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From the Digital Divide to the Connectivity Dividend Difference: A Connectivity Capital Perspective*

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接入鸿沟曾是数字鸿沟的基本形态。互联网基础设施的发展使接入鸿沟缩小、应用覆盖性增强，也触发了互联网红利差异。在互联网资本框架下，以互联网市场为例，对红利差异来源和影响红利差异机制进行考察发现：接入鸿沟缩小带来的是连通性的增强和平台的发展，这使人们有机会把以往投入的各类资产在互联网上转化为有差别的、组合性的互联网资本并从中受益；其中，转化规模差异和转化率差异既受两个“乘数效应”的影响，更受互联网平台的影响，并最终表现为红利差异。

关键词：互联网资本　互联网红利　互联网红利差异　乘数效应　数字鸿沟

The access divide was once the basic form of the digital divide. The development of Internet infrastructure has narrowed the access divide and increased application coverage, but it has also touched off a connectivity dividend difference. Taking the online market as an example, we examine the sources of the dividend difference and the factors influencing it with in a connectivity framework. We found that the narrowing of the access divide has resulted in enhanced connectivity and platform development, giving people the chance to benefit from transforming the various assets in which they have previously invested into differentiated compound connectivity capital. In the course, the scale and rate of the conversion are affected by two multiplier effects and especially by online platforms. The process is ultimately expressed in the dividend difference.

Keywords: connectivity capital, connectivity dividend, connectivity dividend difference, multiplier effect, digital divide

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I. Theoretical Questions about Two Phenomena

The popularization of Internet technology applications has made it an important part of human social and economic life. In urban areas, people's work and daily life are inseparable from the Internet, and rural areas have first adopters who claim "Opening online store on Taobao beats scratching a living away from home." Internet technology applications have had a profound impact on human society. In this context, two phenomena are worth noting:

The first is the development of the digital divide. In 2004, after reviewing the literature, DiMaggio *et al*. suggested that the digital divide had gone through two phases: the digital divide arising from differences in access opportunities and the digital inequality resulting from differences in Internet usage.[1] Previously, DiMaggio and Hargittai had found that users with high levels of education, high incomes, and high scores in cognitive tests were more inclined to use the Internet to "accumulate capital" rather than simply for entertainment.[2] Bonfadelli came to a similar conclusion.[3] However, although DiMaggio *et al*. took note of the connection between Internet use and capital accumulation, they did not delve into the kind of capital accumulated or the mechanisms responsible for its accumulation.

The second is the emergence of the digital dividend.[4] According to data from China's Ministry of Commerce,[5] the volume of China's e-commerce transactions grew at an average annual rate of more than 35 percent between 2011 and 2015, reaching 20.8 trillion yuan in 2015, and average annual growth in online retail sales exceeded 50 percent, with sales volume reaching 4 trillion yuan in 2015, the highest in the world. *The China Taobao Village Research Report (2015)*[6] pointed out that the number of "Taobao Villages" in China increased from 20 in 2013 to 780 in 2015, with the latter figure representing a 268 percent increase over the previous year. The Villages are distributed over 17 provinces, municipalities, and autonomous regions. In some areas, "Taobao Villages" and "Taobao Towns" have become pillars of the local economy.[7]

Given this situation, we need to pursue the following questions: where does the digital

1 Paul DiMaggio, Eszter Hargittai, Coral Celeste and Steven Shaferl, "From Unequal Access to Differentiated Use: A Literature Review and Agenda for Research on Digital Inequality."

2 Paul DiMaggio and Eszter Hargittai, "From the 'Digital Divide' to Digital Inequality: Studying Internet Use as Penetration Increases."

3 Heinz Bonfadelli, "The Internet and Knowledge Gaps: A Theoretical and Empirical Investigation," pp. 65-84.

4 "Digital dividend" is a concept that the World Bank sought to promote in 2016. See World Bank, *World Development Report 2016: Digital Dividends (Overview of Chinese Version)*, p. 2.

5 See Xinhuanet, "National E-Commerce Transaction Volume Expected to Reach 20.8 Trillion Yuan in 2015."

6 *The China Taobao Village Research Report* is an annual research report released by Ali Research Institute on the development of e-business in rural areas.

7 For example, Suining County, Xuzhou City in Jiangsu; Lishui City in Zhejiang; Boxing County, Binzhou City, Shandong; Wugong County, Xianyang City, Shaanxi, etc.

dividend come from? What is the relationship between the digital dividend, "accumulated capital," and the digital divide? If the Internet access divide led to the connectivity dividend difference, will the latter continue to exist once the access divide is nearly bridged? What is behind it?

In discussing these issues, our approach is one of "dialogue between theoretical construction and empirical fact." We first review the development of the digital divide, using the online market as a means to explore the mechanisms generating and influencing the gap in online usage, and then explore the circumstances affecting the transformation of a variety of asset forms into online capital. This brings to light the hidden social facts behind the digital dividend gap.

