An Initial Look at China's Industrialization in light of the Lewis Growth Model

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Abstract

This paper examines China's development experience in light of the Lewis growth model. It first peruses Lewis' own writings and those of Fei and Ranis in order to identify the main predictions of the Lewis model. The paper next considers the problems that arise in checking the validity of these predictions in general and in the particular case of China. Finally the paper examines actual Chinese data. In particular, it examines whether Chinese wage data conform to the Lewis prediction regarding the long-term shape of the wage curve. Overall the findings tend to support the predictions of the Lewis model, though there remain many issues that need to be further investigated.

JEL Classification: O, P
Keywords: Lewis model; China; Development; Duality; Wage curve

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1. Introduction

This paper examines China's development experience in the light of Lewis's growth model. It first peruses Lewis's own writings and those of Fei and Ranis in order to identify the main predictions of the Lewis's model. It considers both the closed economy and the open economy versions of the model. The perusal indicates that the main prediction of the model remains the one derived from the basic closed economy version that suggests that the modern sector wage curve should remain fairly flat for quite some time before reaching a turning point and starting to rise. The wage curve for the traditional sector meanwhile can witness an upward increase from an earlier point of time even through remaining below the modern sector wage in terms of absolute level.

Testing these predictions however pose considerable challenges, as recognized by Lewis himself and other researchers. These problems are even more serious with respect to China because of it several specific institutional characteristics, such as the practice and legacy of central planning, restrictions on urban-rural migration, changes in the jurisdiction of urban and rural counties, establishment of modern industrial enterprises in rural areas in the form of Township and Village Enterprises (TVE), etc. All these special aspects of the Chinese situation add to the list of complications that arise in examining reality through the prism of the Lewis model.

The paper examines a wide variety of Chinese data, focusing on the data on wages. It offers graphical presentation of the relevant wage curves and provides accompanying computational results based on Fei and Ranis's decomposition of the growth rate of the modern sector in terms of capital growth rate, direction of technological bias, and growth rate of the total factor productivity. The paper begins by examining the national data disaggregated by three broad sectors, namely primary, secondary, and tertiary. It next moves to consider data from two different types of provinces, with one being a fast growing coastal one (namely Shanghai) and the other being a slow growing inland province (namely, Gansu). Overall the data tend to support the predictions of the Lewis model. The modern sector wage curves do tend to be flat or very slow rising for a long period of time before turning points are reached. In that sense Chinese development experience does vindicate the validity of the Lewis model as a description of the reality.

However, many conceptual and data issues remain to be overcome before firmer conclusions can be reached.

The discussion of this paper is organized as follows. Section 2 offers a brief recapitulation of the salient features of Lewis model in order to set the background for the discussion of this paper. Section 3 offers as perusal of Lewis's own writings to determine the predictions of his model. Section 4 extends the perusal to the writings of Fei and Ranis, who have played the most active role in amplifying on and using the Lewis model. Section 5 discusses the problems faced in confronting reality with Lewis's model in general and in particular with respect to China. Section 6 presents the empirical analysis and the results. Section 7 concludes.

2. Lewis Model of Growth: A brief recapitulation

Exactly half a century ago, in May 1954, Arthur Lewis published his article, "Development with Unlimited Supply of Labor" in the journal *Manchester School*. This article and his subsequent writings gave rise to the famous "Lewis Growth/Development Model," the hallmark of which is the assumption of a dual structure of the economy.[1] Various terminologies have been used to express this dualism. Among them are urban-rural, capitalist-non capitalist, modern-traditional, agricultural-industrial, etc. Lewis himself started with "capitalist-non capitalist" characterization of this duality, but later recognized the possibility of other characterizations. As Lewis (1972) explains, the difference between the two sectors is analytical, and not descriptive. The first analytical difference between the two sectors lies in the fact (assumption) that same type of labor has much higher (labor) productivity in one (say modern) sector than in the other (say traditional) sector. Thus shift of labor from the traditional sector to the modern sector can therefore augment the total output of the economy. The second analytical difference between the two sectors lies in the fact (assumption) that the traditional sector is characterized by the presence of 'surplus labor,' in the sense that withdrawal of this labor does not lead to a reduction in the total output of the traditional sector. This has two important implications. First, under this condition the *entire* output produced in the

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[1] See Lewis (1954 and 1955) for original exposition of the model.

modern sector by a unit of labor transferred from the traditional sector is an addition to the economy aggregate output, and not just the *difference* between a laborer's output in the modern sector and the output lost in the traditional sector as a result of his or her transfer from the latter to the former. Second, the opportunity cost of labor to be engaged in the modern sector in terms of foregone output in the traditional sector remains constant (and negligible), so that it does not have to offer higher wages to engage more labor. In short, the modern sector faces an *almost perfectly elastic supply of labor* at the going wage rate. The combination of the above assumptions imply that the economy will witness a much larger surplus accumulated in the hands of the entrepreneurs of the modern sector, and assuming that they invest at least a constant proportion of the surplus, the economy will witness higher rate of investment and hence of growth.

Since the appearance of Lewis growth model based on the assumptions above, many debates have been waged concerning the meaning and validity of these assumptions. The recent symposium organized by the journal *Manchester School* to celebrate the 50 years of Lewis 1954 article provides a good recent overview of where these debates stand and what their impacts have been.[2] In this paper however we are not concerned about these debates. We want to accept the model as it is, and find out whether and how these can help in understanding the Chinese experience of industrialization. In a sense, China should have been the obvious case to check out the Lewis model of growth. Interestingly, though some work in this connection has focused on Taiwan, not much research had been done on China.[3]

3. Predictions of the Lewis model

There are different approaches to take. One would be to think of examining directly the assumptions of the model. However, as Milton Friedman is famously contends, it does not matter whether or not the assumptions are realistic. The important thing is whether the predictions of the model prove to be correct. No matter whether or not we

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[2] See in particular, Kirkpatrick and Barrientos (2004), Fields (2004), Figueroa (2004), Ranis (2004), and Tignor (2004).
[3] Among few papers that The only paper that we could find that related the Lewis model with China is by Yingfeng Xu (1994) appearing in China Economic Review. This paper titled, "Trade Liberalization in China: A CGE Model with Lewis Rural Surplus Labor."

agree with Friedman's epistemological position, in confronting Chinese industrialization experience with Lewis model, we can indeed focus on the predictions rather than on the assumptions directly. This brings us to the questions of the predictions of the Lewis model.

Lewis (1972) explains more explicitly that there are three different variants of the model. In Model One the economy is closed and there is no trade between the two sectors. In this model the first turning point is reached when "the labor supply ceases to be infinitely elastic and the wage starts rising through pressure from the non-capitalist sector." (p. 83) He also identifies a second turning point, which is reached when "the marginal product is the same in the capitalist and non-capitalist sectors, so that we have reached the neo-classical one-sector economy." (p. 83)[4]

Model Two continues with the closed economy scenario, but now assumes that the two sectors produce different goods and hence trade with each other.[5] This brings into the analysis the additional issue of terms of trade between the two sectors, and it now creates the possibility that growth in the modern sector can get choked because of adverse shift in the terms of trade even when the pool of surplus labor has not been exhausted.[6] This will happen particularly if the productivity growth in the agricultural sector lags much behind that in the industry sector.[7] However, even if the terms of trade rise (deteriorates) for the industry, its expansion may not cease if the productivity growth in this sector

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[4] In a footnote, Lewis notes that "The second turning point is exactly the same as in Fei and Ranis (1964, p. 201-5). The definition of the first turning point is also the same, but the mechanism for reaching it is different, since Fei and Ranis are working with Model-II, in which the capitalist sector depends on the non-capitalist sector for agricultural products." (Lewis 1972, p. 83)

[5] In explaining the set up, Lewis further notes that "Thus our specifications are altered. The division between the two sectors now turns on commodities rather than on capitalists; it makes no difference to us whether there are capitalists in the slow-growing sector, provided we specify that their profits are not reinvested in the fast-growing sector. What we still need is a substantial initial difference between real wages in the two sectors, so that labor is not initially a problem to the fast-growing sector. Following the conventions, we will now divide the economy into an industrial and an agricultural sector, with industry paying significantly higher wages than agriculture." (Lewis 1972, p. 92)

[6] As Lewis explains, "In this version our two sectors produce different commodities and therefore trade with each other. Thus the capitalist sector faces the additional hazard that it may be checked by adverse terms of trade, arising out of the pressure of its own demands, long before any shortage of labor begins to be felt." (Lewis 1972, p. 91) He further notes that "This is the version, which has been worked out in great detail by Fei and Ranis working with models in which each of the variables is or can be precisely determined. Jorgenson and others also prefer to work with this model." (p. 91)

[7] Following Johnson's trade model, Lewis shows that the terms of trade between the two sectors will remain constant if the relative growth rates of industry and agriculture are the same as the relative income elasticity of demand for product of these two sectors. (p. 93)

outpaces the rate of deterioration in the terms of trade.[8] The concrete outcome will then depend on the concrete paces of productivity increase in the two sectors and the resulting concrete impact on the terms of trade and movement of the real wage.[9]

Model Three allows international trade (an open economy situation) so that a rapidly growing industrial sector faced by a too slow agricultural sector can import agricultural products and pay for the imports by exporting its own product. However, Lewis notes that in order to export more, the producers may have to lower the prices thus causing a dent in the profit margin. Thus the prospects and propensity of export becomes a crucial determinant in this scenario.[10] He surmises that "a country must plan its development in such a way as to be sure that its exports will keep pace with needed imports. If it fails to do this, the rate of growth of output will be constrained by the rate of growth of export earnings." (p. 94) The above shows that Model Two and Model Three basically add some qualifications to the basic predictions arising from Model One.

In this discussion of the open economy scenario, Lewis (1972) focuses on the terms of trade issue. However in the original paper's discussion of the open economy scenario, Lewis (1954) focuses on possible factor movements. Thus Lewis notes that reaching of the turning point and rise of the wage may be checked by mass immigration and export of capital.[11] The checking influence of export of capital can be offset "if the capital export cheapens the things which workers import, or raises the wage costs in competing countries. But it is aggravated if the capital export raises the cost of imports or reduces costs in competing countries. So Lewis points to a connection between factor flows and terms of trade that a country faces. Lewis (1954) noted the possibility of import of capital

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[8] As Lewis (1972, p. 93) explains, "even if the terms of trade are rising, industrial expansion will not necessarily cease. Productivity is rising in the industrial sector, so if real wages (w/c) are constant, the profit margin will not fall unless the terms of trade rise faster than industrial productivity."

