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The Love Aspects of Human Capital and the Economic Activity of Countries

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Abstract: *The influence of non-economic factors and forces on economic activities and their outcomes is undeniable. Love, being so central to many human activities, should similarly have some effects on the economic activity of nations. This paper (a) builds a simple but innovative model, (b) imposes it on a limited data set to estimate the effects of love experience and feeling on the economic activity of a group of 133 countries, and (3) compares such effects to those of other determinants of the economic activity, including Barro-Lee human capital, openness, and physical capital, as well as a broad measure of national well-being, HDI. The results strongly favor physical capital followed, by HDI and Barro-Lee human capital. Although small in magnitude, love effects are more statistically significant than those of openness. There appears to be some multicollinearity and model functional issues which challenge the robustness of the estimates and call for further research. However, the technical efficiency of the estimates is reasonable, so that one may conclude that love is important, but not critical to economic activity. The policy implications call for more investment in physical capital, schooling, and in the overall improvement of human development than in love experience and feeling, even though those are important too.* **JEL Code**: O15, O47, I00, C21, C51, Z13, J12.

Keywords: Love capital, Barro-Lee human capital, Mincer humana capital formula, economic activity

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* Amavilah is an independent resource and engineering economist, as well as an Adjunct Professor of Economics at Glendale College. I have been thinking about the effects of seemingly non-economic factors and forces on economic activities for a long time. I have even self-published a booklet entitled: *Economic Versus Non-Economic Dimensions of the Well-Being of Nations: Some Empirical Estimations*, Lambert Academic Publishing, Koln (Germany), 2009. However, this perspective was inspired by listening to Ms. Melinda Gates's graduation speech to the Class of 2013 at Duke University. I attribute no blame to anyone for any errors.

1. Introduction

> "Some of the impediments to economic progress are beyond the area of economic relations. ... I propose to discuss ... some of these non-economic 'factors' which are yet too little explored, but which appear to exercise a strong negative and positive influence on the attainment of economic betterment" (Bert F. Hoselitz, 1952).

This empirical paper briefly justifies the role of love in and behind human capital formation. It then estimates the effect of love on the aggregate economic activity of 133 countries around the world in 2013. Although the sample is small, and the perspective only a snapshot of reality, a comparison of the effect of love on economic activity to the effects of alternative determinants of economic activity informs both policy and further research. As James Coleman (1990) has remarked, human capital (H) theory is one of the most important contributions to recent economic theory. Economists derived H theory from physical capital (K) theory, and the derivation brought along with it the longstanding Cambridge K controversy.[1] Partly because of its own complexities, but also because of its controversial inheritance from K theory, H continues to present serious measurement challenges to-date, even as many have accepted the idea that H is generated through investment in education, work experience, and on-the-job training.

The original H theory states that H depends on the quality of the population approximated mainly by its educational attainment, health, and material conditions (Schultz, 1961, 1979, 1981, Becker, 1993], Lewis, 1965). Empirical attempts to measure H date all the way to biblical times (Cohn, 1979), but it was not until recently that Jacob Mincer (1958, 1974, 1981) developed a practical formula for relating H to education, work experience, and health. In this formulation, education is measured as either literacy rates, average years of schooling, expected years of schooling, or enrollment ratios. Work experience is measured as job seniority, and health as either life-expectancy, fertility, or mortality rates. In this way H is equivalent to its actual and/or potential earnings, i.e.,

$$H \equiv E = E_0 e^{\theta_i S_i + \theta_i X_i + \theta_i X_i^2},\ i = 1,2,3,...,m, \tag{1}$$

where E is earnings for human capitalized labor, E_0 is the base earnings for labor without H, S is average years of schooling, and X_i's are other variables like job experience. Some X's are assumed to have quadratic effects on H (see T. Lemieux, 2006, J.J. Heckman, J.L. Lockner, and P.E. Todd, 2003). For an economy as a whole, total H is the sum of individual H's, according to the logic of (1) above.