II. The Development of Access Facilities and the Shift in the Digital Difference

With the emergence of information and communication technology (ICT abbreviated below as the Internet), people became aware that connectivity would bring different development opportunities to different groups. In the broad sense, the digital divide refers to the difference between "haves and have-nots" and "users and non-users" in relation to online access and usage among different social groups in a given society.[8] It is worth noting that different interpretations of the "usage divide" reflect different approaches to understanding the digital divide, either in terms of accessibility, or, once access has been obtained, in terms of the usage gap ("using for what"). The former refers to national public policy and infrastructure supply, the latter to inequalities arising from differential use of online technology.

1. Narrowing of the accessibility divide

In terms of accessibility, the first point to draw attention was the divide among different countries and different groups. For example, O'Hara and Stevens define the digital divide as the gap between the information rich and the information poor,[9] while Mack defines it in terms of racial differences in access to information channels.[10]

In China, it was not until 1995, when Yinghaiwei Co. Ltd., (i.e., "Information Highway") was set up, that a public access channel was truly created. Between 1997 and 2000, the number of Internet users increased from 620,000 to 16.9 million. Salient user group characteristics included the following: male; with or currently in higher education; aged 18 to 30; resident in Beijing, Shanghai, or Guangdong; and working in education, R&D, IT or government agencies.[11] In subsequent Internet development, three key factors have worked to reduce the accessibility divide: infrastructure, facilities and the utility of the Internet.

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8 Fabiola Riccardini and Mauro Fazio, "Measuring the Digital Divide"; Nicoletta Corrocher and Andrea Ordanini, "Measuring the Digital Divide: A Framework for the Analysis of Cross-Country Differences," pp. 9-19.

9 Kieron O'Hara and David Stevens, *Inequality.com: Power, Poverty and Digital Divide*.

10 Raneta Lawson Mack, *The Digital Divide: Standing at the Intersection of Race and Technology*.

11 Qiu Zeqi, "The Digital Divide in Chinese Society."

The first factor was the expanded coverage of infrastructure that facilitated access. The early Internet providers had been educational institutions, information enterprises and government agencies; this created an accessibility divide in terms of coverage. Broadband and Wi-Fi have greatly improved accessibility in urban areas, and with the development of the "Connecting Every Village" project, more than 97 percent of townships had Internet access by the end of 2007, and 92 percent even had broadband access.[12]

Second, the growing convenience of Internet facilities has significantly lowered the threshold for Internet access. The initial threshold was high and required specific skills, but a turning point for Internet accessibility was reached with the development of devices such as smart phones and tablet PCs, which provided access opportunities for many more people. According to CNNIC data,[13] China had 656 million mobile phone users connected to the Internet by June 2016, accounting for 92.5 percent of the total number of Internet users.

Third, the growing utility of the Internet has effectively encouraged access action. In the early days of China's Internet development, the numbers and types of online resources were extremely limited, and they had little relevance to people's work and daily life.[14] At the time, relatively few institutions and industries used the Internet; the majority had no need of it. However, the influence of the first two factors did lead to an increase in the number of users, which in turn led to greater connectivity,[15] and thence to greater online utility. This process of positive reinforcement promoted user access. According to CNNIC data for 2015,[16] even in rural areas some 77.14 million internet users had experienced online shopping, accounting for 43.2 percent of all rural users. This figure represented an increase of 12.1 percent over 2013.

It can be seen from the above that the digital divide was initially manifest in the distinction between haves and have-nots with regard to access. Even if one had access, it was only to individual local networks. The question of Internet utility had little impact on people's work and daily life, or on society and the economy; groups on either side of the access gap were not perceptibly unequal. At the time, most discussion of inequality came from government and academic forecasts of future trends. The topic's influence on public policy at home and abroad led to increased accessibility.

2. Post-access: differences in usage

With the narrowing of the accessibility divide, a series of new questions arose as people

12 See Zhang Xinhong, Yu Fengxia and Peter Luo, *Focusing on the "Fourth Divide": A Comparative Study of the Digital Divide between China and Europe*.

13 China Internet Network Information Center, *Statistical Report on Internet Development in China (July 2016)*, p. 12. It is worth noting that the development of urbanization has enabled many rural Internet users to get into urban areas, thus to some extent concealing the achievements of Internet popularization in rural areas. The proportion of rural users should actually be much higher.

