acres in addition to the 5.9 million acres already registered on the tax ledger of the dynastic government (Shin(1996: 42)). The large gap between the true and official figures in pre-colonial Korea reflected rampant corruption in taxation and the power of hereditary aristocracy to thwart the dynastic government’s efforts to survey land accurately and frequently (Palais (1975: chapter 4)). Males of the privileged status, known as *yangban*, normally were in the state of either holding a public sector job or being unemployed.

The Cadastral Survey also revealed for the first time other important details about land utilization in Korea. In 1919 about one third of arable acreage was paddy and the remaining two thirds dry fields. According to the Statistical Yearbook of Korea for the same year, 56% of cultivated land was located in the eight southern provinces, which roughly coincide with present day South Korea (see Figure 1). Roughly one half of the acreage in the southern provinces was paddy fields, while dry fields accounted for less than one fifth of the arable in the north. Finally, about one half of fields were being cultivated under tenancy contract, with paddy fields being far more likely to be rented out to peasants than dry fields. As Gragert(1994) found out, the regime shift from dynastic to colonial Korea did not entail significant shifts in property rights either between different ethnic groups or between social classes. Therefore, the high land tenancy ratio in 1919 could be seen as showing the pattern of landownership in pre-colonial Korea, where a large majority of agricultural land was controlled by *yangban*s.

Figure 1 Map of Korea



Source: Palais (1996)

Some of *yangban* landlords took the trouble of documenting the amounts of rents paid by sharecropping tenants. So far such land rent records from thirty five different places in Korea have been brought to light, mostly located in southern provinces known as Chŏlla and Kyŏngsang (Figure 1), the two key agricultural regions, where 30% of cultivated area was located in 1919. Observations from each of the thirty five sites having been made in different years of the two and half century from the late seventeenth to early twentieth, Rhee(2009) regressed the land rent observations on dummy variables representing individual farm sites and 5-year periods to identify a downward trend up to the late 1880s, which was followed by sustained improvement in the late nineteenth and early twentieth centuries.[1]

[1] The trend thus estimated is similar to that previously identified by Park(2004) using a smaller number of observations and reproduced in Cha(2009: 1138, Figure 1).

The structure of Rhee(2009)'s dummy variable regression imposes a restriction for land rents in different places to follow a common drift, but a glance at the plot of the rent data suggests that different regions may have followed distinct time trends. For instance, the rent observations from one farm located in Kwachŏn in Kyŏnggi, the province surrounding Seoul and greatly underrepresented in Rhee(2009)'s land rent sample, appeared neither to fall nor to rise as a matter of trend in the second half of the nineteenth century. And running Rhee(2009)'s dummy variable regression separately for Chŏlla and Kyŏngsang reveals that the land rent declined significantly more rapidly in Chŏlla than in Kyŏngsang. Therefore, it does not seem unlikely that the national trend in the paddy land rents in late dynastic Korea looked quite different from the trend as estimated by Rhee(2009). More importantly, land rents from dry field, accounting for roughly two thirds of the arable, might have followed a trend distinct from the paddy land rent.

If available observations on land rents were made exclusively on paddy fields located mostly in Chŏlla and Kyŏngsang, there exists a far larger number of observations on farmland prices – roughly 11,000 -- that were taken from surviving records of transaction in agricultural land occurring primarily in middle provinces close to Seoul such as Hwanghae, Kyŏnggi, Kangwon, and Ch'ungchŏng. Only one tenth of the price data refers to Chŏlla and Kyŏngsang, and none to the two northern regions, P'yŏng'an and Hamkyŏng.[2] The land price data refer mostly to paddy land, with dry field prices accounting for only about one sixth of the observations in the farmland price dataset.

Cha & Hong (2010) regressed the prices of paddy fields on the product of 5-year period and regional dummies, a specification that allows paddy land prices in different regions follow different trends. The estimation period was from 1700-1879, because the dynastic government began to circulate debased coins from 1883 making it difficult to tell whether the prices struck in dealings concluded in the 5-year period 1880-4 and later are in terms of regular or debased coins. Nominal prices of paddy land as obtained using estimated coefficients of the dummy variables rose as a matter of trend in all the six regions, but more rapidly in some than in other regions: Table 2 shows that the inflation of paddy land prices was higher in central (Hwanghae, Kyŏnggi, Kangwon), than in far-flung provinces, Ch'ungch'ŏng and Chŏlla, in particular.

The increase in paddy land prices however lagged behind that in rice price (0.58%), and as a result the real price of paddy land was on the decline everywhere in the eighteenth and nineteenth centuries. Table 2 also shows that paddy land prices in terms of rice fell faster in Chŏlla (-0.21%) than in Kyŏngsang (-0.16%), a pattern of regional variation that is consistent with the faster decline in rents in Chŏlla than in Kyŏngsang. The rate of change in real price of paddy land in all Korea may be derived as a weighted average of regional rates of change, using regional shares in paddy fields (shown in the second column from the right) as weight-share indices. The outcome, show at the bottom of rightmost column, was -0.19% per year.

Table 1 Annual Growth Rates, 1700-1879: Paddy Land Price

[2] In P'yŏng'an and Hamkyŏng could be found 18% and 13%, respectively, of cultivated land at the end of the Cadastral Survey.

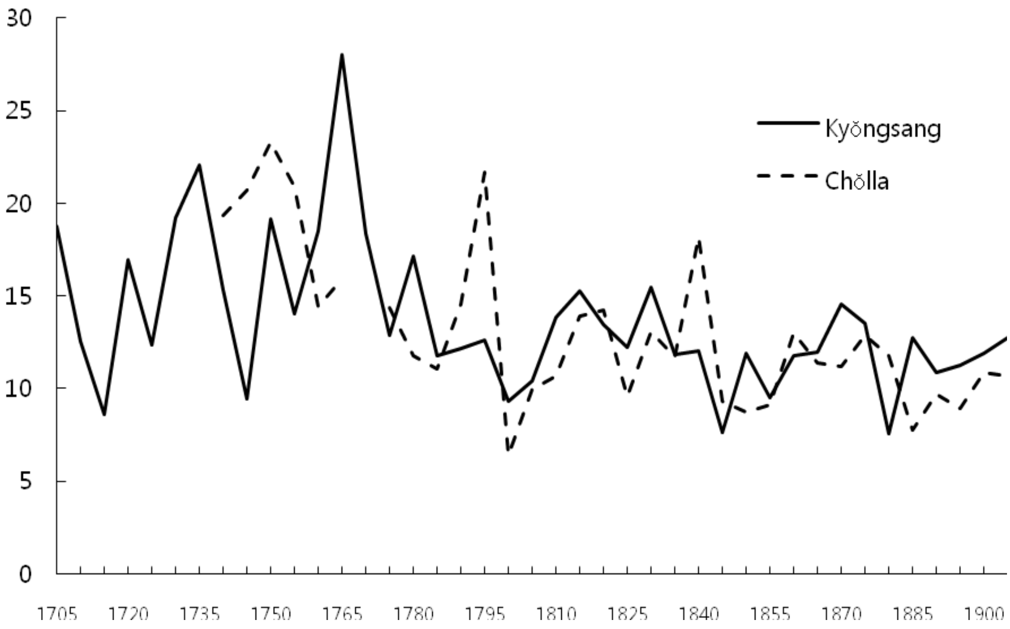
	Paddy Land Price: Nominal (A)	Rice Price (B)	Paddy Land Price: Real (A-B)	Weight (C)	(A-B) x C
Kyŏnggi	0.47%	0.58%	-0.11%	0.15	-0.02%
Hwanghae	0.41%	0.58%	-0.17%	0.10	-0.02%
Kangwon	0.56%	0.58%	-0.02%	0.06	0.00%
Ch'ungch'ŏng	0.26%	0.58%	-0.32%	0.17	-0.05%
Kyŏngsang	0.42%	0.58%	-0.16%	0.26	-0.04%
Chŏlla	0.37%	0.58%	-0.21%	0.27	-0.06%
Sum				*1.00*	*-0.19%*

Note: growth rates refer to slope coefficients generated by the regression of log-transformed prices on year.

Sources: see text.

In Figure 2 are shown the paddy land rent as a share of price of paddy land in Chŏlla and Kyŏngsang. The ratios -- the implicit rate of interest – in the two provinces are remarkably similar in terms of both level and trend: it was roughly 20% at the beginning of the eighteenth century and then followed a downward trend to approach 10% at end of the nineteenth century. The close correspondence suggests that capital markets in different places did not remain disconnected, which makes it justifiable to allow the interest rate in Kyŏngsang to represent the Korean interest rate. The rate of interest changed -0.20% per year, a growth rate which made be added to the growth in real paddy land price, -0.19%, to derive the rate of change in the rent from paddy land in Korea -- -0.39% per year.

