

# Increased wage inequality via ICTs: Making a case for human capital investment

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## ABSTRACT

Globalisation and technological advances have affected workers' livelihoods. This study analysed how capital investment in ICTs at the workplace affected marginalised low wage workers in a large sample of firms (n=632) in Singapore. We found that social investment by the state for ICTs investments in workplaces led to a significant negative, albeit marginal, reduction in wage growth. We argue that these findings are supported by economic theory, and propose that government investment balance towards higher-order digital skills. We advocate for further research to measure the impact of worker ownership in enterprises on productivity growth, and hence equality objectives.

## Keywords

ICT4D, inequality, livelihoods, productivity, poverty, working poor.

## 1. INTRODUCTION

### 1.1 The Invisible 'Working Poor'

As the world transitions from the Millennium Development Goals to the 2030 Agenda for Sustainable Development Goals (SDGs) [1], specific targets such as Goal#8 - decent work and economic growth, will stimulate action over the next fifteen years to achieve sustainable, inclusive economic growth, and eliminate poverty through increasing quality jobs with good wages [2]. While information and communication technologies find less direct emphasis in the SDGs, there yet remains the promise that ICTs could reduce inequality. In this study, we argue that capital investment in ICTs for enterprises, sans a strategy for developing higher-order digital skills, actually dampens wages for the low-skilled.

In a developed country like the United States of America (USA), the state of the poor had been swept into a situation of oblivion until Harrington [3]'s tome provided the impetus for the nation to be jolted into a state of "collective consciousness". We can compare this predicament with the plight of the 'invisible poor' in other developed cities like Singapore, an economic success story in South East Asia with a population of 5.4 million [5]. In comparison to the unemployment rate of South-East Asia and the Pacific region of 4.5% [6], the population in Singapore faces little lack of jobs as unemployment rate has remained low at 2.0% [7]. Despite that, policy makers in Singapore are concerned with the 105,000 households (of average 3.5 members each), earning below S\$1,500 (US\$1,200 per month) [8, 9]. Ng [10] qualified that poverty in Singapore is not like the palpable poverty of some Asian cities, where masses of homeless are seen sleeping in the streets or begging for money. Singapore's poor constituents are made up of

people who are employed but earn very low wages, termed as the *working poor*, as well as the elderly poor, who have earned low wages throughout their career and are now retired with little savings [11]. Similar to the low wage service occupations in USA [12], most of Singapore's working poor are employed in low-skilled service industries such as food preparation and service, housekeeping, cleaning and gardening [13]. With more than 6,600 establishments, small and medium enterprises (SMEs) in Singapore [14], employing more than 190,000 workers [15], pay the average worker a basic monthly wage of around S\$1,220 (or USD\$907), one-third of the national average of S\$3770.

Before we consider the role of state investment in ICTs as an efficient redistribution mechanism to combat wage inequality, we need to analyse the reasons for labour income inequality. To begin, an analysis of wage inequality will be examined in the next section.

### 1.1.1 Inequality of labour income

The theory of wage inequality is based on human capital theory, which posits that different workers contribute differently to an enterprise' output [16, 17], particularly in developed economies that advocate skill-biased technological change [18]. As explained by Autor, Katz and Krueger [19], workers who are more likely to access and use technology will have skills that will experience bigger gains in work efficiency and wages, as technology continues to improve. Therefore, employees who do not know how to use advanced ICTs will be at the wrong end of increasing wage inequality. The current paradigm amongst economists is that this skill-biased technological change explains the phenomenon of wage inequality [17]. Given this argument, the following literature will explore the thesis of how ICT capitalisation, under certain conditions, widens the phenomenon of wage inequality for the working poor.

## 2. LITERATURE REVIEW

### 2.1 ICTs as the inequality leveler?

The potential for using Information and Communication Technologies (ICTs) to achieve the human development goals has captured the scientific imagination, rather than the attendant challenges and lack of evidence of success [20]. Despite the limitations of technology and slow adoption by enterprises, the belief that the use of ICTs can reduce poverty has gained traction amongst a certain set of scholars [21], for example, researchers who correlate the use of ICT with economic growth amongst developed countries [22-24].

Critics such as Toyama [25] observe that despite the explosion of ICTs usage in the USA in the last forty years, the poverty rate remained the same in the country. The transformative effects of

ICTs are contentious because the parallel concepts of digital divide and digital poverty will need to be addressed at the same time. With the near-universal diffusion of consumer level ICTs such as mobile phones becoming a reality [26], the debate about access, as suggested by the digital divide debate, no longer seems valid. Instead, higher order divides are seen as critical. Digital poverty, as described by May [27], comprises of the demand dimension (the poor cannot afford the ICT service), a capability approach dimension (the poor does not have the skills to use the service) as well as a supply perspective (there are no available infrastructure to deliver the service), forming a reinforcing loop for poverty. In an attempt to resolve the supply situation, governments have been investing in ICTs at the enterprise level.

