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An analytical approach

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Abstract:
In this paper we provide a formal analysis to evaluate the subtraction of defensive expenditures from GDP. We consider expenditures that are used to produce non-market goods as candidates for being subtracted from GDP. It will be demonstrated that income net such expenditures will account for total welfare changes only if the supply of the non-market good is constant, while the expenditures should not be subtracted if external factors are constant. We argue that the latter case will apply to most use of the GDP incator for planning purposes.

We also consider a model of disamenities of urbanization, and argue that there are important shortcomings in the methods used to estimate these. Daly and Cobb's estimate consideres only a selection of disamenities, and only those that are negative. We also argue that Nordhaus and Tobins migration based procedure will significantly overestimate the level of disamenity, but is correct at the margin. On the other hand, there may be important problems with double counting.

Keywords: Defensive expenditure, National product, Urbanization.

JEL classification: D60, H50, H60, R23

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1 Introduction.

It has over the last years become increasingly clear that the tendency to use the NNP or GDP as an indicator of the welfare of society and basis for policy decisions can have deploring consequences. Many factors essential to human welfare and life are ignored; perhaps one of the gravest examples of this is pollution. In this paper we will try to describe and assess one of the traditions developed in order to get a measure of welfare taking into account some of the factors not included in NNP and the system of national accounts, SNA.

Nordhaus and Tobin (1972) (NT) presented their "Measure of Economic Welfare", MEW. This measure uses SNA consumption as a starting point to find a more correct measure of consumption or welfare. They intended to study the development of welfare over time, and specifically the correlation between the development of MEW and NNP. Later several other proposals in the same tradition have been put forward, e.g. Daly and Cobb (1990) (DC) suggested the Index of Sustainable Economic Welfare, ISEW. Among the other attempts to measure welfare, the Net National Welfare Committee of Japan (1973) suggested Net National Welfare, and Zolotas (1981) suggested Economic Aspects of Welfare.

The measures in this tradition have some special characteristics. They do to some extent reclassify posts in the SNA and make some imputations to get a more correct measure of consumption than SNA consumption. One example of this is that consumer durables are treated as capital, and services from this stock are imputed and considered as consumption. Factors included in SNA consumption that does not affect welfare directly are subtracted. NT labeled these "instrumental expenses", and argued that they should be treated like input in production. By adding and subtracting imputed values for other factors that affect welfare, e.g. the value of leisure, household work and disamenities of urbanization, a measure reflecting welfare is obtained.

Instrumental expenditures are expenditures that do not yield utility directly, but are "regrettably necessary" inputs in other activities that yield utility. In NT's own words: "Even if the "regrettable" outlays are rational responses to unfavourable shifts in the environment of economic activity, we believe that a welfare measure, perhaps unlike a production measure, should record such an environmental change."

DC use the related concept "defensive expenditures" defined as expenditures necessary as a defense against the unwanted side effects of other kinds of production processes, and not a defense against normal baseline environmental conditions. NT's instrumental expenditures

are not confined to the effects of other production, but include all activities that does not directly yield utility.

The line between final and instrumental outlays is hard to draw, and one difficulty with this kind of adjustment is the interpretation of all or most expenditures as regrettably necessary to live or lead a good life. Becker (1976) pointed out that the household can be seen "as a small factory", and Sen (1985) distinguished between commodities and functionings. Both these points of view indicate that all expenses can be considered instrumental. How directly an expenditure enters a utility function is not observable and hence not a good basis for an accounting procedure.

The concept of defensive expenditures proposed by DC is more operational, since we may observe what enters the production process. They do not, however, specify how directly these side effects must follow from production. Are crime rates a result of alienation due to organization of production? And why should we subtract only expenditure to defense against side effects of production, and not other side effects?

The proposed adjustments was introduced without any explicit model-based analysis. Our intention is to use a more formal and analytical approach than has been usual. This is done in order to clarify the discussion and to highlight some of the implicit assumptions made. We will use the terms defensive and instrumental expenditures interchangeably.

Both NT and DC made a correction for the "disamenities of urbanization". While these are not considered defensive expenditures, the boundary between the two types of corrections is unclear, and hence we will discuss these adjustments too. There are other adjustments made in these measures, e.g. for durable consumer goods, advertising or environment and natural resources, but these are not discussed in any detail here. When attempting to measure the welfare of a nation or society, one must assume a standard of evaluation - a social welfare function. With this assumption, marginal changes in welfare will in general be a weighted sum of the individual welfare changes in monetary units, see e.g. Dréze and Stern (1987). The present analysis will, for sake of argument, adopt the standard assumption that all weights should be chosen equal to unity. This assumption is essential to the claim that NNP has a welfare interpretation. We do not, however, make any claim that this assumption is reasonable.