[9] As Lewis (1972, p. 93) explains, "Real wages cannot be constant if agricultural productivity is rising significantly, since this would be moving the factoral terms of trade against industry. So what will happen to profits in any particular case will depend on a race between agricultural productivity, industrial productivity, real wages (which may rise on their own for exogenous reasons), and the commodity terms of trade. If one makes precise assumptions about these magnitudes one can get precise answers, as Fei and Ranis have done."

[10] The following is how Lewis (1972, p. 94) argues: "However, in order to export more it may have to lower its prices, thus squeezing its profits. Its real wages, in terms of agricultural products, are fixed by definition. If we take as given the propensity to import and the inflexibility of the agricultural sector, we can see that the possible rate of growth of such an economy is determined by its propensity to export."

[11] As Lewis (1954, p. 190) puts it, "The country is still surrounded by other countries which have surplus labor. Accordingly, as soon as its wages begin to rise, mass immigration and the export of capital operate to check the rise."

too. He notes that capital inflow will not generally raise wages as long as surplus labor exists. (p. 191)[12]

4. Extension of Lewis model's predictions by Fei and Ranis

Fie and Ranis (henceforth FR) have played an important role in expanding and extending the Lewis model. As noted above, they impose a "product dualism" on the original Lewis dualistic model in order to introduce in the model the issue of terms of trade. It also makes the model more amenable to the influence of international trade opportunities. According to the "product dualism" the products produced by the two sectors are different. Extending Lewis' idea, FR identifies or proposes four turning points. These are: (a) commercialization point, (b) reversal point, (c) export substitution point, and (d) switching point. (p. 290)

The Commercialization point is basically the same as the first Turning Point mentioned by Lewis above, though FR amplifies on further properties of this point in the context of an open dualistic model.[13] The "reversal point," according to FR, is the pointy at which the traditional sector (which FR equates with agricultural sector) starts to

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[12] "The importation of foreign capital does not raise real wages in countries which have surplus labor, unless the capital results in increased productivity in the commodities which they produce for their own consumption." (Lewis 1954, p. 191)

[13] RF explain that commercialization "indicates the end of the surplus labor condition. From this point on, the real wage in agriculture equals the marginal product of labor, which signifies that labor is now a scarce factor and the wage increases rapidly." (p. 290) RF further explain that the definition of this point remain unchanged for the open economy. As they put it, "this concept (of commercialization point – ni) is also applicable to the open dualistic economy." (p. 290) However they add that "in the open economy case, the arrival of the commercialization point is found in combination with the 'push' effects of technological change in agriculture and the 'pull' of industrial labor demand, both augmented by the access to the international economy." (p. 290) They further note that "the open economy commercialization point at which the MP_L exceeds the IRW at W_a arrives earlier the faster the upward shift of the MP_L, the slower the rate of population growth, the slower the upward creep in the institutional real wage, and the faster the demand for labor increases in the industrial sector." (p. 290) According to them, "the open economy commercialization point is the end of the natural austerity typical of the unlimited supply of labor condition. After the commercialization point the savings rate and the GDP growth rate level off. Furthermore, in an open dualistic labor surplus economy the commercialization point is also likely to change the structure of international trade. The external orientation of the industrial sector – previously based on entrepreneurs taking advantage of cheap labor – gives way to the incorporation of skills and capital goods as the basis of exports. Simultaneously the orientation of the industrial sector shifts to satisfy the growing domestic market for industrial consumer goods." (p. 290)

witness absolute decline in its labor force.[14] The next point according to RF is the "export substitution point." According to their set up, industrialization of the dualistic economy begins with import substitution, and after a while the country progresses to the "export substitution" stage.[15] Finally there is the "switching point," when, according to RF, the country becomes a net importer of agricultural goods.[16]

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[14] "The second turning point is the reversal point signifying an absolute decline in the agricultural labor force." (p. 292) "The analysis of chapters 3 and 7 … shows that when the growth of the industrial labor force (η_W) is sustained long enough at a level above the growth rate of the total labor force (η_P), not only does θ = W/P increase continuously, but a reversal point is reached when the absolute increase of the agricultural labor force gives way to an absolute decline." (pp. 292-293) They further explain that "when the supply of land is fixed, the arrival of the reversal point signifies that the law of diminishing returns is beginning to work in the reverse direction, as the marginal and average productivities of labor in both sectors increase even when technological change is stagnant. This implies that pressure exists to adopt labor-saving technology in agriculture since there is a 'shortage' of manpower under the original technology" (p. 293)

[15] "The third turning point in an international context is the export substitution point… During the long period of growth prior to transition growth, the economy is land based and fueled by primary product exports. During the import substitution phase which characterizes the initial period of transition growth, the open economy relies on agricultural land-based exports to build up and sustain its import substitution industries. The import substitution strategy usually adopted by the government (high tariff protection for domestic market by the official exchange rate, artificially low domestic interest rate, etc.) encourages the use of foreign earned by traditional exports to develop and subsidize import substitution industries. Export substitution occurs when labor intensive manufacturing replaces traditional exports as the dominant export items of the economy." (p. 294)

"When the domestic markets for industrial consumer goods are supplied almost exclusively by import substituting industries, the import substitution phase comes to an end. In the case of a small labor surplus economy, the natural development is the emergence of an export substitution phase – selling labor-intensive manufacturing exports to the world market. This transition is facilitated by changes in government policy to promote (for example realistic exchange rates) base on labor efficiency." (pp. 294-295)

"The emergence of the export substitution phase replacing the import substitution phase is a highly important phenomenon for the labor surplus economy analyzed here. While the import substitution phase was not conducive to full employment – leading to the 'necessary' conflict between employment and growth – there is no such conflict when the export substitution phase arrives since labor is embodied in exports, which is conducive to both rapid growth and full employment. As this process advances, it leads to the 'commercialization' and 'switching' points, signifying the termination of the labor surplus condition in the economy as a whole, as well as in the agricultural sector in particular." (p. 295)

[16] The final transition point in the transition of the open dualistic economy is the switching point. It is based on the notion that countries at some time become net importers of agricultural goods. In general, the phenomenon of land-based exports at the beginning of the transition to the modern industrial economy is a temporary phenomenon. A 'switch' from an agricultural exporting to an agricultural importing economy is bound to occur at some stage of the successful development process. But when it occurs, and on the basis of what kind of agricultural performance, remains an all important issue. It matters greatly whether or not existing reserves of agricultural productivity have been harnessed en route to successful balanced transition growth in the LDC. The alternative is a failure of the total development effort – true for many contemporary LDCs – or an unacceptable reliance on foreign capital." (pp. 296-7)

"The array of government policy measures (for example, tariffs, exchange controls, etc.) adopted to facilitate the import substitution process via the exclusion of foreign competition and the augmentation of profits to the domestic industrialists are subject to change. Stabilization plus dismantling direct controls on trade and exchange rates creates a more market oriented economy conducive to the utilization of the

Many of these additional turning points, particular the latter two, appear to be particularistic, depending on the further assumptions that RF makes onto the basic Lewis dualistic model, and hence may not be considered to be that general. (Further scrutiny is necessary in order to clarify this point.) However this discussion already shows that it is possible to draw more conclusions/predictions from the Lewis model once openness is incorporated more fully into the model. This may however require assumptions that may go beyond what the original model calls for.

As noted earlier, trade in goods and services is however not the only type of flows that openness introduces to a closed economy. Other important flows are of capital, technology, and even labor. FR provides a perceptive discussion of how these other flow can affect the development process of a dualistic economy. (pp. 306-319) They think that availability of foreign capital can have both quantitative as well as qualitative effects. The quantitative effect refers mainly to the increase in the *amount of capital* that becomes available to the developing dualistic economy, and this may quicken the process of capital accumulation, absorption of the surplus labor, and thereby shortening the time required for the economy to reach the Turning Point. Their discussion of the qualitative effect of capital inflow is not as clear. It refers to the possibility that opens up for the country to import capital intensive capital goods and thus to be free to engage its own capital to produce labor intensive goods. However, this aspect referring to the physical attribute of goods seems rather belong to the issue of trade and not capital inflow per se. In this regard FR also point out that the beneficial impact of capital inflow may get obviated by wrong policies pursued by the receiving country, as exemplified by India which followed a capital-intensive industrialization policy and thus failed to make use of its labor abundance. However, this point again was equally valid for the closed economy model, and thereby does not represent an analytical novelty arising from the openness to foreign capital inflow. FR recognizes the point.

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economy's abundant resource – surplus labor – via embodiment in labor-intensive industrial exports. Concurrent to this, the open dualistic labor surplus economy is likely to move from the successful exploitation of its agricultural potential to a long-term position as an agricultural importer as the industrial sector becomes successful. The arrival of such a switching point signifies that the LDC ultimately accelerates its industrial exports to acquire needed food and raw materials. Finally, an absolute decline in the agricultural population shifts the policy focus towards labor-saving techniques in agriculture to prolong the labor-using phase in industry as the economy gets ready for the skill- and capital-intensive phase." (p. 296)

With regard to labor mobility, RF rightly notes that it is of lesser importance given the restrictions on both the demand and supply sides. The impact on the dualistic economy again depends on the policies pursued by the economy itself. They present the Philippines as the "unsuccessful" case, which failed to make use of its surplus labor and let its skilled labor to migrate. On the other hand, RF portrays East Asia as the "successful" case that made good use of it surplus labor. They also mention of a "Returning Point" with regard to migration as exemplified in particular by the experience of Taiwan, whose migrants are now returning to the country. These empirical points are interesting. However, the import of labor mobility for the model itself remains ambiguous. In general it is clear that labor mobility to the extent that it allows the dualistic economy's surplus labor to migrate may bring the Turning Point nearer. On the other hand, if labor mobility rather makes it easier for only the skilled labor to migrate, then such mobility may rather make transition of the dual economy more difficult. The outcome therefore is not clear.

Finally RF comes to the issue of technology. They use their following basic equation to discuss the issue:

(1) $$\eta_P < \eta_W = \eta_K + (J + B_L)/\varepsilon_{LL}$$

where, η_P, η_W, and η_K are growth rates of population, workers in the modern sector, and capital, respectively, J is the innovation intensity, B_L is the factor bias (toward labor) of production, and ε_{LL} is the elasticity of the marginal productivity of labor. The presence of B_L suggests that the more labor biased technology the better for the dualistic economy. RF explains that in the context of dualistic developing countries "J corresponds to the adaptation of foreign technology to domestic production processes, which allows output to increase without necessitating a rise in the domestic capital or labor stock." (p. 313) On the whole, FR seems to advocate "appropriate technology." They explain that "appropriate is not necessarily small-scale or large-scale, labor-intensive or capital-intensive, but that which fits the existing resource endowment at a particular point in time, both with respect to technique choice and product quality." (p.314)

Be that as it may, the implication of the technological possibilities arising from openness remains again ambiguous. Much depends on the policies that the economy pursues. In this regard they emphasize the necessity of removal of price distortions. They portray East as the successful case in removing price distortions that allowed these countries to make the best use of the technological opportunities. The also note the remarkable capacity that Japan displayed in technological adaptation. This all may be true, though the discussion smacks of post-fact theorization.