The question whether such ICT capital will impact wage inequality for the marginalized bears further investigation. The next section explores the impact of social capitalisation of equipment through government investment.

### 2.1.1 Investment in ICTs for social equality

Conceived by the late management guru Prahalad [28], the Bottom of the Pyramid (BoP) model postulates a correlation between business goals of profit maximisation and poverty reduction. As such, the BoP approach is championed as a new tool of “inclusive” global development and lauded by academics and non-governmental organisations (NGOs) in the poverty circles [29]. In this current age when the neoliberal political economy has unleashed a new form of predatory capitalism that is widening the gap between the rich and poor, [17], with Oxfam International reporting that the richest 1% of the world population now owns 50% of total wealth [30]. The notion of Foucault’s governmentality [31] may offer an effective response to improving the welfare of the working poor. As a particular form of governmentality, social investment by the state in businesses [32] is really an interesting assembly of financial tools by the government to encourage businesses to operate in a more socially inclusive manner.

The notion of social investment has come to play a big part in debates about the role of state funding [33]. The idea stemmed from the original theories of investment in human capital and it evolved to include social protection of members of the labour market who may otherwise be neglected by the free market capitalism of labour demand and supply [34]. Iversen and Wren [35] predicted with their ‘trilemma’ of development that countries cannot simultaneously pursue three desirable economic objectives: i) preventing inequality, ii) providing employment growth, and iii) being prudent in social spending. The argument being - when two of these three objectives are the focus, there will always be a third goal being sacrificed. The trilemma, suggests that, with inequality being held constant, capital investment in ICTs will necessarily put downward pressure on wages.

Further arguments for the downward pressure on wages lies in the shift from capital intensive to service oriented industries in advanced economies. Services have become more expensive to produce compared to manufacturing sector – so either wages in the services have to come down, or they have to be supported by some form of state funding [36].

A number of studies on ICTs’ impact on urban livelihoods have examined the impact of technology on corporate productivity, including the association of ICTs use to corporate structure and business processes [37, 38]. On the other hand, less focus has been directed towards the relationship between ICT investment and wages for low wage workers. This study will shed more light in identifying how the government’s social investment on a pay-for-

productivity scheme through ICT capital intensification, can influence wages of the working poor.

## 3. RESEARCH QUESTION

The primary purpose of this study is to assess and compare the effects of ICT capital investment on the wages of low-skilled, low-wage workers in Singapore. Based on the above literature review, the following research question is thus advanced: What is the relationship between ICT capital investment and wage increases?

## 4. METHOD

### 4.1 Data used for the study

The extant data was collected at a not-for-profit organization, Employment and Employability Institute (e2i) in Singapore, which manages the Inclusive Growth Programme (IGP) - a government funded scheme to raise workers’ productivity through subsidising up to fifty percent of the costs of the companies’ investment in technology and equipment [39]. The premise is that with capital investment, companies will improve their operations’ efficiency, i.e., productivity, and share gains with their low wage workers in the form of wage increases. Since its introduction in August 2010, S\$30 million (USD\$22.15 million) has been committed to subsidise such productivity projects in more than 30 industry sectors [40].

As stipulated by e2i, the beneficiaries of the scheme must be workers earning less than SGD\$1,700 (or US\$1,181) per month in the companies. All 36,384 workers in the 632 participating firms received a median wage increase of 11.0% each, during the project period (see Figure 1). The research will assess the change in the salary increases of these workers. The reported data were collected from the productivity projects implemented from 1 August 2010 till 30 September 2014. Of the 632 firms, 540 SME firms were employing 12,386 low wage workers, and 92 firms were multi-national corporations (MNCs) with 23,998 workers.