This paper is organized as follows. In section 2 we consider defensive expenditures. Should expenditures that do not directly enter the utility function be excluded from a welfare measure? In section 3 we consider the disamenities of urbanization. We argue that

the adjustment proposed by DC (section 3.1) is incomplete and only takes into account the negative externalities of urban life. We also present a migration model to analyse the adjustments made by NT (section 3.3 and 3.4). We argue that this adjustment is correct at the margin. On the other hand, there may be serious problems of doublecounting. Section 4 is an overview of the different corrections made within this tradition. Finally, section 5 concludes the discussion.

2 Production of defensive goods and services.

In their MEW, NT subtract public expenditures for national defense, and these and several other subtractions are considered defensive expenditures. By using a simple model with production of services that are public and intended to rectify consequences of production, we will discuss how these should be treated in an attempt to measure welfare or "true" consumption. The important aspect of this model is that the defensive expenditures affect utility only indirectly, and that the actual utility-yielding good is a non-market good; it may be externalities or a public good as in this model.

The discussion is intended as an illustration of a whole class of adjustments, where there are expenditures to reduce disutility-yielding factors, e.g. costs to clean up pollution or health costs to reduce the effect on pollution on health.

2.1 A presentation of the model.

Let us start with a simple model where the utility or welfare of individuals, U, depends on the level of consumption, C, and the level of some service, S, in the society. This service may be clean air from the environment, or national security. In the following, we will use "security" and "services" interchangeably. The amount of security enjoyed depends on the amount of defensive expenditures D used as inputs in the production of security, e.g. expenditures to the police and the judicial system, but it also depends upon some parameter θ. This parameter can be external, like international political events affecting national security, or internal, like increased pollution that affect environmental services. Utility is then $U = u(C, S)$ where u is increasing in both consumption and security. Net national product, Y, can be used for consumption, C, or as input, D, in the production of security. The model is static since there exists no saving or borrowing opportunities. In this model, we will for simplicity assume that Y is exogenously determined, either by the

inherent dynamics in the economic system or by policy makers. We use C as the numeraire good.

The level of services supplied is determined by the production function $S = f(D, \theta)$ where f_D is strictly positive, but decreasing, and where θ is an exogenous variable. θ may reflect dependence on developments that are exogenous in our model like the level of urbanization or specialization of production.

Changes in utility can be written

$$dU = dC + u_s f_D dD + u_s f_\theta d\theta, \tag{1}$$

using Cas numeraire ($u_c = 1$). Maximizing the utility of the representative consumer gives the first-order-condition $u_s \ f_D = 1$. Inserted in (1) this gives

$$dU = dC + dD + u_s f_\theta d\theta = dY + u_s f_\theta d\theta. \tag{2}$$

Alternatively the welfare changes can be written

$$dU = dC + u_s dS = dY - dD + u_s dS \tag{3}$$

This shows that there are two ways to report the welfare changes, either (2) or (3). Assuming that the value of exogenous changes in services is known, it is sufficient to know changes in income Y. Alternatively, if the shadow price on the service, u_s , is known, the welfare changes will be completely determined by the changes in consumption and the changes in services supplied. In cases where (3) is most appropriate, we would have to exclude defensive expenditures, but supplement the income statistics with information on the development of the good produced by these expenditures. In other cases (2) may be the most appropriate form. These two alternatives will serve as a basis for the following discussion.

2.2 Possible adjustments to measure welfare:

If we are searching for a measure representing the change in total welfare, the sole subtraction of defensive expenditures is correct only when the level of services supplied is constant. From (3) we note that

$$dU = dY - dD \text{ if and only if } u_s dS = 0 \tag{4}$$

Since there would be no need for defensive expenditures to produce S if $u_s = 0$, the only interesting case is $dS = 0$. Similarly, using (2) we see that

$$dU = dY \text{ if and only if } u_s f_\theta d\theta = 0 \tag{5}$$

where the interesting case is $f_\theta d\theta = 0$. Which of these conditions is the most reasonable would depend upon the intended use of the welfare measure. Remember that (5) is based on the assumption that the defensive expenditures are optimally chosen.

To understand the consequences of these observations we consider some specific cases. First, consider military spending, that are considered defensive by NT. We will have to consider two cases, first the evaluation of welfare changes over time. In this case S could be interpreted as national security. The exogenous factor θ may represent international political changes, like the breakdown of the communist regimes in eastern Europe. These changes may be important to national security and $u_s f_\theta d\theta$ will hardly be negligible. In this case dY would not account for all welfare changes,as can be seen from (5). On the other hand the assumption that $dS = 0$ would be equally problematic. Thus neither would $dC = dY - dD$ fully account for all welfare changes. In both cases we would have to rely on supplementary information on either $u_s f_\theta d\theta$ or $u_s dS$. The term u_s is common for both cases, and hence we ignore the problem of measuring this shadow price. If we have reliable information about dS but not on $f_\theta d\theta$, subtracting defensive expenditures and adding information on dS would be the best choice, and vice versa. This implies that it is easier to measure the changes in level of national security than to identify external changes contributing to changes in national security. To our knowledge there is exist no such argument to support the subtraction of military spending.