Figure 2 The Implicit Rate of Interest in Chŏlla and Kyŏngsang (%)



Source: see text.

The growth of rent from dry fields may be calculated in the same way. Table 2 shows that nominal dry field price were on the rise in the eighteenth century, but more rapidly in Chŏlla and Kyŏngsang than in the provinces closer to Seoul (Ch'ungch'ŏng and the central region, including Hwanghae, Kyŏnggi, and Kangwon), a pattern of regional disparity opposite to that found in the growth of paddy land prices.[3] Prices of dry fields rose less rapidly than the price of dry field products, hence the real price of dry fields fell in the eighteenth and nineteenth centuries except in Kyŏngsang (fourth column, Table 2). The growth rate of real dry field price for all Korea derived as a weighted average of regional rates of change was -0.31% as shown at the bottom of the rightmost column. Adding to this the rate of change in the implicit rate of interest, -0.20%, gives the growth rate of dry field rents, -0.51%, in all Korea.

Table 2 Annual Growth Rate, 1700-1879: Dry Field Price

	Dry Field Price: Nominal (A)	Product Price (B)	Dry Field Price: Real (A-B)	Weight (C)	(A-B) x C
Central	0.36%	0.74%	-0.33%	0.51	-0.19%
Ch'ungch'ŏng	0.17%	0.74%	0.14%	0.20	-0.11%

[3] In estimating regional dry field prices, the three regions adjacent to Seoul were merged into one, because the number of available observation on dry field prices was not sufficient large.

Kyŏngsang	0.85%	0.74%	-0.26%	0.18	0.02%
Chŏlla	0.55%	0.74%	-0.54%	0.11	0.02%
Sum				*1*	*-0.31%*

Notes: "central" region refer to Hwanghae, Kyŏnggi, and Kangwon; growth rates refer to slope coefficients from the regression of log-transformed prices on year.

Sources: see text

As the final step, we derive the growth rate in the land rent in eighteenth- and nineteenth-century Korea, -0.47% p.a., as a weighted average of growth rates of paddy and dry fields rents using the share of the two types of farmland in acreage total, 0.36 and 0.64, respectively. It should be noted that in this "national" rate of change are not represented Pyŏng'an and Hamkyŏng, where 8.80% and 3.11%, respectively, of paddy fields, and 23.89% and 18.65%, respectively, of dry fields in Korea could be found in 1919.

Wages

Although the use of hired labor did not appear as unusual in pre-colonial Korea, only a very limited amount of wage information in the eighteenth and nineteenth centuries has been discovered. Paper being an expensive commodity in pre-colonial Korea, neither peasants nor landlords probably saw much point in making records of short term employment contract. Longer term contracts in rural Korea typically took the form of sharecropping tenancy known as *pyŏngchak*, a long-established form of contract that was normally entered into verbally without specifying the duration of tenancy. Diaries or accounts books of *yangban* landlords, the very data source used by Rhee(2010) to estimate pre-colonial trend in land rent, normally provides information on the total amount of rents receipts without documenting either the names or the number of tenants paying the rents, which makes it impossible to calculate reward for individual peasants.

So far economic historians managed to locate only two historical documents containing information on the level of wages paid by private employers. One is the diary kept by Pak clan, a *yangban* family based in Yechŏn in northern Kyŏngsang, which was used by Lee (2000) to compile a wage series for agricultural workers in the second half of the nineteenth century and the early twentieth century. The other is the account books kept by Mun clan in Yŏng'am, a village in southern Chŏlla, from which Kim (2004) collected and published quantitative information on annual remuneration given to farmhands in a variety of ways.[4]

As the standard account of the Korean history goes, wage workers emerged as a distinct income group after the invasions by Hideyoshi (1592-1598) and Q'ing China (1627-1637). Korea before the two wars could be described as a tribute economy, where markets were little developed, money hardly circulated, and peasants paid taxes in the form of corvée and a variety of agricultural commodities and handcrafts. The wars

[4] The data used by Lee(2000) and Kim(2004) included both total labor expense and the number days worked or workers hired. The account books used by Kim(2004) also include entries recording total labor costs only. Jun & Lewis (2007) drew on such records to produce an alternative wage series for Yŏng'am. Given the absence of explanation on how they inferred the number of workers hired, it is difficult to tell whether the estimate by Jun and Lewis can be accepted as a valid wage series.

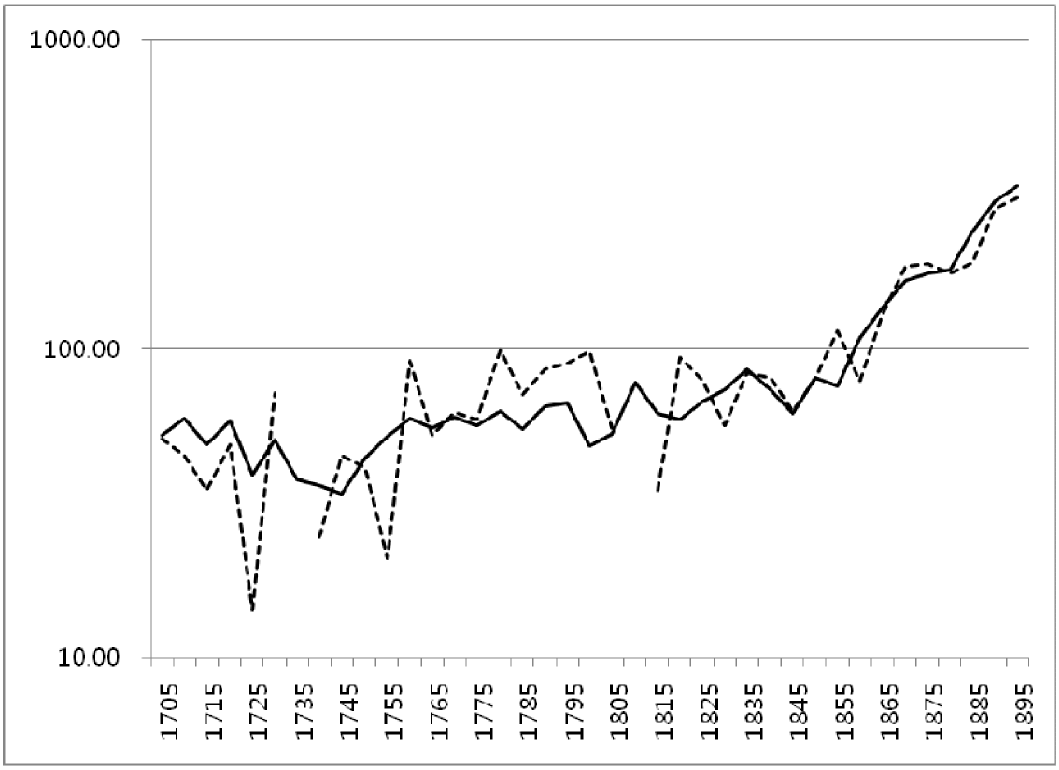
significantly weakened the bureaucracy, making it impossible for the dynastic government to operate the pre-war system of command. Hence, the government introduced copper cash in 1678, ordering peasants to pay taxes with either cash or money commodities, such as rice and cotton cloth, which could be used to pay for a variety goods and labor services the government purchased on the market. In short, the wars with Japan and China enforced "emergency conversion" from command to market economy in Chosŏn Korea.

The emergence of labor market after the wars allowed the dynastic government to recruit workers for public works -- including palace building, restoration of tombs, royal weddings, funerals, and publication - without resort to the threat of brute force. Following the completion of these projects, the authorities in charge (*togam*s) published reports, known as *ŭigwe*(儀軌)s, which documented various aspects of the public works, including compensation for workers hired. Before the *Kabo* Reform, the modernization efforts introduced in 1894, decreed total monetization of the public finance, each of wage records found in *ŭigwe*s consisted of two figures, one representing food provision (料材) and and the other compensation for labor (價布), the former being specified in terms of rice and the latter in terms of cotton cloth. Although *ŭigwe*s convey impression that the *Kabo* Reform caused a sudden transition to cash wages, in fact *togam*s have long been paying the wages partly in kind and partly in cash, converting a portion of wages stipulated in kind into cash wages applying official prices (Yun(1998)). The official prices, known as *taechonka*, were normally four and two *nyang* of copper coins per *sok* of rice and per *pil* of cotton cloth, respectively, and remained virtually constant before the *Kabo* Reform (Pak(2004: 61-2)).