Overall therefore we see that incorporation of possibilities that emerge with opening up does not change the story of the dualistic economy that much. In fact FR had informed of this at the outset of their Chapter 8 announcing that "domestic balanced growth remains the centerpiece of success in the open economy, even in relatively small country cases." (p. 283) However, we also see that "the open economy can (indeed) be of considerable help loosening the strait-jacket of resource constraints and inherited autarky, aiding the domestically-driven growth of the dualistic LDC." (p. 283)

How far this marginalization of the role of openness is valid can be an interesting theoretical issue to examine. However, this paper is meant to examine the Chinese growth experience in the light of the Lewis growth model. In doing so, we need to consider open economy issues, both because Lewis himself and Fei and Ranis in particular made interesting efforts to extend the model to an open economy situation and because the Chinese recent growth itself has been achieved in an, by and large, open economy situation. To the extent that such an analysis can also provide a check on the validity of marginalization of openness, as suggested by FR above, will be a bonus.

5. Problems in empirical testing of Lewis model's predictions

5.1 Problems in general

Thus the most important prediction of the Lewis model concerns the wage curve for the modern sector. The model implies that the wage curve of the modern sector will remain essentially flat or rising very slowly for a long time until the surplus labor of the traditional sector has been absorbed in the modern sector. The point at which the surplus labor gets exhausted and the modern sector wage curve starts to move up (from being

flat) is called the "Turning Point." How long is this "long time" and how flat this "essentially flat" curve has to be are questions of dispute of a secondary order. Earlier, based on wage data of England, Japan, and Taiwan, Ranis showed that the experiences of these countries conform to the Lewis model prediction. The modern sector wage curve for these countries indeed remained more or less flat for about forty years, before the Turning Point was reached.

However there are many problems with regard to testing the validity of Lewis model's prediction. One of these concerns determining the empirical counterparts of the theoretical concept of dual sectors. As noted in Section 1, Lewis himself and the literature have employed many different versions of this duality concept. Capitalist/non-capitalist, modern/traditional, industrial/agricultural, etc, are just a few examples. No matter which of these versions is preferred there is never a perfect match between them and the empirical counterparts that are or can be employed given the availability of data.

Another issue concerns the definition of real wage itself. As Lewis (1972, p. 85) himself noted, "Real wage has many meanings." He drew distinctions among "cost of living wage," defined as (w/c), where w is the nominal (money) wage and c is the cost of living; "factoral wage," defined as (w/a), where a is "the income of the non-capitalist worker;" "ratio of wages to prices," defined as (w/p), where p is the index of the "price received by capitalists;" product wage, defined (wL/vQ), where is the quantity of labor, Q is real output, and v is the value added price of output; and finally (wL/pQ) which is what product wages reduces to when no imported raw materials are used in production. (Lewis 1972, pp. 85-86) Coupled with all the different ways in which the sectors can be defined, this shows the bewildering variety of combinations that can be adopted for empirical testing the predictions of Lewis model.

5.2 Particular Problems with China

When it comes to China, there are additional problems arising from her various institutional specifics. First of all, as explained earlier, the analytical modern-traditional dichotomy is not the same as the empirical urban-rural dichotomy. This is more so in the China. First of all, not all of urban sector is comprised of enterprises embodying modern,

industrial technology having higher labor productivity. A considerable part of the urban sector is comprised of informal enterprises using primitive technologies. Similarly, not all of rural sector, as administratively defined, is comprised of economic (agricultural or otherwise) activities based on traditional, pre-industrial technologies. This is more so in case of China, which has witnessed a phenomenal growth of Township-Village enterprises (TVE) right inside what are administratively classified as rural areas. Yet many of these TVEs employ industrial technology. Second, even the administrative demarcations of urban and rural parts of the country have not stayed the same over time. What was rural a few years earlier became urban due to administrative decisions regarding the jurisdiction of cities and counties.

A (third) problem that is not of correspondence between analytical concepts and empirical concepts, but of a significant departure from the analytical description of the Lewis economy is as follows. The Lewis model assumes on an unrestricted flow of labor from the traditional to the modern sector in response to the economic incentives. The model does not allow for administrative or political restrictions on such flows. This assumption does not hold true for China. For a long time China practiced what is called the Registration System, under which people were not free to move from one location to another. In particular rural people were not free to move to urban areas and take up residence there. Over time many of these restrictions have been either removed formally or enforced not so strictly, making it easier for rural residents to move to urban areas. However, many such restrictions remains, and the situation still remains far removed from the one postulated in Lewis model.

Finally there is the problem of the practice and legacy of central planning in China. As we noted earlier, the initial idea of Lewis model was to explain the growth and expansion of capitalism (or industrialization under capitalism) in developing countries. That might have been one reason why researchers have not been that enthusiastic in examining mainland Chinese growth experience from the viewpoint of Lewis model, even though the model has been extensively used to study the growth process in Taiwan and also to some extent of Japan. Since under central planning wages (as other prices) are determined through fiat/command/administrative methods, it might have been thought

that Lewis model, which in a sense rely on market rationale, was not the appropriate reference model.

However, as Lewis himself noted, industrialization in a dual economy faces the same economic fundamentals even when it is carried out under alternative (non-capitalist) institutions. In fact he mentions that was the experience of the (former) USSR (along with that of the UK) which served as the empirical reference for him in his formation of the model.[17] Clearly, therefore Lewis thought his model to be applicable for analysis of industrialization in a dual economy under socialism (central planning) too. However, in considering the latter process, one has to keep in mind that the planners may not always go by the economic fundamentals, and instead try to impose choices inspired by non-economic, political or ideological considerations.

China's situation is further complicated by the fact that it is neither under central planning nor under entirely market conditions. Instead it is in a transition from the former to the latter. On the one hand it makes the analysis, in particular interpretation of the results more challenging. On the other hand, it offers more opportunities to find whether and how institutional changes impact on the underlying economic processes of industrialization.

6. Empirical Analysis and Results

We begin the analysis by examining the data at the aggregate level. Table 1 shows the real GDP distinguished by three sectors, namely Primary, Secondary, and Tertiary. According to the classification adopted by the Chinese statistical authorities, the Primary sector comprises of agriculture and mining, Secondary of manufacturing, and Tertiary of services. The Secondary sector can by and large be thought to be the "modern" sector of the economy, employing industrial technologies. On the other hand, the Primary sector can by and large be thought to represent the "traditional sector," though mining, that is included in this sector, may actually employ industrial technologies. Even agriculture in China is becoming more machine based, as we will see later. Relatively more

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[17] As Lewis (1972, p. 87) puts it: "When the first article was written, the historical wage data uppermost in my mind were those for the cost of living wage in Great Britain in the first half of the nineteenth century, and the USSR in the 1930s."

problematic is the Tertiary sector, which may include enterprises based on either industrial technology or pre-industrial traditional technologies. It is therefore difficult to place the Tertiary sector in terms of the modern/traditional or industrial/pre-industrial divide.

The graph in Figure 1 shows the dramatic increase in the volume and its share in GDP of the Secondary sector. This reflects the process of industrialization that China is undergoing. The graphs show that there has been a clear acceleration in this regard beginning 1991. The volume of the Tertiary sector's output has also been increased, though nowhere at a rate similar to that of the Secondary. The Primary sector's output has increased at an even slower pace.

Figure 2 shows the employment pattern. It shows that in terms of employment, the Primary sector still surpasses the Secondary sector in importance. The total volume of employment in the Primary sector has remained relatively stable over the long period of time considered (1978-2003). The graph also shows that employment in the Secondary sector has increased but not so dramatically as its output. By contrast, employment in the Tertiary sector has experienced steady increase and since 1994 surpassed the Secondary sector in terms of total employment.

Figure 3 shows what is already suggested by Figures 1 and 2. We see a dramatic rise in labor productivity in the Secondary sector, particularly beginning 1991. The labor productivity in the Secondary sector fat surpasses that in the Tertiary and Primary sectors, and it undergoes a surge beginning 1991. By contrast labor productivity in the remaining sectors experience only very sluggish growth.

Figure 4 shows the wages in the three sectors and for the economy as a whole. We notice that unlike labor productivity, real wages in all the sectors seem to display somewhat similar pattern. Wages in all the sectors experience faster increase beginning 1993. In terms of level and growth, wages in the Secondary and Tertiary sectors seem to move very closely. However, surprisingly, in view of the labor productivity information provided by Figure 3, wages in the Tertiary sector, accordingly to these data, exceed those in the Secondary sector and certainly those in the Primary sector.

Broadly, these wage curves do display the pattern suggested by the Lewis model. After rising at a sow pace for a long time, they start rising at a much faster rate after

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reaching what according to Lewis model would be the First Turning Point. However, the graphs also show that the Chinese economy is nowhere near reaching the Second Turning Point, where the marginal product of the modern sector equals that of the traditional sector and is reflected in the approximate equality of the wages in the modern and traditional sectors. Figure 4 shows that the gap between wages of the Secondary and Tertiary sector on the one hand and of the Primary sector on the other is actually rising.

According to Lewis model, the (first) turning point will be reached provided growth rate of employment in the modern sector exceeds the growth of the total labor force. Denote Primary, Secondary, and Tertiary sectors by the numerals 1, 2, and 3. Then, assuming that the Secondary sector represents the modern sector, the above suggests that employment growth rate in the Secondary sector (η_2) has to exceed the total labor force growth rate (η_{1+2+3}).

Table 1 shows these and other relevant growth rates for different sub-periods. The first sub-period of 1978-83 represents the initial reform period, when reforms were focused mainly on the rural sector. The next sub-period of 1984-1988 represents the beginning years of the industrial reform. The third sub-period of 1989-1991 represents the years of political turmoil preceding and following the Tiananmen incident. The fourth sub-period of 1992-2001 represent years of continued industrial reform leading to China's accession to WTO. The final sub-period, still very short, represents post-WTO years. We see that except for the abnormal sub-period of 1989-91, η_2 did indeed exceed η_{1+2+3} in all the sub-periods.

As noted earlier, Fei and Ranis provides a decomposition of the employment growth rate in terms of growth rate of capital (η_K), labor-bias of technical change (*B*), and TFP growth (*J*). This decomposition allows seeing more clearly the source of employment growth or the lack thereof. It thus helps thinking of policy interventions. Table 2 presents such decomposition of η_2 for all the sub-periods. We see that most of the employment growth was due to capital accumulation. The negative values of B show that technical change bias was against labor rather than favoring labor. Finally, the values of *J* show that total factor productivity growth was generally positive, except during the first sub-period.