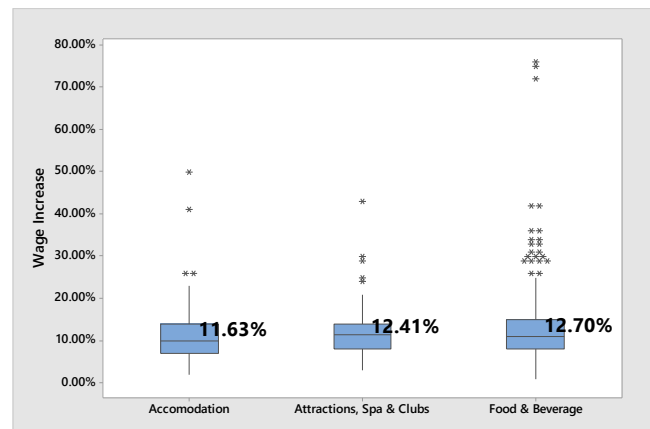


Figure 2. Boxplot of mean wage increases between the industries in the project

### 4.2 Measures

The dependent variable, wage increase per worker impacted, was measured using the wage increase in percentage, reported by the enterprises in the services sectors that participated in the Inclusive Growth Programme. The independent variable was a continuous variable measuring the proportion of the project’s costs attributed to ICT equipment. For example, in a S\$10,000 project, if S\$5,000 had been invested in mobile communication devices and the other half went to purchasing traditional kitchen equipment, it would be counted as 50% ICT capital investment.

## 5. RESULTS

### 5.1 Direct effects - ICTs and wage increases

A linear regression was conducted to evaluate the prediction of the wage increase resulting from the ICT investment for companies. The regression equation is as follows: Wage Increase =  $-.022 * \text{ICT Investment} + .135$ . The 95% confidence interval for the slope,  $-.035$  to  $-.009$  does not contain the value of zero, showing that the ICT investment is significantly, and negatively, related to wage increase.

While the relationship is statistically significant, the negative coefficient of  $-.022$  means that less wage increase occur when ICT investment increases. We note that, based on the magnitude of the correlation coefficient  $-.133$ , the relationship of ICT investment on wage increase is one of a weak association. Approximately 2% ( $R^2 = .018$ ) of the variance in wage increase is associated with ICT investment.

## 6. CONCLUSION & DISCUSSION

The traditional socialist position of income redistribution holds that the only way to alleviate poverty is through the efforts of government to interfere in the productive process of businesses, or what is termed as 'efficient redistribution' [17]. On the other hand, the free-market paradigm posits that market forces and individual capabilities will help to balance out the distribution of income for the working poor eventually, without politics. This study suggests that capital investments in ICTs at the enterprise level negatively (albeit marginally) impact low-income workers' wages. It is simultaneously important to note that overall wages did increase, though not as a result of ICT investment.

The findings from this study present further questions on whether investment in ICTs represents an efficient redistribution of income for the working poor. We argue that state investments in ICTs should consider resolving higher-order digital divides such as digital skills rather than merely focusing on access, which is a likely outcome of mere capital investments in ICTs. This commensurate with Piketty and Goldhammer [41]'s argument that the phenomenon of wage inequality could well be due to a failure to invest in high-quality professional training of the workers, as evidenced in the Scandinavian countries, where wage inequality is more moderate due to its egalitarian and inclusive educational system. State funding for ICT investment could be in the form of digital skills training and education for workers. Investment in skills training and education increases future productive capacity of the society, thereby achieving the objectives of employment growth [33].

Classic economists reflect that productivity leads to higher wages as earnings are a proxy for productivity [42, 43]. On the other hand, efficiency wage theorists suggests that as the worker gets a higher pay, the fear of being made unemployed will motivate the employee to work harder to keep his or her job [44]. Essentially, Serneels [45] suggests a reconciliation of the two theories by including productivity in the wage equation and also incorporating wages in the productivity equation.

Before we conclude that productivity increases are brought about by both forms of ICT investment, capital and training of labour, we would need to establish a positive relationship between ICT investment and productivity. It is further possible that increases to productivity are being diverted to profits of the enterprise rather than towards workers' wages. As economists debate about low productivity being the key cause of low income growth for low skilled workers, commentators like Han [46] reflect that it is too easy to rationalise their plight as a product of globalisation and to

accept what the world is willing to pay for these workers. To test the theory further, future research should examine correlation of digital skills increase in tandem with ICTs' investment on the dual outcomes of wage equality and productivity.

To ensure that productivity increases via ICT investment translate into higher wages, profit-related pay can be encouraged by governments [47]. A number of studies already establish such correlations between profit-related pay to productivity [47-50], suggesting that it is not only the type of ICT investment, but the nature of the enterprise ownership that determines resultant productivity, and therefore, the wage and welfare of the workers.

In conclusion, we argue that governmental investment in ICTs as a pro-social measure to increase wages needs to balance capital investment with training of workers in higher-order digital skills. Secondly, we suggest that greater investigation of the proportion of productivity increases caused by ICT attributed to profits and pay is required to arrive at optimal distribution of public resources.

