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Openness and urbanization: The case of the People's Republic of China

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Openness and Urbanization: The Case of the People's Republic of China

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Abstract

Urbanization usually occurs with structural transformation driven by a “push” from agricultural productivity growth and a “pull” from industrial productivity growth, and usually the former exceeds the latter. This paper presents a simple model to illustrate how the open policy in the People’s Republic of China (PRC) since 1979 reversed the pattern such that the “pull” effect dominated the “push” effect during the PRC’s structural transformation and urbanization. This model helps explain why the PRC, whose industrial productivity growth exceeds its agricultural productivity growth, has experienced a standard pattern of structural transformation. The paper also demonstrates how a developing country’s business services intensity increases with its urbanization.

JEL Classification: L16; O14; O40

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1. INTRODUCTION

It has been well documented that structural transformation reflects some stylized facts among the Organisation for Economic Co-operation and Development (OECD) countries: In tandem with economic development, employment share (and value-added share) decreases in the agriculture sector but increases in the service sector (Kuznets 1966; Maddison 1980; Kongsamut, Rebelo, and Xi 2001). Ngai and Pissarides (2007) further argue that the employment share first increases but latter decreases in the manufacturing sector and follows a hump shape. Moreover, Duarte and Restuccia (2012) show that the relative share of traditional services (i.e., personal services) decreases while that of nontraditional services (i.e., business services) increases with development.[1] However, this within-service-sector structural change observed by Duarte and Restuccia (2012) is another stylized fact that has not been addressed in the literature (Herrendorf, Rogerson, and Valentinyi 2014).

There are two threads of literature about structural transformation.[2] The first corresponds to the analysis found in Kongsamut, Rebelo, and Xie (2001), in which structural change is driven by income effect but relative prices remain the same. To entail the income effects, they assume a nonhomothetic Stone–Geary utility in which agricultural goods are inferior goods with less than one income elasticity, manufacturing goods are normal goods with unity income elasticity, and service goods are superior goods with larger than one income elasticity. Since the relative prices remain the same along income growth, the manufacturing sector, which is characterized by unit income elasticity, must grow monotonically with income. As a result, this first model cannot account for one of the stylized facts: that the manufacturing sector follows a hump-shaped pattern.

The second thread corresponds to the analysis found in Ngai and Pissarides (2007) and also in Acemoglu and Guerrieri (2008), in which structural transformation is driven by changes in relative prices, but the sectoral income elasticity is of unity. Ngai and Pissarides (2007) first address the hump-shaped pattern in the manufacturing sector by assuming that all consumption goods are inelastic substitutes. Employing a homothetic constant elasticity of substitution (CES) utility function that is inelastic, their model shows that only the sector with the smallest productivity growth and the sector that produces capital goods prevail, while the other sectors that produce consumption goods eventually vanish. Their price effect approach can account for the stylized facts only when agricultural productivity grows the fastest, service productivity the slowest, and manufacturing productivity in between.

Combining the income effect (due to different elasticity of substitution in production) and the relative price effect (due to different rates of sectoral productivity growth), Gollin, Jedwab, and Vollrath (2013) introduce trade to a static model of structural transformation with the nonhomothetic Stone–Geary utility. They use this model to explain why natural resources lead the countries in sub–Saharan Africa to urbanization while not experiencing the standard pattern of structural transformation as in the developed and East Asian countries.

[1] Per Duarte and Restuccia's (2012) definition, the traditional services, consisting of domestic and household services, health and housing are mainly personal services. Their non-traditional services, consisting of communication and transport services, insurance and financial services and recreational and cultural services, are highly related to business-related services.

[2] See Herrendorf, Rogerson, and Valentinyi (2014) for a survey of the literature.

However, all the models mentioned above fail to address the stylized fact occurring within the service sector, that business services intensity increases with development and urbanization (Duarte and Restuccia 2012; Herrendorf, Rogerson, and Valentinyi 2014). In practice, for example, the financial and business services subsector in Singapore experienced the highest employment growth rate within the service industry, while the manufacturing industry shed 10% of its workers in the 1990s. In contrast, the personal services subsector in Singapore as a share of total service output declined from 40% in 1960 to 20% in 1996.[3]