14 Juha Nurmela and Marja-Liisa Viherä, "Patterns of IT Diffusion in Finland: 1996-2002," pp. 20-35.

15 Qiu Zeqi, Fan Zhiying, and Zhang Shuqin, "Back to Connectivity: The Historical Turn in Social Network Research."

16 China Internet Network Information Center, *2014 Research Report on Rural Internet Development (May 2015)*, pp. 38-40.

began to become aware of differences in Internet usage. Qiu Zeqi believes that, for given conditions of accessibility, use of the Internet to change one's socioeconomic status has become a new dimension of social stratification, in a break with the decisive influence of occupation on social mobility.[17] Jan van Dijk *et al.* believe that the possession, skills, and use of IT will have a complex influence on social inequality.[18] Hargittai uses different groups' ability to retrieve information as a means of measuring differences in their Internet use,[19] and DiMaggio *et al*., using the traditional dichotomies (with/without Internet access; Internet user or non-user), look at how the usage gap in terms of equipment, initiative, skills, social support, and purposes of Internet use affects different groups, emphasizing that the usage gap is a further development of the digital divide.[20]

Some scholars go further and focus on differences in the purposes of Internet use, as presented in the first phenomenon or situation discussed in this paper. Hao Dahai and Wang Lei used CFPS data to examine the influence of socioeconomic status on Internet use, obtaining results consistent with Bonfadelli's,[21] and Wei Lu and Zhang Mingxin used 2004 Pew Research Center political communication data to show that under conditions of equal access, people use the Internet in very different ways, giving rise to differences in political knowledge.[22]

In short, it has been observed that as access opportunities become more equal, differences in usage begin to emerge. Some studies have pursued the question of whether this usage divide reflects new forms or developments in social inequality in the information age,[23] while others have explored the distinctive features of this inequality and ways in which it can be improved by public policy.[24] What this paper attempts to ask is, if the usage gap leads to inequality, how does this occur? That is, what are the consequences of the usage gap for users? What produces these consequences? And what are the main influencing factors?

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17 Qiu Zeqi, "The Digital Divide in Chinese Society."

18 Jan van Dijk and Ken Hacker, "The Digital Divide as a Complex and Dynamic Phenomenon," pp. 315-326.

19 Eszter Hargittai, "Second-level Digital Divide: Differences in People's Online Skills."

20 Paul DiMaggio *et al*., "Digital Inequality: From Unequal Access to Differentiated Use: A Literature Review and Agenda for Research on Digital Inequality."

21 Hao Dahai and Wang Lei, "Regional Differences or Differences in Social Structure?: A Multilevel Model Analysis of the Digital Divide among Chinese Residents."

22 Wei Lu and Zhang Mingxin, "The Third Digital Divide: The Knowledge Gap on the Internet."

23 Jan van Dijk, "Evolution of the Digital Divide: The Digital Divide Turns to Inequality of Skills and Usage," pp. 57-75; Avi Goldfarb and Jeff Prince, "Internet Adoption and Usage Patterns Are Different: Implications for the Digital Divide," pp. 2-15.

24 Paul DiMaggio *et al*., "Digital Inequality: From Unequal Access to Differentiated Use: A Literature Review and Agenda for Research on Digital Inequality"; Amy Bach, Gwen Shaffer and Todd Wolfson, "Digital Human Capital: Developing a Framework for Understanding the Economic Impact of Digital Exclusion in Low-Income Communities," pp 247-266.

III. The Connectivity Dividend and the Connectivity Dividend Difference

Although equipment, skills, mode of use and purpose of use are all dimensions that measure differences in Internet usage, we believe that a more important dimension is the socioeconomic consequences arising from Internet usage.

1. The connectivity dividend

The direct outcome of differences in Internet usage is that some people are gaining socioeconomic benefits. We refer to the surplus revenue generated by Internet use as the connectivity dividend. The development of China's online commercial platforms clearly demonstrates the connectivity dividend produced by "Internet Plus."

Sun Han is a villager of Dongfeng Village, Shaji Town, Suining County, Xuzhou City, Jiangsu Province. In 2006, when the villagers were still devoting themselves to township industry, he opened an online store on Taobao and earned his first bucket of gold. His success encouraged a boom in Internet commerce in his home village. By 2015, the village had more than 6,500 e-business people, with more than 8,100 online stores, 1,590 factories, and sales revenue exceeding 4 billion yuan. The village's commerce extends not only to urban and rural areas in China, but also to scores of countries and regions overseas.[25]

Villages like Dongfeng have proliferated in rural China since 2013, developing different product types and development models. All the models, regardless of their differences, show that online usage has brought better returns than traditional business models; that is, users enjoy a connectivity dividend.