Having collected more than one thousand wage records for both skilled and unskilled workers from a variety of *ŭigwe*s from 1600-1909, Pak(2004: 78-81) converted pre-1894 wages records (given in terms of rice and cotton cloth) into nominal amounts by applying *taechonka*. The post-1894 *ŭigwe* wage records (given in cash) was deflated with the market price for *sok* of rice, which was then multiplied with *taechonka* for rice (i.e. four *nyang*). Slicing the two separate series into a single wage series, Pak(2004) claimed that the pre-1850 part of the time series can be seen as an index of rice wage, because, in his view, rice prices, hence the real value of the part of wages paid in cash remained stable until the mid-nineteenth century (Pak(2004: 90)). On the other hand, since rice prices rose in the second half of the nineteenth century reducing the real value of the cash portion, Pak(2004) argued that the post-1850 part of his wage series can be considered as showing an upper bound for the level of rice wages.

Prices rose far more rapidly after than before the mid-nineteenth century, but contrary to Pak(2004)'s claim, prices were on the rise for the best part of the eighteenth and nineteenth centuries (Figure 3). To be more specific, prices fell until the 1730s and then rose consistently until around 1860, which was followed by more rapid increase in the remaining decades of the nineteenth centuries. The persistent inflation in the presence of the cash portion in workers' compensation implies that Pak(2004)'s wage series is an upper bound measure not just for the late nineteenth century, but for the better part of the eighteenth and early nineteenth centuries.

Figure 3 Prices of Rice and Dry Farm Products



Notes: Vertical axis is logarithmic; solid and broken lines are rice and dry farm product indices, respectively.

Source: Cha and Hong (2010)

Not being an acceptable index of real wages, Pak(2004) wage figures contain useful information that can be used to infer the trends in the real wage in late dynastic Korea. Assume for the sake of simplicity that *togam*s paid wages with rice and copper cash, then wages earned by unskilled workers in terms of rice (w) may be expressed by equation (1):

$$w=W*(1-r)/4 + W*r/P \quad (1),$$

where W stands for the upper bound measure of unskilled real wages Pak(2004) derived, r the portion of wages paid with cash, and P market price of rice. The first term on the right-hand side of equation (1) represents the amount of rice *togam*s handed over to workers, 4 being the *taechonka* for rice Pak(2004) applied to derive his wage numbers. The second term corresponds to the amount of rice unskilled workers could have bought with the cash wages. Equation (1) make it evident that, other variables remaining constant, rise in rice price (P) or cash share in wage payment (r) would depress real wages (w).

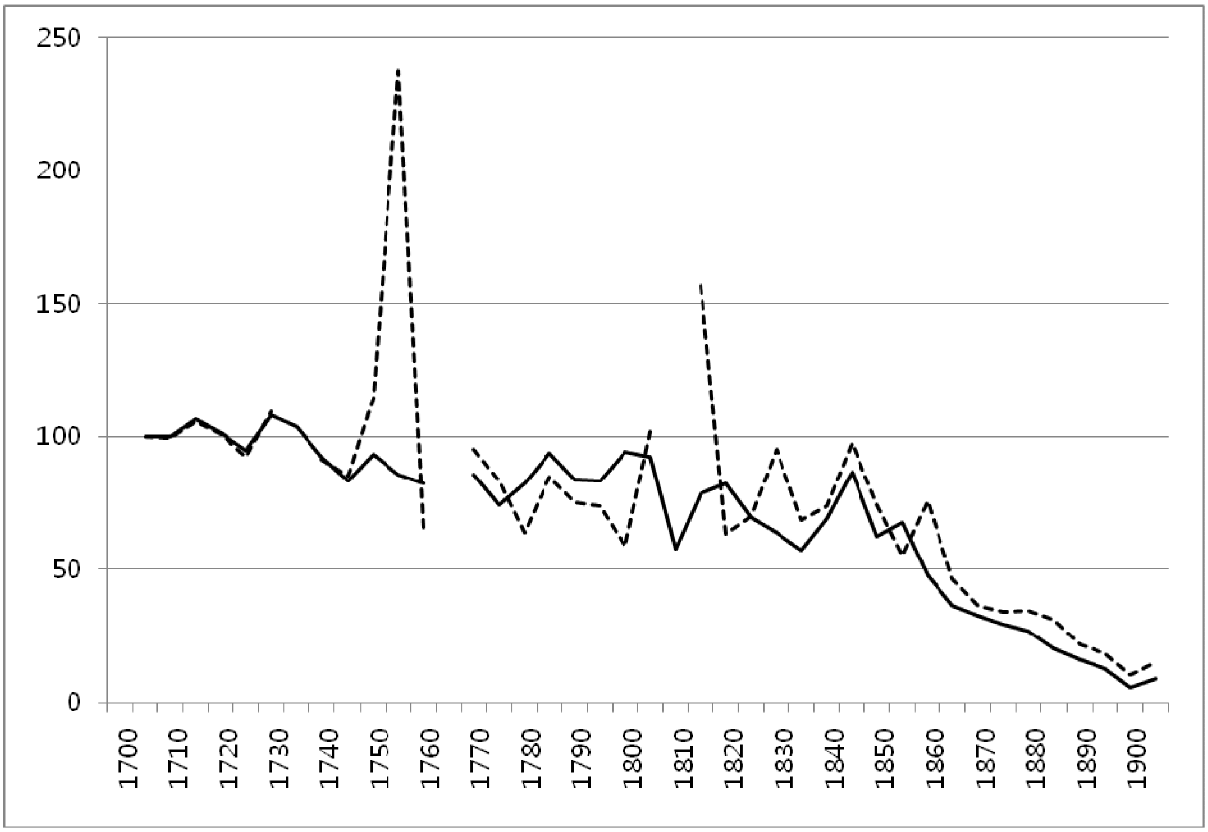
It is difficult to know precisely how large was the share of cash in total wage payment, but the importance of cash wage almost certainly was on the rise in the eighteenth and nineteenth centuries as both the economy and public finance were being monetized. In 1700 copper coins played a significant part neither in the aggregate economy nor in the finance of the dynastic government, simply because there circulated only a limited amount of coins. Falling level of prices until the 1730s (Figure 3) suggests that mintage was not large enough to replace coins being destroyed or hoarded. As money stock expanded from around 1740, not only did an increasingly larger part of taxes was paid with cash, but also the government paid for its purchase from the private sector less and less with commodities, such as rice and cotton cloth, and more and more with copper coins.[5] In the total revenue of the *togam*s as examined by Pak(2004), cash accounted for virtually nothing in the 1690s, but the share of cash rose consistently in the following two centuries, so that by the 1880s all of *togam*s' revenue consisted of cash (Pak(2004: 55)).

While cash played an increasingly important role in the finance of the dynastic government, the monetization appeared to proceed at a faster pace in lower than in higher offices in the bureaucratic hierarchy. On the eve of the *Kabo* reform, about 40% of the total receipts of the Ministry of Finance in Seoul still consisted of rice, cotton cloth and other commodities. Cash accounted for a far larger part of the revenue of provincial bureaus, because the Ministry dictated them to transfer taxed received in kind to Seoul and to keep cash receipts for local spending, although it would have cost less to transport coins (Kim (2008: 12)). The reason for this policy was probably because the inflation since the 1730s led officials to expect copper coins to lose their value relatively to goods and therefore to prefer to receive in kind and pay with cash as far as possible. This implies that the share of cash in the wages earned by workers hired by *togam*s is likely to have increased more rapidly than the share of cash in *togam*s' total receipts as shown by Pak(2004: 55). Indeed, as Yun(1998: 287) found, *togam*s paid wages mostly in kind in the early eighteen century, but as early as in the second half of the eighteenth century wages were being paid to laborers normally with cash.

Therefore, I derive unskilled wage in terms of rice (w) by setting r in equation (1) -- the share of cash in wage payment -- equal to 0 before 1750 and to 1 thereafter. To obtain W by 5-year period, I regressed Pak(2004)'s wage data on 5-year period dummies and three dummies representing three different types of unskilled jobs. Finally, rice price index as estimated by Cha and Hong(2010) was used for P in equation (1).

Figure 4 Rice and Cotton Cloth Wages of Unskilled Workers Per Month, 1700-1900

[5] See Palais(1975: 166) and Kim(2008: 10), among others.



Notes: solid and dotted lines represent rice and cotton cloth wages, respectively; index numbers (1700=100).

