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An International Index of Child Welfare

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An International Index of Child Welfare

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1. Introduction

This paper develops an international index of child welfare that can be used for comparisons across countries and over time. Values of this index for the year 1998 are presented for 118 countries. The paper is organized as follows. Sections 2 briefly discusses the importance of child welfare both as a means to advance economic development objectives and as an end in itself. Section 3 calculates National Performance Gaps (NPGs), a concept first introduced by UNICEF (1995) to measure child welfare variables relative to international norms based on per capita income. After reviewing some methodological issues, I present estimates of NPGs for five variables: (1) the infant mortality rate; (2) the under-five mortality rate; (3) the percentage of under-five children who are underweight; (4) the primary school enrollment rate; and (5) the percentage of children reaching grade five. Section 4 draws on these NPGs to devise a composite index of child welfare, which I term WINOCENT. Finally, Section 5 offers some concluding remarks.

2. Child Welfare as Means and as an End

Studies in the field of child welfare span the whole gamut of social sciences, with contributions from psychologists, demographers, nutritionists, and health and education professionals, as well as economists. The economists' contribution to the literature has been two-fold. Some studies have focused on child welfare as an end in itself, investigating how household behavior and government policies affect child-welfare outcomes. Others have examined child welfare as a means to further other social objectives, investigating the impacts of child health and education on economic growth, productivity, and distributional and gender equity.

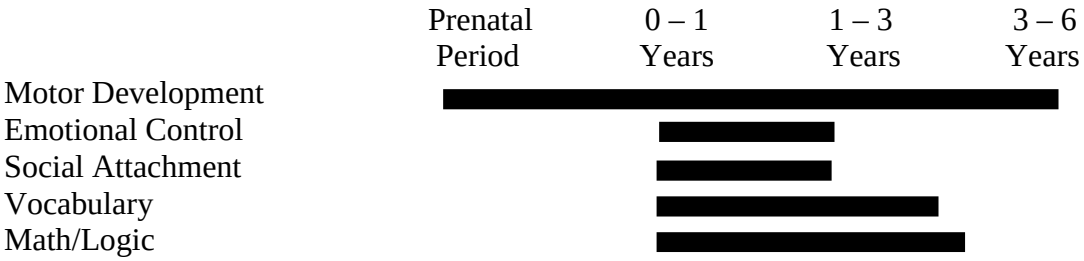
2.1 Child Welfare as an End

Amartya Sen's work (1984) can be viewed as a cornerstone of the present-day economic literature on child welfare. Sen's "human capabilities" approach recognizes that there are complementarities among various dimensions of well-being. The capability to be well-nourished, for example, depends not only on entitlements to food, but also on entitlements to health care and education. Recent literature has sought to estimate the degree of significance and the directions of causation of these complementarities (Pollitt 1990; Behrman 1996; Behrman et al. 1997; Glewwe 1995, 1996).

One previously neglected issue on which the capabilities approach has helped to shed light is the intra-household distribution of food. Particularly at times of economic hardship, biases against children and women often affect the distribution of food within households (Basu et al. 1995). The potential for bias against children has now been factored into early childhood development (ECD) policy design and formulations (Behrman, 1996; Grantham-McGregor et al. 1991).

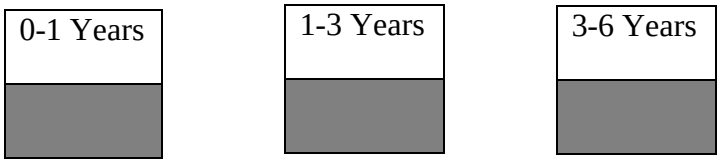
A growing body of literature attests to the efficacy and importance of ECD programs in both developing and the developed countries (Young 1995). Researchers have identified the "windows of opportunity" for the development of children's five core abilities: motor development, emotional control, social attachment, vocabulary, and math and logic (see Figure 1). These windows specify the critical periods in a child's development, when the capability for physical, emotional and cognitive functioning is established. Once a window is closed, interventions in that area will lose their optimal effectiveness. Figure 2 summarizes the needs and areas of intervention for children at three stages: 0-1 years; 1-3 years; and 3-6 years.

Figure 1: Windows of Opportunity



Source: van der Gaag (1997)

Figure 2: Needs and Interventions



0-1 Years	1-3 Years	3-6 Years
Safe Shelter	Safe Shelter	Safe Shelter
Food and Micronutrients	Food and Micronutrients	Food and Micronutrients
Health Care	Health Care	Health Care
Stimulation	Stimulation	Stimulation
	Access to Safe Water	Access to Safe Water
		Preschool Education
		Parent Education

Source: van der Gaag (1997)

In addition to instrumental arguments discussed below, some authors have advocated a "human rights" approach to child welfare, based on ethical and legal norms (Parker, Johnsson, Dall, 1995). Neglect of child rights, it is argued, often has more to do with power relationships, i.e. lack of 'political will,' than with aggregate resource constraints. Here the focus of analysis is on the control and distribution of resources at various levels of society: household, community, state, national, and international. The fact that children cannot care for themselves places a moral obligation on the family, the community, and governments to allocate adequate resources to meet child needs.

In recent years, the rights-based perspective has made increasing inroads into the policy frameworks of international organizations. The 1989 Convention on the Rights of the Child, which by 1995 was ratified by 170 nations, distinguishes between positive rights and negative rights of children. Positive rights are those that have to be produced, such as rights to nutrition, health care, and basic education. These rights depend on resource allocation. A need becomes a positive right when a society is capable of meeting that need, and when fulfillment of that need is essential to human well- being. Negative rights are those that refer not to the provision of goods and services, but rather protection from harm. Negative rights thus do not involve resource costs and are considered to be universal and inviolable.

Given the shortcomings of market forces in meeting child's positive rights, the state can play a crucial role in allocation of resources to this end. Article 24 of the Convention on the Rights of the Child obliges all countries to "diminish infant and child mortality and to combat disease and malnutrition". Article 4 declares that countries "shall undertake such measures [towards this obligation] to the maximum extent of their available resources". This entails a significant implication, namely that there must be a way to assess whether a government is, in fact, guaranteeing positive rights to its children. In 1993, the United Nations' Children's Fund (UNICEF), in its publication The Progress of Nations, introduced one such measure: the National Performance Gap (NPG) to measure the extent to which positive child rights are being honored in relation to available resources as measured by the GNP per capita.