2. The connectivity dividend difference

Although the application of Internet technology has provided people with equal opportunities to benefit, this does not mean that all users will benefit equally. We define the difference in the benefits obtained by different groups, regions and urban/rural dwellers from the connectivity dividend as the connectivity dividend difference (abbreviated as "dividend difference"). These contrasts are not only noticeable in affluent countries, but also increasingly apparent in developing countries. China exhibits similar phenomena and trends.[26]

In China, one sees not only industry differences but also regional differences in the connectivity dividend. The industries that benefit most are still the creative industries, and the regions that benefit most are mainly located in the southeastern coastal area. This is consistent with the state of industrial and regional development since the 1980s.[27] According to the *China Information Society Development Report* issued by the State Information Center in

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25 Unless otherwise indicated, the data on Dongfeng Village came from the author's field research in Suining County, Jiangsu, in January 2016. For a vivid illustration, see Chen Hengli, *The First Taobao Village in China*.

26 World Bank, *World Development Report 2016: Digital Dividend (Overview of the Chinese Version)*, p. 2.

27 Wei Houkai, "Township Enterprise Development and Regional Disparities in China."

2015,[28] the average annual compound growth rates of the information society index in China's eastern, central, and western regions from 2007 to 2015 were 6.15 percent, 6.43 percent, and 7.08 percent respectively. However, in terms of absolute value, the gap between the eastern and western regions increased from 0.1248 to 0.1760 during the same period, and this gap is widening. Even among the emerging Taobao Villages, a connectivity dividend difference exists between different groups and regions.[29]

The facts prove that the narrowing of the access divide does not eliminate differences in Internet usage between different groups, regions and urban/rural domicile. Moreover, the distribution of the connectivity dividend arising from Internet usage and the distribution of the industrialization dividend appear to be isomorphic for different groups, regions and urban/rural domicile. We found that of the 780 Taobao Villages in 2015,[30] 17 were in seven provinces and municipalities in the central and western region; over the previous year, the number of Taobao Villages in nationally designated poverty counties had increased from four in the previous year to ten, and the number in provincial-level poverty counties had reached 166.

What, then, are the factors that affect the connectivity dividend difference between groups, regions and urban and rural dwellers, and how is it related to the industrialization dividend?

IV. How Does Connectivity Capital Affect the Dividend Gap?

Here we put forward the analytical framework of connectivity capital. Our thesis is that the root cause of the dividend gap lies in differences in connectivity capital and its usage among individuals, groups, regions and urban and rural dwellers.

1. Internet capitalization of assets

In discussions of the digital divide, DiMaggio and Hargittai speak of "accumulated capital," while Bach *et al*. refer to "digital human capital."[31] They believe that human capital and the knowledge economy constitute the foundation of digital human capital and that the Internet is increasingly becoming a tool for transforming human capabilities into production, education, and participation in society. However, digital human capital alone is not enough to explain the connectivity dividend difference.

Other studies link the Internet to social capital. However, most of these see social capital as a dependent variable and do not link it to the connectivity dividend difference. For instance, Huang Ronggui *et al*. hold that Internet usage helps individuals expand and maintain their social networks.[32] Fu Xiaoyan argues that users' Internet literacy in terms of social networking

28 State Information Center, *China Information Society Development Report, 2015*.
29 Alibaba (China) Co. Ltd.,*Taobao Villages in China*.
30 Ali Research Institute, *Research Report on China's Taobao Villages, 2015*, pp. 9-10.
31 Amy Bach, Gwen Shaffer and Todd Wolfson, "Digital Human Capital: Developing a Framework for Understanding the Economic Impact of Digital Exclusion in Low-Income Communities."
32 Huang Ronggui, Luo Tianjue, and Gui Yong, "The Impact of the Internet on Social Capital: An Empirical Study Based on Internet Activity."

tools, networking structures and content affect their accumulation of "virtual social capital."[33] Deng Jianguo's research shows that users of blogs, classified websites, and social networking websites have more online trust than non-users.[34] The problem with such studies, however, is that increases or decreases in social capital do not directly explain the dividend gap.

We define "capital" as assets formed by consolidating past inputs that provide market entry opportunities and can therefore accrue market benefits. It is both a factor and a specific social mechanism; hence it can be regarded as a developmental factor in specific social mechanisms with a given content.

Hernando de Soto holds that the world's poor possess a variety of assets ranging from labor to material assets such as housing, land, and natural resources. If these assets cannot enter the market, they are "dead capital." He emphasizes the significance of gaining "real ownership" and the conversion of assets into capital to lift the poor out of poverty.[35] Unlike Soto, we explore the conversion of the assets of different Internet technology users to capital under given connectivity conditions together with the mechanisms from which they benefit.

The process of converting assets into capital, that is, the process by which assets enter the market, is called capitalization.[36] In this process, capital growth can occur in two ways. The first is intensive capital growth, involving increasing the degree of capitalization: for a given volume of assets, the higher the degree of capitalization, the higher the capital growth. Second is extensive capital growth, involving increasing the volume of assets. For a given degree of capitalization, an increase in the quantity of assets means an increase in capital. This can be expressed as:

$$c_s = tr_a \times a_v$$

In the formula, c_s is capital from single asset; tr_a is the transferring rate of the asset, or degree of capitalization; and a_v is the volume of assets that can be converted.