Unfortunately a number of disturbing developments continue to frustrate the empirical applications of (1). First, (1) does not account for depreciation; it should to be fully consistent with K theory. The second frustration is that many now overstress S and systematically and frequently ignore the

[1] See *Journal of Economic Perspectives*, Volume 17, No. 4 , 2003, for introductory comments on the controversy (cf. Taylor (2000), Amavilah and Newcomb (2004), and Eatwell, Milgate and Newman, 1990).

other X's altogether. This is not such a terrible oversight in advanced economies like the USA where S contributes the largest share of H, but such negligence is troubling for developing countries with both small S and low initial H. The third frustration relates to basing H only on labor (L), instead of population (N), as original developers of H theory intended. Again, it is now common to specify H simply as,

$$H = e^{\theta S} L \;\Rightarrow\; E_0 = 1, X_i = 0, \tag{2}$$

see, e,g., Jones (1997). Clearly, even if (2) is assumed to have no specification errors (it has correct functional forms), it still has mis-specification errors insofar as it excludes relevant variables, and does not account for depreciation. Moreover, according to Amavilah (2008) a correct specification of (2) is one that broadens the base for H to the economically active population (N*), not just L. In other words,

$$H = (1-\delta) e^{\theta_1 S} N^*, \tag{3}$$

where δ is the depreciation rate.

The fourth frustration is that (1) - (3) are incomplete because they measure H as an area. To the extent that H is knowledge and skill that determine the production and distribution processes of goods and services, *measuring it as an area is inconsistent with both common language and understanding*. In common language and understanding we speak of *deep knowledge* and *wide knowledge*, both functions of time. We also know of *intimate knowledge*. Thus, correctly measured, (3) is a volume, i.e.,

$$H = \int_t \int_{N^*} \pi [(1-\delta) e^{\theta_1 S} N^*]^2 \, dN^* \, dt. \tag{4}$$

Eq. (4) acknowledges that developing H is essentially "mining" N for the quality attributes which accumulate into H over time. In that sense there is an inverse relationship between the quantity (Q) and quality (q) of H. To characterize the form and nature of the inverse relationship, one may take a cue from the quantity-quality (Q-q) models familiar to mining and geological engineering, as well as mineral economics, by which the specific relationship may be linear, power, or quadratic. All three forms have advantages and disadvantages. However, they have all been used successfully to evaluate resources (H is a resource), forecast potential resource supply, and determine the economic feasibility of projects (economic growth is a lifetime project) – see, e.g., Harris (1984, 1993). For example, the Lasky model, the linear and most common of the Q-q models, expresses the responsiveness of the log of cumulative quantity of resource (N*) to the change in its average quality (q), i.e.,

$$H = e^{\theta_0 + \theta_1 q} N^*, \Rightarrow N^* = H/(e^{\theta_0 + \theta_1 q}) \;\; q = [\ln(H/N^*) - \theta_0]/\theta_1. \tag{5}$$

Then plugging (5) into (4) gives us

$$H = \int_t \int_q \pi[(1-\delta)e^{\theta_0 + \theta_1 S + \theta_2 q}]^2 dq dt, \;\; \forall q = f(N^*(N)) > 0. \tag{6}$$

2. The Love in and behind H

The African proverb that "it takes a village to raise a child" is profound. It suggests that the H building activity (child raising) requires *cooperative investment* above and beyond *individual investment* in the actual (biological) bearing of the child. In other words, there is a positive externality from pooling existing child-raising knowledge/technologies insofar as the marginal social benefits of H are larger than the corresponding marginal private benefits. Speaking to the graduating class of 2013 at Duke University, Ms. Melinda Gates (wife to Bill Gates II of Microsoft, Inc.) stressed what she called "the contribution of experiences and places and people" to human connection and connectedness, and hence to H formation. Obviously "neighborhood", "agglomeration", and "cluster" effects have been familiar to most economists for quite some time. What stands out as insightful from Gates's commencement speech is the suggestion that "technology is" a combination of experiences, places and people, and by itself as such it is "just a tool, ... a powerful tool, but ... just a tool [nonetheless]." What makes technology powerful is the "deep human connection", and the "deep human connection is different [from technology because] it is not a tool. It's not a means to an end. It is the end – the purpose and the result of a meaningful life – and it will inspire the most amazing acts of love, generosity, and humanity," Gates says.