2.2 Child Welfare as a Means to Advance Other Ends

The effects of child welfare on other social objectives, including economic growth, productivity, and distributional and gender equity, has also spawned a substantial literature. Here I review several of the more important contributions.

2.2.1 Economic Growth

Direct studies of the impact of health and nutrition on national income are rare. Behrman (1996) reports that, controlling for the level of real per capita income, for every year of added life expectancy, the subsequent annual growth rate in total GDP increases by 0.15 percent, exports increase by 0.44 percent, and the population growth rate declines by 0.056 percent.

Among the various human resource investments, schooling is widely perceived to lead to greater productivity, and hence to economic growth. Studies for the impact of education on economic growth date back to the early 1960s (Schultz, 1961; Denison, 1962; 1967). The contribution of education to increases in output has been estimated at l to 3 percent of the percentage output growth per year in Mexico and Brazil, and 16 percent in Argentina (Patrick and Kehrberg, 1973; Pachico and Ashby, 1976). Estimates for Ghana, Malaysia, Nigeria, Kenya, Venezuela, and the Republic of Korea have found this contribution to be in the 12 to 23 percent range (Psacharopoulos and Woodhall, 1985).

In a study of human resource development in Latin America and the Caribbean, Behrman (1996) concluded that for every one-grade increase in average years of schooling, the rate of growth in real GDP increases by about 0.35 percentage points. Furthermore, he found that schooling has effects on international competitiveness and fertility rates, both of which can impact real per capita GNP growth. For every extra grade of schooling, the export growth rate rose by 0.7 percentage points and population growth was lower by 0.2 percentage points. Disaggregating school enrollments, Behrman found that a 30% difference in primary enrollment rates is associated with a 2.1% difference in subsequent annual per capita GDP growth, and a 5.4% difference in subsequent annual export rates. This study also found that a 30% difference in secondary school enrollments was associated with a reduction in subsequent annual population growth by 1.8 percent.

2.2.2 Productivity and Wages

There is ample evidence of a relationship between nutritional status and maximal physical work capacity, as measured by maximal oxygen consumption ($VO_{2\ max}$). Studies in East Africa, Sudan, and Colombia (Spurr, 1988; Spurr, Reina, and Barac-Nieto, 1983) have shown that VO_{2max} is positively correlated with output from work. A study by Satyanarayana, Naidu, and Rao (1979) shows that the height and weight of children at age five explains 64 percent of the variance in their current physical work capacity.

There is substantial evidence that early childhood health affects productivity and earnings during adulthood. Health problems during the first years of life can cause physical growth to falter (Martorell et al. 1995, Satyanarayana et al. 1979) and growth deficits as an adult (Bundy, 1997). Studies by Golden (1994) and Martorell et al. (1994) suggest that growth deficits attributed to early childhood ill health result in a reduction in subsequent productivity. A study in rural India found that better nourished boys were paid higher wages, and that men and women with stronger physiological attributes earned as much as 40% above the normal pay (Satyanarayana, 1980; Satyanarayana et al. 1979). In a study of Ghana, Glewwe and Jacoby (1995) found that for health and nutritional reasons for each year of delay in primary school enrollment, a child lost 3 percent of lifetime wealth. Behrman and his associates (1997), based on a study of data from Pakistan, also found a strong effect: a one-year delay caused a six percent decrease in the value of lifetime earnings. In addition, they found that improved nutrition can yield up to a 32 percent increase independently of the school-delay effect.

There is also a wealth of evidence on the indirect impact of health and nutrition on productivity via cognitive and educational development. For example, Pollitt (1990), Pollitt et al. (1984), Simeon and Grantham-McGregor (1990), and Grantham-McGregor (1990) have found that severe malnutrition has long-term consequences for mental functioning and educational achievement, and that mild-to-moderate malnutrition can lead to developmental lags that may affect educational achievement. Jamison (1986), Moock et al. (1986), Balderston (1981), Beasley (1995), and a study by UNICEF (1996) have found that low height-for-age is a statistically significant predictor of non-enrollment and slower progress through school. Martorell and colleagues (1992), after controlling for socio-economic circumstances and maternal education, found that slow growth among children up to 3 years old was associated with poorer subsequent school achievement. Several studies suggest that cognitive development is impaired in infants with low birth weight (Saigal et al. 1991, Stjernqvist et al. 1995, Smedler et al. 1992, Hille et al. 1994).

The impact of schooling on wages, earnings, and economic productivity is substantial, with relatively high returns to primary (as opposed to secondary or higher) education. Psacharopoulos (1994), for example, found that one extra year of primary education increases a person's future productivity and wage by 10 to 30 percent. A survey for the World Bank showed that if a farmer completed four years of elementary education, his or her productivity would increase, on average, by 8.7 percent (Lockheed, Jamison, and Lau, 1980; see also Jamison and Moock, 1984).

2.2.3 Equity: Income Distribution and Gender Inequality

Child welfare has also been shown to have significant impacts on income distribution and gender inequality. In a cross-national study of Latin America, Behrman (1996) found lower average years of schooling to be associated with a more inequitable distribution of national income. Indeed, his results indicated that education is the variable with the strongest impact on income inequality; variations in years of schooling 'explained' about 25% of income inequality. Within countries, low schooling was the variable most strongly associated with incomes at the bottom 20 percent: the probability of being in this income category increases as years of schooling decreases. A number of earlier studies of developing countries also reported evidence that increasing education contributes to a more equal income distribution of income (Langoni, 1973; Chiswick et al. 1972; Carnoy et al. 1978).

Behrman (1996) also found that schooling has significant impacts on gender inequality and on the education and health of future generations. High primary school enrollment rates, in particular, are found to be strongly associated with subsequent (20-25 years later) increases in reductions of government expenditures on social services as a percentage of GDP, reductions in low birth weights, reductions in gender differences (favoring males) in infant and under-5 mortality rates, and reductions in gender gaps favoring males in primary school enrollments. For every additional grade of average initial schooling, the primary enrollment rate two decades later is 3.7 percent higher, and 5.6 percent higher for females; the secondary enrollment rate is 5.2 percent higher, and

5.6 percent higher for females; and adult literacy is 6 percent higher, 6.8 percent higher for females.