If we apply de Soto's logic to Internet usage, we find that in the Internet market, the conversion of assets to capital means both an expansion of asset volume and an increase in the degree of asset capitalization. Therefore, connectivity capital is:

$$Cc = \sum_{s=1}^{n} c_s;\ (n = 1, 2, \cdots k)$$

That is, under given connectivity conditions, C_c (connectivity capital) is the sum of each

33 Fu Xiaoyan, "The Construction of 'Virtual Social Capital' for Chinese Netizens: An Empirical Study Based on Their Internet Adoption Process."

34 Deng Jianguo, "A Survey of the Relationship between Internet User Behavior and Citizens' Social Capital in the Web 2.0 Era."

35 Hernando de Soto, *The Mystery of Capital*. Note that unlike the authors of this paper, de Soto does not strictly differentiate between "assets" and "capital." We do make such a distinction, referring to those that are unconverted as "assets" and those that have been transformed via the Internet market as "capital."

36 In the economic literature, "capitalization" is often used for the present value derived from the asset reference rate. The capitalization discussed here is different, referring as it does to the conversion of assets to capital in de Soto's sense.

type of converted capital (c_5).

Product reputation, technological capacity, and even fragmented time all belong to "dead capital" in de Soto's sense. The application of Internet technology provides an opportunity to activate these dead assets, turning assets that had previously been difficult to convert into capital into Internet capital. We therefore define "connectivity capital" as any asset formed by past investments that has access to and can benefit from the Internet market.

2. Characteristics of connectivity capital

The application of accumulated assets in each era tends to be limited to the part suited to it. In the Internet market, assets from different time periods are all convertible. The types and volumes of convertible assets expand, while the asset conversion rate rises due to connectivity; this forms a kind of online market capital that is unlike the capital of the past. This is the chief feature of connectivity capital.

We can elaborate on this discussion with four points. First, if human assets are linked to Internet facilities but not integrated with the operation of the market, they will simply be Internet technology assets in the possession of particular entities. It is when Internet technology assets are integrated with the discovery, capture, and use of market opportunities that they translate into Internet technology capital.

Second, Internet technology assets expand the scope of people's social interaction, thereby expanding their social capital and developing their Internet reputational assets. An Internet top dog is someone who has substantial social and reputational Internet assets. The combination of technological, social and reputational Internet assets constitutes the Internet portfolio owned by particular entities. When this portfolio of Internet assets is integrated with market operations and thus benefits from the Internet, it is converted into connectivity portfolio capital.

Third, when such capital combines with industrial assets and the latter are integrated with market operations through the former, we get "Internet Plus" capital, which takes effect through the Internet.

Fourth, and most important, is the fact that in the conversion of various types of assets into connectivity capital, the Internet platform is the infrastructure, the matchmaker, and the controller. The capitalization of assets used to depend on currency, which had a connectivity function recognized by the market. With the emergence of the Internet, the Internet platform has had a similar role. Unlike currency, it is dynamic, and this dynamism allows it to act as a matchmaker and controller and to function smoothly in converting Internet assets into connectivity capital. As a classic case of platform role-playing and platform competition, the Zhao Wei incident of 2016 merits focused discussion.

The above four points indicate that connectivity capital differs from human capital and social capital. Current discussion of human and social capital place special emphasis on possession, regarding industrialization as the default standard and not distinguishing between assets and capital, whereas connectivity capital is a development-oriented type of capital

with market access to social mechanisms. At the same time, connectivity capital is capital that contains a capitalization mechanism, emphasizing the capitalization of different assets and their influence on development under highly connected conditions. Finally, connectivity capital is portfolio capital, which stresses asset portfolios and benefits gained from Internet utilization through the operation of Internet assets.

3. Conditions for the functioning of connectivity capital: two multiplier effects

The functioning of connectivity capital is conditional on two multiplier effects. In the online market discussed in this paper, for example, the multiplier effects are market volume and potential volume of differentiated demand. The multiplier effects are based on connectivity, i.e., on Internet features generated by users establishing Internet connections. The development of Internet use has enabled users to connect to an increasing network scale, offering them ever more chances to connect with other users.