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We noticed earlier the difficulty with placing the Tertiary sector in the modern/traditional divide of the economy. Assuming that it is part of the modern sector, it should also witness a faster employment growth in order to help reach the turning point. Table 1 indeed shows that employment growth rate of the Tertiary sector (η_3) was indeed higher than the employment growth for the overall economy (η_{1+2+3}) for all the sub-periods. Table 3 offers a decomposition of η_3 using Fei and Ranis formula. We again see that capital accumulation has been the main source for the employment growth. Technological bias even in this sector has been against labor, as manifested in the negative values of B. Finally, we notice that total productivity growth had a relatively less important role in this regard in the Tertiary sector than in the Secondary sector.

One important characteristic of recent development of the Chinese economy has been unevenness of the growth and industrialization process across different provinces resulting in enormous regional disparity. This can be seen clearly from the information presented in Table 4. We see that the per capita income ranged from as high as 46,718 yuan in Shanghai province to a low figure of only 3603 yuan in Guizhou province. In other words the per capita income of the richest province was about 13 times higher than that in the poorest province. This is an enormous disparity to be observed inside the same country anywhere is the world. Also, the difference is not only in terms of income. The coastal and the interior provinces of China seem to be experiencing entirely different development processes. While the former has become very an integrated part of the global economy, the latter still remains isolated and looking inward. It is therefore necessary to go beyond the aggregate level and see how different the processes in different provinces appear when looked from the viewpoint of the Lewis growth model.

In order to do so we choose two provinces from two extremes of the income distribution. One is the province of Shanghai, the richest province, and the other is Gansu, the next to the poorest province.[18] One is a coastal province, while the other is an interior province. (The map in Figure 5 shows the geographical location of these and other provinces of China.)

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[18] We could not select Guizhou province for this purpose, despite our original intention to do so, because of data paucity for that province.

Figure 6 presents the manufacturing wage information for two rich provinces, namely Shanghai and Beijing, and two poor provinces, namely Guizhou and Gansu. We see that wage curves for Shanghai and Beijing undergo a sharp upturn beginning 1997. Wage curves for Guizhou and Gansu also undergo an up turn beginning that year, but nowhere as sharp as is the case with the richest provinces. It may be noted that all these provinces had very similar wages at the beginning of the period (i.e., in 1985). In fact it is of much interest to note that wages in Gansu were higher than in both Shanghai and Beijing. So the dramatic divergence in average wages in entirely a recent phenomenon.

Figure 7 shows per capita income for Shanghai and Gansu provinces. We see the dramatic increase in the per capital income in Shanghai, particularly beginning 1991, while the per capita income of Gansu does not experience any such spurt. Figure 8 shows the agricultural and non-agricultural population in Shanghai. We see that an absolute decline in the size of the agricultural population and a steady increase in the size of the non-agricultural population. Figure 9 shows the size of urban and rural population in Gansu province. We see that Gansu also witnesses considerable increase in the size of its urban population. It witnesses a decline in the size of the rural population too, though not by that much.

Table 5 presents employment growth rates for various sectors of the Shanghai province. We see from Table 5 that the Tertiary sector employment growth rate (η_3) always exceeded the total employment growth rate (η_{1+2+3}). This however cannot be said with regard to the Secondary sector employment growth rate (η_2), which, as Table 5 shows, proved to be smaller than η_{1+2+3} in all the three recent sub-periods. This shows that Shanghai has reached the stage where the service sector supplants the manufacturing sector as the main driving force of the economy.

Tables 6 and 7 provide the Fei and Ranis decomposition of the Secondary and Tertiary sector employment growth rates, respectively, of the Shanghai province. We see that in each case, capital accumulation is the main force driving employment growth. Technological bias seems to be against labor, particularly in the Secondary sector in the more recent periods, accompanied by high total factor productivity growth. The Tertiary

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sector in contrast has used more labor-favoring technology, suffering at the same time from lack of TFP growth.

Tables 8, 9, and 10 provide analogous results for Gansu province. Table 8 shows both η_2 and η_3 to exceed η_{1+2+3} in all the sub-periods, except the turmoil period of 1989-1991. Table 9 provides the Fei-Ranis decomposition of η_2. Data are patchy for Gansu, making it not possible to conduct this decomposition for all the sub-periods, particularly the beginning ones. Broadly, we see again capital accumulation to be main force driving employment growth. The technology bias appears to be consistently against labor. There does not seem much role for TFP growth in case of the Tertiary sector, though in the Secondary sector witnesses some positive development in this regard in the more recent sub-periods.

We noted in Sections 3 and 4 that openness, making international trade and factor flows possible, creates many possibilities for modification of the basic predictions of the Lewis model. The comparison between Shanghai and Gansu can be helpful in seeing the impact of openness, because these two provinces also present different degrees of openness and integration with the outside world.

Figure 10 shows the export and import figures for Shanghai. We see the explosive growth of both exports and imports beginning particularly 1993. Also imports begin to exceed export in Shanghai from 1999 onwards. Figure 11 presents similar information for Gansu province. We see growth in export and import for Gansu too, however not as dramatic as for Shanghai. Only in very recent years that it seems that exports and imports are gaining momentum in Gansu. However, the absolute magnitudes are still very paltry, so that small changes can get easily magnified, and discerning robust trends may be difficult. Unlike in Shanghai, imports always exceed export in Gansu.

Figure 12 provides the decomposition of import in Shanghai in terms of agricultural and capital goods. It shows clearly that most of the import is of capital goods. By contrast import of agricultural goods remains almost unchanged. Figure 13 provides analogous decomposition for the Gansu province. Again we see most of the import to be of capital goods. However the absolute magnitudes are very small. Import of agricultural goods by Gansu province has remained either unchanged or even declined.

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In order to see the role of imported capital in the growth process, we expand the production function to allow two types of capital, domestic and imported. Let K_{Di}, K_{Mi}, represent domestic capital and imported capital, respectively. The production function (in Cobb-Douglas form) can then be written as:

$$(2) \qquad Y = A\left(K_D^{1-\beta} K_M^{\beta}\right)^{\alpha} L^{1-\alpha}.$$

Noticing the elasticity of marginal product of labor this case is $\varepsilon = -\alpha$, we have the following equation providing decomposition of the output growth rate into its various sources:

$$(3) \qquad \hat{Y} = \hat{A} + \alpha(1-\beta)\hat{K}_D + \alpha\beta\,\hat{K}_M + (1-\alpha)\hat{L}.$$

Table 11 and 12 provide decomposition of growth in Shanghai and Gansu, respectively, following equation (3). From Table 11, we see that TFP growth plays a very important role in the growth of Shanghai. It also shows significant contribution from imported capital. In fact, positive contribution of imported capital contrasts with the negative contribution of domestic capital. This shows that composition of capital in Shanghai is changing towards imported capital.

Table 12 shows that the situation in these regards is very different in Gansu. First of all the role of TFP growth is very limited. Second most of the contribution is from domestic capital, with a minuscule role for imported capital. This suggests an association between higher TFP and use of imported capital.

It is also interesting to note that contribution from proves to be negative in both the provinces during most of the period, except the very recent year. This is borne out by actual labor force data, as presented in the Appendix Table.

7. Conclusions

This paper examined the Chinese development experience from the viewpoint of Lewis growth model. It first identified the main predictions of the model and then

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confronted the Chinese data to check the validity of these predictions. The fundamental prediction of the Lewis model is that the wage of the modern sector will rise only very slowly at the beginning until when a turning point is reached signifying exhaustion of the 'surplus' labor contained in the traditional sector. Introduction of internal trade and external trade and factor flows offer only different modifications to this basic prediction.

The empirical investigation of the paper begins with Chinese data at the national level, disaggregated in terms of Primary, Secondary, and Tertiary sector. The wage curve for all these sectors are found to display the distinct Lewis pattern, rising only slowly for a long period before a Turning Point beyond which the curves rise steeply. The turning point is more pronounced for the Secondary and Tertiary sectors than for the Primary sector, which is what is expected.

This pattern seems to hold both for the rich coastal provinces, as exemplified by the data of Shanghai, as well as for poor interior provinces, as exemplified by the data of Gansu. However, the turning point is much sharper for Shanghai than for Gansu. This suggests that import of agricultural product as a mitigating force (with respect to rise in wages) did not play much of a role. China herself being a large agricultural country having comparative advantage in production of many pertinent agricultural goods may have played a role in this regard. Instead, faster capital accumulation, both domestic and of foreign source, have led to sustained increase in non-agricultural employment. Higher TFP growth, in part due to the use of imported capital, has made it possible to sustain growth while paying out higher wages.

The turning point for the interior province of Gansu proves less sharp because of smaller sizes of the Secondary and Tertiary sectors relative to the Primary sector. The fact that the wage curve experiences an upward turn even when the rural sector remains large is by itself an interesting finding. It remains of much interest to see how the wage curves behave in the coming years in the interior provinces.

Overall therefore the data lend support to Lewis's basic proposition that the economies of populous developing countries, such as of China, are characterized by a duality, instead of being characterized by perfect mobility and equalization of factor returns across sectors as assumed by the neoclassical growth model. It is this duality that

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allows the modern sector to expand for a significant period of time without having to feel pressure of rising real wage rates.

Of course there remain many conceptual and data issues that remain to be sorted out before these conclusions can be made firmer. We hope that future research will indeed help us to do so.

Technical Appendix

Appendix 1: Derivation of Fei-Ranis Condition

Ranis and Fei (1997) identify the conditions for industrialization in which the minimum labor reallocation condition for successful development becomes

$$\eta_P > \eta_W \ \ (\textit{Failure})$$

$$\eta_P = \eta_W \ \ (\textit{Stagnation})$$

$$\eta_P < \mu_W \ \ (\textit{Industrialization})$$

$$\eta_P < \eta_W = \eta_K + \frac{B_L + J}{\varepsilon_{LL}}$$

where η_P is the growth rate of total population, η_W is the growth rate of labor forth in urban sector, η_K is the growth rate of capital stock (capital accumulation) in urban sector, B_L is the labor-using bias of innovation, J is the intensity of innovation and ε_{LL} is the elasticity of marginal product of labor (in Cobb-Douglas Case).

Following Fei and Ranis (1997), pp262-268, and Akiyama (1999), pp149-152, assuming the Cobb-Douglas production function with homogeneous of degree one.

$$Y_i = A_i K_i^{\alpha_i} L_i^{1-\alpha_i}$$

Y, K, and L are the value added, capital stock and labor force in the industry *i* respectively. A_i stands for the technology level and α_i is the expenditure share of capital. All variables are the functions of time, *t*.