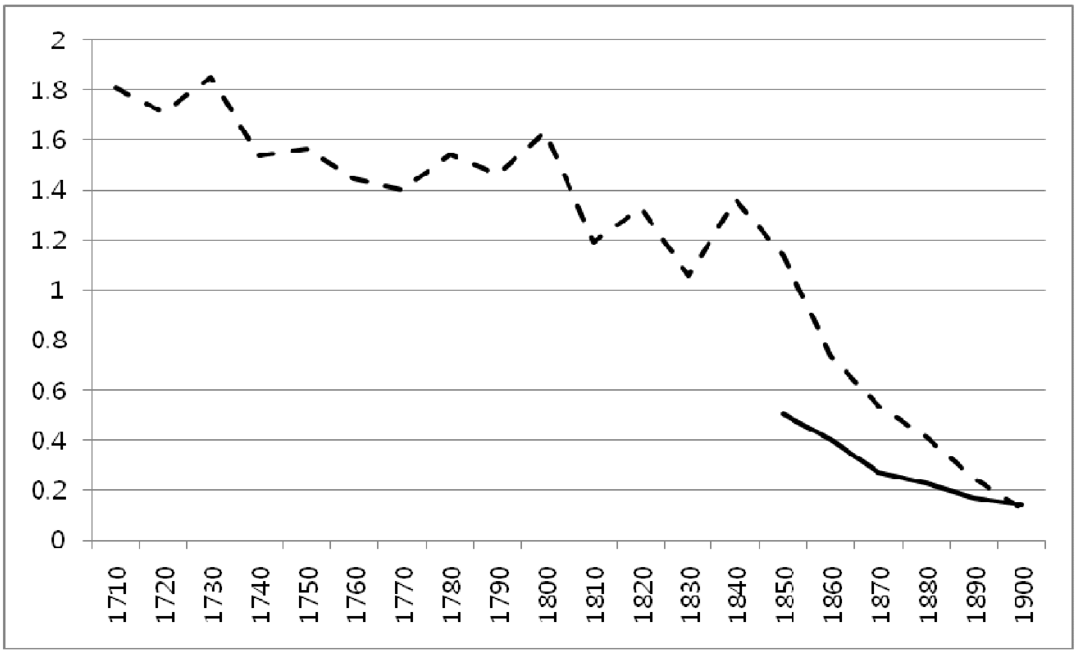
The solid line in Figure 4 shows the rice wage thus derived and then converted into index numbers to set the level in 1700 equal to 100. Expressed in terms of rice, wages of unskilled laborers working for *togam*s fall consistently in the eighteenth and nineteenth centuries, so that the level of wages in 1900 was less than one tenth of that in 1700. The rate of change as implied by a linear trend fitted onto log-transformed rice wages was -0.78% per year. One can derive a wage index in terms of cotton cloth by replacing the denominator of the first term on the right-hand side of equation (1) with 2, the *taechonka* for cotton cloth, and using price of cotton cloth for *P* in the second term. Price information for cotton cloth is extremely scarce, probably because in dynastic Korea peasants produced cotton cloth mostly for tax payment or their own consumption. Hence, I derived market prices of cotton cloth by assuming that the price per *pil* of cotton cloth was equal to *taechonka* in 1700, i.e. two *yang*, and that it fluctuated following the dry farm product price index as shown in Figure 3. The cotton cloth wage index thus derived and presented in Figure 4 as a dotted line changed -0.61% per year in the eighteenth and nineteenth centuries.

Workers' in pre-colonial being consumers of rice, cotton cloth, and dry farm products, the growth rate of the real wages of unskilled worker would lie between the growth rates of rice and cotton cloth wages. I take a simple average of two growth rates, -0.70% (=(-0.78%-0.61%)/2) to use it as the rate of change in the real wages in eighteenth- and nineteenth-century Korea.

Did wages of laborers employed by *togam*s reflect market wages in Seoul and Kyŏnggi, where public works normally took place? There are reasons to believe that they were not far removed from prevailing level of wages. Yun(1998: 287, 291)'s pioneering study on the transition from forced to wage labor in the wake of wars with China and Japan Korea describes a number of incidents indicating that the public sector was by no means a wage-setter in the postwar labor market. When an epidemic breaking out in 1699 reduced labor supply, *togam*s responsible for the repair of royal ice storage had to raise its wage offer. And in 1701, 600 workers ran away from the building site of a royal tomb, when their demand to be paid with cash, rather than in kind, was rejected. The walkout was not a response to the failure on the part of the *togam* in charge to abide by agreed terms of payment, but workers' unilateral action to protect themselves from the impact of falling prices. Nevertheless, the *togam* was forced to call back the workers by raising the level of wage in kind. Finally, in attracting workers for palace repair in 1747, the royal employer adopted the strategy of beginning by tendering a lowish wage and then, if it fails to draw a sufficient number of workers, trying a higher wage.

There remains a question of how well the wages working for public works in Seoul and Kyŏnggi represent the market wage in all Korea. Figure 5 compares the unskilled wages in terms of rice as estimated from *ŭigwe*s and those observed in Yechŏn, a village about 300 km away from Seoul, in terms of both level and trend. The level of rice wage in Yechŏn appears as lower than in the capital area in the mid-nineteenth century, which however is likely to be more apparent than real; for while the two rice wages in Figure 5 were obtained by applying the "national" rice price index as estimated by Cha and Hong (2010), rice was likely to have been cheaper in a producing region like Yechŏn than in places of consumption such as Seoul and Kyŏnggi. The port opening in 1876 triggered integration of regional rice markets in Korea as well as the integration of Korea into the world rice market (Pak and Rhee(2004)). As rice price differential between different regions of Korea contracted, the apparent wage gap between Yechŏn and Seoul also narrowed to virtually disappear at the end of the late nineteenth century.

Figure 5 Wages in the Private and Public Sectors (*sŏk* of polished rice per month)



Source: Lee (2000).

Note: solid and broken lines refer to rice wages earned by agricultural workers in Yechŏn and by laborers hired by the government in Seoul and Kyŏnggi.

There exists other evidence indicating that workers in other parts of Korea than Seoul and Kyŏnggi also suffered worsening living standards in the eighteenth and nineteenth centuries. First, slave price index estimated using slave transactions records found all over Korea fell in terms of rice changed -0.24% per year from 1700-1889. The rate of change in the rate of interest as estimated in the second section, -0.2%, would imply, other things being equal and assuming slave maintenance to be a fixed share of marginal product, real wages growing at the rate of -0.44% (=-0.24%-0.2%). This is a significantly slower pace of change than that in rice wages estimated here (-0.70%), a difference attributable to declining cost of slave monitoring, which occurred as power equilibrium shifted in favor of *yangban* slave owners and against the throne striving to bring more of its subjects under direct control for taxation by enforcing a variety of anti-slavery policies (Cha and Lee(2010)).

Second, in the absence of barriers preventing a wage worker from opting to become a sharecropping peasants or the other way around, wage workers and sharecropping peasants are unlikely to have differed significantly in terms of living standards. Given that peasants earned one half of the output they produced under *pyŏngchak*, the decline in land rents as seen in the second section would imply that peasants tilling a given area of farmland would have suffered real income declining as rapidly as the land rent. Since the area cultivated by a typical peasant household was getting smaller and smaller, peasants' real earnings would have fallen more rapidly than the land rent, which is in line with our estimates of growth rates in the real wages and land rent in the pre-colonial centuries, -0.70% and 0.47%, respectively.[6]

Population Growth in Pre-colonial Korea

Faster decline in the real wage than in the land suggests population growth under way in late dynastic Korea. Consider a constant elasticity of substitution (CES) production function having labor (*N*), capital (*K*), and land (*T*) as inputs. Partially differentiating the production function with respect to land and labor and then setting the outcomes equal to the land rent (*s*) and real wage (*w*) yields equations expressing demand for land and labor, respectively. Dividing the land with labor demand equation gives the following relation:

$$w/s = \delta/(1-\delta)\ (N/T)^{-\rho-1} \qquad (2),$$

where δ refers to a distributional parameter and ρ is related to elasticity of substitution (σ): $\rho+1= 1/\sigma$. Taking logs and differentiating with respect to time converts equation (2) into a relation between growth rates:

$$g_N = \sigma\ (g_s - g_w) + g_T \qquad (3),$$

where g_x denotes the growth rate of variable *x*. Assuming a stable population, where age structure remains constant, population growth equals labor input growth (g_N), which in equation (3) is related to the difference

[6] For evidence of land fragmentation, see Rhee(1988: 94-5, 436-559).