At the same time, gender equity has been shown to lead to higher child welfare. For example, Cochran et al. (1980) estimated that one additional year of mother's education leads to a 9 per 1000 reduction in infant mortality, whereas the corresponding figure for father's education was a reduction in infant mortality of 5 per 1000 births. Behrman (1996) reports that an increase by one grade of initial female, relative to male, schooling is estimated to reduce infant mortality by 12 to 13 children per 1000 births; and reduce under-5 mortality by 20 per 1000 births.

These two lines of argument – child welfare as an end in itself, and as a means to other ends – are not mutually exclusive: each can be seen as adding weight to the other. A merit of the former, rights-based argument, however, is that it directs our attention to the possibility that societal failures to invest in early childhood development may be not merely a result of ignorance and mistakes by policy makers, but also a result of systematic biases that deprive vulnerable sections of society of fundamental rights.

3. National Performance Gaps and Child Welfare

This section builds on the pioneering work of UNICEF (1995) to calculate National Performance Gaps (NPGs) for five child-welfare indicators: the infant mortality rate; the under-five mortality rate; under-five malnutrition; the primary-school enrollment rate; and the percentage of children reaching grade five. These NPGs are derived for 112 lower and middle-income countries on the basis of comparisons between actual performance and that predicted by simple regressions of the child-welfare indicators on per capita income.

3.1 UNICEF's Efforts – Precedent and Shortcomings

The concept of National Performance Gap was first introduced by the UNICEF in the publication The Progress of Nations, in 1993. This represented the first attempt to assemble an international set of child-welfare indicators that would allow comparisons across countries and over time, controlling for differences in national income per capita. Updated NPG measures were also reported in the 1995 and 1996 editions of the The Progress of Nations. The most comprehensive set of NPGs appeared in the 1996 edition, which reported data for three child welfare indicators – the under-five mortality rate; the percentage of students reaching grade five; and the percentage of children under the age of five who are underweight – for a total of 136 countries.

This paper extends and improves upon these early NPG measures in six ways. First, I calculate NPGs for an expanded set of child welfare indicators, adding the infant mortality rate and the primary school enrollment rate to the three indicators provided by the UNICEF.

Second, I refine the NPG for the rate of attainment of grade five so as to provide a more robust measure. The UNICEF measure was based on the percentage of primary school entrants who reach grade five. This measure can yield rather odd conclusions, since a country where very few children ever enter primary school, but where all of those who do enroll continue through grade five, performs "better" than one where everyone enters but a few drop out before grade five. To redress this problem, I calculate the percentage of children with the relevant age group who reach grade five, including those who never enrolled in school.

Third, UNICEF calculated NPGs on the basis of data from countries at all income levels, including high-income countries. Here I use data for low-to-middle income countries only, on the grounds that among high-income countries the most relevant indicators of international variations in child welfare pertain to other variables, such as the consumption of tobacco, substance abuse, injuries and deaths from fire arms, and access to health care.

Fourth, the NPGs reported in the UNICEF publications are calculated based on the GNP per capita. As is well known, GNP figures fail to reflect inter-country differences in purchasing power (see Kravis et al. 1978). To control for this, I instead use purchasing power parity-adjusted GNP per capita.

Fifth, the UNICEF studies defined the NPG simply as the absolute difference between the actual values of the child-welfare variable and their expected value, i.e., as the simple residuals when child welfare is regressed on per capita income. The resulting measures do not adequately take into account the differences among countries in their expected values. For example, an under-five mortality rate that exceeds the expected value by 35 deaths per 1000 children arguably means something different when the expected rate is 20 deaths per thousand than it does when the expected rate is 120 deaths per thousand. In addition to such *absolute* NPGs, therefore, I also present *relative* NPGs, defined as the absolute gap divided by the expected value, i.e., the percentage difference between actual and expected values.

Finally, in order to calculate the NPGs, I first undertake statistical comparisons of alternative specifications of the relationship between child welfare and per capita income relation, estimated on the basis of several functional forms. In The Progress of Nations, UNICEF describes the method it employed to calculate the NPGs as follows: "Deriving an expected level of performance requires the fitting of a line to country data represented by points on a graph of which one axis is always GNP per capita." Details as to the specifications of this line are not provided in the UNICEF publication. In personal interviews at UNICEF headquarters in New York, I learned that the statistical method used to calculate the NPGs was "locally weighted least squares." This involved fitting two separate linear regression lines to two subsets of the data, truncated at some level of per capita income. The rupture points between the specified ranges were then "smoothed" to yield a curvature between the two estimated linear segments. This procedure is somewhat arbitrary in its specification of the linear form of the segments, the choice of the truncation points, and the ad hoc "smoothing" of the resulting kink in

the regression line. In this paper, as described below, I test alternative specifications of the child welfare-income relation, choosing the one that provides the best statistical "fit" for use in the calculation of NPGs.

3.2 Data Sources

I analyze data for countries with a per capita real income of fifteen thousand dollars or less. I use purchasing power parity-adjusted gross national product per capita (GNPPC), averaged over the years 1996-98, as the variable for real income. This is calculated from data reported by the World Bank's World Development Indicators. I use data on five distinct child-welfare variables: the infant mortality rate (IM); the under-five mortality rate (U5M); the malnourishment rate among children under five years of age (STUNT); the net enrollment rate in primary school (PEN); and the percentage of children reaching the fifth year of school (TRG5).

IM (the infant mortality rate) is defined as the number of children who die between birth and one year of age, per 1000 live births. Data on this variable are taken from the World Health Organization's World Health Report 1999. Most of these data refer to the years 1995 to 1998; in cases where more up-to-date data are not available, I use data from as far back as 1992.

U5M (under-five mortality rate) is the number of children who die between birth and five years of age, per 1000 live births. Data on U5M are also taken from WHO's World Health Report 1999. In cases where data from 1995-1998 were unavailable, I again used U5M data from as far back as 1992.

STUNT refers to the percentage of children under five years of age who are moderately to severely malnourished. According to the World Health Organization (2000b), stunted growth reflects a process of failure to reach linear growth potential as a result of sub-optimal health and/or nutritional conditions. The degree of stunting is measured by the height-for-age ratio criterion: the World Health Organization defines moderate stunting as being two standard deviations or more below the median value of height-for-age. The primary sources of data for rate of under-five stunting are the World Health Organization's World Health Report 1999 and Global Database on Child Growth and Malnutrition 2000. Further data are available from UNICEF's State of the World's Children 2000. There are systematic discrepancies, however, between the WHO and UNICEF data. For countries for which data from both the WHO and UNICEF are available, I calculated that the average ratio of the WHO to UNICEF data was 1.6. Therefore, for countries for which the WHO does not report data on stunting but UNICEF does, I used the UNICEF data, scaling it upwards by a factor of 1.6.