Taking the rate of change in time, we have the following;

$$\hat{Y}_i = \hat{A}_i + \alpha_i \hat{K}_i + (1 - \alpha_i)\hat{L}_i$$

A hut stands for the rate of change in time, that is $\hat{Z} = \dfrac{dZ/dt}{Z}$. This can be arranged as follows;

$$\hat{L}_i = \hat{K}_i + \frac{\hat{A}_i + \left(\hat{L}_i - \hat{Y}_i\right)}{\alpha_i} \tag{A1}$$

In our notations, $\hat{L}_i = \eta_i$, $\hat{K}_i = \eta_K$, $\hat{A}_i = J_i$, $\hat{L}_i - \hat{Y}_i = B_i$, $\alpha_i = \varepsilon_i$. ε_i is an elasticity of marginal productivity of labor. In the Cobb-Douglas production function with homogeneous of degree one;

$$\varepsilon_i = -\frac{\partial MP_L}{\partial L}\frac{L}{MP_L} = -\frac{-\alpha_i(1-\alpha_i)AK^{\alpha_i}L^{-\alpha_i-1}}{(1-\alpha_i)AK^{\alpha_i}L^{-\partial_i}} \cdot L = \alpha_i$$

Hence the eq. (A1) can be rewritten as

$$\eta_W = \eta_K + \frac{B+J}{\varepsilon_i}$$

Appendix 2: A Modified Fei-Ranis Condition

A modified Fei-Ranis condition for economic development is described as follows;

$$\eta_p < \eta_L = \theta_M \eta_M + \theta_S \eta_S$$

where η_p, η_M, η_S are the growth rates of population, manufacturing and service sectors, respectively, and θ_M, θ_S are shares of labors employed in manufacturing and service sectors in sum of employed persons in secondary and tertiary sectors. η_M, η_S are further decomposed as;

$$\eta_i = \eta_{Ki} + \frac{B_i + J_i}{\varepsilon_{LL}}, \ i = M, S$$

where η_{Ki} indicates the growth rate of capital stock, B_i is technology biases, J_i is the technological progress for i industry. ε_{LL} stands for the elasticity of marginal product of labor which equal the capital expenditure share in Cobb-Douglas production function case.

Appendix 3: Adjusted Number of Employees in Shanghai and Gansu (10,000 persons)

	Shanghai	Gansu
1997	762.24	1530.32
1998	752.31	1539.80
1999	730.61	1489.00
2000	745.24	1476.45
2001	768.64	1488.93
2002	792.04	1500.59
2003	813.05	1510.85

Source: Comprehensive Statistics Data and Materials on 50 Years of New China, Table c9.2, Shanghai Statistical Yearbook、Tables 1.2 (1999-2003), and Gansu Year book, Table 2-8 (2004)

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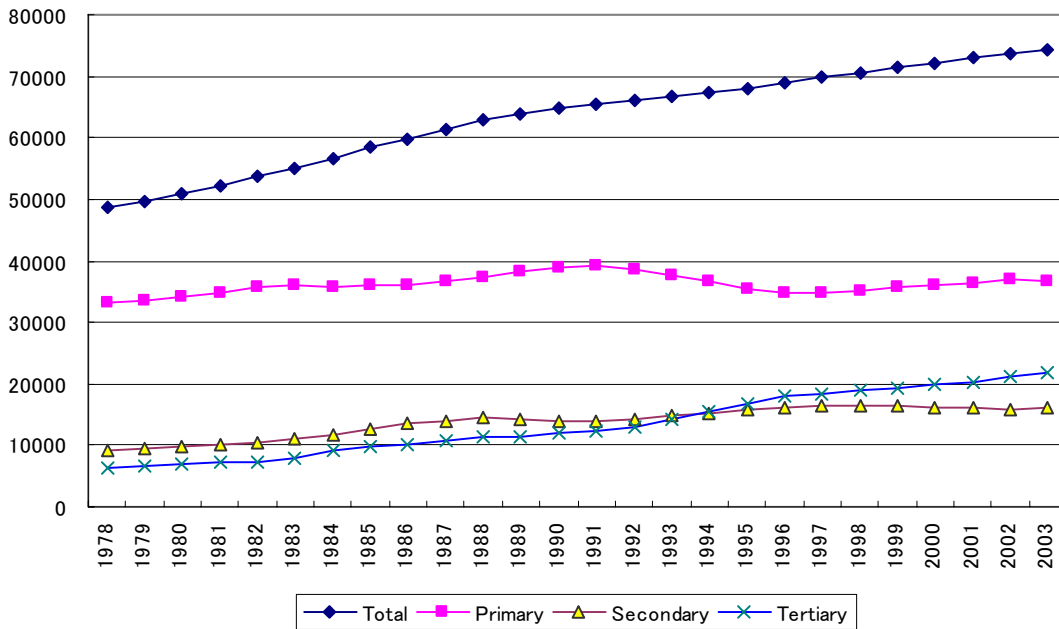
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Figure 1: Real GDP by Industries (100 million yuan)
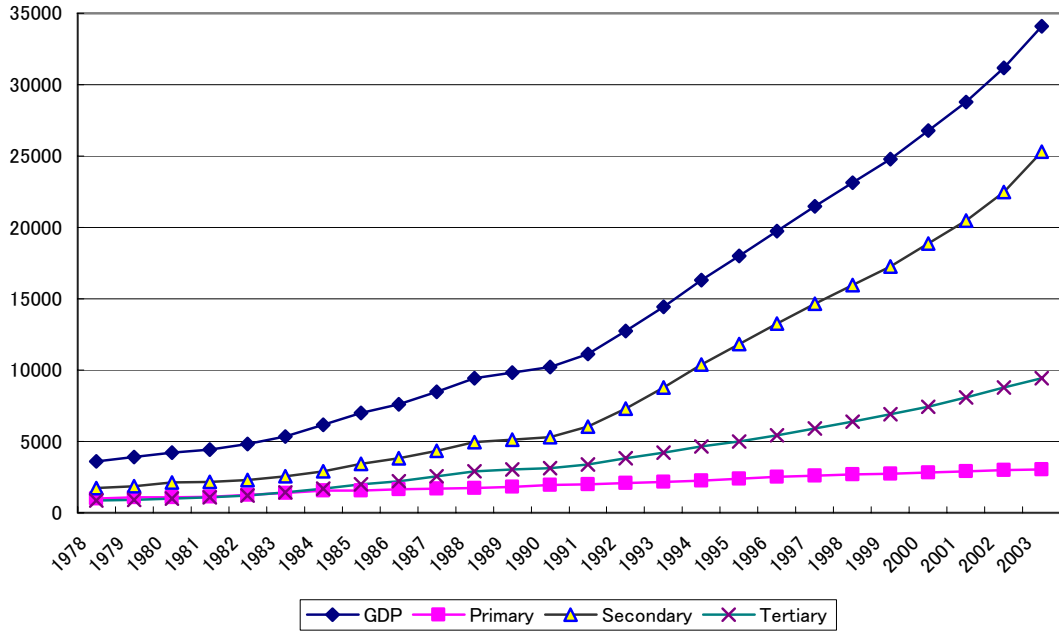
Source: China Statistical Yearbook, various issues.

Figure 2: Number of Employees (10,000 person)

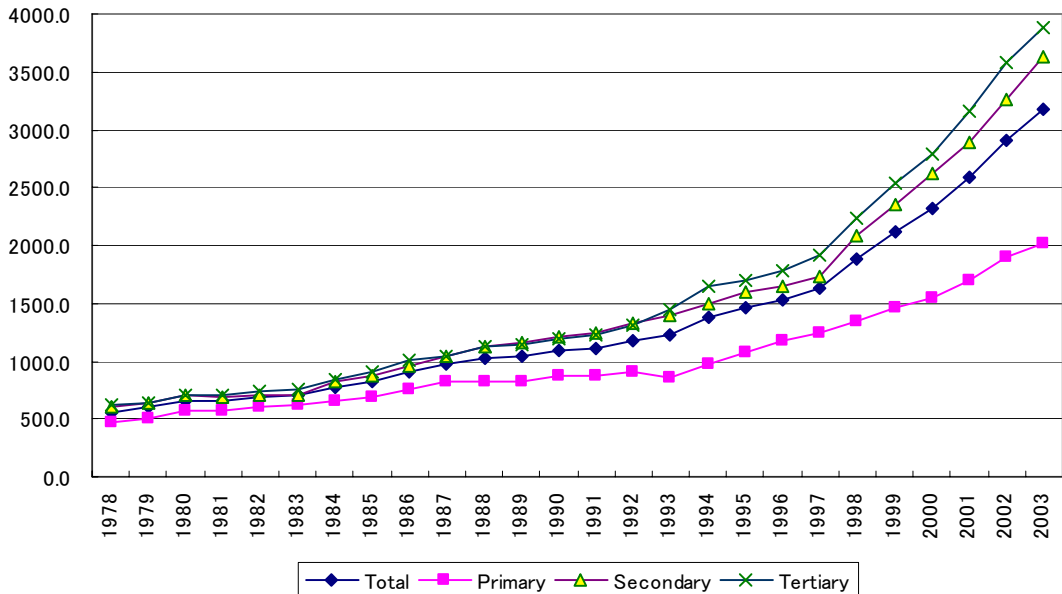Source: China Statistical Yearbook, various issues.