between land rent and real wage growth(g_s - g_w) and land input growth (g_T). Population growth normally causes acreage expansion: in particular, as population grew in late dynastic Korea, de-forestation occurred, and supply of dry field increased (Lee (2010)). Now assume a linear relationship between population growth and land supply:

$$g_T = \eta \cdot g_N \qquad (4),$$

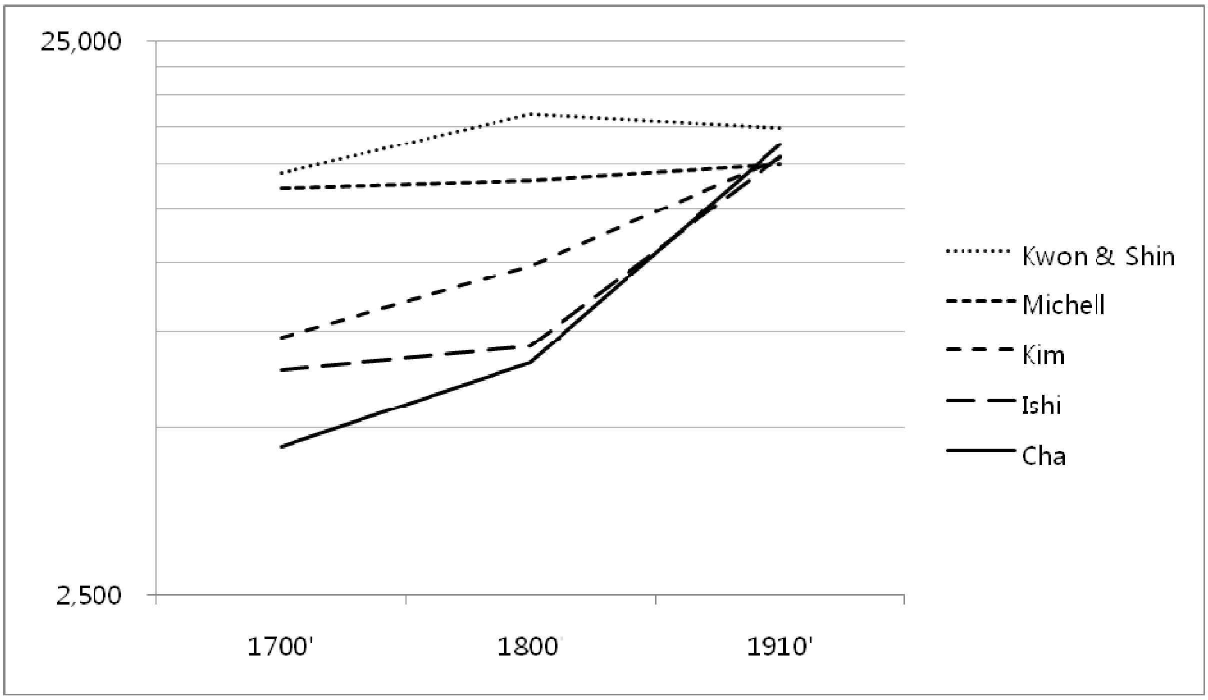
where η is elasticity of land supply with respect to population. Plugging (4) into equation (3) yields:

$$g_N = \sigma/(1- \eta)\,(g_s - g_w) \qquad (5).$$

In England, arable acreage expanded 0.05%, while population grew 0.54% p.a. from 1700-1880, which implies a elasticity of land supply with respect to labor supply (η in equation (5)) as large as 0.10 (=0.05%/0.54%). The English land rent and real wage grew 0.45% and 0.10% per year, respectively, while population grew 0.43% per year from 1540-1799 (Clark(2001: 37); Wrigley, et al. (1997)). Plugging these numbers into equation (5) gives 1.11 -- a number reasonably close to unity -- as the implied elasticity of substitution (σ) in early modern England.

In pre-colonial and colonial Korea, *pyŏngchak* continued to prevail as a typical way how land and labor were combined, and there is no evidence of peasants' share either rising or falling as a matter of trend in the two and half centuries. In particular, the persistence of *pyŏngchak* in the context of rapid population growth in colonial Korea suggests that the Korean elasticity of substitution (σ) was not too different from unity. In colonial Korea, acreage expanded 0.22% as population grew 1.30%, so we set η equal to 0.17(=0.22%/1.30%) in equation (5). Substituting the factor income growth rates obtained in the preceding section, i.e. g_s = -0.47% and g_w = -0.70% and setting σ equal to unity gives 0.28% as the rate of population growth in the eighteenth and nineteenth centuries. This figure may be compared with existing estimates of Korean population growth in eighteenth and nineteenth centuries, which vary widely with Michell(1981/82) and Cha(2009) offering the lowest and highest annual growth rates, 0.05% and 0.62%, respectively. In Figure 6 are presented three other estimates growing at paces in- between the two rates.

Figure 6 Different Estimates of Pre-colonial Population of Korea (persons)



Sources: Kim (1967), Ishi(1972), Kwon and Shin(1977), Michel(1979/80), Cha(2006).
Note: vertical axis is logarithmic.

The five different estimates shown in Figure 6 do not disagree widely on the population total in 1910, which adds up to roughly 16 million persons, because they were derived by projecting the population size as counted by the first modern census in 1925 backwards drawing on different assumptions and methods.[7] The five estimates may be split into two distinct clusters, one comprising Kwon & Shin and Michell (Group A hereafter) and the other including Kim, Ishi, and Cha (Group B), with Group B estimates growing more rapidly than those in Group A. Group B figures also indicate population growth accelerated in the nineteenth century, while, according to Kwon and Shin (1977) in Group A, population growth ground to a halt at around 1800 and contacted in the early nineteenth century. Michell(1981/82)'s estimate also implies population growth accelerating in the nineteenth century (Table 3).

Table 3 Estimates of Annual Population Growth Rate

	Kwon&Shin	Michell	Kim	Ishi	Cha
1700-1910	0.09%	0.05%	0.36%	0.42%	0.62%
1700-1800	0.25%	0.03%	0.30%	0.10%	0.35%
1800-1910	-0.05%	0.06%	0.41%	0.72%	0.83%

Sources: same as Figure 6.

The disagreement on the course of demographic change in pre-colonial Korea arises from whether one

[7] For an assessment of different estimates of pre-1925 population, see Pak(2008)

believes the degree to which the dynastic survey underestimated the true population size to have remained constant or not in the eighteenth and nineteenth centuries. Producers of Group A estimates assumed that the completeness of dynastic censuses neither improved nor worsened significantly in the eighteenth and nineteenth centuries, which led Kwon and Shin(1977) to derive population total by blowing up population figures published by the dynastic government using a multiplier that stays in the neighborhood of 2.5.[8] Similarly, Michell (1981/2: 13) obtained his estimates by multiplying official household total with 7.95, a factor reflecting the assumption that the dynastic surveys were able to take account of only half of existing households, and that when required to register, household heads typically left out 23% of members of households.

This assumption of constant degree of completeness in different dynastic censuses however appears as counterfactual. One big reason for saying so is that the practice of compiling household registers on a regular basis broke down in the nineteenth century, a change that appeared as a symptom of general disintegration of bureaucratic rule after the death of King Chŏngjo in 1800.[9] It therefore appears likely that the gap between the true size of population and the population total as published by the dynastic government was probably larger in the nineteenth than in the eighteenth century. Considering the dynastic enumeration of the nineteenth century population as unacceptably at variance with the true population total, both Kim(1967) and Ishi(1977) chose to infer population trend for late dynastic Korea by linking dynastic head counts in the eighteenth centuries and the population at the beginning of the colonial period. Cha(2009) rather chose to forget about the official number and to estimate fertility and mortality indices using birth and death records of individuals found in genealogies, to arrive at population *growth rates* which are even higher than those proposed by Kim (1967) and Ishi(1977).[10]

The pre-colonial trends in land rents and real wages indicate that population growth in dynastic Korea was probably faster than Group A estimates suggest and closer to the growth rates implied by estimates by Kim(1967) and Ishi(1973) in Group B. The factor price evidence also suggests that population expanded more rapidly in the nineteenth as in the eighteenth century as is implied by existing population estimates except Kwon and Shin (1977): while land rents appeared fall at a roughly constant rate during the eighteenth and nineteenth centuries, real wage decline appeared to accelerate after 1800. Further facts exist to indicate that the nineteenth century was a period of demographic expansion, rather than stagnation. In the nineteenth century, de-forestation was under way fairly rapidly (Lee(2004)). Rhee(1988: 479-82, 541-3) found that in the nineteenth century farmland was being fragmented into ever smaller plots, and that the decline accelerated in the second half of the nineteenth century, the period when real wages fell faster than ever (Figure 4).

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[8] Recall that the first enumeration by Japanese in 1905 found a population total 2.2 times as large as that identified by the dynastic government in 1904.

[9] In the nineteenth century, different consort clans took control of state power one after another, and rent-seeking activities proliferated (Palais (1975: chapter 2)). Under such circumstances, the state grain loan system, initially introduced as a system of famine relief, turned into a device for raising public revenue in the nineteenth century, and the number of working reservoirs diminished rapidly due to lack of oversight and repair, tasks for which local governments were responsible.

[10] Ishi(1977) fit logistic curves on official population figures. [Add explanation on Kim(1967)'s method.]

Productivity Trends in the Eighteenth and Nineteenth Centuries: Korea vs. Britain

From the identity stating that the aggregate output equals sum of factor incomes, one may derive a formula expressing total factor productivity growth as a weighted average of factor income growth using factor shares as weight-share indices (Hieh(2002)). In eighteenth- and nineteenth-century Korea, the land rent, the real wage, and the rate of interest all drifted downwards, revealing that total factor productivity was also on the decline. There is however little evidence on factor shares in late dynastic Korea, which make it difficult to estimate the rate of decline precisely. In this section, I use factor shares inferred from observations made in the colonial period to estimate TFP growth in eighteenth and nineteenth century Korea.