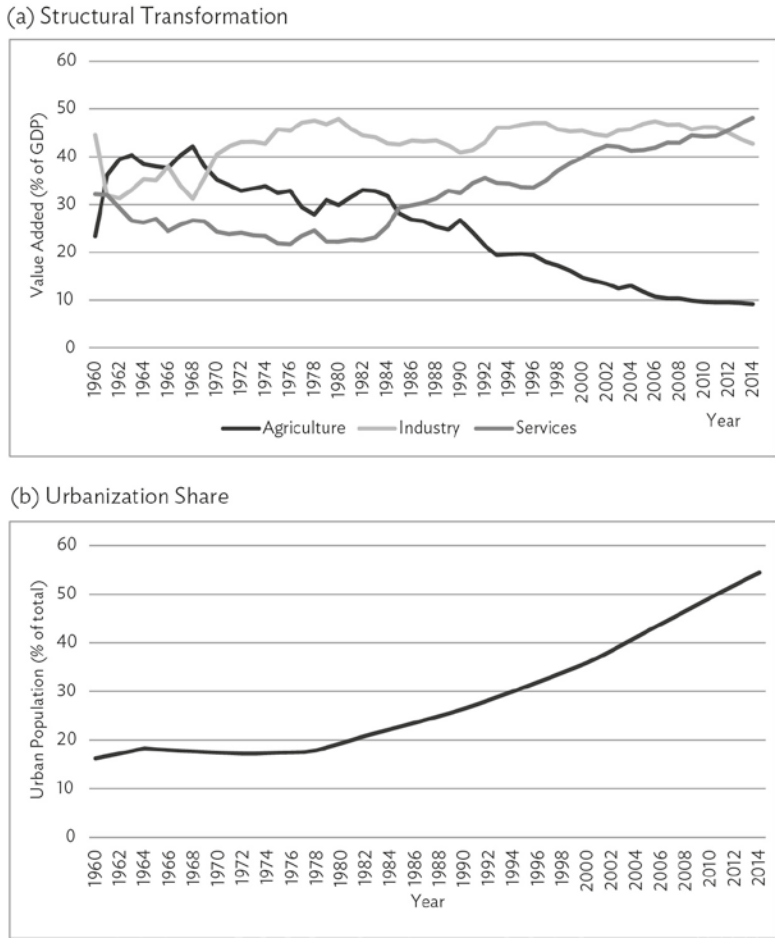
Structural transformation leads to urbanization when productivity growth in the agriculture sector decreases gradually with development due to the "pull" effect. It is crucial in the literature that, during their period of structural transformation and urbanization, OECD countries observe the greatest productivity growth in the agriculture sector, followed by the manufacturing sector, and the least productivity growth in the service sector. In addition to studying the OECD countries, there are some case studies of less developed countries: Kuznets (1966) examines not only 13 OECD countries but also former Soviet republics between 1800 and 1960, while Herrendorf, Rogerson, and Valentinyi (2014) examine the main OECD countries and the Republic of Korea as well from 1970 to 2007. These studies report that the agriculture sector ranks first in total factor productivity (TFP) growth, followed by the manufacturing sector and then the service sector. Note that the former Soviet Union (1917–1991) consisted of 15 republics—Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, the Kyrgyz Republic, Latvia, Lithuania, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Both the Republic of Korea and the former Soviet republics in the 19th century could be considered less developed countries.

However, with respect to historical evidence in the People's Republic of China (PRC), another socialist country located in East Asia, the data show that the TFP growth rate of the agriculture sector is lower than that either of the manufacturing or the service sector in the PRC (e.g., Tian and Yu 2012; Bosworth and Collins 2008). As opposed to the suggestion in the relative price effect model (e.g., Ngai and Pissarides 2007), as shown in Figure 1, the PRC's urbanization surged after it launched its opening-up policies and market-oriented reform in 1978. The PRC's TFP growth was close to zero before 1978, and most technical progress has occurred after 1978 (Tian and Yu 2012). That is, the status of the PRC economy before 1978 is quite comparable to that of OECD countries in the 19th century when structural transformation and urbanization took off in those countries.

Figure 1(a) shows that the value added of the agriculture sector decreases with development and that of the service sector increases with development, while that of the manufacturing sector displays a hump-shape in the PRC. Along with these structural transformations in the country, Figure 1(b) demonstrates that the urbanization rate increases substantially. In contrast to OECD countries in which agricultural productivity has the highest growth among sectors, the PRC, where agricultural productivity has the lowest growth among sectors, also experiences the standard pattern of structural transformation and rapid urbanization.

[3] See Monetary Authority of Singapore (1998).

Figure 1: Structural Transformation and Urbanization Share in the People's Republic of China, 1960–2014



GDP = gross domestic product.

Data source: World Bank. World DataBank. http://databank.worldbank.org/data/home.aspx.

To address the structural transformation and urbanization in the PRC, this paper develops a simple static model of structural transformation by incorporating business services into Gollin, Jedwab, and Vollrath's (2013) framework. I argue that this simple model can demonstrate all of the stylized facts in the structural transformation in a country with openness to trade. In particular, this simple model helps explain why the PRC also showed the standard pattern of structural transformation and urbanization after it adopted its open policies.

The next section presents the model in which the business services subsector is incorporated into the standard structural transformation model and how the ranking of sectoral productivity in the PRC differs from that of OECD countries. I introduce trade and comparative advantage into the model in the third section. The fourth section addresses urbanization in the PRC, which is driven by the stylized facts of within-economy and within-service-sector structural transformation. The final section concludes.

2. THE MODEL

I extend the model of Gollin, Jedwab, and Vollrath (2013) by incorporating business services, such that there are four sectors in an economy: agriculture, manufacturing, personal services, and business services.

2.1 Utility Function

Population is in inelastic supply at any time and labor is the only production factor in the economy. A representative individual has a utility function which is a composite of agricultural, personal services and modern sector goods that are aggregated with a nonhomothetic Stone–Geary utility function:

$$U_t = [\lambda_a^{1/\theta}(c_{at} - \overline{c}_a)^{(\theta-1)/\theta} + \lambda_M^{1/\theta} c_{Mt}^{(\theta-1)/\theta} + \lambda_s^{1/\theta} c_{st}{}^{(\theta-1)/\theta})^{\theta/(1-\theta)}, \tag{1}$$

where $\theta > 1$ is the elasticity of the substitution parameter and $\sum \lambda = 1$ is a share parameter. Here, c_{at} denotes consumption of agricultural goods at time t, $\overline{c}_a$ denotes consumption of subsistence food, and c_{st} denotes consumption of personal services. The good in the modern sector c_{Mt} is composed of manufacturing goods and business services, which will be discussed later. All individuals must consume at least a subsistence amount of food $\overline{c}_a$ to survive.[4] For simplicity, let us assume zero time preference and that all individuals are identical all the time so that the per-period utility can represent the lifetime utility.