The above discussion assumes that we are comparing welfare at different points in time. Perhaps the most important use of GDP as a welfare measure is to evaluate the consequences of different policy proposals. While there are policy options that would be interpreted as provocative to hostile regimes, the exogenous factors that influence national security will be the same for most policy options. In this case $d\theta = 0$, and hence dY would fully account for the welfare changes without any subtraction for defensive expenditures. On the other hand, unless the defensive expenditures are equal in all policy proposals, $dS \neq 0$. Thus GDP less defensive expenditures would be an inappropriate welfare measure. Note, however, that NT did not consider this use of their Measure of Economic Welfare.

These arguments also appear to provide a justification for not treating food consumption

as defensive expenditures. Consuming the same amount of food at different points in time, or under different policy proposals, would provide the same nutrition, hence $d\theta = 0$. But even food is not solely used to meet basic needs. The access to fresh exotic fruits is now common even to relatively poor people in Scandinavia, while some hundred years ago this was high status, hardly available for the king. The status a black and white TV-set can provide today is radically different from the status it provided some 25 years ago. Many of the functionings that commodities provide are social in character and would change as social structures are changing. For a discussion see Dittmar (1992). Thus it is not clear that the assumption that $d\theta = 0$ is better founded for material consumption than for military spending.

As pointed out above, one of the main differences between instrumental expenses in NT and defensive expenditures in DC is that DC require the defensive expenditures to be defenses against unwanted side effects of production. With this restriction, we would not expect $d\theta = 0$ when considering different policy alternatives, and we cannot unambiguously conclude that dD should be included in the welfare measure. This may be the main reason to restrict attention to side effects of production. But even if $d\theta \neq 0$, we have to prove that $dS = 0$ to conclude that $dY - dD$ is the best welfare measure.

While DC is not explicit on the requirement that $dS = 0$, they appear to recognise it. E.g. they explicitly claim that governmental expenditures except expenditures on health services do not contribute to welfare at all; thus $dS = 0$. They also claim that 50% of the increase in health expenses from the 1950 level are welfare improving, implying that the remaining 50% of the increase is just enough to offset the negative effects of pollution and other side effects of production. In our model this would be interpreted as a claim that

$$u(D_0 + \frac{1}{2}dD, \theta_0 + d\theta) = u(D_0, \theta_0)$$

where (D_0, θ_0) referes to the level in 1950. By the first order condition $f_D u_s = 1$, we get $u_s f_\theta d\theta = -\frac{1}{2}dD$. Their implicit claim is that the value of the side effects is minus half the value of increased health expenditures. Inserted in (5), we get an estimate of the total welfare effect

$$dU = dC + \frac{1}{2}dD,$$

which is the proposal of DC. (While these assumptions provide a justification for their correction, their assumption has not been justified, but remains somewhat arbitrary.) Note that these arguments at best apply to changes over time. If we are comparing policies with

different levels of government expenditures and health expenses, it seems unreasonable to assume that they all exactly offset the unwanted side effects of production.

To conclude this section we note that the subtraction of defensive expenditures is not reasonable when there are no external forces, $d\theta = 0$. It should also be documented that there are no changes in the supply of security, $dS = 0$. We have also argued that for the purpose of evaluating different policy proposals, defensive expenditures should not be subtracted in cases where the side effect is independent of the proposed policy.

NT's expressed intention by subtracting defensive expenditure, is to get a better measure of what they call "economic welfare" or "true" consumption. Defining S as non-economic and C as the real consumption, $C = Y - D$, would tautologically be a measure of economic welfare. Such a proof by definition is of course not convincing, and the real argument is that some parts of GDP is defensive rather than consumption. But, even food expenditure can be considered as a defense against hunger, see Jaszi (1973), and thus be excluded from a measure of economic welfare. The subtraction of defensive expenditures needs a theoretical foundation to justify the asymmetrical treatment of D and C. One possible argument for the asymmetry is that C enters directly in the utility function while D enters only indirectly through S. As pointed out in the introduction this argument is inappropriate. In Becker's (1976) model of household production, most consumption goods are treated as input in the household production function. Similarly, Sen (1985) distinguished between the commodities, their characteristics, and the functionings they are used to provide. In this setup, the functionings and not the commodities are the objects of valuation. Thus any expenditure would only indirectly enter the utility function. It may be more reasonable to think of D as the focus of analysis. D may be military spending indirectly entering the utility function through national security or food consumption indirectly entering the utility through the production of a pleasure of eating or absence of hunger. C are the remaining expenditures and is used as numeraire good. For simplicity we let C enter the utility function directly although it can be easily checked that letting C entering the utility function indirectly would not seriously alter our results.