A survey on rice production costs carried out in 1933 indicated that land, labor, and capital costs accounted for 44%, 32%, and 12%, respectively, of gross output, with the remaining 12% attributable to expenditure on intermediate inputs (Ban(1974: 187)). During the first two decades of Japanese rule the Korean agriculture achieved significant improvement, which included the spread of the use of chemical fertilizer and improvement in irrigation facilities. In pre-colonial Korea, chemical fertilizer was virtually unknown, and as a consequence of two centuries long degeneration and neglect, only a limited number of reservoirs and dams were in working condition when the colonial rule began. It would therefore seem plausible to assume that the roles played by capital and intermediates inputs were smaller than the 1933 production survey indicated. Under *pyŏngchak* peasants paid landlords one half of gross output, and retained the other half as a reward for their labor and capital including seeds and tools. Setting land share in total cost equal to 0.5 and adjusting the share of capital and intermediate inputs each downwards from 12% to 7% gives 0.36 as labor share under *pyŏngchak*, which implies 0.54, 0.39, and 0.07 as land, labor, and capital shares in value-added output.

The factor shares together with the factor income growth rates as estimated above implies TFP changing -0.54% (= –0.47%x0.54 – 0.70%x0.39 – 0.20%x0.07) per year in the eighteenth and nineteen centuries. Now consider the following growth accounting equation relating output growth(g_Y) to TFP growth (g_A) and input growth (g_N, g_T, and g_K), which is applicable to constant returns to scale production functions:

$$g_Y = g_A + \alpha \cdot g_N + \beta \cdot g_K + (1-\alpha-\beta) \cdot g_T \qquad (6),$$

where α and β are labor and capital shares. Subtracting g_N from both sides of equation (6) and recalling $g_T = 0.17 \times g_N$ gives an expression for per capita output growth (g_y) :

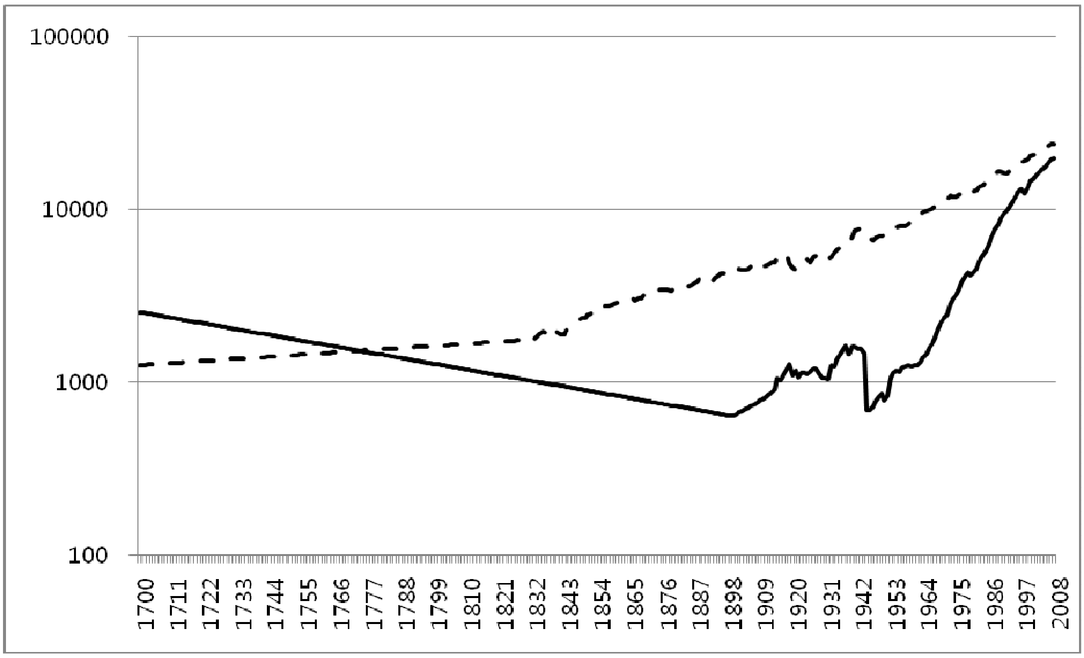
$$g_y = g_A + (0.83 \times \alpha - 0.17 \times \beta - 0.83) \cdot g_N + \beta \cdot g_K \qquad (7).$$

For lack of information, assume $g_K=0$, set g_N equal to the population growth rate as derived in the preceding section (0.28%), and finally plug in the factor shares as estimated above ($\alpha=0.39$ and $\beta=0.07$), which gives -0.69% as per capita output growth (g_y) during the eighteenth and nineteenth centuries. Comparing this with the TFP growth rate as obtained above, -0.54%, indicates that most of the deterioration in pre-colonial living standards was attributable to TFP failure.

Figure 7 shows long run trend in the Korea per capita output growth since 1700, which was obtained by projecting Maddison(2006)'s per capita output series for colonial and South Korea backwards applying the estimated rate of pre-colonial per capita output growth, -0.69%. In doing so, I assumed that the trend reversal occurred in 1900, and that per capita output growth in 1900-1910 was equal to that in colonial Korea (2.3% p.a.), because there is evidence of the downward trends in factor incomes being reversed before the beginning of Japanese rule: land rents appeared to stop falling around 1890, while real wages probably started to improve about a decade later (Rhee (2009); Lee(2001)).

In the same figure is also presented Maddison(2006)'s per capita output series for the United Kingdom, annual figures for pre-1830 years being linear interpolation between Maddison's estimates for two benchmark years, 1700 and 1820. In 1911, per capita output in the United Kingdom ($4706) was about 5.8 times as high as that in Korea ($815). As one goes away from 1911 further towards the past, the gap becomes narrower, and eventually in the early eighteenth century relative income levels are reversed. It appears that divergence in living standards between Britain and Korea preceded the Industrial Revolution, and that the income gap found between the two countries in 1800 was attributable more to the Korean decline than to the British advance, while the opposite was true one century later.

Figure 7 Trend in Per Capita Output in Britain and Korea, 1700-2007 (1990 Geary-Khamis International Dollars)



Sources: Maddison(2006) and see text.

Note: vertical axis is logarithmic; ;solid and broken lines refer to Korea and Britain, respectively; per capita output after 1945 refers to South Korea.

Living standards in the two countries shifted in opposite directions in the eighteenth and nineteenth centuries, largely because total factor productivity trended downwards in Korea and upwards in Britain

(Clark(2007: 240); Antràs and Voth(2003)). To see how comparative productivity levels shifted in the eighteenth and nineteenth centuries, one may start by determining productivity gap in 1910 and then project backwards using productivity growth rates as implied by factor price evidence.

To determine the efficiency gap in 1910, consider an equation relating per capita output (y) to total factor productivity (A), capital/output ratio (K/Y), and land/labor ratio (T/N), which was derived from a Cobb-Douglas production function using labor, capital, and land as productive inputs:

$$y = A^{1/(1-\beta)} (K/Y)^{\beta/(1-\beta)} (T/N)^{(1-\alpha-\beta)/(1-\beta)} \quad (8),$$

where α and β represent labor and capital shares, respectively.[11] Arrange equation (8) with respect to total factor productivity to arrive at the following relation:

$$A = y^{(1-\beta)} (K/Y)^{-\beta} (T/N)^{(\alpha+\beta-1)} \quad (9).$$

Plugging observations on per capita output (*y*), capital/output ratio (*K/T*), and land/labor ratio (*T/N*) made in equivalent units into equation (9) yields comparative levels of total factor productivity (*A*) in Britain and Korea. For *y*, we use per capita output in 1990 international dollars for the United Kingdom as made available by Maddison(2006). Second, capital output ratio for Britain is provided by Feinstein, Matthews, and Odling-Smee (1982), and estimates of capital stock and output were taken from Cha and Kim (2006). Third, to calculate *T/N*, we use the number of persons aged from 15-64 and cultivated acreage expressed in acre, respectively. Finally, averages of factors shares in Britain and Korea were used, which are $\alpha = 0.61$ and $\beta = 0.12$.

Table 4 Per Capita Output, Capital/Output Ratio, and Land/Labor Ratio in Britain and Korea circa 1910

	Britain	Korea
Per Capita Output	4706	815
Capital/Output Ratio	3.3	0.5
Land/Labor Ratio	0.43	0.63

Notes: Per capita output and land/labor ratios are in 1990 international dollars and arable acre per person, respectively.

Sources: Maddison(2006); Feinstein, Matthews, and Odling-Smee (1982); Cha and Kim (2006)

The values of per capita output, capital/output ratio, and land/labor ratio as observed around 1910 in England and Korea are presented in Table 4, which imply that the British economy was 6.5 times as efficient as the Korean economy in 1910.