The composite consumption of the modern sector good c_{Mt} in (1) is aggregated by a CES utility function:

$$c_{Mt} = [\eta^{1/\phi} c_{mt}{}^{(\phi-1)/\phi} + (1-\eta)^{1/\phi} c_{bt}{}^{(\phi-1)/\phi}]^{\phi/(1-\phi)}, \tag{2}$$

where $1 > \eta > 0$ is a share parameter. Here, c_{Mt} is consumption of manufacturing goods and c_{bt} is demand for business services. In modern times, when individuals purchase a manufacturing good, such as an automobile or a computer, they usually need financial services (e.g., purchasing this good by credit or debit card or by check), wholesale and retail service, repair, maintenance, and delivery services, among others. On the other hand, in order to produce and market manufacturing goods, a company generally needs a variety of business services, such as telecommunications, financial, marketing, accounting, consultant, legal, and transportation services. Many of these business-related services are not stand-alone for direct consumption but facilitate the manufacturing sector. That is, the manufacturing good and these business services are somehow complementary, such that it is feasible to assume that the elasticity of substitution between them is $1 > \phi > 0$ in this model.

The budget constraint of an individual is given by

$$p_{at}c_{at} + p_{mt}c_{mt} + p_{bt}c_{bt} + p_{st}c_{st} = w_t, \tag{3}$$

[4] Among others, see Kongsamut, Rebelo, and Xie (2001), Gollin, Jedwab, and Vollrath (2013), and Duarte and Restuccia (2010). However, I add health care in this subsistence bundle.

where w_t is the income of a representative individual. Here, p_{at}, p_{mt}, p_{bt}, and p_{st} denote the unit prices of a unit of agricultural good, manufacturing good, and business service and personal service at time t, respectively.

Using equations (1) through (3), the aggregate price index for the aggregate good and modern goods, respectively, could be derived as

$$P_{Ct} = [\lambda_a p_{at}^{1-\theta} + \lambda_M p_{Mt}^{1-\theta} + \lambda_s p_{st}^{1-\theta}]^{1/(1-\theta)}, \tag{4}$$

$$p_{Mt} = [\eta p_{mt}^{1-\phi} + (1-\eta) p_{bt}^{1-\phi}]^{1/(1-\phi)}. \tag{5}$$

Similar to Gollin, Jedwab, and Vollrath (2013), let us define surplus income as

$$w_t - p_{at}\overline{c}_a = zw_t, \tag{6}$$

where $z = 1 - \frac{p_{at}\overline{c}_a}{w_t}$ is the surplus share. The fraction of the surplus income that is spent on the agricultural goods, implied in equations (1), (2), and (4), is given by

$$\Omega_{at} = \frac{\lambda_a p_{at}^{1-\theta}}{P_{Ct}^{1-\theta}}. \tag{7}$$

Similarly, in equations (1), (3), and (4), the fraction of the surplus income that is spent on the personal services is

$$\Omega_{st} = \frac{\lambda_s p_{st}^{1-\theta}}{P_{Ct}^{1-\theta}}. \tag{8}$$

In equations (1), (3), (4), and (5), the fraction of the surplus income that is spent on the manufacturing goods is

$$\Omega_{mt} = \frac{\lambda_M p_{Mt}^{1-\theta}}{P_{Ct}^{1-\theta}} \frac{\eta p_{mt}^{1-\phi}}{P_{Mt}^{1-\phi}}, \tag{9}$$

and the fraction of the surplus income that is spent on the business services is given by

$$\Omega_{bt} = \frac{\lambda_M p_{Mt}^{1-\theta}}{P_{Ct}^{1-\theta}} \frac{(1-\eta) p_{bt}^{1-\phi}}{P_{Mt}^{1-\phi}}. \tag{10}$$

From equations (7) through (10), we obtain $\Omega_{at} + \Omega_{mt} + \Omega_{bt} + \Omega_{st} = 1$ in equilibrium.

2.2 Production

The production function in all sectors is simplified as

$$Y_{jt} = A_{jt} L_{jt}, \tag{11}$$

where A_{jt} is the productivity of sector j, and L_j is the total labor employed in the sector $j \in (a, m, s, b)$. Note that subscript a denotes the agriculture sector, m denotes the manufacturing input, s denotes the personal services sector, and b denotes the business services sector. Labor is freely mobile across sectors and perfect competition leads to equilibrium

$$w_t = p_{at}A_{at} = p_{st}A_{st} = p_{mt}A_{mt} = p_{bt}A_{bt}\,. \tag{12}$$

Rewriting the surplus share as $z = 1 - \frac{\overline{c}_a}{A_a}$ to get full employment equilibrium gives

$$L_t = L_{at} + L_{mt} + L_{st} + L_{bt}. \tag{13}$$

2.3 Sectoral Productivity

Kuznets (1966) examines 13 OECD countries and the former Soviet Union between 1800 and 1960; Maddison (1980) examines 16 OECD countries from 1870 to 1987; and Herrendorf, Rogerson, and Valentinyi (2014) examine Australia, Canada, Japan, the Republic of Korea, and the United States (US), as well as the aggregate 15 European Union (EU) countries from 1970 to 2007. They all report that the agriculture sector ranks first in terms of the TFP growth rate, followed by the manufacturing sector and then the service sector.