There is more to what Gates said than what catches the ear, and it is that love is in and behind deep human connections. Deep human connections make technology possible. Technology facilitates human communication. Human communication aids the accumulation of knowledge, and knowledge improves human well-being by enhancing human material conditions, education, and health, leading to new technologies, and so on – a never-ending cycle. In that sense "love plays a [huge] role" in H accumulation – the love in and behind H. This too is not a brand new insight. From C.S. Lewis's (1988[1960]) classic, *The Four Loves*, for instance, it is clear that, no matter which one of the four loves (affection, friendship, eros, or charity) one is referring to, love itself is a passion. Whether Platonic or non-Platonic, as a passion love is by definition a strong motivator often for good, and occasionally for bad as well. The more passionate, the more likely the pursuit of H. Higher H means better technology, a vibrant economic activity, and hence faster economic growth. Faster economic growth enhances the standard of living.

In their study of parental marriage-matching of Chinese urban couples, Huang, Jin, and Xu (2010) discovered that it is a wrong question to ask whether money can buy love. Instead, the correct question to ask is whether love can buy money. The authors conclude that couples in loving marriages end up with better outcomes (in terms of incomes, family harmony, and even quality children). Fernandez, Nezih, and Knowles (2005) assessed correlations between love ("household matching") and economic outcomes ("wage inequality and per capita income"), and they found that "the degree of marital sorting, wage inequality, and fertility differentials are positively correlated across steady states and negatively correlated with per capita income" (p.). Again love is important to economic activities and their outcomes. Love is one of the foundations of institutions like the family; institutions are critical to economic performance. If so, then it is not too strong to suggest that there is love in and behind H, and estimating its effect enhances our understanding of production activity. In the next section I rationalize the mechanics through which love affects economic activity as an element of H.

3. Model

I represent an economic activity with a production function

$$Y=L^{\alpha}K^{\beta}(AH)^{\gamma}T^{\lambda} \Rightarrow y=a_0+\beta k+\gamma h+\lambda t,$$
$$y=\ln(Y/L),\ a_0=\gamma\ln A,\ k=\ln(K/L),\ h=\ln(H/L),\ t=\ln(T/L), \tag{7}$$

where L is labor, (K, k) is physical capital, (A, a_0) is the current state of technology, (H, h) is human capital, and (T, t) is openness to trade, and $\alpha,\ \beta,\ \gamma,\ \lambda$ are coefficients of elasticity. Then using (2) we can rewrite (7) as

$$Y=L^{\alpha}K^{\beta}(Ae^{\theta S}L)^{\gamma}T^{\lambda} \Rightarrow y=a_0^*+\beta k+\gamma\theta S+\lambda t,\ a_0^*=\gamma a_0, \tag{7'}$$

where S is some measure of educational attainment as in Barro and Lee (2010), Bils and Klenow (2000), Hanushek and Kimko (2000), and Hanushek and Woessmann (2008). However, Amavilah (2008) has argued that L is too narrow a base for H, so that at the national, as opposed to plant/production, level, a complete version of (7) is one broad enough for more dimensions and aspects of H, such that

$$Y=N^{*\alpha}K^{\beta}(A(1-\delta)e^{\theta S}N^*)^{\gamma}T^{\lambda},\ \Rightarrow y^*=\beta k^*+\gamma\theta S^*+\lambda t^*+\bar{a}_0^*, \tag{8}$$

where $y^*=\ln(Y/N^*),\ k^*=\ln(K/N^*),\ S^* = e^{\theta S}N^*/N^*,\ t^*=\ln(T/N^*)=t,\quad \bar{a}_0^*=\gamma\ln[A(1-\delta))].$

Including in (8) the love aspect H leads to

$$Y=N^{*\alpha}K^{\beta}T^{\lambda}A^{\gamma}\int_t\int_q \pi[(1-\delta)e^{\gamma\theta_0+\gamma\theta_1 S+\theta_2 q}]^2 dqdt. \tag{9}$$

Eq. (9) appears complicated, but in the present case it shouldn't, given the first and only time period, t =0, (9) would have only one integral, i.e.,

$$Y=N^{*\alpha}K^{\beta}T^{\lambda}A^{\gamma}\int_q \pi[(1-\delta)e^{\gamma\theta_0+\gamma\theta_1 S+\theta_2 q}]^2 dq. \tag{9'}$$

Hence, solving the integral, dividing through by N*, and taking the natural logarithms of (9') gives:

$$\begin{aligned} &y^{*}=\bar{a}_0^{**}+\beta k^{*}\theta_1^{**}S^{*}+\theta_2^{**}q+\lambda t,\ \bar{a}_0^{**}=Constant+\lambda A+\pi(1-\delta),\\ &\theta_1^{**}=2\gamma\theta_1/2\gamma\theta_2,\ \theta_2^{**}=2\gamma\theta_2/2\gamma\theta_2=1. \end{aligned} \tag{10}$$