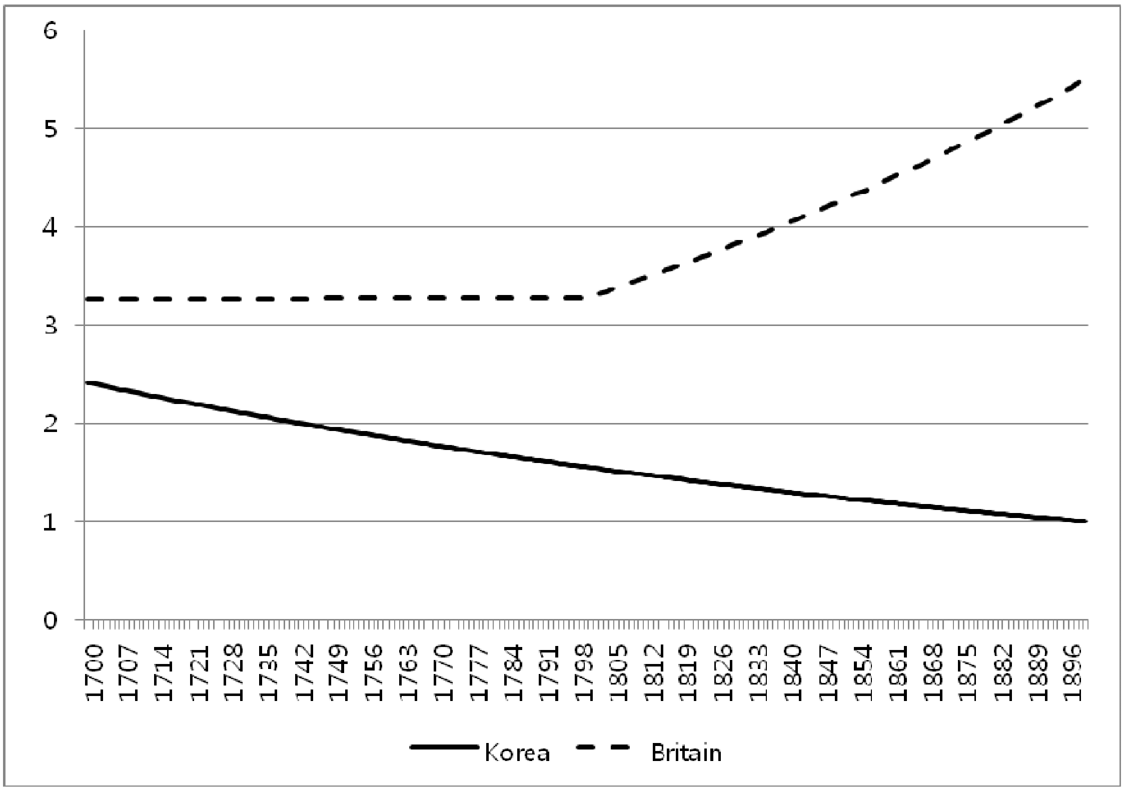
[11] To obtain equation (8), first divide the Cobb-Douglas production with N and K to derive expressions for per capita output (*Y/N*) and output/capital ratio (*Y/K*). Gather the terms on the right-hand side of the per capita output equation, so that it simplifies into an expression in terms of *A*, *N/T*, and *K/T*. Finally, transpose the output/capital ratio equation into a relation with respect to *K/T* to plug it into the per capita output equation.

To check the plausibility of the productivity relative estimate, I infer TFP gap in 1910 from that half a century later: Christensen, Cummings, and Jorgenson (1981) estimated TFP in South Korea and the U.K. relative to the U.S. in 1960 as being equal to 0.24 and 0.70, respectively, implying that the U.K economy was almost three times as efficient as the South Korean economy. According to Feinstein, Matthews, and Odling-Smee (1982), British TFP growth adjusted for quality change in inputs was 0.1% p.a. from 1913-37. TFP growth in Korea from 1911-40 as estimated without taking quality change in factor inputs into account was as high as 1.3%, while the dual approach yielded a slower rate of productivity improvement, 1.0% (Cha and Kim (2006)). Since factor prices reveal shifting quality of productive inputs, the dual estimate would seem better comparable to the British TFP growth estimate by Feinstein, Matthews, and Odling-Smee (1982). Assuming that TFP grew 0.1% and 1.0% per year from 1910-60 in Britain and Korea, respectively, and applying these growth rates to the relatively productivity levels in 1960 for backward projection indicates that the British TFP level in 1910 was 4.6 times as high as that in Korea.

One certainly cannot put much faith in this relative, 4.6, because the TFP growth during WWII and postwar decades was set equal to that in the interwar period, which in turn was estimated following different procedures. Nevertheless, there is a reason to suspect that the TFP gap obtained using figures in Table 4 is an overestimate, which refers to the larger human capital stock in Britain than in Korea in 1910.[12] Therefore, I assume that the ratio of British to Korean TFP in 1910 was 5.5, an average of the two estimates of productivity gap.

Figure 5 Comparative Total Productivity Levels in Britain and Korea (Korea in 1900=1)

[12] In 1910, primary school enrollment in Britain and Korea was 4% and 70%, respectively. [Add source]



Source: see text.

Figure 5 shows productivity trends in Britain and Korea in the eighteenth and nineteenth centuries obtained by projecting the TFP gap in 1910, 5.5, backwards using productivity growth implied by growth of factor prices. Late dynastic Korea being a predominantly agrarian economy, the TFP decline as seen in Figure 5 would reflect worsening efficiency of the Korean agriculture. Likewise, the sustained, albeit barely visible in the figure, improvement in the British TFP in the eighteenth century is an indication of the "agricultural revolution," while productivity growth accelerated in the nineteenth century as the agricultural development was combined with faster technological progress in modernized sectors of the British manufacturing (O'Grada; Clark; Craft and Harley). Overall, the widening gap between the British and Korean TFP in the eighteenth and nineteenth centuries had much to do with the efficiency of agriculture shifting in opposite directions.

It seems nonsensical to say that the declining TFP in dynastic Korea indicates an increasingly larger portion of Korean peasants opting for inferior techniques of agricultural production in the eighteenth and nineteenth centuries. And agricultural historians have found it difficult to pinpoint a particular set of farming methods to explain the improvement of agricultural productivity in Britain (Allen(2010); Clark(2009)). Rather than being an indicator of the quality of agricultural technology, available evidence on wages, crop yields, and land use in different parts of pre-industrial Asia and Europe suggest that the TFP as implied by factor prices is likely to be an indicator of soil fertility. For instance, when population pressure resulted in contraction of pasture and woodland and consequent reduction in manure supply in the thirteenth century, English peasants suffered falling real wages and crop yields, which would lead one to conclude total productivity productivity deteriorated in thirteenth-century England (Postan(1966 & 1972)). Similarly, seventeenth-century Spain suffered stagnant crop yields and falling real wages, as area of cultivated land expanded, pasture contracted, causing shortage of animals (Allen(2009); Anes(1994: 63-64)).[13] Third, peasants found it necessary to use an increasingly larger amount of fertilizer to prevent crop yields from falling, while the real wage and land rent appeared to follow downward trends in late Q'ing China as in late Chosŏn Korea.[14] In eighteenth- and nineteenth-century China, land was used almost without interruption mostly for growing grains, and de-forestation was under way, reducing the availability of green manure and raising the possibility of flooding and topsoil erosion.[15] Finally, in contrast to these instances, both labor and land productivity improved – implying rising TFP -- in eighteenth-century Japan, which managed to avoid de-forestation and remain as a "Green Archipelago." (Nishikawa(1985: 33); Totman(1989)).

Although we have little direct evidence indicating that soil fertility was being depleted in late dynastic Korea, the country resembled Q'ing China far more than Tokugawa Japan: not only could it be described as a "crops-only" economy, but also wooded area was being rapidly diminished in pre-colonial Korea (Lee (2000)). And different studies on the causes of agricultural development in colonial Korea invariably point to increased use of fertilizer as the most important single cause driving output expansion, to the extent that when fertilizer input is included in growth accounting, one obtains negative TFP growth in colonial Korea (Ban(1974); Kang and Ramachandran(1999): Woo).

Why did then the peasants and landlords of pre-colonial Korea fail to apply a sufficient amount of fertilizer each year and to let farmland to fallow long enough for soil fertility to be maintained? An idea gap clearly is not an answer: not only were Korean peasants well aware of the need to maintain soil fertility by letting land lie fallow or by applying green manure and animal and human waste hardened by wood ash, but also they practiced catch cropping (*kanchak*, 間作) soybean to take advantage of its ability to fix nitrogen (Park(1997); Kato). Instead, there seem to be two possible answers worth considering, which are insecure tenancy rights and high interest rate.

Tenants are unlikely to make efforts to improve soil unless they can be assured of reaping fully future flow

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13 Inference based on wage and yield/seed ratio to be added.

