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Measuring Progress:

Inflation and Non-tradables

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Abstract

This paper addresses the issue of measuring economic progress. First, it discusses the problem in detail and reviews three of the most common indices (GDP, Green GDP and National Wealth) in use. Secondly, it analyses a new link through which non-tradeables assets, such as the environment, quality of political institutions, etc., may have an effect on general price levels. The implication of such a link is that inflation increases whenever the availability of non-tradeable assets increases. Analysis using 66 middle and high income countries for the period between 2005-2010 does not indicate that these factors have a strong effect.

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"[T]he Gross National Product does not allow for the health of our children, the quality of their education, or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country; it measures everything, in short, except that which makes life worthwhile. And it can tell us everything about America except why we are proud that we are Americans."

-- Robert Kennedy, 1968

Economists are interested in measuring economic performance. In particular, comparing economic performance in different countries and regions, and over different time periods. To frame things more generally, the task is to measure how well-off a particular country or region, at a particular point in time, makes its population. For example, "The United States in the year 2000" could be one region of interest, "the United States in the year 1900" a different region, and "Canada in the year 2000" yet another.

In any given state of the world, the world is populated with a certain set of agents, endowed with certain knowledge, institutions and behaviors, with access to certain tools and machinery, embedded in a particular natural environment. Any particular state of the world may generate benefits for those people who live (either presently or in the future) in that state. One may ask several questions about these benefits: how large are they, how many agents are alive to receive them, and how are they distributed. Thus measuring benefits becomes of paramount importance.

If one considers the problem carefully for a moment, the task of measuring progress

looms large. Numbers and qualities of goods and services, government institutions, natural environments, laws and regulations, prevailing social norms, relationships with neighbouring countries: all of this and more is to be condensed into a single number. Conceptually, the process is simple. Imagine that an intergalactic immigrant is on their way to Earth and must decide on which country to settle in. The relative amounts of economic power they would be willing to pay, or give up, to settle in different places would be a measure of that individuals relative values of the places. Aggregating individual rankings over a set of such individuals would then give an indication of that groups valuations of the states in question.

In practice, of course, asking everyone how much they value a particular set of states is not a practical solution to the problem. Instead, approximations must be used. One common approximation is the value of all traded goods produced in a given time frame (the Gross Domestic Product, or *GDP*), and then using differences in this measure across states to decide if a particular country has progressed or not (after adjusting for inflation and/or exchange rates). Objections, such as the one raised by Mr. Kennedy above, point to dimensions of the problem that may be missed by such approximations.

With that in mind, this paper attempts to address some of Mr. Kennedy's concerns. To begin, the first section carefully defines the task of measuring progress, and discusses three standard approaches to the problem. The second section suggests a novel link between inflation and non-tradeables, along with deriving the testable implications of this hypothesis. The third section presents empirical results of a cross-country analysis, and finally section four concludes.

1. Introduction

Measuring progress refers to comparing the relative value of different states of the world. A

state is a description of the world, in particular a defined region or set of people, at a given point in time. It describes a set of circumstances that determine how well a particular set of preferences are satisfied.

When asking economic questions about the relative value of different states, it is necessary to define what is meant by *value.* The definition used here is that the value of a state is the present discounted value of all benefits derived from that state. Benefits refer to satisfying particular desires of a particular set of individuals, thus clearly benefits depend on individual preferences. Secondly, benefits may or may not be separable into distinct quantities. For example, as is often assumed in elementary microeconomics, demand for (and hence benefits derived from) a particular good may also depend on the availability of other goods, thus making it difficult to disentangle which benefits accrue from which goods. Thirdly, benefits may be realized in the present, or at any point in the future. For the purposes of simplicity and clarity, the topics of risk and uncertainty are ignored, although clearly these are also important elements of measuring state value.

In this sense, *economic value* is a measure of how "rich" agents are in a particular state of the world. In thinking about what it means for a group to be rich, it may help to think of how one determines if a single individual is rich or not.

A synonym for rich is wealthy. A person's wealth is a measure of the benefits that individual is entitled to. It is stored in many ways - hard currency, real estate, vehicles, etc. The larger a person's bank account, the wealthier they are. Similarly, more expensive jewelry and fast cars also imply greater wealth. However, it is important to keep in mind that wealth is not the same as consumption or income. It is possible to have a high income (or high consumption) without necessarily being wealthy. Income is the flow of current purchasing power, whereas wealth is the stock of all previously saved income. Current consumption is tied to current

benefits; wealth, on the other hand, represents access to benefits at some point in the future. Therefore, making the claim that one state is relatively more valuable than another is equivalent to saying that the value of the assets in that state are relatively greater (as judged by a particular set of preferences) than in the other.