3 Disamenities of urbanization.

Both NT and DC have made subtractions for the disamenities of urbanization. There is an important connection between the estimation of these disamenities and the concepts of

defensive or instrumental expenses. For instance DC subtract the cost of commuting, which may be considered a defensive expenditure. Commuting to and from work is a service that is necessary in order to get to work, and the cost of commuting changes due to external forces like increased urbanization. I.e. the service "getting to work" is the same at all locations and at all points in time and $dS = 0$. Thus we should subtract the cost of commuting. If there are systematic differences in costs of commuting between urban and rural areas, this would change the measured welfare improvements from migration, which is the reason for correcting for disamenities of urbanization.

When using GDP or SNA consumption as a measure of welfare, migration from rural into urban areas will show up as an increase in welfare because of the higher income in the cities (assuming that income is higher in urban than in rural areas). Some of this increase may not cause an increase in welfare, but rather reflect the income differential necessary to make the individual indifferent between living in urban and rural areas. The higher level of income is (regrettably) necessary in order to offset the negative welfare effects from living in urban areas. This means that GDP or SNA consumption does not necessarily represent the welfare effects from migration correctly.

Both NT and DC assume and estimate disamenities and costs from urbanization. We will separate the different factors and treat them separately; costs of commuting, costs of housing and disutility from externalities.

Because of higher densities in urban areas, there will be different costs of commuting. While not measuring time spent as a cost, there will still be expenses on petrol, car maintenance, fares for public transportation etc. These are considered regular consumption in GDP, but does not yield utility directly. In the following discussion we will assume that costs of commuting is strictly necessary to get to work and is exogenous. For simplicity we assume that there are no costs of commuting in rural areas; alternatively there may be differences in costs of commuting between areas.

Because of higher population densities in urban areas, land prices will be higher in urban areas. This implies higher costs of buying and renting a house or apartment. (The costs can be divided into a component for land and a component for buildings and structures.)

Inhabitants in urban areas experience a higher level of pollution, violence etc. that can be expected to yield disutility. There do not exist any prices or markets where these factors are given a money value. These externalities are exogenous to the individual, and not subject to any optimizing behaviour.

Throughout this discussion there has been an assumption that the welfare effects of living in urban areas (apart from higher wages) are negative. There are clearly some positive effects too, like more variety of available jobs and better access to public services and cultural activities. These positive effects can be treated in our framework in the same way as the negative ones.

3.1 The model.

The migration model presented below is designed to reflects the reasoning that seems to be the basis for the discussions by DC and NT. It is a simple model incorporating central economic factors behind choice of residential area and the level of wages. We have found no similar model in the migration literature, but it may be characterized as a simple model in the human capital tradition. For a survey of models of Urban-Rural migration, see Bhattacharya (1993).

The representative consumer has a utility function $U = u(x, d)$ where x is the consumption vector and d is the "disamenities" or externalities which represents factors influencing utility that is not marketed and optimized. Utility u is increasing in all elements in x, and increasing or decreasing in d; there may be positive or negative externalities. The individual maximizes utility subject to the budget constraint. The indirect utility function is

$$v(p, y, d) = \max_{px \leq y} u(x, d)$$

where y is income.

The consequences of urbanization that DC correct for are three-fold. Prices are different, cost of commuting is different and finally the external factor d is different. The cost of commuting is a necessary expenditure to earn an income, hence if the cost of commuting is r only $y - r$ is left for consumption. Both NT and DC argue that the cost of commuting should be subtracted from the GDP measure. The label "disamenity of urbanization" on this subtraction is based on the view that congestion, a typically urban problem, is one of the main causes for increased cost of commuting. Before discussing this adjustment, we consider some of the other adjustments for urbanization.

The vector of "disamenities" d refers to many different qualities of the location, ranging from the amount of pollution to access to cultural activities. These include both positive and negative externalities related to urban areas. We use subscripts r and u to denote variables referring to rural or urban areas respectively. Using the rural areas as point of

reference, we assume that the willingness to accept d is independent of income and prices, i.e. there exists a function $\psi(d)$ such that

$$v(p, y + \psi(d_u), d_u) = v(p, y, d_r) \text{ for all } p \text{ and } y.$$

$\psi(d)$ is the amount necessary to make an individual willing to accept the differences in external welfare-affecting factors between urban and rural areas. $\psi(d)$ is the necessary compensation for the disamenities.