## 7. REFERENCES

- [1] United Nations, *Transforming our world: The 2030 Agenda for Sustainable Development*, New York City, New York, 2015.
- [2] International Labour Organization. "Decent work," 21 January, 2016; <http://www.ilo.org/global/topics/decent-work/lang-en/index.htm>.
- [3] M. Harrington, *The Other America*, New York: Touchstone, 1962.
- [4] S. Abramsky, "The other America 2012," *The Nation*, vol. 294, no. 20, pp. 11-14, 14 May, 2012.
- [5] Singapore Department of Statistics, *Population Trends 2013*, Ministry of Trade and Industry, Singapore, 2013.
- [6] International Labour Organization. "Weak economic recovery does not extend to jobs," 6 May, 2014; [http://www.ilo.org/global/research/global-reports/global-employment-trends/2014/WCMS\\_233931/lang-en/index.htm](http://www.ilo.org/global/research/global-reports/global-employment-trends/2014/WCMS_233931/lang-en/index.htm).
- [7] Ministry of Manpower Singapore. "Unemployment," 21 January, 2015; <http://stats.mom.gov.sg/Pages/Unemployment-Summary-Table.aspx>.
- [8] R. Basu, "Welfare must not undermine value of hard work; Boost wages of poor to keep them in jobs, and to get the able-bodied to work," *The Straits Times*, Singapore Press Holdings Limited, 2013.
- [9] R. Chan, and R. Basu, "The 'invisible poor'; It is an issue many in affluent Singapore feel awkward about - poverty. Robin Chan and RadhaBasu explore why this is so, after Hong Kong set an official poverty line.," *The Straits Times*, Singapore Press Holdings Limited, 2013.
- [10] P. T. Ng, "An examination of lifelong learning policy rhetoric and practice in Singapore," *International Journal of Lifelong Education*, vol. 32, no. 3, pp. 318-334, 2013.
- [11] L. K. Yeoh, "Rethinking a new social compact for Singapore," *Ethos*, vol. 3, pp. 7-12, 2007.
- [12] M. Gatta, H. Boushey, and E. Appelbaum, "High-touch and here-to-stay: Future skills demands in US low wage service occupations," *Sociology*, vol. 43, no. 5, pp. 968-989, October 1, 2009, 2009.
- [13] Ministry of Manpower Singapore. "Occupational Wage Tables 2013," 7 August, 2014; <http://stats.mom.gov.sg/Pages/Occupational-Wages-Tables-2013.aspx>.