4. Estimation

Estimation begins with (7) in which $h=\theta_1 S,\ h=\ln(H/L)$. Next, it moves on to (8). $h=[\ln(1-\delta)+n^{*}]+\theta_1 S,\ n^{*}=\ln(N^{*}/L)>1,\quad h=\ln(1-\delta)+\theta_1 S,\ h=\ln(H/N^{*})$. and it acknowledges that H is more than S.

Finally, I experiment with the human development index (HDI) literature, derive H from there, and compare its effects to those from the estimations of (7)-(10) above. How do I do that? – Well, we know from the same literature that life-expectancy at birth, average years of schooling, expected years of schooling, and per capita income, these four represent HDI in three dimensions: living standards (y^*, y, y^{**}), education (S), and wellness/health (W), where S + W = H. To illustrate let

$$HDI\equiv x=H^{b}Y^{c}\ \Rightarrow\ H=x^{1/b}Y^{-c/b}\Rightarrow\ \ln H=\frac{1}{b}\ln x-\frac{c}{b}\ln Y,\ b+c=1, \tag{11}$$

where $b=2/3$ and $c=1/3$ are weights. Plugging (11) into (8) leads to

$$Y=N^{*\alpha}K^{\beta}T^{\lambda}A^{\gamma}x^{3\gamma/b}Y^{-\gamma/2}. \tag{12}$$

Eq. (12) assumes q is independent of the H derived from x . In reality the two are correlated and cannot be included in the same regression at the same time. Then dividing by N* and taking the natural logarithms of both sides of (12) leads to

$$y^{*}=a_0^{*}+\beta k^{*}+\frac{3\gamma}{2}x-\frac{\gamma}{2}y^{*}+\lambda t,\ a_0^{*}=\gamma\log A. \tag{13}$$

Gathering terms yields $(1+\frac{\gamma}{2})y^{*}=a_0^{*}+\beta k^{*}+\frac{3\gamma}{2}x+\lambda t,$ and solving for y* gives

$$y^{*}=\varphi_0+\varphi_1 k^{*}+\varphi_2 x+\varphi_3 t, \tag{14}$$

where $\varphi_0=(2a_0^{*})/(2+\gamma),\ \varphi_1=(2\beta)/(2+\gamma),\ \varphi_2=(3\gamma)/(2+\gamma),\ \varphi_3=(2\lambda)/(2+\gamma).$ and

4.1 Method

I use the OLS estimator on data for a sample of 133 countries in 2013. The objective is to estimate and compare coefficients of included variables. Appropriately adjusted the estimates should show that love (q) is an important part of H, and hence it determines the economic activity of countries along with school attainment, physical capital, and openness. In other words, the approach I adopted tests *indirectly* the hypothesis that the effect of q on H, and *directly* on y, are just as significant as the effects of conventional determinants.

In performing the estimations one can expect the usual statistical problems. First is the few degrees of freedom given the small smaple. Second is multicollinearity due to the "bunching" of cross-section data (Intrilligator, 1978). Unfortunately there is nothing surefire one can do about these two problems. To deal with the efficiency of the estimates and spatial correlations I use White's (1980a, 1980b) techniques to correct the estimations.

4.2 Variables, Data, and Data Sources

A key advantage of this paper is that it is variable and data economical. For example, the dependent variable is either per worker GDP (y = ln(Y/L)), per capita GDP (y* = ln(Y/N*), or trade-weighted GDP (y**). All three are in PPP terms at 2005 constant chain dollar prices as reported in Penn World Tables (PWT) 7.1.