PEN (net primary enrollment rate) refers to the total enrollment in primary education in the age group corresponding to the official school age for primary education, divided by the population of the same age group[1]. Data on PEN are taken from UNESCO's World

[1] The gross primary enrollment rate refers to the total enrollment in primary education, regardless of age, divided by the population of the age group which officially corresponds to primary schooling. I also

Education Report 2000 for the years 1995-1998; again when data were not available for those years, I used data from as far back as 1992.

The primary source of data on the percentage of primary school entrants who reach grade five (RG5) is the World Bank's World Development Indicators, 2000. In cases where data were unavailable from the World Bank, data were taken from UNICEF's State of the World's Children 2000 and from UNESCO's World Education Report 2000. For countries where data are available from both the World Bank and the United Nations sources, the average ratio of the former to the latter was 0.99. Therefore, data on this variable from the UNICEF and UNESCO were assimilated with the data from the World Bank without any adjustment. Although RG5, thus defined, is a useful indicator of school performance, for the purposes of this paper, where the focus is on child welfare, a more appropriate indicator is the total percentage of all children in the relevant age group who reach grade five (TRG5). To calculate TRG5, I used data for two variables: the percentage of primary school entrants who reach grade five (RG5) and the net primary enrollment rate (PEN). Let TRG1 = the imputed percentage of all children who enroll in grade one:

$$(RG5)(TRG1) = TRG5 \tag{1}$$

Assuming a linear school drop-out rate between grades one and five, PEN (for all five years) can be expressed as the simple average of TRG1 and TRG5:

$$PEN = (TRG1 + TRG5) / 2 \tag{2}$$

Substituting from equation (1):

$$PEN = (TRG5 / RG5 + TRG5) / 2 \tag{3}$$

Simplifying and rearranging terms, we get:

$$TRG5 = 2(PEN) / (1 + 1/RG5) \tag{4}$$

The raw data on education indicators appear to be of relatively poor quality. It is doubtful, for example, whether the 100% enrollment rate reported for Cambodia is accurate. In some cases, the education data may be a better indicator of administrative

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examined data on this variable, but I do not report it here as the data on net PEN appear to be more consistent.

norms than of on-the-ground realities. It is noteworthy that the WHO's World Health Report presents health data in tables distinguished according to their degree of reliability. In contrast, UNESCO's World Education Report by does not offer any indications as to the degree of reliability of the national data.

3.3 Calculation of the National Performance Gap

Using ordinary least squares (OLS) regression analysis, I estimated the relationship between these five child-welfare measures and real income, using five alternative specifications: linear, quadratic, log-linear, double-log, and log-quadratic models. Table 1 provides details and summarizes the results, reporting the adjusted R^2 for all five specifications and all five child-welfare variables[2]. In two of the five cases, the double-log specification (which implies a constant elasticity of child welfare with respect to income) yields the "best" fit, and in the other three cases it comes close to the highest. Accordingly, I used this specification in calculations of the NPGs reported below. The percent of variation thus "explained" by income ranges from 45% in the case of primary enrollments to 98% in the case of infant mortality.

The first step in the calculation of the NPGs is the derivation of the expected values for each of the five child-welfare variables, via regressions using the double-log specification. The expected values were converted from natural logarithms to numerical values. The next step was to subtract these expected values from the actual values to yield the NPG in absolute terms. A positive NPG thus indicates that actual values are higher than expected; a negative value indicates the reverse. Finally, this was divided by the expected value to obtain the NPG in relative terms. For the health and nutrition variables (IM, U5M, STUNT) positive NPGs reflect worse performance than that expected on the basis of per capita income; for the education variables (PEN and TRGs) positive values indicate better-than-expected performance.

3.4 Results

Tables 2 and 3 present absolute and relative NPGs for the five child-welfare variables, as well as the actual values of these variables and their expected values based on national income per capita. For the health and nutritional variables reported in Table 2, higher values indicate lower child welfare. The results demonstrate the importance of the distinction between absolute and relative NPGs. For example, Guinea Bissau has the poorest infant mortality performance, in absolute terms, with 31 more deaths per 1000 infants than expected on the basis of national income, while Mozambique has the best performance, with 19 fewer than expected. Both countries, however, have extremely high infant mortality rates (in excess of 100 per 1000), underscoring the shortcomings of absolute NPGs as a basis for international comparisons. In terms of relative NPGs, the poorest performer turns out to be Ecuador, where infant mortality was 32 percent above the expected level, and the best performer was Georgia, with infant mortality 28 percent below the expected level.

[2] The adjusted R^2 statistic is a measure of the percentage of variation in the dependent variable (child-welfare) that is statistically "explained" by variations in the independent variable (per capita income).

For the educational variables reported in Table 3, higher values indicate better child welfare. In terms of relative NPGs, best performers in these two dimensions of education are Malawi and Kyrgyzstan, respectively, while the worst performers are Haiti and the Central African Republic[3].

4. A Holistic Indicator of Child Welfare: WINOCENT

Children's well-being has multiple dimensions, encompassing health, nutrition, and education. The composite of these dimensions and the interactions among them ultimately define children's status, providing a fuller picture of their situation than any single dimension. To present a holistic indicator of child welfare, I now derive a quantitative measure that I call WINOCENT, standing for the "Welfare Index of Children in their Entirety." Like established social and economic indexes such as the United Nations Development Programme's HDI (Human Development Index) and GEM (Gender Equality Measure), WINOCENT provides a convenient measure of a multi-dimensional phenomenon, in this case children's welfare. It thereby provides a tool for gauging the extent to which the needs of children as a whole are met. It is hoped that WINOCENT will be useful to policy-makers, and particularly to those interested in the human-capabilities approach to development. The WINOCENT index is the simple average of the relative NPGs for five child-welfare indicators: the infant mortality rate; the under-five mortality rate; the rate of under-five malnourishment; the primary-school enrollment rate; and the percentage of children reaching grade five. The signs of the various NPGs were reversed for the health and nutrition variables, so that higher values uniformly denote greater child welfare. Thus:

$$\text{WINOCENT} = (-\text{NPG}_{\text{IM}}\% - \text{NPG}_{\text{U5M}}\% - \text{NPG}_{\text{STUNT}}\% + \text{NPG}_{\text{PEN}}\% + \text{NPG}_{\text{TRG5}}\%) / 5$$