As for the service sector, Jorgenson and Timmer (2011) document substantial heterogeneity among Japan, the EU and the US. Personal services have the lowest productivity growth in both Japan and the EU.[5] In the US, however, financial and business services have the lowest productivity growth, distribution services have the highest productivity growth, and personal services are in the middle. Note that in their paper, distribution services are classified into the business services sector. Thus, according to their research, the business services sector (with distribution and financial services included) in the US still has a higher productivity growth rate than personal services (with health care included).

Therefore, I presume that productivity growth in the business services sector is greater than that in the personal services sector but not greater than that in the manufacturing sector. However, relaxing this assumption will not alter our main results, provided that the manufacturing productivity growth is sufficiently higher than the personal services productivity growth. Conclusively, as in the literature mentioned earlier, the growth rates of sector productivity in the world (e.g., OECD) are ranked as

$$\frac{\dot{A}^*_{at}}{A^*_{at}} > \frac{\dot{A}^*_{mt}}{A^*_{mt}} > \frac{\dot{A}^*_{bt}}{A^*_{bt}} > \frac{\dot{A}^*_{st}}{A^*_{st}} \text{ when } 0 \le t \le T, \tag{14}$$

where T is the period of interest Note that income grows with productivity, so that income also grows with time in the following discussion.

[5] Their results are consistent with a study by the World Bank report (Fernandes 2007), which reports that real estate and financial intermediation in the EU-8 countries exhibited the highest average labor productivity growth in 1997–2004.

3. OPEN ECONOMY

In an open economy, we assume that sector productivity is a combination of domestic and foreign contributions in Cobb–Douglas form:

$$A_{kt} = A_{kt}^{1-\mu_k} A_{kt}^{*\,\mu_k}, \tag{15}$$

where $1 \geq \mu_k \geq 0$ denotes the extent to which knowledge spillovers take effect and $k \in \{a, m, s, b\}$. Suppose that the home country is underdeveloped, such that $A_{kt}^* >> A_k$. Therefore,

$$\frac{\dot{A}_{kt}}{A_{kt}} = (1-\mu_k)\frac{\dot{A}_{kt}}{A_{kt}} + \mu_k \frac{\dot{A}_{kt}^*}{A_{kt}^*}. \tag{16}$$

In the late 1970s, the PRC opened its economy to foreign investors, leading to a large increase in manufacturing jobs. As in many developed economies, the open policy in the PRC (i.e., export-oriented policies) generally favors the manufacturing sector and leaves both the agriculture and service sectors highly protected. Thus, it is feasible to assume $\mu_m > \mu_b > \mu_s > \mu_a$ in the case of the PRC: While the manufacturing sector could experience a larger degree of knowledge spillovers from foreign investment than the other sectors, the business services sector could acquire less since its intangible nature limits its tradability (although it complements the manufacturing sector), and the agriculture sector might acquire the least due to substantial protection. As a result, in contrast to the rest of the world, as indicated in equation (14), in the case of the PRC in the period concerned, the ranking of productivity growth is supposed to be

$$\frac{\dot{A}_{mt}}{A_{mt}} > \frac{\dot{A}_{bt}}{A_{bt}} > \frac{\dot{A}_{at}}{A_{at}}, \frac{\dot{A}_{st}}{A_{st}}. \tag{17}$$

For simplicity, due to $\mu_s > \mu_a$ and the inequality in equation (15), we do not distinguish the ranking of the personal services and agriculture sectors in productivity growth.

The inequality in equation (17) is in line with several studies. For example, Tian and Yu (2012) present a meta-analysis of 5,308 observations of the TFP growth rate in the PRC from 150 published and unpublished studies and find that the average TFP growth rate in the PRC after 1978 is about 2.3%. They also find that between 1950 and 2009, the average TFP growth rate for the manufacturing sector is 7.59%, while the figures for the service and agriculture sectors are 5.5% and 2%, respectively. Meanwhile, Bosworth and Collins (2008) compare India and the PRC and reveal that the PRC's TFP growth rate in the agriculture sector is 1.7%, that of the manufacturing sector (including construction, public utilities, and mining) is 4.3%, and that of the service sector is 1.8% per year from 1978 to 2004.

The studies by Tian and Yu (2012) and Bosworth and Collins (2008) conclude that the manufacturing sector in the PRC had the greatest annual TFP growth after 1978, significantly higher than other sectors (e.g., about 2.5 times greater than the agricultural TFP growth). Comparatively, this finding in the PRC's sectoral TFP growth is quite different than in OECD countries in terms of ranking, such that the current relative price effect model cannot apply to the case of the PRC's structural transformation. This discrepancy motivates our current study.