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Figure 3: Labor Productivity (GDP/Employees) (100 million yuan)
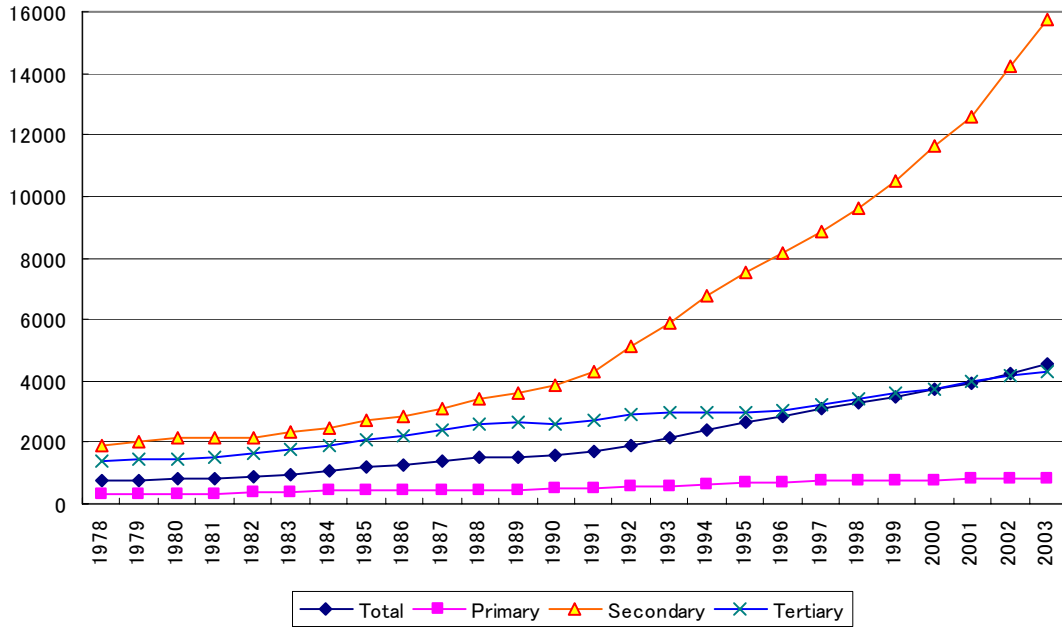
Source: China Statistical Yearbook, various issues.
Note: Labor productivity is calculated by dividing GDP by the number of employees.

Figure 4: Real Wage Rates (yuan)

Source: China Statistical Yearbook, 2004, and China Labour Statistical Yearbook, 1996, 2004.

Table 1: Annual Growth rate of Labor by Industry (%)

	$\eta_{(1+2+3)}$	η_1	η_2	η_3	$\eta_{(2+3)}$
1978-1983	2.46	1.65	3.52	5.01	4.13
1984-1988	2.60	0.95	5.02	5.58	5.26
1989-1991	1.30	1.22	-0.73	4.04	1.43
1992-2001	1.10	-0.64	1.41	4.95	3.22
2002-2003	0.94	-0.88	1.88	3.41	2.76

Table 2: Decomposition of the Growth Rate in Manufacturing Labor Force (%)

	η_2	η_K	B	J	α
1978-1983	3.52	36.60	-4.32	-18.18	0.68
1984-1988	5.02	10.47	-9.20	5.81	0.62
1989-1991	-0.73	8.72	-9.11	3.27	0.62
1992-2001	1.41	9.44	-10.69	5.33	0.67
2002-2003	1.88	14.72	-10.82	2.19	0.67

Table 3: Decomposition of Growth Rate in Service Labor Force (%)

	η_3	η_K	B	J	α
1978-1983	5.01	42.84	-2.63	-14.72	0.46
1984-1988	5.58	23.16	-8.46	0.36	0.46
1989-1991	4.04	11.79	-4.69	0.48	0.54
1992-2001	4.95	15.58	-7.51	2.29	0.49
2002-2003	3.41	14.67	-9.39	5.14	0.38

Source: Authors' calculation. All necessary data are obtained from China Statistical Year Book, various issues, National Bureau of Statistics of China.

Notes: A 20% depreciation rate is used for the calculation of capital stock in both manufacturing and service sectors. Year 1978 is used as the base year for calculation. Labor expenditure (income) shares of total economy are used. α equals ε_{LL} (see appendix). Capital expenditure share (α) is calculated as simple average of the two period α s. α s are calculated by dividing the nominal wage earnings (average nominal wage rate times the number of employees) by nominal GDP for each year.

Figure 5: Provinces of China

China: Administration

Province-Level Names

Characters	Pinyin	Pronunciation	Characters	Pinyin	Pronunciation
安徽	Anhui	ahn-way	辽宁	Liaoning	lee_ow-ning
北京	Beijing	bay-jing	内蒙古	Nei Mongol	nay-mung-goo
福建	Fujian	foo-jee_en	宁夏	Ningxia	ning-she_ah
甘肃	Gansu	gahn-soo	青海	Qinghai	ching-hi
广东	Guangdong	g_wong-doong	陕西	Shaanxi	shun-she
广西	Guangxi	g_wong-she	山东	Shandong	shahn-doong
贵州	Guizhou	g_way-joe	上海	Shanghai	shong-hi
海南	Hainan	hi-nan	山西	Shanxi	shahn-she
河北	Hebei	huh-bay	四川	Sichuan	ssu-ch_wan
黑龙江	Heilongjiang	hay-loong-jee_ong	天津	Tianjin	te_en-jin
河南	Henan	huh-nan	新疆	Xinjiang	shin-jee_ong
湖北	Hubei	hoo-bay	西藏	Xizang	she-dzong
湖南	Hunan	hoo-nan	云南	Yunnan	yu_oon-nan
江苏	Jiangsu	jee_ong-su	浙江	Zhejiang	juh-jee_ong
江西	Jiangxi	jee_ong-she			
吉林	Jilin	jee-lynn	台湾	Taiwan	tie-wan

Source: University of Texas at Austin Library, http://www.lib.utexas.edu/maps/china.html#country.html

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Table 4: Basic Statistics of China by Province (2003)

	Region	Gross Regional Product (yuan)	Primary Industry (%)	Secondary Industry (%)	Tertiary Industry (%)	Per Capita Gross Regional Product (yuan/person)	Birth Rate (‰)	Death Rate (‰)
	National Total	117251.9	14.6	52.3	45.3	9101	12.41	6.4
1	Shanghai	6250.8	1.5	50.1	48.5	46718	4.9	6.2
2	Beijing	3663.1	2.6	35.8	61.6	32061	5.1	5.2
3	Tianjin	2447.7	3.7	50.9	45.5	26532	7.1	6.0
4	Zhejiang	9395.0	7.7	52.6	39.7	20147	9.7	6.4
5	Guangdong	13625.9	8.0	53.6	38.3	17213	13.7	5.3
6	Jiangsu	12460.8	8.9	54.5	36.7	16809	9.0	7.0
7	Fujian	5232.2	13.2	47.6	39.1	14979	11.4	5.6
8	Liaoning	6002.5	10.3	48.3	41.4	14258	6.9	5.8
9	Shandong	12435.9	11.9	53.5	34.6	13661	11.4	6.6
10	Heilongjiang	4430.0	11.3	57.2	31.5	11615	7.5	5.5
11	Hebei	7098.6	15.0	51.5	33.5	10513	11.4	6.3
12	Xinjiang	1877.6	22.0	42.4	35.6	9700	16.0	5.2
13	Jilin	2522.6	19.3	45.3	35.4	9338	7.3	5.6
14	Hubei	5401.7	14.8	47.8	37.4	9011	8.3	5.9
15	Inner Mongolia	2150.4	19.5	45.3	35.2	8975	9.2	6.2
16	Hainan	670.9	37.0	22.5	40.5	8316	14.7	5.5
17	Henan	7048.6	17.6	50.4	32.0	7570	12.1	6.5
18	Hunan	4638.7	19.1	38.7	42.2	7554	11.8	6.9
19	Shanxi	2456.6	8.8	56.6	34.7	7435	12.3	6.0
20	Qinghai	390.2	11.8	47.2	41.0	7277	16.9	6.1
21	Chongqing	2250.6	14.9	43.4	41.6	7209	9.9	7.2
22	Tibet	184.5	22.0	26.0	52.0	6871	17.4	6.3
23	Ningxia	385.3	14.4	49.8	35.8	6691	15.7	4.7
24	Jiangxi	2830.5	19.8	43.4	36.9	6678	14.1	6.0
25	Shaanxi	2398.6	13.3	47.3	39.4	6480	10.7	6.4
26	Anhui	3972.4	18.4	44.8	36.7	6455	11.2	5.2
27	Sichuan	5456.3	20.7	41.5	37.8	6418	9.2	6.1
28	Guangxi	2735.1	23.8	36.9	39.3	5969	13.9	6.6
29	Yunnan	2465.3	20.4	43.4	36.2	5662	17.0	7.2
30	Gansu	1304.6	18.1	46.6	35.3	5022	12.6	6.5
31	Guizhou	1356.1	22.0	42.7	35.3	3603	15.9	6.9

Source: Tables 3-1 and 3-11, China Statistical Year Book, 2004, National Bureau of Statistics of China.
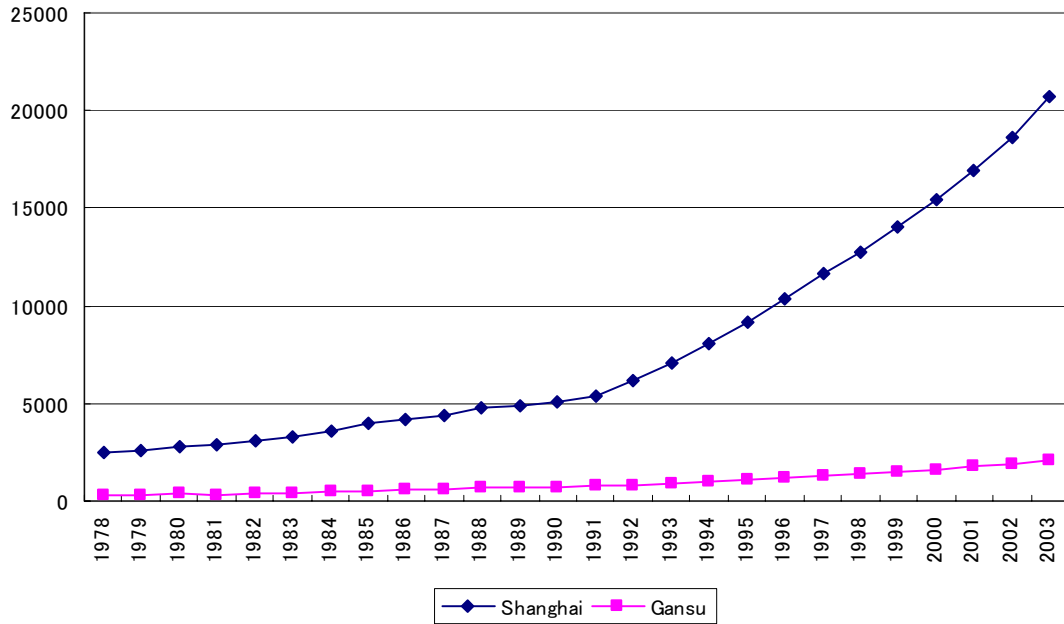Notes: Gross regional product and per capita GRP are in nominal values.