Table 4 presents the WINOCENT index, with countries ranked from the highest (best performance) to the lowest (worst performance). The index is calculated only for countries for which data on all five child-welfare indicators are available. The best performer is Georgia, with a WINOCENT of 42; that is, child welfare in Georgia is, on average, 42% higher than would be expected on the basis of its national income. The worst performer is Botswana, with a WINOCENT of minue 120; that is, child welfare is less than half of what would be expected on the basis of national income. In the Americas, the WINOCENT ranges from 32 in Jamaica to minus 59 in Guatemala. In Asia and Pacific, it ranges from 30 in Sri Lanka to minus 38 in Malaysia. In Eastern Europe and Central Asia and Europe, the WINOCENT is positive for all countries. In Middle East and North Africa, the WINOCENT ranges from 17 in the expected level in the Syrian Arab Republic to minus 28 in Turkey.

[3] The accuracy of Malawi's reported PEN of 99% is doubtful, however. As noted above, the educational data generally appear to be of poorer quality than the health data.

5. Summary

This paper has reintroduced and developed the concept of the National Performance Gap as an indicator of child welfare, building upon the pioneering works of UNICEF, which first introduced the concept. I have attempted to update that work and improve upon it in several respects, including the use of purchasing power parity-adjusted GNP per capita as the measure for national income; the use of a double-log specification of the child welfare-income relation, chosen after goodness-of-fit comparisons with alternatives; and the computation of relative as well as absolute NPGs.

Based on these results, a holistic child welfare index, WINOCENT, was constructed to represent children's overall well-being. Like the national performance gaps from which it is constructed, WINOCENT is a tool for monitoring progress in child welfare while controlling for the level of per capita income. In this sense, it provides a useful picture of children's status for making inter-country and inter-regional comparisons. The NPGs and WINOCENT could be of interest to health, nutrition, and education analysts at the national and international levels, as tools for planning and evaluating early childhood interventions. The WINOCENT can also serve as a baseline on children's status for all involved in promoting and protecting children's rights and interests worldwide.

This paper also sheds light on the role of one basic determinant of international variations in child welfare: national income per capita. Clearly, however, much variation remains to be explained. The NPGs can be used to study and evaluate reasons for divergences in child-welfare among countries and over time. Potential explanatory variables of interest include some that are readily susceptible to policy interventions (e.g., government expenditure on health and education), and others such as income distribution and the extent of civil and political liberties that are more "structural" and hence less amenable to short-run policy remedies. In future research, I intend to assess the relative importance of these determinants.

Table 1 Goodness-of-Fit For Alternative Specifications of Child-Welfare vs. Income Curve (R^2)

Specification	IMR	U5M	STUNT	PEN	TRG5
Linear $CWI_i = \alpha + \beta (GNPPC_i) + \upsilon$	0.52	0.38	0.47	0.30	0.44
Quadratic $CWI_i = \alpha + \beta_1(GNPPC_i) + \beta_2 (GNPPC_i)^2 + \upsilon$	0.75	0.54	0.51	0.46	0.62
Log-Linear $\mathbf{ln}CWI_i = \alpha + \beta (GNPPC_i) + \upsilon$	0.80	0.54	0.53	0.26	0.36
Double-Log $\mathbf{ln}CWI_i = \alpha + \beta (\mathbf{ln}GNPPC_i) + \upsilon$	0.98	0.65	0.48	0.45	0.57
Log-Quadratic $\mathbf{ln}CWI_i=\alpha + \beta_1(\mathbf{ln}GNPPC_i)+ \beta_2(\mathbf{ln}GNPPC_i)^2 +\upsilon$	0.93	0.59	0.53	0.40	0.54

Key:
CWI_i = child welfare indicator for the *i*th country
$GNPPC_i$ = purchasing-power adjusted GNP per capita for the *i*th country
IMR = infant mortality rate
U5M = under-five mortality rate
STUNT = under-five rate of malnutrition
PEN = net primary enrollment rate
TRG5 = percentage of children reaching grade five
α = intercept term
β = regression coefficient
υ = error term

Table 2 National Performance Gap: Health and Nutritional Dimensions of Child Welfare, 1995-98

Country	Infant Mortality (IM)				Under-Five Mortality (U5M)				Under-Five Malnutrition (STUNT)			
	Actual	Expected	NPG_{IM}		Actual	Expected	NPG_{U5M}		Actual	Expected	NPG_{STUNT}	
			Absolute	Relative			Absolute	Relative			Absolute	Relative
Americas												
Argentina	10	11	-1	-10	22	15	7	47	5	9	-4	-45
Bolivia	43	37	6	17	78	51	27	53	29	22	7	32
Brazil	17	17	0	0	40	23	17	74	10	12	-2	-17
Chile	13	11	2	19	12	14	-2	-15	2	9	-7	-78
Colombia	18	17	1	6	28	23	5	22	15	12	3	25
Costa Rica	18	18	0	0	15	23	-8	-35	6	12	-6	-50
Dominican Rep.	24	24	0	0	49	32	17	54	11	15	-4	-27
Ecuador	33	25	8	32	37	33	4	13	33	16	18	113
El Salvador	25	31	-6	-20	36	42	-6	-15	23	19	4	22
Guatemala	29	27	2	8	52	36	16	45	50	17	33	195
Haiti	64	71	-7	-10	116	99	17	18	32	35	-3	-9
Honduras	40	43	-3	-7	46	58	-12	-21	40	24	16	67
Jamaica	30	30	0	0	24	40	-16	-40	7	18	-11	-62
Mexico	15	15	0	0	35	19	16	85	23	11	12	110
Nicaragua	48	51	-3	-6	42	71	-29	-41	24	27	-3	-12
Panama	21	18	3	17	25	23	2	9	9	12	-3	-25
Paraguay	24	27	-3	-12	27	35	-8	-23	14	17	-3	-18
Peru	25	24	1	5	47	32	15	47	26	16	10	63
Trinidad&Tobago	15	17	-2	-12	18	22	-4	-19	5	12	-7	-59
Uruguay	13	14	-1	-8	19	18	1	6	9	10	-1	-10
Venezuela	19	15	4	27	25	20	5	25	13	11	2	19
Asia and Pacific												
Bangladesh	63	76	-13	-18	96	106	-10	-10	55	36	19	53
Cambodia	70	71	-1	-2	143	99	44	45	50	35	15	43
China	32	32	0	0	36	43	-7	-17	31	19	12	64
India	45	53	-8	-16	83	73	10	14	52	28	24	86
Indonesia	39	33	6	19	52	44	8	19	42	20	22	110
Korea Rep.	9	9	0	0	11	12	-1	-9	..	..	..	..
Lao PDR	54	65	-11	-17	111	76	35	47	47	32	15	47
Malaysia	15	13	2	16	12	17	-5	-30	30	10	20	200
Mongolia	61	58	3	6	60	80	-20	-25	25	30	-5	-17
Nepal	73	79	-6	-8	107	110	-3	-3	48	37	11	30
Pakistan	55	57	-2	-4	120	79	41	52	61	30	31	104
Papua New Guinea	43	39	4	11	76	53	23	44	43	22	21	96
Philippines	27	28	-1	-4	40	38	2	6	33	18	15	84
Sri Lanka	33	38	-5	-14	18	52	-34	-66	24	22	2	10
Thailand	19	18	1	6	33	23	10	44	16	13	3	24