3.1 Comparative Advantages in Tradables

As is well known, the PRC has had a comparative advantage in manufacturing goods and a disadvantage in business services since implementation of its open policy in 1978. Therefore, it is feasible to presume, in the case of the PRC, that $p_{mt} / p_{bt} < p^*_{mt} / p^*_{bt}$, where the asterisk * denotes the rest of world (particularly OECD countries). Following the open policy, the PRC has imported business services at a price of $\frac{p^*_{mt}}{p^*_{bt}} p_{mt}$. Therefore, with equations (4), (5), and (12), the productivity index of modern goods is

$$A_{Mt} = [\eta A_{mt}{}^{\phi-1} + (1-\eta)(\frac{p^*_{mt}}{p^*_{bt}} A_{mt})^{\phi-1}]^{1/(\phi-1)} = \zeta A_{mt}, \tag{18}$$

where $\zeta = [\eta + (1-\eta)(\frac{p^*_{mt}}{p^*_{bt}})^{\phi-1}]^{1/(\phi-1)}$.

Similarly, the productivity index of aggregate goods is given by

$$\begin{aligned} A_{C_t} &= [\lambda_a A_{at}{}^{\theta-1} + \lambda_M A_{Mt}{}^{\theta-1} + \lambda_s A_{st}{}^{\theta-1}]^{1/(\theta-1)} \\ &= [\lambda_a A_{at}{}^{\theta-1} + \lambda_M \zeta^{\theta-1} A_{mt}{}^{\theta-1} + \lambda_s A_{st}{}^{\theta-1}]^{1/(\theta-1)}. \end{aligned} \tag{19}$$

Incorporated with equations (6) and (19), the fraction of the surplus income that is spent on the agricultural goods in equation (7) can be rewritten as

$$\Omega_{at} = \frac{\lambda_a A_{at}{}^{\theta-1}}{A_{Ct}{}^{\theta-1}}. \tag{20}$$

Similarly, the fraction of the surplus income spending on personal services in equation (8) is

$$\Omega_{st} = \frac{\lambda_s A_{st}{}^{\theta-1}}{A_{Ct}{}^{\theta-1}}. \tag{21}$$

Incorporated with equations (18) and (19), the fraction of the surplus income that is spent on the manufacturing goods in equation (9) can be rewritten as

$$\Omega_{mt} = (\frac{\lambda_M A_{Mt}{}^{\theta-1}}{A_{Ct}{}^{\theta-1}})(\frac{\eta A_{mt}{}^{\phi-1}}{A_{Mt}{}^{\phi-1}}) = \eta \zeta^{\theta-\phi} (\frac{\lambda_M A_{mt}{}^{\theta-1}}{A_{Ct}{}^{\theta-1}}), \tag{22}$$

and the fraction of surplus income that is spent on the business services in equation (10) can be rewritten as

$$\Omega_{bt} = (\frac{\zeta^{\phi-1} - \eta}{\zeta^{\phi-\theta}})(\frac{\lambda_M A_{mt}{}^{\theta-1}}{A_{Ct}{}^{\theta-1}}). \tag{23}$$

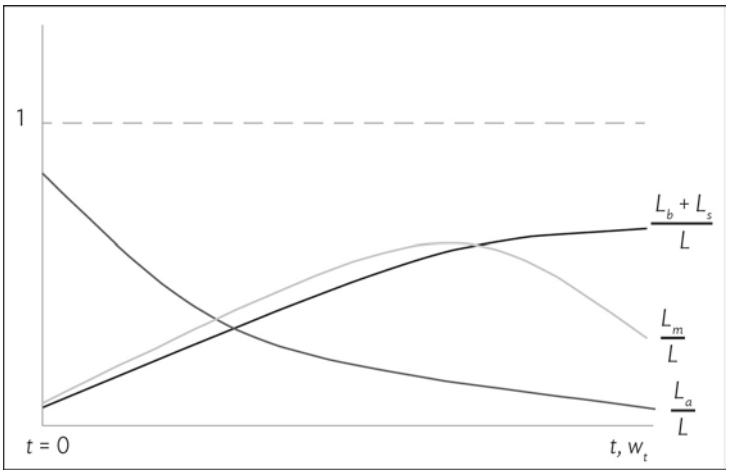
4. STRUCTURAL TRANSFORMATION AND URBANIZATION

Now let us calculate the fraction of employment in each sector, which is also the sectoral value-added share in gross domestic product (GDP). With equations (6) and (20), the fraction of labor employed in the agriculture sector is given by

$$\frac{L_a}{L} = 1 - (1 - \frac{\overline{c}_a}{A_{at}})[\frac{\lambda_M \zeta^{\theta-1} A_{mt}{}^{\theta-1} + \lambda_s A_{st}{}^{\theta-1}}{A_{Ct}{}^{\theta-1}}]. \tag{24}$$

It is easy to determine that, with $\theta > 1$ and the inequality in equation (17), equation (24) increases with development along the time axis, as shown in Figure 2. In line with Gollin, Jedwab, and Vollrath (2013), a green revolution (an increase in A_{at}) leads to the "push effect" and an industrial revolution (an increase in A_{mt}) leads to the "pull effect" in the agriculture sector.

Figure 2: Employment Shares of All Sectors



Note: Employment in the manufacturing sector (L_m) and service sector ($L_b + L_s$) constitute urban population, and L_a is agricultural employment.

Source: Author.

With equations (6) and (22), the fraction of labor employed in the manufacturing sector is

$$\frac{L_m}{L} = \eta \lambda_M \zeta^{\theta-\phi} (1 - \frac{\overline{c}_a}{A_{at}})(\frac{A_{mt}}{A_{Ct}})^{\theta-1}. \tag{25}$$

With $\theta > 1 > \phi$ and the inequality in equation (17), both the second and third terms in equation (25) increase with development along the time dimension. However, as implied in equation (14), we can rewrite $\zeta = [\eta + (1-\eta)(\frac{p^*_{mt}}{p^*_{bt}})^{\phi-1}]^{1/(\phi-1)}$ $= [\eta + (1-\eta)(\frac{A^*_{mt}}{A^*_{bt}})^{\phi-1}]^{1/(\phi-1)}$, indicating that ζ decreases with time. On net, it turns out

that $\frac{L_m}{L}$ presents a hump-shape with development along the time axis, as shown in Figure 2.