The World Bank report points out that following decades of development, connectivity has made unprecedented progress. Nearly 70 percent of the population in the lowest income quintile own a mobile phone, and enterprise connectivity has also gone ahead rapidly.[37] By the end of 2015, Chinese enterprises' Internet usage approached 90 percent.[38]

Market volume (market scale) is an example. G. William Skinner thought that a Chinese village fair had an average coverage of eighteen villages.[39] If the vendors at such traditional fairs were put into the Internet context, the eighteen villages would only have been a local market. Small world theory[40] holds that on the Internet, the scope of the market open to any one vendor is, in theory, the entire Internet community, a set that tends toward infinity. An increase in the number of user nodes in the market means not only an increase in the number of sellers and buyers but also a market volume multiplier effect, i.e., Davidow's positive feedback.[41]

Assuming there is sufficient supply of goods, market capacity depends only on the volume of buyers. If the market was that of a traditional rural fair, it would have had a range of 18 villages. Since the number of households or size of population in each village is a finite set and market capacity fluctuates at different times, market volume is:

$$v_1=\rho \sum_{i=1}^{n} x_i;\ (n=1,2,\cdots 18)$$

In this formula, v_1 (volume of local market) is the market volume for sales of any kind of

37 World Bank, *World Development Report 2016: Digital Dividend (Overview of Chinese Version)*, p. 2.

38 According to CNNIC data, as of December 2015, the proportion of computer usage, Internet usage, and fixed broadband access of Chinese enterprises reached 95.2 percent, 89.0 percent and 86.3 percent respectively. See China Internet Network Information Center, *Statistical Report on Internet Development in China (January 2016)*.

39 G. William Skinner, *Marketing and Social Structure in Rural China*, pp. 21-40.

40 Stanley Milgram, "The Small World Problem," pp. 60-67; Duncan J. Watts and Steven H. Strogatz, "Collective Dynamics of 'Small-World' Networks," pp. 440-442.

41 William H. Davidow, *Overconnected: The Promise and Threat of the Internet*.

product; ρ is a market capacity parameter that fluctuates over time within an interval of 0-1; n is the number of villages; and x_i is a finite set of the volume of the village market. Due to the homogeneity of local market demand, v_1 is always a finite set.

Once connected to the Internet, n becomes a set that tends to infinity, unlike the local market. The selectivity of sales is thus enhanced, and ρ tends toward 1 (even if market capacity fluctuates overtime, sellers can change their product portfolio to offset the fluctuation in market capacity of a single product). At this point, the market volume the seller faces is:

$$v_v=\rho\sum_{i=1}^{n}x_i;\ (n=1,2,\cdots\infty)$$

Under the same conditions, because $\rho\rightarrow1$, and the sum of x_i (demand volume) is a set that tends to infinity, the market volume (v_v, volume of volumes) once the Internet is accessed will be a set that tends to infinity. This is because the high degree of interconnection or connectivity created by the Internet has greatly reduced the search cost of market expansion and has expanded market scope. Assuming there are no other obstacles, its volume is theoretically an infinite set. In the following description, we use the term "infinite set" to denote the market's huge potential for expansion with low search costs as against the market of the industrialized era.

This is one effect that connectivity has on the Internet market: the market volume multiplier effect. Another is the multiplier effect of the potential volume of differentiated demand produced by the joint effects of slight differences in market demand and volume multiplier.

In the 1980s, if a manager of township factory wanted to get returns from the factory's production, he would increase output or improve product quality, or both. In such cases, multiple constraints made expansion of production volume the practical choice.

Increased production does not necessarily imply profits; profits are also affected by sales. To boost sales, sales people need to use social networks, including the use of various means to keep expanding market volume. Market volume can therefore be expressed as:

$$v_i=\rho\sum_{i=1}^{m}s_i;\ (m=0,1,2,\cdots k)$$

In this formula, (volume of industries) is the market volume facing factory products; ρ is a market capacity parameter that fluctuates overtime within an interval of 0-1; m is the number of factory sales people; and s is the market volume opened up by one sales person.

Clearly, m is a finite set, as is the sum of s_i is also a finite set, so v_i must be defined as a finite set. That is, market expansion directly affects the market volume of the product, which in turn affects the profit the factory makes from production.

Suppose that the factory manager's son opens a Taobao store. He cannot explore the market the way township enterprises do, because on online sales platforms, sellers cannot know where the demand is and therefore cannot actively promote their products. They can only wait for their platforms to match supply with demand or for buyers to find them through platform searches.

For buyers, the industrial mode of mass production offered a single option: standardized consumption. In real life, buyers have individual needs. With the aid of digital technology, personalized needs can be met. At the same time, connectivity also provides opportunities for the expression of such needs. "Differentiated demand" has thus become a valuable Internet market, as nuanced differences in buyer demand are reflected in the demand for slight differences in product features (d). By the same token, satisfying the demand for differentiated products will stimulate the expansion and dominance of potentially differentiated needs.

Further, supposing that in the volume multiplier effect, subtle differences in product characteristics can be not only be combined but also aggregated and categorized, then Internet aggregation of subtly differentiated demand gives sellers the opportunity and stimulus to satisfy potential demand for differentiated products. The mutual reinforcement of the two parties arising from demand for differentiated products and satisfaction of that demand is precisely what constitutes the positive feedback mechanism under conditions of connectivity.