Country	Infant Mortality (IM)				Under-Five Mortality (U5M)				Under-Five Malnutrition (STUNT)			
	Actual	Expected	NPG_{IM}		Actual	Expected	NPG_{U5M}		Actual	Expected	NPG_{STUNT}	
			Absolute	Relative			Absolute	Relative			Absolute	Relative
Vietnam	54	57	-3	-6	42	79	-37	-47	47	30	17	57
Central Asia												
Armenia	45	43	2	5	18	58	-40	-69	12	24	-12	-50
Azerbaijan	43	54	-11	-21	21	74	-53	-72	22	28	-6	-22
Kazakhstan	24	28	-4	-15	29	37	-8	-22	16	17	-1	-6
Kyrgyzstan	42	45	-3	-7	41	61	-20	-33	25	25	0	0
Tajikistan	82	86	-4	-5	33	121	-88	-73	40	40	0	0
Uzbekistan	45	43	2	5	29	58	-29	-50	31	24	7	30
Europe												
Albania	34	39	-5	-13	31	53	-22	-42	15	22	-7	-32
Belarus	17	21	-4	-20	14	27	-13	-49	..	..	..	..
Bulgaria	22	24	-2	-9	15	33	-18	-55	..	..	..	..
Croatia	16	20	-4	-20	10	27	-17	-63	1	14	-13	-93
Czech Republic	10	11	-1	-10	6	14	-8	-58	2	9	-7	-78
Estonia	15	19	-4	-22	12	25	-13	-52	..	..	..	..
Georgia	29	40	-11	-28	20	55	-35	-64	12	23	-11	-48
Greece	9	9	0	0	8	12	-4	-34	..	..	..	..
Hungary	12	15	-3	-20	12	19	-7	-37	3	11	-8	-73
Latvia	19	24	-5	-21	19	31	-12	-39	..	..	..	..
Lithuania	17	22	-5	-23	12	29	-17	-59	..	..	..	..
Macedonia	24	28	-4	-15	18	37	-19	-52	..	..	..	..
Moldova	46	57	-11	-20	22	78	-56	-72	..	..	..	..
Poland	15	17	-2	-12	11	22	-11	-50	..	..	..	..
Portugal	9	9	0	0	8	11	-3	-28	..	..	..	..
Romania	19	22	-3	-14	25	29	-4	-14	8	15	-7	-47
Russian Federation	18	22	-4	-19	20	29	-9	-32	13	15	-2	-14
Slovak Republic	12	14	-2	-15	10	18	-8	-45	..	..	..	..
Slovenia	9	10	-1	-10	7	12	-5	-42	..	..	..	..
Ukraine	31	39	-8	-21	17	53	-36	-68	..	..	..	..
Middle East and North Africa												
Algeria	23	23	0	0	40	31	9	30	18	15	3	20
Egypt Arab Rep.	31	33	-2	-7	59	44	15	35	25	20	5	25
Iran Islamic Rep.	21	20	1	5	33	26	7	27	19	14	5	36
Jordan	37	32	5	16	31	43	-12	-28	16	19	-3	-16
Lebanon	25	20	5	25	30	26	4	16	12	14	-2	-15
Morocco	31	31	0	0	61	42	19	46	24	19	5	27
Saudi Arabia	11	12	-1	-9	26	15	11	74	..			
Sudan	70	69	1	2	105	96	9	10	34	34	0	0
Syrian Arab Rep.	36	34	2	6	32	46	-14	-31	21	20	1	5