Similarly, with equations (6) and (21), the fraction of labor employed in the personal services sector is given by

$$\frac{L_s}{L} = (1 - \frac{\overline{c}_a}{A_{at}})(\frac{\lambda_s A_{st}^{\theta-1}}{A_{Ct}^{\theta-1}}). \tag{26}$$

In an analysis similar to that in equation (25), with $\theta > 1$ and the inequality in equation (17), labor employment in the personal services sector starts at a low level and slowly increases with development, as shown in Figure 2. This argument is in line with Herrendorf, Rogerson, and Valentinyi (2014), who documented that the employment share of the agriculture sector could have been as high as 70% and the employment share of the manufacturing and service sectors could have been as low as 10% before 1970 in OECD countries, implying that the employment share of personal services is fairly low at the beginning of the period covered. Therefore, we can illustrate that the share of employment in the personal services sector also follows a hump-shape as in the manufacturing sector. This is consistent with the observation in Singapore, where the share of personal services in the total service sector climbed to 40% in 1960 and then dropped to 20% in 1996.

With equations (6) and (23), the fraction of labor employed in the business service sector is

$$\frac{L_b}{L} = (1 - \frac{\overline{c}_a}{A_{at}})(\frac{\zeta^{\phi-1} - \eta}{\zeta^{\phi-\theta}})(\frac{\lambda_M A_{mt}^{\theta-1}}{A_{Ct}^{\theta-1}}). \tag{27}$$

As we already know that ζ decreases with time, it is easy to determine that $(\frac{\zeta^{\phi-1} - \eta}{\zeta^{\phi-\theta}})$ increases with time (and development) when $\theta > 1 > \phi$. As a result, all three terms in brackets in equation (27) increase with development over time.

Then, let us define business services intensity as

$$\frac{L_b}{L_s} = (\frac{\zeta^{\phi-1} - \eta}{\zeta^{\phi-\theta}})(\frac{\lambda_M A_{mt}^{\theta-1}}{\lambda_s A_{st}^{\theta-1}}). \tag{28}$$

To sum up, from equations (26) and (27), business services intensity is monotonically increasing with development over time. Equation (28) also demonstrates a within-service sector divergence: The business services sector may exceed the personal services sector in value added and employment in a developed economy. Combining equations (26) and (27), total employment in the service sector is

$$\frac{L_b + L_s}{L} = (1 - \frac{\overline{c}_a}{A_{at}})\left[(\frac{\lambda_s A_{st}^{\theta-1}}{A_{Ct}^{\theta-1}}) + (\frac{\zeta^{\phi-1} - \eta}{\zeta^{\phi-\theta}})(\frac{\lambda_M A_{mt}^{\theta-1}}{A_{Ct}^{\theta-1}})\right], \tag{29}$$

which increases with development over time.

4.1 Structural Transformation

It is worth noting that since $\frac{\zeta^{\phi-1}-\eta}{\zeta^{\phi-\theta}}$ increases with development over time, as implied in the inequality in equation (14), equation (28) also implies that more developed economies tend to have higher business services intensity. This argument is in line with Duarte and Restuccia (2012), who assert that the relative share of traditional services (i.e., personal services) in the total service sector decreases with income, while that of nontraditional services (i.e., business services) in the total service sector increases with development.

With equations (24) through (29), we can then summarize the employment share across sectors all together, as illustrated in Figure 2. Initially, the agriculture sector has the greatest income share (and employment share), while both the manufacturing and service sectors are remotely low behind.[6] Over time, as incomes increase as productivity grows, the agriculture sector gradually drops to well below the other two sectors in terms of income share (and employment share) due to the so-called "green revolution" and "industrial revolution." The service sector's income share (and employment share) increases to become the highest income versus the other two sectors. The share of the manufacturing sector first increases but later decreases with income, following a hump shape. This illustration is consistent with the stylized facts from Kuznets and is in line with the current literature regarding structural transformation.

4.2 Urbanization

Let us presume that workers in the manufacturing and business services sectors, as well as in the personal services sector constitute the urban population. In equations (25) and (29), the urbanization rate in the economy could be described as

$$\frac{L_m+L_b+L_s}{L}=(1-\frac{\overline{c}_a}{A_{at}})(\frac{\lambda_s A_{st}^{\ \theta-1}+\zeta^{\phi-1}\lambda_M A_{mt}^{\ \theta-1}}{A_{Ct}^{\ \theta-1}}). \tag{30}$$