Finally, Cobb an Daly adjust the GDP measure for differences in the cost of housing. In general we can assume that the price vector is different in urban and rural areas. Once again using the rural values as reference point, let $\phi(p)$ denote the necessary compensation needed for an individual to be willing to accept the price vector p; the necessary compensation for price differences. Thus

$$v(p, y_r + \phi(p), d_r) = v(p_r, y_r, d_r). \tag{6}$$

Using Roy's identity, we note that if $p \approx p_r$, then as a linear approximation $\phi(p) \approx x \cdot (p - p_r)$. While prices may be different for many commodities, DC only consider the differences in cost of housing, assuming that these differences are mainly representing different prices of land. Based on a linear approximation, a rough estimate of $\phi(p)$ would be the area of urban land, times the differences in average prices on urban and rural land.

To summarize this discussion, we consider the income γ that the representative consumer needs in an urban area to achieve the same utility as he would achieve in a rural area with income y_r and prices p_r. From (6) we conclude that to compensate for differences in land prices, he would need $y = y_r + \phi(p_u) \approx y_r + x_u(p_u - p_r)$. To compensate for differences in d, he would need $\psi(d)$. Finally, to compensate for the higher costs of commuting in urban areas he would need an extra $r_u - r_r$. Adding up we get

$$\gamma = y_r + r_u - r_r + x_u(p_u - p_r) + \psi(d) \equiv y_r + \rho. \tag{7}$$

where ρ denotes the correction term and is the income difference necessary to make the individual indifferent between the areas. The idea of adjusting GDP for disamenities of urbanization, is to make the different income concepts comparable, by transforming urban income y_u into an equivalent disposable rural income $\tilde{y}_u$ where

$$\tilde{y}_u = y_r + (y_u - \gamma) = y_u - \rho. \tag{8}$$

Thus the corrected income is the average rural income, plus the urban income in excess of the income needed to be as well off as if living in a rural area with average income.

This is DC's suggested corrections, and is a subtraction of costs of commuting (in urban areas), necessary compensation for disamenities, $\psi(d)$, and necessary compensation for price differences, $\phi(p)$.

3.2 Possible adjustments and their interpretations

A way to adjust GDP would be to transform all incomes into rural equivalent disposable income. This is equivalent to subtracting the disamenities of urbanization ρ times the population in urban areas. A problem with implementing this approach is that $\psi(d)$ is not directly observable. Since there are both positive and negative aspects of urban life, the sign of $\psi(d)$ is not obvious.

The approach followed by DC is to subtract land rent, cost of commuting and an estimate of some of the positive parts of $\psi(d)$, (i.e. reflecting the negative aspects of urban life like pollution, congestion etc.). This adjustment is thus urban-hostile in spirit. The positive externalities of urban life like more variety of available jobs, easy access to cultural and social events, and less stringent social control are completely ignored. If these positive externalities are large, the adjustments made by DC may even be in the wrong direction.

Is it likely that the positive externalities are in order of magnitude at least similar to the negative one that DC adjust for? The apartment prices in Manhattan are very high, even though New York is a city with a considerable degree of violence, pollution, congestion and social problems. Never the less people wish to live there. Some of those living there are celebrities and movie stars, who hardly will reduce their cost of commuting to jobs. Perhaps the high costs of living in urban areas may just reflect the size of these positive externalities? In Norway, it is necessary to pay teachers, policemen and medical doctors a bonus to induce them to work in the northern rural areas. Refugees are rebelling against being located in rural areas. These are all observations that indicates that the positive externalities may well outweighed the negative ones. See Berman (1982) and Sennet (1990) for a discussion of the role of the cities and the urban influence on man, society and the arts.

Commuting is necessary for working, but so is basic nutrition and sufficient clothing to appear in public without being ashamed. Why should cost of commuting be subtracted, while cost of clothing are not? Why are only the difference in one component of the price vector considered? Why are only negative externalities of urban life considered, while there are people (like Woody Allen's characters) preferring the urban way of life and perhaps

even willing to pay for it? While each of these adjustments can be defended, there is also a question of the overall balance in the adjustment.

NT suggested that disamenities should estimated on basis of observed choices between urban and rural life, through migration data. This approach will thus in principle account for all relevant differences between urban and rural life. To analyze this approach, we have to extend the previous model to explain migration.

3.3 A model of migration

If $y_u > y_r + \rho$, the individual is better off in the urban area than in the rural area. Now suppose that the value of ρ is different for different individuals in the population, e.g. because some people care the most about the negative externalities while there are others that appreciate the urban way of life. Let $f(\rho)$ denote the density distribution, i.e. the number of individuals with $a \leq \rho \leq b$ is $\int_a^b f(\rho)d\rho$. With the wages y_u and y_r, the number of individuals who want to live in the urban area is $Q(y_u - y_r)$, where

$$Q(y_u - y_r) = \int_{-\infty}^{y_y - y_r} f(x)dx$$

Let P_u be the number of people actually living in urban areas. Assuming that during the next unit of time a fraction θ of those who live in one location but would prefer to live in the other move to their preferred location, the migration is

$$M = \dot{P}_u = \theta\left[Q(y_u - y_r) - P_u\right] \tag{9}$$

The higher the difference between the number of people who want to live in the urban area at a given income difference and the number of people actually living in the urban area, P_u, the higher is migration. If $M = 0$ all individuals i with $\rho_i > y_u - y_r$ would live in rural areas, while all individuals where the opposite inequality applies, live in the urban areas. The hypotetical wage difference that would induce zero migration at the current size of P_u, should not be confused with the actual equilibrium level of wage difference, $\rho_e = (y_u - y_r)^e$ that will prevail when the migration approaches zero and the urban population reaches the equilibrium level P_u^e, see figure 1 below[1].