Country	Infant Mortality (IM)				Under-Five Mortality (U5M)				Under-Five Malnutrition (STUNT)			
	Actual	Expected	NPG_{IM}		Actual	Expected	NPG_{U5M}		Actual	Expected	NPG_{STUNT}	
			Absolute	Relative			Absolute	Relative			Absolute	Relative
Tunisia	20	22	-2	-10	32	29	3	11	22	15	7	47
Turkey	17	17	0	0	42	23	19	83	20	12	8	67
Yemen Rep.	122	116	6	6	96	165	-69	-42	51	50	1	2
Sub-Saharan Africa												
Angola	85	91	-6	-7	204	128	76	60	53	42	11	27
Benin	97	79	18	23	140	111	29	27	25	38	-13	-35
Botswana	19	16	3	19	105	21	84	400	29	12	17	142
Burkina Faso	96	92	4	5	210	130	80	62	33	42	-9	-22
Burundi	140	139	1	1	196	198	-2	-2	52	57	-5	-9
Cameroon	63	57	6	11	150	78	72	93	26	29	-3	-11
Central Afr. Rep.	78	70	8	12	162	98	64	66	28	34	-6	-18
Chad	98	97	1	2	172	136	36	27	40	43	-3	-7
Congo Dem. Rep.	111	111	0	0	141	157	-16	-11	21	48	-3	-7
Congo Rep.	98	75	23	31	143	105	38	37	44	36	-15	-42
Côte d'Ivoire	60	58	2	4	143	80	63	79	24	30	-6	-20
Eritrea	86	87	-1	-2	90	121	-31	-26	38	40	-2	-5
Ethiopia	139	155	-16	-11	173	222	-49	-23	64	61	3	5
Gabon	19	18	1	6	132	23	109	474	..	..	..	..
Gambia	62	66	-4	-7	78	89	-11	-13	30	33	-3	-10
Ghana	52	54	-2	-4	96	75	21	28	26	28	-2	-8
Guinea	53	54	-1	-2	184	74	110	149	29	28	1	4
Guinea Bissau	137	106	31	30	205	150	55	37	23	46	-9	-20
Kenya	87	81	6	8	124	114	10	9	34	38	-4	-11
Lesotho	43	41	2	5	144	56	88	158	44	23	21	92
Madagascar	110	101	9	9	146	143	3	3	50	45	5	12
Malawi	142	128	14	11	229	183	46	26	48	53	-5	-10
Mali	119	120	-1	-1	218	170	48	29	30	51	-21	-42
Mauritania	59	56	3	6	140	77	63	82	40	29	11	38
Mauritius	14	13	1	8	22	17	5	30	10	10	0	0
Mozambique	110	129	-19	-15	213	183	30	17	36	54	-18	-34
Namibia	20	20	0	0	112	27	85	315	29	14	15	108
Niger	111	103	8	8	250	146	104	72	39	46	-7	-16
Nigeria	110	104	6	6	119	146	-27	-19	43	46	-3	-7
Senegal	67	60	7	12	121	82	39	48	23	30	-7	-24
Sierra Leone	171	175	-4	-3	283	252	31	13	35	67	-32	-48
South Africa	14	15	-1	-7	83	19	64	337	23	11	12	110
Tanzania	159	148	11	8	136	211	-75	-36	43	59	-16	-28

Country	Infant Mortality (IM)				Under-Five Mortality (U5M)				Under-Five Malnutrition (STUNT)			
	Actual	Expected	NPG_{IM}		Actual	Expected	NPG_{U5M}		Actual	Expected	NPG_{STUNT}	
			Absolute	Relative			Absolute	Relative			Absolute	Relative
Togo	65	62	3	5	144	85	59	70	34	31	3	10
Uganda	80	81	-1	-2	170	113	57	51	38	38	0	0
Zambia	119	105	14	14	192	148	44	30	42	46	-4	-9
Zimbabwe	38	42	-4	-10	125	57	68	120	21	23	-2	-9

Sources:

WHO, World Health Report 1999.

World Bank, World Development Indicators 1997, 1998, 2000.

WHO, Global Database on Child Growth and Malnutrition 2000.

UNICEF, State of the World's Children 2000. STUNT - Moderate to severe malnourishment

.. Indicates data were not available for the country.

Table 3 National Performance Gap: Educational Dimensions of Child Welfare, 1995-98

Country	Primary Enrollment Rate (PEN)				% Reaching Grade Five (TRG5)			
	Actual	Expected	NPG_{PEN}		Actual	Expected	NPG_{TRG5}	
			Absolute	Relative			Absolute	Relative
Americas								
Argentina	100	100	0	0	..	..	..	..
Bolivia	97	75	22	30	73	63	10	16
Brazil	97	96	1	2	81	92	-11	-12
Chile	90	100	-10	-10	90	100	-10	-10
Colombia	89	96	-7	-8	76	92	-16	-18
Costa Rica	89	95	-6	-7	84	91	-7	-8
Dominican Rep.	91	87	4	5	67	79	-12	-16
Ecuador	100	85	15	18	92	76	16	22
El Salvador	89	80	9	12	78	69	9	14
Guatemala	74	83	-9	-11	50	74	-24	-33
Haiti	20	62	-42	-68	13	46	-33	-72
Honduras	88	72	16	23	66	59	7	12
Jamaica	96	81	15	19	95	70	25	36
Mexico	100	100	0	0	93	99	-6	-7
Nicaragua	79	68	11	17	57	54	3	6
Panama	90	95	-5	-6	82	91	-9	-10
Paraguay	96	84	12	15	85	74	11	15
Peru	94	87	7	9	..	..	..	..
Trinidad & Tobago	100	96	4	5	99	93	6	7
Uruguay	94	100	-6	-6	94	100	-6	-6
Venezuela	83	100	-17	-17	79	98	-19	-20
Asia and Pacific								
Bangladesh	75	61	14	23	48	45	3	7
Cambodia	100	62	38	62	66	47	19	41
China	100	79	21	27	97	68	29	43
India	77	68	9	14	58	54	4	8
Indonesia	99	78	21	27	93	67	26	39
Korea Rep.	100	100	0	0	100	100	0	0
Lao PDR	73	64	9	15	53	49	4	9
Malaysia	100	100	0	0	100	100	0	0
Mongolia	85	66	19	29	81	51	30	59
Nepal	78	60	18	30	54	44	10	23
Pakistan	..	..	..	..	..	..	..	..
Papua New Guinea	79	75	4	6	59	62	-3	-5
Philippines	100	82	18	22	83	72	11	16
Sri Lanka	100	75	25	34	91	63	28	45
Thailand	88	95	-7	-8	83	91	-8	-9