14 Li(1998) . Allen, et al (2007) found that Chinese real wages were on the decline in the eighteenth and nineteenth centuries. Standardizing money wage figures available from Chao (1986: 219-20) with Yangzi rice price from Wang(1992), I regressed the real wages thus obtained on decade and macroregion dummies to obtain a significant and negative time trend over the eighteenth and nineteenth centuries. Kishimoto (1997) suggested that real wage were on the decline in the eighteenth century. Standardizing the paddy land prices as presented in Chao (1986: 130) with Wang(1992)'s rice prices indicates that real paddy land prices in China stagnated in the eighteenth century and then declined in the following century. Homer and Sylla (1996:. 614) suggests that the interest rate was on the decline in the eighteenth and nineteenth centuries in China, which would imply falling rent from an acre of paddy land in the eighteenth and nineteenth centuries. Drawing on a variety of sources, Chao (1986: 212. 214) concluded that "rice yields increased before the eighteenth century and either declined slightly or stagnated thereafter," and that wheat yields fell during the eighteenth and for most of the nineteenth centuries.

15 On de-forestation, see Mark, Pomeranz.

of returns on their investment in soil quality. Apparently, peasants in late dynastic Korea did not enjoy tenancy rights as stable as in early modern England: they were not protected by formal contracts from landowners' attempt to terminate tenancy at will. However, an investigation made by Japanese authorities at the beginning of the colonial period concluded that although Korean peasants and landlords rarely signed legally binding agreement specifying the terms of sharecropping, neither was it common that tenants were arbitrarily kicked out of land (*chosen no kosaku kanko*). Second, had insecure tenancy been an important cause to explain soil depletion, real land prices would have been falling faster in provinces, where land tenancy ratio was higher, a correlation which could not be confirmed for pre-colonial Korea. Finally, soil exhaustion being unprofitable not only for tenants but also for landlords, an alternative institutional arrangement would have emerged, had insecure tenancy contract been the root cause of the problem.

Characterizing soil fertility as a capital stock and fertilization as an act of investment, Clark(1992) drew attention to the decline in the interest rate in early modern England as a key factor encouraging peasants and landlords to enlarge nitrogen stock by allocating a larger portion of land to pasture. In particular, he estimated that it become profitable to devote all land to growing grains, when the rate of interest is rises above 7%. According to Clark(1992: 76), the relatively risk-free rates of return, including rent charges and return on holding land, in England was about 10% before the Black Death, but fell to 5-6% in 1400-1650 and then to 4% in 1750. As a consequence non-arable land came to play a more prominent part in early modern than in medieval England, making it a "mixed economy," which is less prone to soil exhaustion than a "crops-only" economy.

In Figure 2, we saw that the rate of interest implied by land rents and prices in late dynastic Korea remained way above 7%, the threshold level. The rate of return as inferred from seasonal fluctuation of rice prices in pre-colonial Korea was over 70%, and the rate of interest charged by a clan fund in Yechon hovered around 50% per year.[16] High time preference of Korean peasants and landlords therefore appears as capable of explaining why a "crops-only" economy prevailed, and as a result soil exhaustion occurred in pre-colonial Korea.

Relatively high interest rates prevailed in other countries where soil fertility was being depleted. Although information on the rate of interest comparable to such risk-free rates as available for Britain or Korea is difficult to obtain, the interest rate in Spain appeared to rise in the seventeenth century after falling from the medieval high: according to Homer and Sylla (1996: 130, 141), "In 1673 an interest rate of 40% was paid by the Spanish Crown for short-term floating debt," and "Minimum commercial rates rose sharply in the late sixteenth century" in Italy.[17] The rate of interest as estimated by Shiue(2002) using monthly grain prices was 7%, while a similar calculation by Pomeranz (1993: 34-5)) for northern China yielded a rate of return ranging from 6% to 24% in the early twentieth century. Only in Japan, did the rate of interest remain as low as in early modern England:

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[16] Van Zanden on the Indonesian interest rate to be added.

[17] "The astonishing feature of this series [i.e. Genoa interest rate] is the lowness of the discount rates in the late sixteenth and early seventeenth century (120)." "In the seventeenth century, low rates developed in England and Holland, while the markets formerly dominated by Italians, including that of Antwerp, were disorganized following the disasters to their chief debtor, the Spanish Crown." Add Cipolla.

the rates of interest charged by money exchangers, which probably included a substantial risk premium, in the eighteenth and early nineteenth century were well below 5% (Shimbo(1978: 234)). [The rate of interest implied by monthly grain prices from Miyamoto – to be added]

Conclusions

From factor price evidence, I inferred population, per capita output, and productivity growth in Korea from 1700-1900. Real wages fell more rapidly than land rents, and the gap between the rates of change in the two factor incomes indicated that population grew significantly more rapidly than dynastic census results would lead one to believe. Simultaneous decline in the two key factor incomes in dynastic Korea implies worsening total factor productivity, which appeared to be a sign of soil exhaustion. Soil fertility was gradually being drained, because peasants and landlords devoted an unsustainably large part of land to crop cultivation, leaving only a small portion for pasture and woodland. This pattern of land utilization revealed that peasants and landlords were not prepared to make sufficient amount of investment required to maintain a given level of soil fertility. It appears therefore incongruous to characterize late dynastic Korea as a place benefiting from Smithian growth: as markets developed after the conclusion of wars with Japan and China, efficiency gains through increasing degree of specialization may have occurred, but if they did, they appeared to have been outweighed by soil degradation and de-forestation. Neither does "involution" appear as an accurate description of what was happening in Korea, for increasing amount of labor input per acre of farmland did not lead to rising land productivity.

Limited evidence accumulated so far suggests that late Q'ing China followed a similar path of degeneration, while British and Japanese could avoid soil exhaustion and achieve moderate improvement in the eighteenth century by keeping relatively large areas under grass or as woodland. The disparity appeared as a consequence of difference in time preference as revealed by a substantial gap in the rate of interest prevailing in these countries.

Peasants with higher time preference would be more interested in enjoying leisure now, while those with greater patience would be more willing to work and save for present and future consumption.[18] Indeed, peasants in Japan and northwestern Europe adopted new "industrious" behavior in the eighteenth century, while evidence of rising work intensity has yet to be found for China and Korea (de Vries (2008); Hayami(1986)). Far from becoming ever more diligent, according to different observers of rural Korea, peasants in pre-colonial Korea were characterized by lethargy. Bishop(1897), a British traveler, found that Korean peasants used very little fertilizer at the end of the nineteenth century and were normally reluctant to exert themselves beyond producing what they would need for survival. Observing soil fertility on the decline one century earlier, U Hayŏng, a *yangban* intellectual who spent most of his unemployed life in the countryside, found the root cause of the deterioration in the failure of peasants diligently to collect ash, grass, and human waste. After returning

[18] Partially differentiating the steady state level of work effort in the Ramsey model as modified by Barro and Sala-i-Martin (2004: 426, equation (9.78)) to include leisure as an additional argument in the utility function with respect to time preference yields an expression with a negative value.

from his travel to northern China as a member of diplomatic corps in 1778, Pak Chega observed that Korean roads are littered with animal waste which would have been painstakingly gathered in China for use as manure or fuel.[19] The contrast with Tokugawa Japan could not be greater, where markets for human waste emerged, and peasants managed to improve agricultural productivity largely by working harder to increase fertilizer output (Nishikawa (1985: 35)).

Q'ing China and late Chosŏn Korea registered higher levels of fertility than early modern England and Tokugawa Japan, a disparity which is also consistent with the difference in time preference between the two sets of countries.[20] Peasants with lower time preference would be more concerned about the consequences of having a greater number of children, i.e. a smaller amount of resources available for each of their children, and hence would be likely to multiply at a slower rate. For peasants with higher time preference, this worry would be outweighed by the immediate pleasure of having a larger family, which would result in higher fertility.

Why did then peasants in pre-colonial Korea discount the future more than British or Japanese counterparts? Macfarlane(1997) pointed out that Britain and Japan, being islands, enjoyed longer periods of peace and were better protected from transmission of diseases than countries on the continents. [To be completed.]

Measures in Pre-colonial Korea

One *sŏk* = 90 liters

One *sŏk* (石) = 0.5 Japanese *sŏk*

One *chŏnsŏk* (田石) = 20 *tu* (斗)

One *pyŏngsŏk* (平石) = 15 *tu* (斗)

One *tu* (斗) = 10 *sŭng* (升)

One *nyang* (兩) = 10 *chŏn* (錢) = 100 *mun* (文)

[19] Add further evidence: Kato, Lee Chun'nyong.

[20] For the evidence of fertility difference, see Cha (2006). Barro and Sala-i-Martin (2004: chapter 9).

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Chosen sotokufu. Chosen no kosaku kanko.

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