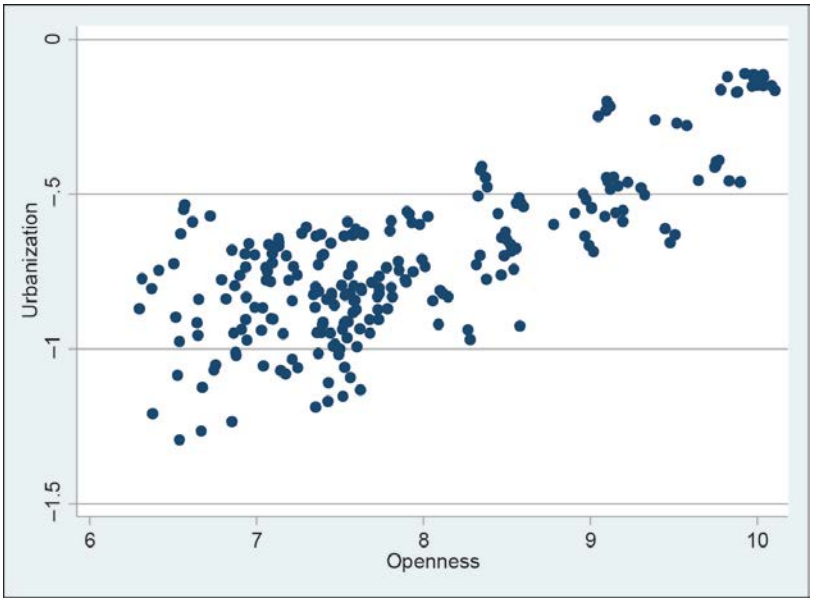
In the literature, an increase in productivity in the agriculture sector leads to the "push" effect, relocating labor to cities, and an increase in productivity in the modern sector leads to the "pull" effect, giving rise to urbanization. Nevertheless, the urbanization in the literature, as indicated in the inequality in equation (14), is mainly driven by the "push" effect. That is, productivity growth in agriculture has to outstrip that in the other sectors to give rise to the structural transformation and urbanization. However, in contrast to the current literature, as highlighted in our inequality equation (17), openness to trade also helps reshape an economy's structural transformation, such that the "pull" effect might dominate the "push" effect, at least in the case of the PRC.

The intuition is clear. With its open policy and consequent knowledge spillovers from advanced countries, the PRC's productivity has grown substantially in the manufacturing sector (i.e., A_{mt}) in comparison to the other sectors, such that PRC manufacturing goods have gained more comparative advantage in world markets and thus have been exported more. The increase in output and exports in the manufacturing sector leads to the "pull" effect, attracting labor from the agriculture

[6] We assume that labor is freely mobile across sectors, so that the sectoral income shares are equal to the sectoral employment share in the model.

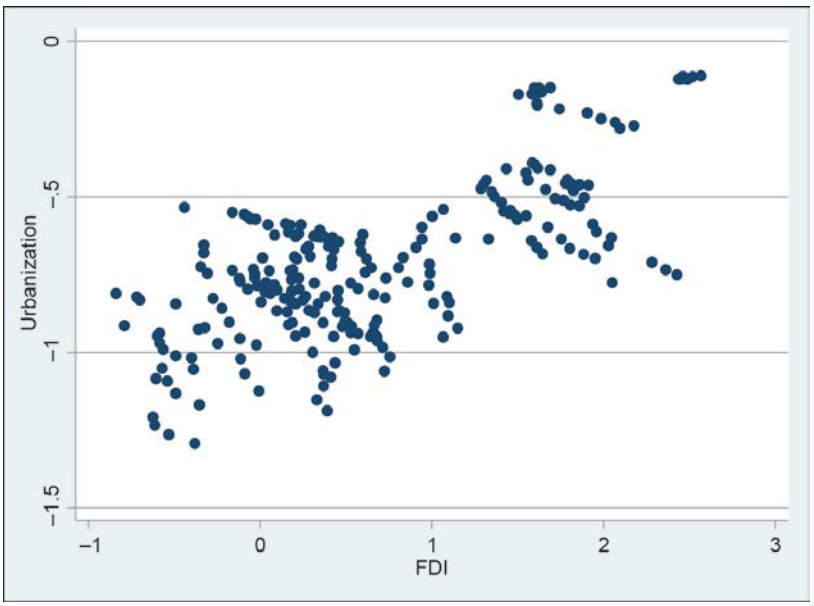
sector to the manufacturing sector. As implied in equation (30), an open policy alone is able to promote an economy's structural transformation and urbanization. As a result, the open policy since 1989 has accelerated the structural transformation and urbanization in the PRC. This argument finds support from real data, as illustrated in Figures 3 and 4, where I use province-level data in the PRC to examine whether urbanization increases with both openness and foreign direct investment (FDI).

Figure 3: Urbanization and Openness across Provinces in the People's Republic of China, 2006–2013



Source: Annual data from the National Bureau of Statistics of the People's Republic of China, 2006–2013.

Figure 4: Urbanization and FDI across Provinces in the People's Republic of China, 2006–2013