Table 1 - Descriptive statistics*

Variable	Mean	Std. Deviation	Variance	Minimum	Maximum
q = Love	68.530	13.33	177.690	29.000	93.00
S = H	8.1646	2.6296	6.9148	1.8000	13.100
y	27655.00	33121.00	0.10970E+10	606.13	0.26667E+06
y*	13997.00	18236.00	0.33254E+09	319.04	0.14673E+06
y**	12460.00	13561.00	0.18389E+09	316.02	62890.00
k	23.322	8.6000	73.559	3.1300	58.080
t	90.000	54.541	2974.700	29.200	409.22
x = HDI	0.6789	0.17387	0.030232	0.29800	0.95200

* Sample size is the following132 countries based on the Gallup World Poll of the "experience of love on any given day": 1. Philippines 93% (2193), 2. Rwanda 92% (1495), 3. Puerto Rico 90% (495), 4. Hungary 89% (1002), 5. Cyprus 88% (988), 6. Trinidad and Tobago 88% (506), 7. Paraguay 87% (1986), 8. Lebanon 86% (970), 9. Costa Rica 85% (1985), 10. Cambodia 85% (1961), 11. Nigeria 84% (1965), 12. Guyana 83% (486), 13. Spain 83% (998), 14. Mexico 82% (989), 15. Tanzania 82% (1941), 16. Ecuador 82% (2126), 17. Jamaica 82% (534), 18. Venezuela 82% (997), 19. Cuba 82% (978), 20. Brazil 82% (1038), 21. Laos 81% (1947), 22. Argentina 81% (1985), 23. Belgium 81% (1015), 24. Canada 81% (1006), 25. Greece 81% (996), 26. U.S. 81% (1224), 27. Denmark 80% (1003), 28. Portugal 80% (995), 29. Netherlands 80% (993), 30. Vietnam 79% (1901), 31. New Zealand 79% (1775), 32. Italy 79% (1000), 33. Colombia 79% (1994), 34. Madagascar 78% (998), 35. Uruguay 78% (1969), 36. Turkey 78% (985), 37. Dominican Republic 78% (1976), 38. United Arab Emirates 77% (961), 39. Saudi Arabia 77% (978), 40. Chile 76% (1982), 41. Malawi 76% (1997), 42. Ghana 76% (1986), 43. South Africa 76% (1968), 44. Australia 76% (1199), 45. Panama 75% (1995), 46. Zambia 74% (1971), 47. Kenya 74% (1965), 48. Namibia 74% (996), 49. Nicaragua 74% (1988), 50. Germany 74% (1214), 51. Ireland 74% (992), 52. Sweden 74% (993), 53. U.K. 74% (1200), 54. Switzerland 74% (986), 55. Montenegro 74% (800), 56. Austria 73% (984), 57. France 73% (1217), 58. Kuwait 73% (934), 59. Finland 73% (993), 60. El Salvador 73% (2000), 61. Pakistan 73% (2253), 62. Zimbabwe 72% (1989), 63. Honduras 72% (1947), 64. Peru 72% (1982), 65. Egypt 72% (1024), 66. Serbia 72% (1474), 67. Bosnia and Herzegovina 72% (1896), 68. Sierra Leone 71% (1986), 69. India 71% (3140), 70. Taiwan 71% (984), 71. Bangladesh 70% (2200), 72. Belize 70% (464), 73. Croatia 69% (958), 74. Macedonia 69% (1000), 75. Mozambique 69% (996), 76. Bolivia 69% (1948), 77. Liberia 68% (988), 78. Iran 68% (963), 79. China 68% (7206), 80. Slovenia 68% (1000), 81. Haiti 68% (471), 82. Norway 67% (992), 83. Sri Lanka 67% (1974), 84. Poland 67% (939), 85. Guatemala 67% (1988), 86. Uganda 66% (1961), 87. Sudan 66% (971), 88. Israel 66% (957), 89. Kosovo 65% (983), 90.

Table 2 – Correlation matrix of variables

Love = q	1.0000							
S = H	0.0658	1.0000						
y	0.1857	0.5476	1.0000					
y*	0.1849	0.4966	0.5549	1.0000				
y**	0.1829	0.6226	0.7642	0.7183	1.0000			
k	-0.0572	-0.0705	0.0865	0.0439	0.0438	1.0000		
t	-0.1024	0.2442	0.2403	0.2410	0.3717	0.0796	1.0000	
x = HDI	0.1608	0.8651	0.6496	0.6163	0.7522	-0.0013	0.2596	1.0000
	q	S	y	y*	y**	k	t	x