Figure 6: Manufacturing Wage by Region (yuan)
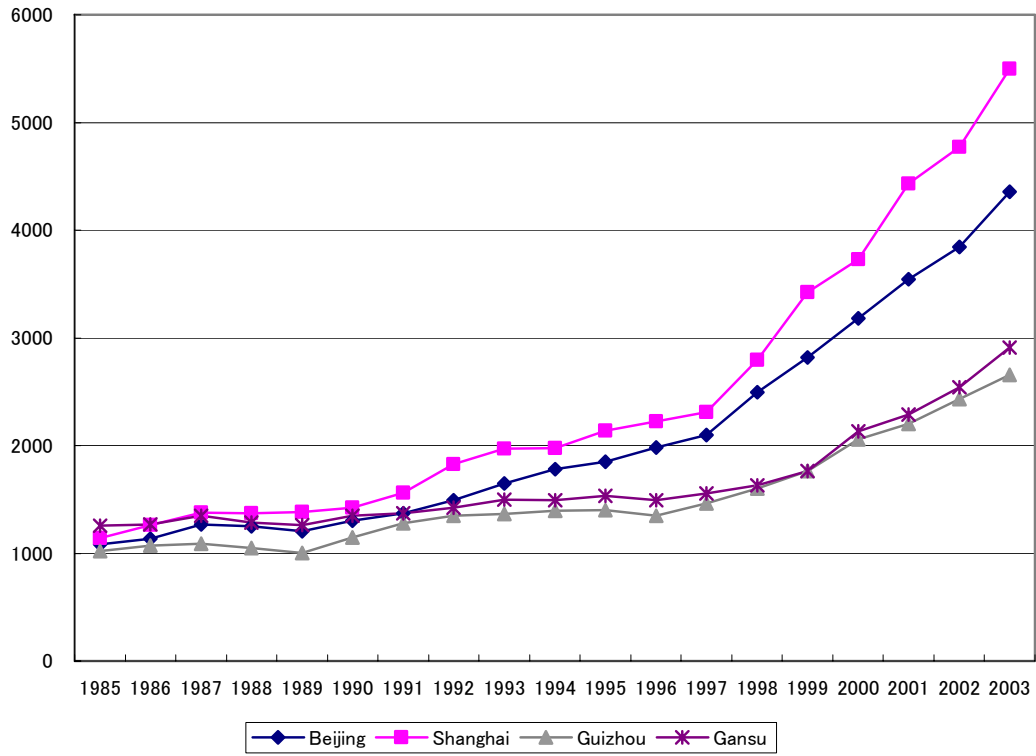
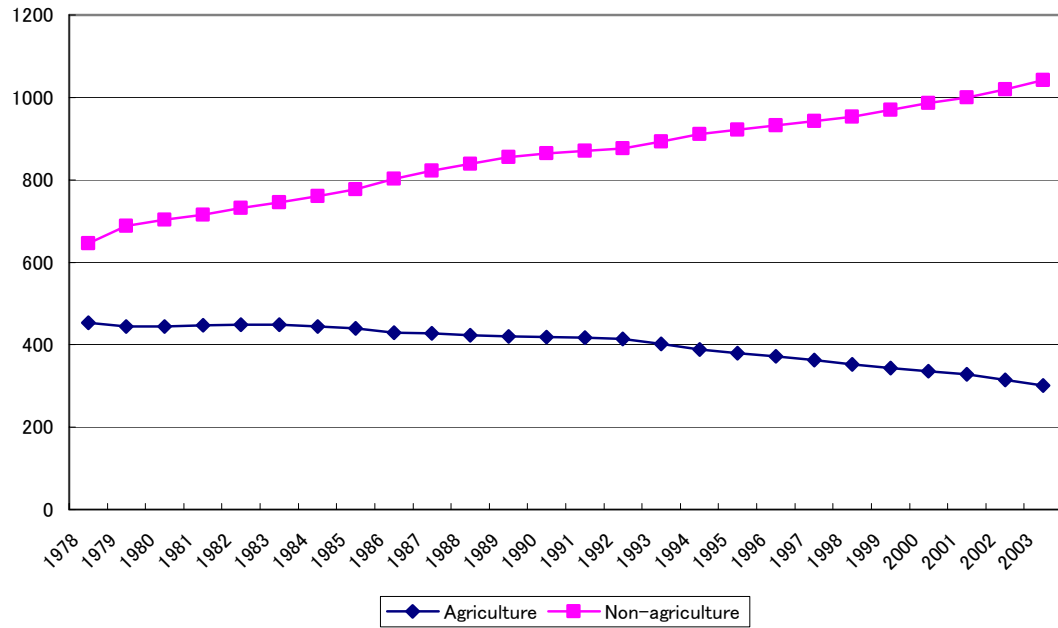Source: China Statistical Yearbook, various issues.
Note: Price deflators of urban sectors for each province are used. 1978 constant price.
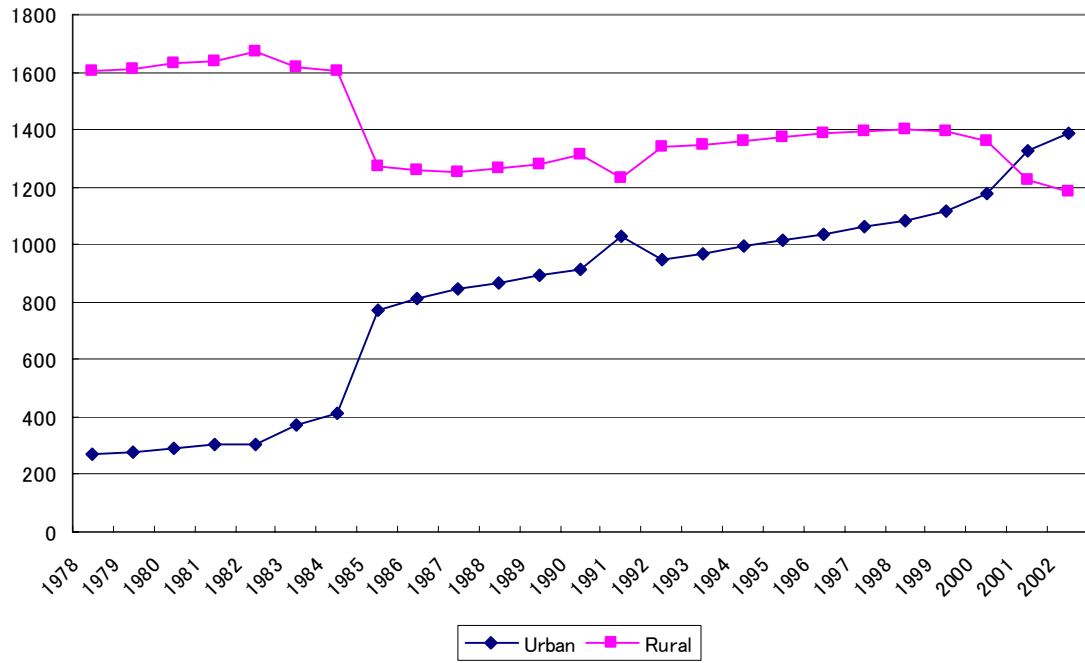
Figure 7: Per Capita GDP (Yuan)

Source: Shanghai Statistical yearbook various issues and Gansu Yearbook various issues
Note: 1978 constant price.

Figure 8: Population in Shanghai (10,000 person)

Source: Shanghai Statistical Yearbook 2004.

Figure 9: Population in Gansu (10,000 person)

Source: Gansu Yearbook 2004.

Table 5: Annual Growth rate of Labor by Industry in Shanghai (%)

	$\eta_{(1+2+3)}$	η_1	η_2	η_3	$\eta_{(2+3)}$
1978-1983	1.94	-5.95	5.69	4.38	5.26
1984-1988	0.72	-11.31	2.49	4.32	3.08
1989-1991	0.84	-3.51	0.80	2.52	1.38
1992-2001	0.05	2.17	-3.75	4.44	-0.20
2002-2003	2.65	-12.19	-1.14	9.01	4.41

Table 6: Decomposition of the Growth Rate in Manufacturing Labor Force in Shanghai (%)

	η_2	η_K	B	J	α
1978-1983	5.69	NA	NA	NA	NA
1984-1988	2.49	19.20	-6.34	-8.35	0.88
1989-1991	0.80	6.33	-3.98	-0.03	0.73
1992-2001	-3.75	13.73	-15.54	3.21	0.71
2002-2003	-1.14	7.17	-17.24	11.15	0.73

Table 7: Decomposition of Growth Rate in Service Labor Force in Shanghai (%)

	η_3	η_K	B	J	α
1978-1983	4.38	NA	NA	NA	NA
1984-1988	4.32	36.79	-6.18	-18.21	0.75
1989-1991	2.52	8.22	-4.37	0.23	0.73
1992-2001	4.44	22.73	-9.58	-3.64	0.72
2002-2003	9.01	7.91	1.01	-0.27	0.68

Source: Authors' calculation. All necessary data are obtained from China Statistical Year Book, various issues, National Bureau of Statistics of China and Shanghai Statistical Yearbook, various issues, Shanghai Municipal Statistical Bureau. .
Notes: A 20% depreciation rate is used for the calculation of capital stock in both manufacturing and service sectors. Year 1978 is used as the base year for calculation. Labor expenditure (income) shares of total economy are used. α equals ε_{LL} (see appendix).

Table 8: Annual Growth rate of Labor by Industry in Gansu (%)

	$\eta_{(1+2+3)}$	η_1	η_2	η_3	$\eta_{(2+3)}$
1978-1983	NA	NA	NA	NA	NA
1984-1988	3.27	-0.16	11.03	12.55	11.78
1989-1991	3.44	4.50	3.74	-0.34	1.60
1992-2001	1.44	-0.15	3.31	5.49	4.44
2002-2003	0.72	0.14	1.39	1.54	1.47

Table 9: Decomposition of the Growth Rate in Manufacturing Labor Force in Gansu (%)

	η_2	η_K	B	J	α
1978-1983	NA	NA	NA	NA	NA
1984-1988	11.03	NA	NA	NA	NA
1989-1991	3.74	64.89	-3.42	-28.86	0.53
1992-2001	3.31	8.22	-7.39	4.68	0.55
2002-2003	1.39	15.85	-10.81	4.97	0.40

Table 10: Decomposition of Growth Rate in Service Labor Force in Gansu (%)

	η_3	η_K	B	J	α
1978-1983	NA	NA	NA	NA	NA
1984-1988	12.55	NA	NA	NA	NA
1989-1991	-0.34	58.74	-7.41	-21.05	0.48
1992-2001	5.49	19.69	-6.20	-2.36	0.60
2002-2003	1.54	11.95	-8.26	2.31	0.57

Source: Authors' calculation. All necessary data are obtained from China Statistical Year Book, various issues, National Bureau of Statistics of China, and Gnasu Yearbook, various issues, China Statistics Press. .

Notes: A 20% depreciation rate is used for the calculation of capital stock in both manufacturing and service sectors. Year 1989 is used as the base year for calculation. Labor expenditure (income) shares of total economy are used. α equals ε_{LL} (see appendix).