Given that supply is finite, we can modify the model applied to the volume multiplier effect as follows:

$$cdd=\varphi\sum_{d=1}^{n} d_d;\ (n=1,2,\cdots\infty)$$

$$v_d=\sum_{d=1}^{n}(\mu\times cdd_i);\ (n=1,2,\cdots\infty)$$

Here, each cdd (category of differentiated demands) is a function of a categorizable parameter (φ) and a differentiated demand (d_d). Differentiated demand (d_d) is a set that tends to infinity, that is, it is perpetually and continuously generated. We suppose that not all differentiated demands can be aggregated and categorized; that is, the value range of the categorizable parameter (φ) is also 0-1. When the given is a time-varying market capacity parameter for each type of differentiated demand with an interval of 0-1, the differentiated market volume (v_d) is still a set that tends to infinity.

This demonstrates that the gains from the Internet market will also be a set that tends to infinity, as shown by long tail theory.[42] Subtle differences in market demand find a match through Internet platforms, active search on the part of buyers, and sellers' use of sales data. This enables the potential volume of differentiated demand facing the seller to gain a multiplier effect, thus fundamentally changing the industrial profit model.

Both multiplier effects are very important if users are to benefit from the use of Internet technologies. They produce not only an increase in product demand, but also competitive stability in product prices. If the price fluctuation (γ) caused by local market competition is taken into account, the interval for profit from the local market (p_1) will always be an estimated finite interval.

$$p_1=\gamma v_1$$

42 See Chris Anderson, *The Long Tail*.

In other words, p_l (profit from the local market) is related not only to market volume (v_l) but also to price fluctuations (γ is a price fluctuation parameter with an interval of 0-1). As the market produced by the two multiplier effects is a set that tends to infinity, the gains from the Internet market are limited by, and only by, a supply set that tends to infinity. Theoretically, even if prices fluctuate, their effect on gains can be offset by product mix or differentiation. Hence the connectivity dividend is:

$$ps_i = p_i - p_l$$

In this formula, ps_i (surplus profit from the Internet) is the connectivity dividend; p_i (profit from the Internet) is the profit from sales on the Internet market; and p_l is the profit from sales on the local market. In normal market environments and conditions, ps_i is theoretically always a positive number.

4. Interpreting the connectivity dividend difference

The various developments in Internet application show that the divide in gains from the connectivity dividend arise from the aggregation of different assets and their conversion into Internet capital. The factors affecting Internet capitalization involve the conversion of various types of assets related to the intensive and extensive growth of connectivity capital.

The transformation of human assets offers an example. Taobao Villages often come into being when other villagers copy the early adopters after the latter have acquired a connectivity dividend. Analysis of such cases shows that the difference in gains among Taobao stores essentially reflects differences in connectivity capital and its utilization.[43] A considerable portion of previously accumulated assets that could not be converted into capital in the industrial era is activated to different degrees under conditions of connectivity, becoming transformed into a divide in connectivity capital. Education is an example. As part of human assets, educational attainment likewise displays the divide in Internet capitalization.[44] It can be argued that in conversion into connectivity capital, past differences in asset characteristics are important factors affecting the divide in intensive connectivity capital growth.

In addition to activating dead assets, connectivity capital can integrate existing assets and add new assets to create extensive growth.

In particular, it should be noted that whether connectivity capital growth is intensive or extensive, it will necessarily be affected by Internet platforms and by the multiplier effects of both market volume and potential volume of differentiated demands.

As has been shown, in Skinner's local fair, rural products (not necessarily agricultural products) face a strongly homogeneous local market. At this time, capital, regardless of its nature, can only make profits through the local market, so the asset divide is not readily

43 Limited by the scope of this paper, utility of the capital of connectivity will not be discussed in detail.

44 Cui Lili, Wang Lijing, and Wang Jingquan, "Empirical Analysis of Social Innovation Factors Promoting the Development of Internet Commerce of Taobao Villages: The Example of Lishui, Zhejiang."

visible. Once the local market connects with networked society and is subject to the matching and manipulation of Internet platforms, the two multiplier effects will show up in differences in the various kinds of Internet capital and thus will be seen in the divide in Internet capital. The gains from the connectivity dividend may even enjoy a multiplier effect.

The connectivity capital divide in highly connected networks has thus been fully demonstrated. On the one hand, different types of connectivity capital are aggregated into the same category; on the other, the connectivity capital divide expands as a share of gains from the connectivity dividend for different categories. Market volume at this time is:

$$v_c = C_c \rho \sum_{i=0}^{n} x_i;\ (n = 0, 1, 2, \cdots \infty)$$

In the formula, the market range ($\sum_{i=0}^{n} x_i$) can be from 0 (none at all) to a set that tends to infinity, and Internet capital (C_c) is a finite set with a highly variable interval. Even if $\rho \rightarrow 1$, the market volume (v_c) from which users with different types of connectivity capital can obtain dividends will be an interval that varies greatly with the connectivity capital divide. Hence the connectivity dividend also shows high variability.