*continued from previous page: Thailand 65% (2377), 91. Jordan 65% (998), 92. Albania 64% (855), 93. Guinea 62% (952), 94. Botswana 62% (999), 95. Angola 62% (957), 96. Burkina Faso 62% (1876), 97. Malaysia 61% (2115), 98. Mali 61% (984), 99. Niger 61% (1925), 100. Palestinian Territories 61% (991), 101. Romania 61% (937),102. Senegal 61% (1805), 103. Indonesia 61% (2013), 104. Afghanistan 60% (1128), 105. Hong Kong 60% (789), 106. Cameroon 59% (1967), 107. Japan 59% (1138), 108. Nepal 59% (1965), 109. Bulgaria 59% (927), 110. Slovakia 58% (991), 111. Singapore 58% (3002), 112. Czech Republic 58% (992), 113. Mauritania 57% (1960), 114. Benin 56% (974), 115. South Korea 56% (2056), 116. Myanmar 55% (1047), 117. Latvia 54% (1942), 118. Togo 54% (988), 119. Estonia 53% (1800), 120. Lithuania 50% (1863), 121. Russia 50% (4667), 122. Chad 49% (1915), 123. Yemen 48% (959), 124. Ukraine 48% (1930), 125. Ethiopia 48% (1913), 126. Azerbaijan 47% (1824), 127. Tajikistan 47% (1847), 128. Moldova 46% (1937), 129. Kazakhstan 45% (1871), 130. Morocco 43% (1011), 131. Belarus 43% (1992), 132. Georgia 43% (1904), 133. Kyrgyzstan 34% (1969), 134. Mongolia 32% (928), 135. Uzbekistan 32% (962), 136. Armenia 29% (1954) – Betsey Stevenson and Justin Wolfers are Bloomberg View columnists. NB: Although part of the q list, the following countries are not included in the estimations of this paper for lack of other relevant data: Kosovo, Palestinian Territories, and Myanmar (Burma).

Table 3 – Determinants of worker productivity (Y/L) across countries
(Mean dependent variable = 9.5756; Parentheses t-values at 5% significance level)

Variable	Estimation 1	Estimation 2	Estimation 3	Estimation 4	Estimation 5	Estimation 6
Constant	4.921 (5.807)	4.414 (3.423)	3.855 (4.548)	4.888 (6.634)	6.992 (7.139)	4.010 (5.266)
k	0.559 (2.454)	0.376 (1.207)	0.558 (2.543)	0.557 (2.466)	0.447 (1.456)	0.564 (2.605)
S	0.36516.678)		0.358 (15.573)	0.364 (18.057)		
t	-0.010 (-0.069)	0.602 (2.756)	0.040 (0.294)		0.018 (2.472)	0.013 (2.819)
q		0.020 (2.776)	0.013 (2.862)			
Adj. R^2	0.597	0.089	0.614	0.600	0.042	0.617
SEE	0.794	1.194	0.778	0.791	1.225	0.775
DW [ρ}	1.792 [0.093]	1.856 [0.067]	1.873 [0.052]	1.791 [0.094]	1.855 [0.069]	1.878 [0.048]
χ^2 (df)	7.031 (6 df)	13.468 (6 df)	3.052 (5 df)	7.131 (7 df)	7.396 (7 df)	3.946 (6 df)
LF	-154.884	-208.66	-151.551)	-154.886	-212.56	-151.589

Table 4 – Determinants of per capita GDP (Y/N*) across countries
(Mean dependent variable = 8.8088; Parentheses t-values at 5% significance level)

Variable	Estimation 1	Estimation 2	Estimation 3	Estimation 4	Estimation 5	Estimation 6
Constant	3.863 (4.546)	3.060 (2.244)	2.478 (3.031)	4.073 (5.584)	6.099 (5.931)	2.955 (4.079)
k	0.509 (2.206)	0.319 (0.991)	0.509 (2.323)	0.517 (2.275)	0.403 (1.267)	0.525 (2.437)
S	0.382 (16.862)		0.373 (15.914)	0.385 (18.380)		0.379 (17.635)
t	0.059 (0.417)	0.710 (2.976)	0.124 (0.911)			
q		0.024 (3.403)	0.017 (4.392)		0.021 (2.993)	0.017 (4.230)
Adj. R^2	0.598	0.110	0.629	0.601	0.048	0.627
SEE	0.833	1.241	0.805	0.831	1.283	0.803
DW [ρ]	1.525 [0.076]	1.767 [0.109]	1.952 [0.010]	1.834 []	1.753 [0.119]	1.963 [0.005]
χ^2 (df)	9.841 (6 df)	2.451 (2 df)	6.449 (5 df}	12.817 (7 df)	25.423 (7 df)	6.606 (6 df)
LF	-161.215	-213.756	-156.032	-161.289	-218.683	-156.374