[1]As the population in both areas change as a result of migration, we would expect wages to change too. When the population of an area is reduced, the supply of labor is redced too, and we would expect wages in this area to rise. By introducing the wage difference as a function of urban population through the demand for labor, we find an equilibrium wage difference and urban population consistent with demand for labour as well as individual preferences / supply of labour.

To identify the hypotetical wage difference that induce zero migration, suppose that f is uniform. In this case Q will be linear, $Q(x) = qx + q_0$. Now (9) can be rewritten as

$$y_u = y_r + \alpha_M M + \rho_m \tag{10}$$

where $\alpha_M = (\theta q)^{-1}$ and

$$\rho_m = \beta_0 + \beta_P P_u$$

where $\beta_0 = -q_0/q$ and $\beta_P = q^{-1}$. Using a linear regression as in (10) and letting $M = 0$, ρ_m can be estimated. ρ_m is the income differential necessary to achieve zero migration at any *given* level of urban population and is a function of P_u. The difference between ρ_m and ρ_e is illustrated in figure 1.

Assume furthermore that the income of an individual in the rural areas can be written as a linear function of some explanatory variables, i.e. $y_r = \alpha X$. In NT variables like "Population over 65", and "Log of property tax per Capita" are used to explain income. If we add the assumption that all parameters in the migration model are independent of X, then

$$y = \alpha X + \alpha_M M + \rho_m D_u$$

where D_u is an urban-dummy, with value 1 in urban areas and 0 in rural areas. Thus ρ_m can be estimated through a linear regression on income data.

This approach to estimating ρ_m will not suffer from the problems pointed out with DC's approach. The factors included in ρ_m are all that the individuals actually migrating consider relevant. Hence NT cannot be criticized for being biased in the set of urban externalities they do correct for. The drawback of this method is rather the opposite. Since ρ_m is not selective, we do not know precisely which externalities are included.

Suppose that cost of commuting is subtracted from GDP as indicated above, and suppose moreover that there are systematic differences in cost of commuting between urban and rural areas. If people migrating to an urban area take this systematic difference into account, the difference in commuting cost between urban and rural areas would be subtracted twice. Similarly, due to differences in urban and rural life-style, there may be systematic differences in household production in urban and rural areas. If household production is added to GDP, there may be a similar double counting of the difference in household production. The problem of double-counting also arises with pollution. The differences in pollution between areas may affect the willingness to live in urban areas, and hence be included in the estimated ρ_m. In this case some or all of the difference in pollution will be taken into account using this

method (depending upon what information is available to the individuals). Subtracting for pollution and degradation of the environment separately may then imply double-counting, but we cannot tell from the estimated ρ_m if, and to what extent, these factors are already taken into account.

Our model of migration is a very simple model reflecting the economic mechanisms of migration of income and preferences in order to highlight and describe the discussion about whether and how to adjust NNP in order to measure welfare. As a description of the actual processes leading to migration, we would expect this model to be a poor approximation. Most of the U.S. migration does actually consist of migration within or between urban areas and are not primarily urban-rural. Moreover, the motivation for migration are often of a non-economic nature, e.g. related to life-style, a lesser degree of social control etc. Job variability and the freedom of choice is almost certainly important as well.

3.4 Using ρ_m to correct GDP

There are several possible ways to adjust for the fact that some or all of the wage differential between the areas are not welfare augmenting. We will argue that none of them are entirely convincing. For simplicity we assume that those who most prefer to live in the urban areas are the first to move. Thus at any point in time, ρ for the individual that last moved, ρ_m, is the highest among those who live in the urban areas,

$$P_u = \int_{-\infty}^{\rho_m} f(x)dx.$$

The total loss to those who live in the urban areas are now

$$D = \int_{-\infty}^{\rho_m} \rho f(\rho)d\rho$$

The welfare changes due to migration increasing the urban population from P_u to $\hat{P}_u$ with a corresponding increase of ρ_m to $\hat{\rho}_m$ is

$$\Delta D = \int_{\rho_m}^{\hat{\rho}_m} \rho f(\rho)d\rho \approx \Delta P_u \rho_m. \tag{11}$$

In order to find the welfare effect from migration we should use ρ_m, the compensation needed for the individual in the urban area (before migration takes place) with the highest ρ .