Country	Primary Enrollment Rate (PEN)				% Reaching Grade Five (TRG5)			
	Actual	Expected	NPG_{PEN}		Actual	Expected	NPG_{TRG5}	
			Absolute	Relative			Absolute	Relative
Vietnam	100	66	34	52	..	..	..	..
Central Asia								
Armenia	..	..	..	..	..	..	..	..
Azerbaijan	..	..	..	..	..	..	..	..
Kazakhstan	..	..	..	..	..	..	..	..
Kyrgyzstan	100	71	29	41	99	58	41	71
Tajikistan	93	59	34	58	..	..	..	..
Uzbekistan	..	..	..	..	..	..	..	..
Europe								
Albania	96	75	21	28	86	62	24	39
Belarus	85	90	-5	-6	85	84	1	2
Bulgaria	98	86	12	14	94	77	17	23
Croatia	100	91	9	10	99	85	14	17
Czech Republic	100	100	0	0	99	100	-1	-1
Estonia	100	93	7	8	99	88	11	13
Georgia	89	74	15	21	89	61	28	46
Greece	100	100	0	0	100	100	0	0
Hungary	98	100	-2	-2	98	100	-2	-2
Latvia	100	87	13	15	99	79	20	26
Lithuania	..	..	..	..	..	..	..	..
Macedonia	95	83	12	15	93	73	20	28
Moldova	..	..	..	..	..	..	..	..
Poland	99	97	2	3	98	93	5	6
Portugal	100	100	0	0	..	..	..	..
Romania	100	89	11	13	98	81	17	21
Russian Federation	100	89	11	13	..	..	..	..
Slovak Republic	..	..	..	..	..	..	..	..
Slovenia	95	100	-5	-5	95	100	-5	-5
Ukraine	..	..	..	..	..	..	..	..
Middle East and North Africa								
Algeria	96	87	9	11	94	79	15	19
Egypt Arab Rep.	95	78	17	22	95	67	28	42
Iran Islamic Rep.	90	91	-1	-2	86	85	1	2
Jordan	68	79	-11	-14	68	68	0	0
Lebanon	76	92	-16	-18	..	..	..	..
Morocco	74	80	-6	-8	66	69	-3	-5
Saudi Arabia	60	100	-40	-40	57	100	-43	-43
Sudan	..	..	..	..	..	..	..	..
Syrian Arab Rep.	95	78	17	22	93	66	27	41

Country	Primary Enrollment Rate (PEN)				% Reaching Grade Five (TRG5)			
	Actual	Expected	NPG_{PEN}		Actual	Expected	NPG_{TRG5}	
			Absolute	Relative			Absolute	Relative
Tunisia	100	89	11	13	96	82	14	18
Turkey	100	96	4	5	98	91	7	8
Yemen Rep.	..	..	..	..	..	..	..	..
Sub-Saharan Africa								
Angola	35	58	-23	-40	18	41	-23	-57
Benin	68	60	8	14	52	44	8	19
Botswana	80	98	-18	-19	76	94	-18	-20
Burkina Faso	32	57	-25	-44	28	41	-13	-32
Burundi	36	51	-15	-30	31	34	-3	-9
Cameroon	62	67	-5	-8	50	52	-2	-4
Central Afr. Rep.	46	62	-16	-26	18	47	-29	-62
Chad	48	57	-9	-16	36	40	-4	-10
Congo Dem. Rep.	58	54	4	8	42	38	4	11
Congo Rep.	78	61	17	28	58	45	13	29
Côte d'Ivoire	58	66	-8	-13	50	51	-1	-2
Eritrea	29	59	-30	-51	24	42	-18	-43
Ethiopia	35	49	-14	-29	24	32	-8	-25
Gabon	..	..	..	..	..	..	..	..
Gambia	66	64	2	4	60	48	12	25
Ghana	..	..	..	..	..	..	..	..
Guinea	46	68	-22	-33	41	53	-12	-23
Guinea Bissau	52	55	-3	-6	18	39	-21	-54
Kenya	65	60	5	9	53	44	9	21
Lesotho	69	73	-4	-6	62	60	2	4
Madagascar	61	56	5	9	36	39	-3	-8
Malawi	99	52	47	91	51	35	16	46
Mali	38	53	-15	-29	35	36	-1	-3
Mauritania	57	67	-10	-15	45	52	-7	-14
Mauritius	97	100	-3	-3	97	100	-3	-3
Mozambique	40	52	-12	-24	26	35	-9	-26
Namibia	91	91	0	0	81	84	-3	-4
Niger	24	55	-31	-57	21	39	-18	-47
Nigeria	59	55	4	8	..	..	..	..
Senegal	60	66	-6	-10	56	51	5	10
Sierra Leone	44	47	-3	-7	..	..	..	..
South Africa	100	100	0	0	87	99	-12	-13
Tanzania	48	50	-2	-4	43	33	10	31

Country	Primary Enrollment Rate (PEN)				% Reaching Grade Five (TRG5)			
	Actual	Expected	NPG_{PEN}		Actual	Expected	NPG_{TRG5}	
			Absolute	Relative			Absolute	Relative
Togo	82	65	17	27	68	50	18	36
Uganda	..	..	..	..	42	44	-2	-5
Zambia	72	55	17	31	66	39	27	70
Zimbabwe	93	73	20	28	83	60	23	39

Sources:

World Bank, World Development Indicators 1997, 1998, 2000.

Unesco: World Education Report 1998, Statistical Yearbook 1999, and World Education Report 2000.

Unicef: State of the World's Children 2000.

.. Indicates that data were not available for the country.

Table 4 National Performance Gap for the WINOCENT Child Welfare Index, 1995-98

Country	WINOCENT	Country	WINOCENT	Country	WINOCENT
Georgia	42	Benin	4	Colombia	-16
Croatia	41	Egypt Arab Rep.	3	Côte d'Ivoire	-16
Jamaica	32	Jordan	3	Indonesia	-17
Kyrgyzstan	31	Bangladesh	1	Morocco	-18
Albania	31	Honduras	-1	Thailand	-19
Sri Lanka	30	Uruguay	-2	Cameroon	-21
Mongolia	25	Panama	-4	Venezuela	-22
Czech Republic	25	Algeria	-4	Guinea Bissau	-22
Hungary	25	Tunisia	-4	Ecuador	-24
Romania	22	Mali	-4	Burkina Faso	-25
Malawi	22	Mozambique	-4	Haiti	-28
Trinidad & Tobago	21	Ethiopia	-5	Turkey	-28
Nicaragua	17	Madagascar	-5	Papua New Guinea	-30
Paraguay	17	Togo	-5	Central Afr. Rep.	-30
Syrian Arab Rep.	17	Burundi	-6	Mauritania	-31
Tanzania	17	Zimbabwe	-7	Niger	-34
Costa Rica	14	Dominican Rep.	-8	Angola	-36
Zambia	14	Senegal	-8	Malaysia	-39
Gambia	12	Philippines	-10	Mexico	-41
El Salvador	8	Chad	-10	Guinea	-42
Congo Dem. Rep.	8	Lao PDR	-11	Lesotho	-52
Chile	7	Mauritius	-11	Guatemala	-59
Nepal	7	Bolivia	-12	Namibia	-86
Congo Rep.	7	India	-13	South Africa	-91
China	5	Eritrea	-13	Botswana	-120
Kenya	5	Brazil	-14		
Cambodia	4	Iran Islamic Rep.	-14		

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