- [14] SPRING Singapore. "Industry Background and Statistics," 25 January, 2015; <http://www.spring.gov.sg/Industry/FBS/Pages/industry-background-statistics.aspx>.
- [15] R. Whang, "Automation helps F&B firms dish out wage hikes," *The Straits Times*, Singapore Press Holdings Limited, 2014.
- [16] G. S. Becker, *Human capital : a theoretical and empirical analysis, with special reference to education*, Third Edition ed., Chicago: The University of Chicago Press, 1993.
- [17] T. Piketty, and A. Goldhammer, *The economics of inequality*, p. vii - 142, Cambridge, Massachusetts: Belknap Press of Harvard University Press, 2015.
- [18] M. Weiss, and A. Garloff, "Skill-biased technological change and endogenous benefits: the dynamics of unemployment and wage inequality," *Applied Economics*, vol. 43, no. 7, pp. 811-821, 2011.
- [19] D. H. Autor, L. F. Katz, and A. B. Krueger, "Computing inequality : have computers changed the labor market?," *NBER working paper series: no. 5956*, Cambridge, MA.: National Bureau of Economic Research, 1997.
- [20] UNDP, *Promoting ICT for Human Development in Asia 2004: Realizing the Millennium Development Goals*, United Nations Development Programme, India, 2005.
- [21] R. Heeks, "ICT4D 2.0: The next phase of applying ICT for international development," *Computer*, vol. 41, no. 6, pp. 26-33, 2008.
- [22] S. D. Oliner, and D. E. Sichel, "Information technology and productivity: where are we now and where are we going?," *Journal of Policy Modeling*, vol. 25, no. 5, pp. 477-503, 7//, 2003.
- [23] M. P. Timmer, and B. van Ark, "Does information and communication technology drive EU-US productivity growth differentials?," *Oxford Economic Papers*, vol. 57, no. 4, pp. 693-716, October 1, 2005, 2005.
- [24] K. M. Vu, "Information and Communication Technology (ICT) and Singapore's economic growth," *Information Economics and Policy*, vol. 25, no. 4, pp. 284-300, 12//, 2013.
- [25] K. Toyama, *Geek heresy : rescuing social change from the cult of technology*, New York: PublicAffairs, 2015.
- [26] International Telecommunication Union, *ICT Facts & Figures: The world in 2015*, International Telecommunication Union, Geneva, Switzerland, 2015.
- [27] J. D. May, "Digital and other poverties: exploring the connection in four East African countries," *Information Technologies & International Development*, vol. 8, no. 2, pp. 33-51, 2012.
- [28] C. K. Prahalad, *The fortune at the bottom of the pyramid: eradicating poverty through profits - 5th anniversary ed. revised and updated*, New Jersey: Pearson Education Inc, 2009.
- [29] C. Dolan, and K. Roll, "Capital's New Frontier: From 'Unusable' Economies to Bottom-of-the-Pyramid Markets in Africa," *African Studies Review*, vol. 56, no. 3, pp. 123-146, 2013.
- [30] D. Hardoon, *Wealth: Having it all and wanting more*, Oxfam International, Oxford, UK, 2015.
- [31] M. Foucault, G. Burchell, C. Gordon, and P. P. D. Miller, *The Foucault effect : studies in governmentality : with two lectures by and an interview with Michel Foucault / edited by Graham Burchell, Colin Gordon, and Peter Miller*, Chicago: University of Chicago Press, 1991.
- [32] R. Aitken, "Socially Responsible Investing and/as Governmentality ". pp. 1-15.
- [33] B. Nolan, "What use is 'social investment'?,", *Journal of European Social Policy*, vol. 23, no. 5, pp. 459-468, December 1, 2013, 2013.
- [34] I. Dudova, "Social investment as a new paradigm of social policy," *Danube: Law and Economics Review*, no. 3, pp. 231-242, 2013.
- [35] T. Iversen, and A. Wren, "Equality, Employment, and Budgetary Restraint: The Trilemma of the Service Economy," *World Politics*, vol. 50, no. 4, pp. 507-546, 1998.
- [36] P. Bernard, and G. Boucher, "Institutional competitiveness, social investment, and welfare regimes," *Regulation & Governance*, vol. 1, no. 3, pp. 213-229, 2007.
- [37] E. Brynjolfsson, and L. Hitt, "Paradox lost? Firm-level evidence on the returns to information systems spending," *Management Science*, vol. 42, no. 4, pp. 541-558, 1996.
- [38] L. Becchetti, D. A. L. Bedoya, and L. Paganetto, "ICT investment, productivity and efficiency: Evidence at firm level using a stochastic frontier approach," *Journal of Productivity Analysis*, vol. 20, no. 2, pp. 143-168, 2003.
- [39] e2i. "Want to improve your business operations?," 6 May, 2014; <http://e2i.com.sg/employers/inclusive-growth-programme-igp/inclusive-growth-programme/>.
- [40] J. Heng, "Higher productivity pays off for workers; 33,000 earn more after companies get help from scheme," *The Straits Times*, Singapore Press Holdings Limited, 2012.
- [41] T. Piketty, and A. Goldhammer, *Capital in the Twenty-first Century*, Cambridge Massachusetts: Harvard University Press, 2014.
- [42] M. S. Turner, "A comparison of some aspects of the Cambridge theory of wages and Marginal Productivity theory," *Journal of Economic Issues*, vol. 1, no. 3, pp. 189-198, 1967.
- [43] A. Barr, and P. Serneels, "Reciprocity in the Workplace," *Experimental Economics*, vol. 12, no. 1, pp. 99-112, 2009.
- [44] S.-C. Chua, Y.-W. Lim, T.-T. Ter, and S.-B. Chew, "Efficiency wage theory: Evidence for Singapore manufacturing sector," *The Singapore Economic Review*, vol. 59, no. 3, pp. 1-12, 2014.
- [45] P. Serneels, *Do wages reflect productivity?*, Economic and Social Research Council (ESRC), 2005.
- [46] F. K. Han, "What dark secret is in the S'pore basement?," *The Straits Times*, Singapore Press Holdings Limited, 2015, p. 34.
- [47] L. B. Alison, and J. Frank, "Earnings, Productivity, and Performance-Related Pay," *Journal of Labor Economics*, vol. 17, no. 3, pp. 447-463, 1999.
- [48] C. Brown, "Firms' Choice of Method of Pay," *Industrial and Labor Relations Review*, vol. 43, no. 3, pp. 165S-182S, 1990.
- [49] A. C. Gielen, M. J. M. Kerkhofs, and J. C. van Ours, "How performance related pay affects productivity and employment," *Journal of Population Economics*, vol. 23, no. 1, pp. 291-301, 2010.
- [50] D. C. Jones, P. Kalmi, and A. Kauhanen, "Teams, incentive pay, and productive efficiency: Evidence from a food-processing plant," *Industrial & Labor Relations Review*, vol. 63, no. 4, pp. 606-626, 2010.