One way to estimate the disamenities of urbanization is $\rho_m P_u$, see figure 1. This approach is equivalent to pick among those in the urban area the individual that who least

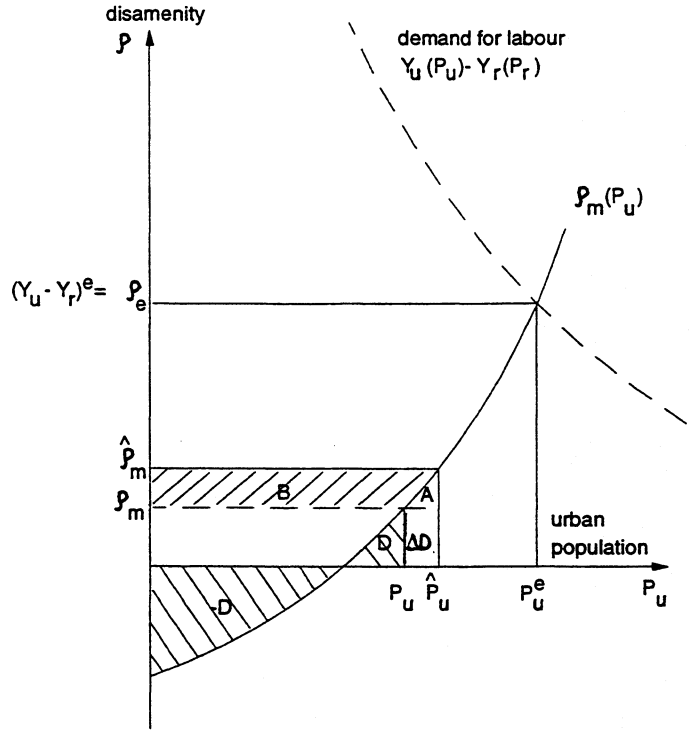

Figure 1: Disamenity of urbanization

appreciates living there as a representative for the entire urban population. This corresponds to NT's adjustments although they use a continuous model with varying degrees of population densities and their results are not directly comparable to our model. When ρ_m is kept constant, the *changes* in the estimated disamenities are correct.

Another possibility would be to use the equilibrium ρ_e instead of the marginal. This would be equivalent to using the individual with the highest disutility from living in the urban areas among the individuals that would live in the city if the wage difference and population are at their equilibrium values (consistent with zero migration). An approach like this is obviously wrong, and will not be discussed further.

Figure 1 shows the inverse of the cumulative distribution function, i.e. ρ_m as a function of P_u. The equilibrium urban population is P_u^e and the corresponding equilibrium income differential is $(Y_u - Y_r)^e = \rho_e$. With an actual urban population of ρ_u as shown in the figure, the corresponding evaluation of living in the urban area for the individual that last moved there and is the one in the urban population that least likes to live there is ρ_m. In our figure, the total disamenity given by the areas $-D$ and D is clearly negative, i.e. the total welfare effects of living in the urban area is positive. The estimated disamenities using $\rho_m P_u$

suggests that the estimated welfare effects are negative. This is equivalent to using prices as weights on different commodities and ignoring consumer surplus. When there is migration and urban population increases to $\hat{P}_u$ the correction should now be $\rho_m \hat{P}_u$ and not $\hat{\rho}_m \hat{P}_u$. The reason for this is easily seen from the figure. The marginal urban individual at population $\hat{P}_u$ has a higher disamenity than the marginal individual at population P_u, but there is no changes in the disamenity of the original urban population. The error is represented by the area B. By using $\rho_m$this higher disamenity experienced by the last ones to migrate is indeed ignored, but this error represented by the area A is of secondary importance. Further, the change in disamenities will be correct, and equal to ΔD in (11).

In this approach we have not studied the effects of the increase in density in urban areas as a result of the migration or the effect of less congestion in the rural areas. These will, however, show up in the higher level of ρ_m in the next time period. But another complication may be worth mentioning. Lewis (1954) argued that when farming is the main occupational activity in the rural areas, income will reflect the average productivity of labor, while it is reasonable to assume that income in the urban areas reflects the marginal productivity of labor. There may now be a **benefit** from urbanization, in excess of the wage differences. This effect may not be very big in developed countries, but may be important in less developed countries with a large share of the labour force in the agricultural sector. On the other hand, Harris and Todaro (1970) shows that migration to urban areas may be consistent with urban unemployment. Migration will then have a negative external effect on the unemployed urban population. For a discussion see Bhattacharya (1993).