Table 5 – Determinants of trade-weighted GDP (y) across countries**
(Mean dependent variable = 8.7519; Parentheses t-values at 5% significance level)

Variable	Estimation 1	Estimation 2	Estimation 3
Constant	3.990 (5.666)	6.213 (6.226)	3.125 (4.265)
k	0.547 (2.514)	0.433 (1.380)	0.554 (2.632)
S	0.377 (21.494)		0.373 (20.542)
q		0.018 (2.329)	0.013 (2.693)
Adj. R^2 SEE DW [ρ] χ^2 (df) LF	0.609 0.803 1.624 [0.178] 11.954 (7 df) -156.748	0.038 1.258 1.650 [0.172] 6.407 (2 df) -216.122	0.624 0.787 1.691 [0.143] 5.243 (6 df) -153.638

Table 6 – Effects of HDI on economic activity across countries
(Parentheses t-values at 5% significance level)*

Variable	Estimation 1	Estimation 2	Estimation 3	Estimation 4	Estimation 5
Constant	4.623 (10.54)	4.405 (11.31)	3.558 (8.984)	3.566(10.04)	3.507 (10.75)
k	0.249 (2.447)	0.243 (2.346)	0.185 (1.803)	0.185 (1.842)	0.223 (2.419)
t	-0.063(-0.77)		0.002 (0.027)		
x	6.560 (23.974)	6.515 (11.309)	6.879 (24.613)	6.881 (25.530)	6.713 (28.185)
adj. R^2 SEE DW [ρ] χ^2 (df) LF	0.834 0.513 1.777 [0.106] 21.457 (6 df) -96.576	0.834 0.509 1.769 [0.110] 26.029 (7 df) -96.729	0.835 0.534 1.919 [0.033] 34.728 (6 df) -102.448	0.836 0.532 1.919 [0.033] 35.28 (7 df) -102.448	0.840 0.513 1.731 [0.129] 38.829 (7 df) -97.672

*Estimation 1: *y* with t; Estimation 2: *y* without t; Estimation 3: *y** with t; Estimation 4: *y*** with t; and Estimation 5: *y*** without t.

Among independent variables is a measure of physical capital (K, k), approximated as investment-GDP (y) ratio, also from PWT 7.1. We assume L = 1, and the growth rate of L equals the growth rate of N*, whose growth rate equals the growth rate of N, i.e. $dL/Ldt = dN^*/N^*dt = dN/Ndt = n$. We assume (H, h) = S, according to Barro-Lee's dataset. The variable q = love, and its comes from a GallupWorld Poll of 136 countries about their "love experience and feeling of love on any day" conducted over 2006-2007 and reported in 2013 (see, Wolfers, 2013). The list of the countries included in the poll is at the bottom of Tables 1 and 2. Intuitively, we are alleging that the effect of q on y does not wear off; q affects y with a time lag of up to three years. Finally, HDI = x data comes from Human Development Report (20013), and is adjusted for income inequalities.

Respectively, Tables 1 and 2 present descriptive statistics and a correlation matrix of untransformed variables. There is significant correlation among some key variables such as between y** and S, S and x, and x and y. However, such correlation is not of the kind unacceptable in this kind of data. Preliminary charts (not presented, but available upon request) reveal that the correlations among variables are not systematic. The relationship between the economic activity and the Barro-Lee measure of human capital is scattered randomly. The differences between economic activity and q as well as between the economic activity and x, are only scale differences. By country q is declining, but only because the data for q was ranked from the "most loving" country (Phillipines with a score of 93%) to the "least loving" country (Armenia with a score of 29%).

5. Results

Tables 1 - 4 summarize the results of the estimations. Table 3, for example, shows the effects of the key variables on worker productivity (y). The impact of Barro-Lee human capital (S) on y is larger than that of love (q) human capital. A one percent increase in S contributes up to 36 cents to output per worker. The comparable effect of q ranges only between one and two cents. The predictive power of all estimates is low, as the standard errors of the estimates indicate. Even so, up to 61% of variations in worker are explained by the included variables. Unexplained variations attributable to random errors are reasonable, although not in all regressions, especially in Estimations 2 and 5. Moreover, from the same table it is clear that the effects of physical capital are larger than those of Barro-Lee H = S, which are larger than those of q. Openness (T) to international relations has either a negative, or insignificantly positive, influence on output per worker.