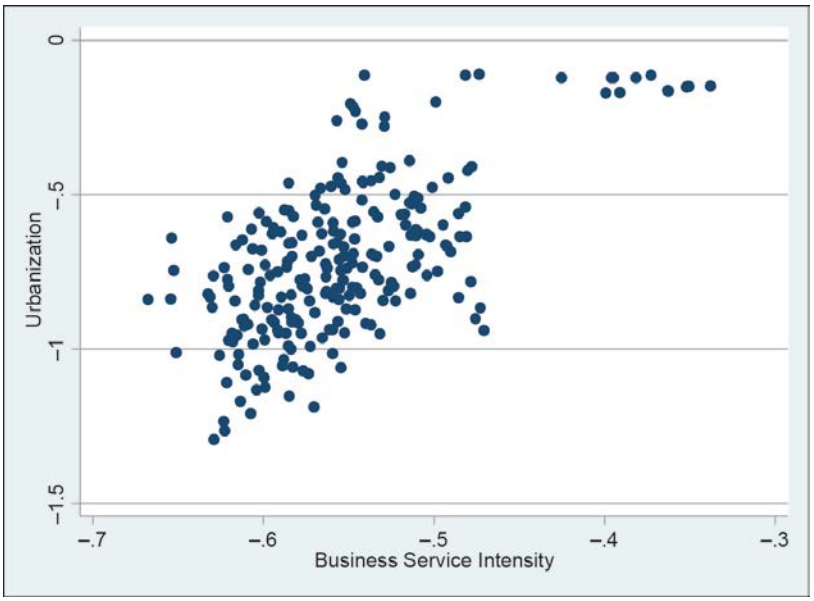
FDI = foreign direct investment.

Source: Annual data from the National Bureau of Statistics of the People's Republic of China, 2006–2013.

There are mainly 30 administrative divisions (provinces, municipalities, and autonomous areas) in the PRC.[7] In conventional ways, I define a division's urbanization rate as the share of its urban population in the total population, openness as the share of a division's imports plus exports relative to its GDP, and FDI as the share of utilized FDI in a division relative to its GDP. I collect these province-level data from 2006 through 2013 from the PRC's National Bureau of Statistics. As shown in Figures 3 and 4, these regional urbanization rates logarithmically increase with the country's openness and FDI, respectively.

The case of the PRC also supports the stylized fact occurring within the service sector that both Duarte and Restuccia (2012) and Herrendorf, Rogerson, and Valentinyi (2014) point out: Business services intensity increases with development and urbanization. In contrast to traditional services, the business services here consist of information transmission, computer services, and software; financial intermediation; real estate; leasing and business services; education; scientific research, technical services, and geological prospecting; and public management and social organizations. Business services intensity is defined as the ratio of business services to the total regional service sector in terms of value. As shown in Figure 5, urbanization rates in the PRC logarithmically increase with business services intensity, which further confirms the hypotheses in this paper.

Figure 5: Urbanization and Business Services Intensity in the People's Republic of China, 2006–2013



Source: Annual data from the National Bureau of Statistics of the People's Republic of China, 2006–2013.

[7] I drop the Tibet Autonomous Region in the plots in Figures 3 and 4, since it is an outlier in many aspects.

5. CONCLUSIONS

In the current literature, the ranking of productivity growth among sectors is crucial to the stylized structural transformation (e.g., Gollin, Jedwab, and Vollrath 2013). However, I have extended their model to show that, even reversing the ranking of their sectoral productivity growth, the structural transformation in a country presents similar stylized facts and urbanization after opening to trade. This model helps explain why the PRC, whose agriculture sector ranks last in terms of productivity growth and whose manufacturing sector ranks first, has experienced a pattern of industrialization and urbanization similar to that in OECD countries. I argue that it is the open policy in the PRC that makes the difference. This current model also supports the stylized fact addressed by Duarte and Restuccia (2012) that business services intensity increases with development.

REFERENCES*

Acemoglu, D., and V. Guerrieri. 2008. Capital Deepening and Non-balanced Economic Growth. *Journal of Political Economy* 116(3): 467–498.

Bosworth, B., and S. M. Collins. 2008. Accounting for Growth: Comparing China and India. *Journal of Economic Perspectives* 22(1): 45–66.

Duarte, M., and D. Restuccia. 2010. The Role of the Structural Transformation in Aggregate Productivity. *Quarterly Journal of Economics* 125: 129–173.

———. 2012. Relative Prices and Sectoral Productivity. Manuscript, University of Toronto.

Fernandes, A. M. 2007. Structure and Performance of the Services Sector in Transition Economies. Word Bank Report WPS4357.

Gollin, D., R. Jedwab, and D. Vollrath. 2013. Urbanization with and without Structural Transformation. Manuscript.

Government of Singapore, Monetary Authority of Singapore. 1998. Singapore's Services Sector in Perspective: Trends and Outlook. Occasional Paper No. 5.

Herrendorf, B., R. Rogerson, and A. Valentinyi. 2014. Growth and Structural Transformation. *Handbook of Economic Growth* 2: 855–941.

Jorgenson, D. W., and M. P. Timmer. 2011. Structural Change in Advanced Nations: A New Set of Stylized Facts. *Scandinavian Journal of Economics* 113: 1–29.

Kongsamut, P., S. Rebelo, and D. Xie. 2001. Beyond Balanced Growth. *Review of Economic Studies* 68: 869–882.

Kuznets, S. 1966. *Modern Economic Growth: Rate, Structure, and Spread*. New Haven: Yale University Press.

Maddison, A. 1980. Economic Growth and Structural Change in the Advanced Countries. In *Western Economies in Transition: Structural Change and Adjustment Policies in Industrial Countries*, edited by I. Leveson and J. W. Wheeler. London: Croom Helm. pp. 41–65.

Ngai, L. R., and C. A. Pissarides. 2007. Structural Change in a Multisector Model of Growth. *American Economic Review* 97: 429–443.

Tian, X., and X. Yu. 2012. The Enigmas of TFP in China: A Meta-Analysis, *China Economic Review* 23(2): 396–314.

* The Asian Development Bank refers to "China" as the "People's Republic of China."