Another problem is that we have not considered costs and externalities of moving in this model. When there are costs of moving in terms of money spent on the transportation of furniture, time spent in the process of moving and the loss of friends and social contacts and time and effort spent on getting new ones, these will be reflected in ρ. Although this is clearly a part of the increase in income that is not affecting welfare. The individuals that lives in the urban areas are not facing these costs and thus the subtraction of these may lead to an overestimation of the disamenities faced by the urban population.

4 The Actual Adjustments made in ISEW and MEW.

We have so far considered the theoretical foundation of subtracting defensive or instrumental expenditures and adjusting for disamenities of urbanization. We have referred to some of

the actual corrections made by NT and DC to illustrate several points in this discussion. In this section we will give a brief overview of all the corrections that they made.

Type	**MEW**	**ISEW**
Military spending	I	subtracted
Cost of police	I	subtracted
Health expences	investment	D*
Education expeditures	investment	D*
Cost of commuting	I	D
Environmental damages	part of U	subtracted
Urban housing	part of U	U
Other urban externalities	part of U	subtracted

I denotes instrumental expenditures, D defensive expenditures and U disamenities of urbanization.

D* - 1/2 of growth in expenditures are defensive

Table 1: The corrections in MEW and ISEW

In table 1 we have listed the subtractions that are suggested by NT in MEW and by DC in ISEW and we have given their own classifications of the subtractions. In both MEW and ISEW most of the public expenditures are subtracted because they are not considered to yield utility directly. NT have explicitly stated that expenditures for police services and national defence are considered instrumental while DC stated that "we have excluded most government expenditures because they measure inputs or costs rather than outputs or profits". None of them have attempted to value the outputs or indirect utility resulting from these expenses. (Their approach is equivalent to assuming that $dS = 0$ in the model presented in section 2.) Public expenditures on health and education are not included in MEW, and the private expenditures are considered investments by NT and hence subtracted from MEW. DC consider half of the growth in expenditures (both private and governmental) on health since 1950 as defensive. They also consider half of the growth in expenditures for higher education since 1950 as defensive. How the subtraction of health expenditures is consistent with the model of defensive expenditures is discussed in section 2.2. The expenditures for education are easier to consider using the model of urbanization in section 3.1. Education is necessary in order to find work, just as commuting is, and this is DC's reason for making this subtraction. NT have subtracted costs for commuting because

these costs are considered instrumental, DC considered these costs as defensive. Neither included costs of time spent commuting, partly because of lack of data. Disamenities of urbanization are the estimated income difference between urban and rural areas consistent with zero migration in MEW. NT used a continuous valuation of the degree of urbanization while ours in section 3.3 is discrete. They made corrections based upon the influence of county population, density and per cent of county population in urban areas. DC make a subtraction intended to capture the increasing cost of land caused by urbanization. They further subtract costs of traffic accidents and some environmental damage that can be associated with urbanization. The imputed value of environmental damages and the costs of traffic accidents can be seen as an attempt to estimate $\psi(d)$. These suggested adjustments in ISEW does not correspond exactly to the model we studied in section 3.1. The main difference is that we have transformed urban income into an equivalent rural disposable income and hence used rural welfare as point of reference or numeraire while DC uses the hypothetical zero-cost situation as reference point. To subtract all costs of residential land as they have done may seem strange, but they capture all welfare effects including the increase in welfare in rural areas when prices there are reduced, while we have chosen to focus the welfare differences in urban and rural areas.

5 Concluding notes

In this paper we have used a formal approach in order to emphasize the method and assumptions underlying the results and recommendations found in the existing literature. The formalization itself has been a separate and important point in this paper, although it has led up to some criticism regarding the suggested adjustments to measure welfare.

We noted that the defensive expenditures should not be subtracted if there are no exogenous changes in the supply of services provided by these expenditures. For planning purposes this will be the case for many of those expenditures that were considered instrumental by NT, but it may not be true in comparison over time as was NT's intention. Defensive expenditures as defined in DC are explicitly assumed to be related to production, and thus there may be external changes even in a planning context. Still the alternative assumption that the supply of services is constant, is in many cases no more attractive. We argued that the real issue is in what form supplementary information is best provided. If external changes are easier to report than changes in services, then defensive expenditures

should not be subtracted, and vice versa. In section 3 we provided a model of disamenities of urbanization. While differences in rental cost of housing and cost of commuting may be part of this disamenity, the total difference is complex and involves also positive elements. We argued that the proposal of DC is selective with a urban-hostile bias. This bias is to some extent overcome with the migration model and NT's approach. We demonstrated however, that their estimate will tend to overestimate both level and marginal changes in the disamenities of urbanization. There may also be serious problems of double counting.

In describing some of the adjustments to GDP used by NT and DC among others, we have used some smaller models to study specific approaches. In order to arrive at conclusions and recommendations regarding all adjustments necessary to measure welfare or changes in welfare, a whole set of concepts and a bigger model is necessary. In particular there are many aspects of the concept of welfare that need to be resolved.

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