Figure 10: External Trade of Shanghai (100 million yuan)
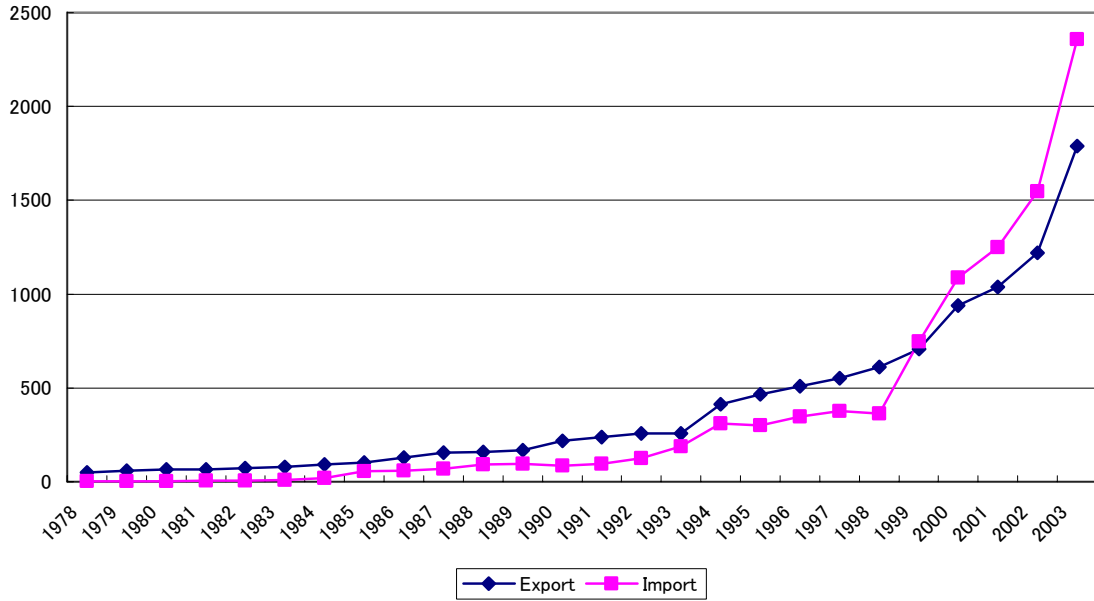
Source: Comprehensive Statistical Data and Materials on 50 Years of New China, Shanghai Statistical Yearbook various issues, and IMF IFS various issues.

Figure 11: Extrnal Trade of Gansu (100 million yuan)
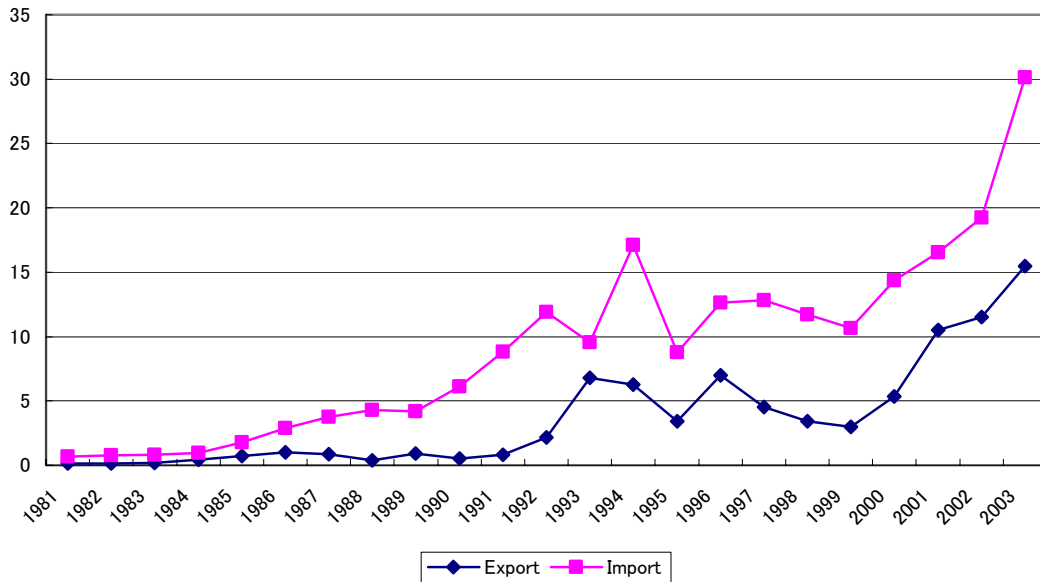
Source: Comprehensive Statistical Data and Materials on 50 Years of New China, Gansu Yearbook various issues, and IMF IFS various issues.

Figure 12: Agricultural and Capital Goods Imports of Shanghai (100 million yuan)
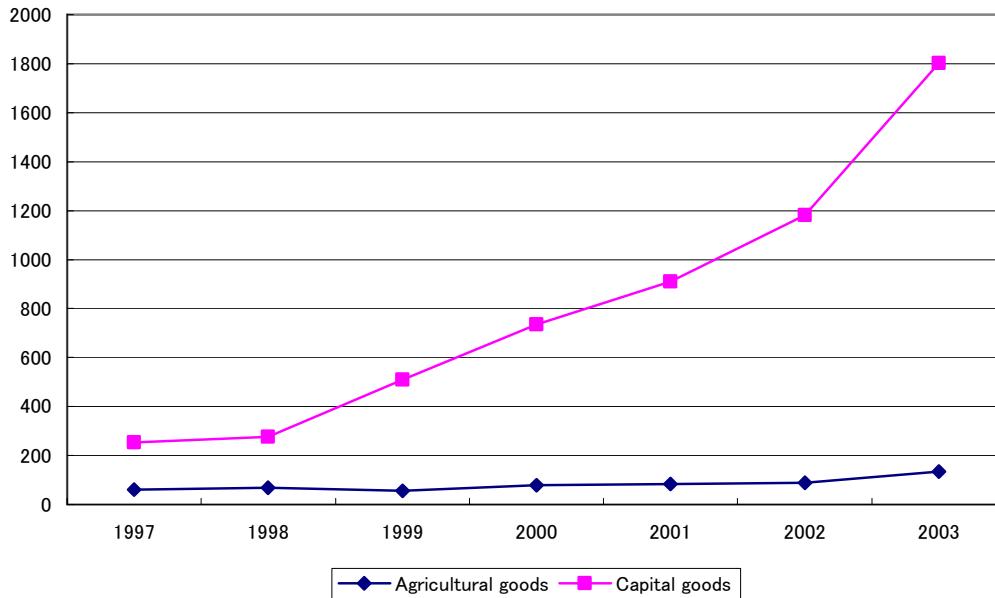
Source: Shanghai Statistical Yearbook various issues, and IMF IFS various issues.

Figure 13: Agricultural and Capital Goods Import of Gansu (100 million yuan)
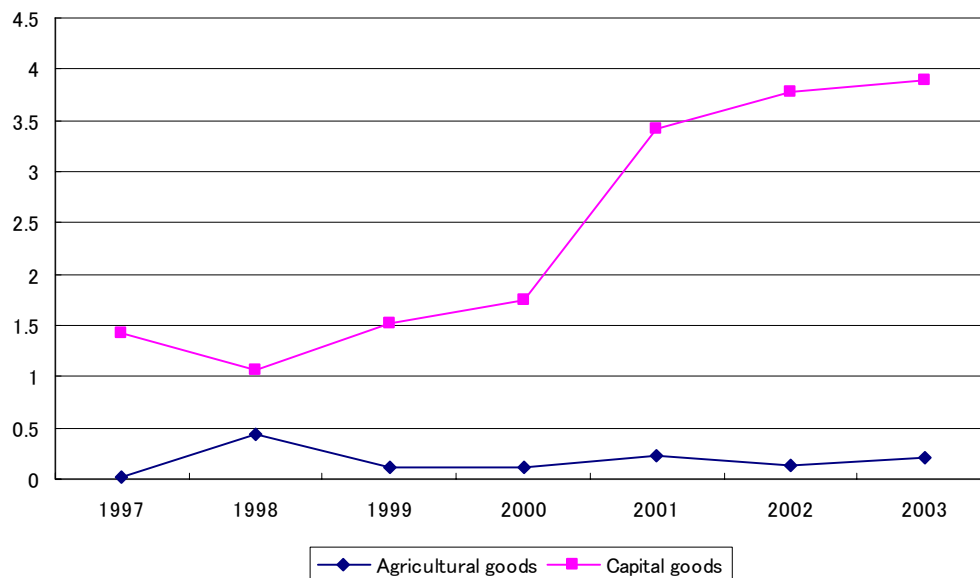
Source: Gansu Yearbook various issues, and IMF IFS various issues.

Table 11: Growth Decomposition of Shanghai (%)

	$\hat{Y}$	$\hat{A}$	$\alpha(1-\beta)\hat{K}_D$	$\alpha\beta\hat{K}_M$	$(1-\alpha)L$
1997-2003	10.67	4.91	-1.59	6.61	0.73
1997-2001	10.32	6.41	-0.79	4.56	0.14
2002-2003	11.80	5.38	-4.11	8.82	1.72

Source: Authors' calculation. All necessary date come from Comprehensive Statistical Data and Materials on 50 Years of New China, Shanghai Statistical Yearbook various issues, and IMF IFS various issues.

Note: K_D and K_M stand for domestic capital stock and imported capital stock respectively. See appendix for the decomposition formula. We assume the prices of domestic and imported capitals are the same. The capital expenditure share (α) is calculated as one less the share of total wage earnings to total value added for each period. The total wage earnings are obtained from the average wage rate times the total number of employees.

Table 12: Growth Decomposition of Gansu (%)

	$\hat{Y}$	$\hat{A}$	$\alpha(1-\beta)\hat{K}_D$	$\alpha\beta\hat{K}_M$	$(1-\alpha)L$
1997-2003	9.18	0.39	8.59	0.30	-0.05
1997-2001	8.90	0.51	8.35	0.25	-0.17
2002-2003	10.10	1.92	7.84	0.19	0.20

Source: Authors' calculation. Comprehensive Statistical Data and Materials on 50 Years of New China, Gansu Yearbook various issues, and IMF IFS various issues.

Note: K_D and K_M stand for domestic capital stock and imported capital stock respectively. See appendix for the decomposition formula. We assume the prices of domestic and imported capitals are the same. The capital expenditure share (α) is calculated as one less the share of total wage earnings to total value added for each period. The total wage earnings are obtained from the average wage rate times the total number of employees. The average wage rate is the arithmetic average of average wages in agriculture, manufacturing, and whole sale sectors.