Table 4 considers the effects of the same variables, but this time the economic activity is represented by per capita GDP (y*). Here too real output rises by an average of only two cents for ever one percent improvement in q compared to nearly 38 cents in the case of Barro-Lee H, with up to 60%of variations in output explained. One observes similar results in Table 5, which takes a look at trade-adjusted real GDP (y**). Whether estimated exclusively, or with both included in one regression, the impact of S is double that of q. Physical capital has the largest effects followed by the Barro-Lee H, with q and openness often trading the lowest place.

Finally, Table 6 allows us to compare the importance to economic activity of love capital (q), Barro-Lee H (S), and all human capability and well-being (x = HDI). The results clearly show the effects of physical capital accounting for 1.85% to as high as 55% of economic activity. The Barro-Lee H affects the economic activity in a more positive way than q, but both less than HDI = x. The residual effects are of lower magnitude. For policy action this would mean countries gain more from investment in human development, physical capital, and Barro-Lee-like human capital in that order. Openness (T) appears over-stressed as a determinant of economic activity across countries. In fact, the effects of T are less statistically significant than those of q; in nearly all regressions attempted T is significant and positively signed only when q is excluded. There may be a point worth noting that loving families lead to high economic outcomes, which meas better health, including that of children. Healthy kids means high human capital and a high HDI.

6. Conclusion

This paper acts on a hunch inspired by the commencement speech given by Ms. Melinda Gates to the Duke University Class of 2013. In the speech she told graduating students to use technology as a tool for forging deep human and spatial connections. Love makes connections possible and it compels communication. Communication makes learning and knowledge accumulation possible, which in turn leads to new technologies, and improved productivity. Productivity improvement leads to progress and increased standard of living. Using that assertion as a template this paper begins with a brief justification of the love as an aspect in human capital formation. Then it goes on to estimate and assess the effects of love on the economic activity of 133 countries in relation to the Barro-Lee measure of human capital, and other conventional determinants of economic activity.

Excluding the level of development, the results reveal that physical capital accounts for the largest and most stable effects on the economic activity of nations, followed by the Barro-Lee H. The effects of love are generally positive, but of low magnitude. One may conclude that love alone is important, but not a dominant determinant of economic activity as Tables 3 and 4, Estimations 2 and 5, as well as Estimation 2 of Table 5 clearly indicate. In fact, the results bear out what the q data on individual countries depict. A good number of countries which rank high on the q index have low physical and Barro-Lee human capital. For example, with an S of 9 years of schooling, the Phillipines ranks first on the q list, but the country's investment rate is only about 21% of its real GDP, the same as for Armenia which is dead last on the q list. Niger where H is only two years of schooling ranks higher on the q list than the Czech Republic where H is 12 years of schooling and K is over 23%. Malaysia and Hungary are the most open economies in the world, their H's are not far apart, even as they are worlds apart according to the q list. The United States is behind Rwanda on the q list despite that it has the highest H in the world.

The data may also have a cultural bias to it. Many Asian nations score low on the list. It may be the case that in some cultures love is a private matter and as such not openly expressed. If so, we are cautioned not to dump the baby out with the bath water. The love aspect of H in some case has stronger effects on economic activity than openness.

The implication for policy is to invest in K and Barro-Lee H, and other factors and forces that improve the HDI of nations. It may be possible that as the standard of living increases, individualism also goes up, and people are not as quick to express love. But that doesn't mean they lack the experience and feeling of love. Although adjusted for spatial correlations and heteroskedascity, the OLS method is not the best estimator in the presence of multicollinearity. The econometrician purist would recommend alternative estimators like GLS, ridge regression, and or principal component analysis. I chose not to attempt those methods because I do not think their benefits outweigh their costs, given the small sample on hand.

The findings also have lessons for further research. Both the loglikellihood functions (LF) and the Chi-squared test seem to indicate that the model as specified is inadequate. Even with such limitations, the paper clearly shows that love plays an important role in the economic sphere of nations worldwide.

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