In addition to the connectivity capital divide among groups, the dividend gap among villages and regions is affected by other factors. Apart from individual factors, among, the connectivity capital portfolio of administrative divisions and regions also includes their social and cultural assets as well as any assets with market access opportunities, such as regional advantages, resource endowments, and institutional arrangements. The gap in these assets further affects the divide in connectivity capital utility through the influence of assets such as people and regions on the degree and scope of capitalization.

The product innovation of Taobao Villages is a powerful demonstration of the significance of creative assets in connectivity portfolios. Among agricultural products, Chinese wolfberries have been sold at 2,000 yuan per 500 grams.[45] This shows that under the influence of a given Internet platform, through the divide in the connectivity capital portfolio arising from the asset portfolio divide and the two multiplier effects it faces, a connectivity assets multiplier effect is created which directly and significantly affects the connectivity dividend difference. This is the secret of connectivity capital.

Put simply, the connectivity dividend difference (dps_c) is a function of connectivity capital (C_c) and the multiplier effect of market volume (v_v) and potential differentiated demands (v_d), which can be expressed as:

$$dps_c = f(C_c)(v_v \cap v_d)$$

It should be noted that the above examples all show that connectivity is not a decisive factor, but a trigger. What it triggers is not a fixed portfolio of connectivity capital, but rather a portfolio suited to the market at a specific point in time.

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45 Ali Research Institute, "Counterattack of Wolfberries: Sexy Marketing of Agricultural E-Commerce: 500 Grams Sold for 2,000 Yuan."

Given this, the connectivity dividend difference is not a continuation and expansion of the industrialization dividend, but a new type of divide based on the divide in connectivity assets.

V. Conclusion

When Internet infrastructure was in short supply, the main form of digital divide was the accessibility divide. Although the number of Internet users was growing, they were still relatively few, and development opportunities were extremely limited, as users were scattered among small local networks. From an economic perspective, any divide in Internet utilization had minimal effect compared to the divide in accessibility. More importantly, the connectivity dividend had yet to appear. "The access difference" was thus the initial form of the digital divide.

The surplus return yielded through the operation of the Internet market, as compared to other markets, constitutes the connectivity dividend difference. In various forms of Internet technology application, the connectivity dividend difference has replaced the access divide of the early days to become the new form of digital divide. An access divide that is the result of a shortage of infrastructure can be improved through public policies. Thereafter, the main factor affecting people's gains from the connectivity dividend is connectivity capital, or a portfolio of assets shaped by past investments that has access to and benefits from the Internet market.

In the Internet market, on the one hand, people convert various assets, including "dead assets," into connectivity capital; on the other, through Internet platform matchmaking or manipulation, they expand the volume of convertible assets and increase the conversion rate. This has made the diversity and variety of connectivity capital the main factor and mechanism affecting the connectivity dividend difference.

In this mechanism, the two multiplier effects that come with connectivity are extremely important. They make market volume a set that tends to infinity, and at the same time increase the value of differentiated and/or potentially differentiated demand that had little or no value in local networks, bringing change, aggregation, and categorization to such demand. Moreover, in the two dimensions of category and volume, they approximate a set that tends to infinity. It is the two multiplier effects that supply the degree of capitalization for various types of asset differentiation. In this process, the Internet platform provides important infrastructure. It not only functions as a medium, but also affords the opportunity to control the conversion of assets into connectivity capital and the two multiplier effects in relational structure. Regrettably, current research on the Internet platform as a special organizational form has only just begun. Its nature, operational characteristics and related factors need to be further explored, and the efficiency loss that may be caused by its monopolistic nature is also an issue not to be ignored.

In addition, the portfolio nature of connectivity capital makes it difficult for users to have completely equivalent, homogeneous amount of capital; that is, there is a connectivity capital divide between users and between different time-points for the same user. Therefore,

the connectivity capital divide, while not decisive, makes a significant contribution to the connectivity dividend difference. It is worth noting that the importance of creative assets in connectivity capital means that user capture and satisfaction of the market for differentiated demand is always a finite set. This means that the connectivity dividend cannot remain concentrated on a small number of users.

This is the secret of connectivity capital, and also the mechanism influencing the development of the digital divide under given connectivity conditions. In today's highly connected China, public policy must focus on how connectivity can play a positive role in the equitable development of connectivity capital, in order to allow Chinese society to benefit fairly from the connectivity dividend.

It should be noted that this paper is merely an attempt to explore connectivity capital. Due to limited space and data, we have not elaborated on some important issues, including the types of capital converted from connectivity assets, the Internet process by which assets are converted to connectivity and the multiplier effects expression mechanism, as well as the mechanisms affecting Internet platforms.

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