The focus on wealth implies a strange dichotomy. On the one hand, wealth is the ultimate measure of interest since it serves as a proxy of overall benefits. On the other hand, changes in wealth say nothing about benefits realized in the present. A country may produce a lot, but if it save all of its production in the form of wealth, in the present it will be miserable. Of course, saving just represents postponed consumption benefits, so the benefits of hard work will eventually be realized. The point is simply that investments in future benefits come at the expense of current well-being.

The definition of value given above implies that the horizon of interest when calculating economic value is the present and the future. Past history is only valuable insofar as it has determined the present state of the world. Current and future benefits (appropriately corrected for uncertainty and time preferences) are the items of interest.

2. Indicators of Progress

This section briefly outlines some of the main indicators and issues associated with measuring progress. It begins with what for many years has been the most popular measure of value, the Gross Domestic Product (GDP). Originally introduced by Kuznets in 1934, GDP and its various incarnations measure the currency value of all market activity in an economy produced by domestic factors of production. Different variations consider nationally-owned, rather than domestically-located, production (GNP - Gross National Product), calculate values using prices

from a different time period (real, as opposed to nominal, GDP), or use income rather than expenditure accounting (see Lawn, 2003).

For many years, GDP has been considered to be a strong indicator of economic progress. GDP (and its derivatives) is measured as the sum of all final goods produced in a state over a given time period. One can think about GDP and economic value by considering the parallels between wealth and income of an individual versus a nation.

One simple indicator of individual wealth at a particular time is that individuals most recent annual income. This may, or may not, be positively related to their overall wealth. Consider someone with high income. In many cases this may be because they have a good job that pays this high income. Consequently, over years this job will have permitted them to amass a substantial stock of savings, and hence income and wealth will be positively correlated. However, if income is only high because the person recently sold their house and car, then the correlation is in fact negative.

In the same way as income may be used as a proxy for wealth, GDP has been and still is (although to a lesser extent) used as a measure of state value. Criticisms of GDP as a measure of value, including the caveat mentioned above, are nothing new (Michalos, 2011). A brief summary of the major issues are presented here.

Goods

The first point worth noting is that GDP is a weighted sum of stocks of goods. When considered as a measure of progress, this implies that all benefits derived from a state may be assigned to particular goods.

On an intuitive level, this makes sense. Economic value is related to the production and consumption of goods (and services): tractors, books, housing, health care; things that can produce benefits for their owners. A natural starting point for anyone faced with an accounting

problem is to focus on things that are easily countable, and therefore for an economist concerned with measuring progress, this means looking at the goods of an economy. Many such items form an important part of what may be considered as economic value. However different types of goods confer different amounts of benefits, and thus if they are to be combined into a single measure of value, then weights are required. In practice, the most practical weights to use are transaction prices.

This separating assumption clearly simplifies the problem, however it also raises a couple of issues that bear immediate consideration. The plausibility of this assumption is left for later discussion.

Consumption vs. investment

One concern when measuring value as benefits derived from goods is *double counting*. To avoid double counting, value must only include direct consumption benefits from goods, and not, in particular, the value of goods that are used as investment in the production of other goods. The approach advocated by the U.N. is to classify goods into consumption and non-consumption categories, so that *"only expenditure for the direct satisfaction of human needs and wants is included in household final consumption expenditure*" (SNA 2008, p. 8).

Unfortunately, in many cases it is not clear how to delineate a goods consumption and investment uses. Consider food, perhaps the prototypical consumption good. Clearly eating confers some enjoyment to the individual, it is something that most people enjoy every day. On the other hand, eating may may also be thought of as an investment, since it gives energy to the body to function. Without food, output is not possible. Hence even something as simple as food would appear to have both a consumption and an investment value. This suggests that the task of cleanly separating goods into their consumption benefits and use as a vehicle for investment will be an exercise fraught with difficulty.

Value added

An equivalent approach to measuring consumption value of goods is the *value-added* approach. This measures the value-added of each good as the difference between the costs of the inputs and the value of the output. In simple economic terms this approach makes sense since many inputs and many outputs have an observable market price. However, difficulties arise when considering the fact that certain inputs (such as natural resources, and access to market institutions) may not have explicit prices. Additionally, the concept of value-added is essentially the same as net profit, and economic theory suggests that in many competitive markets profit should be zero. Even in cases where profit is not zero, it eventually accrues to some group of persons. One possible interpretation of this profit flow is as a kind of return to entrepreneurial time. Such a return can then just be thought of as another a cost of production, so then it is again not clear what exactly profits are.

Inclusion of "bads"

The GDP measures the value of all transactions in economy, regardless of whether they increase current benefits, or are hidden costs of other activities (health care, weapons and security, pollution cleanup, advertising). This concern, for example, has been expressed most recently by Kubiszewski et al, 2013 (p. 1):

> "*A major issue is that [GDP] interprets every expense as positive and does not distinguish welfare enhancing activity from welfare-reducing activity.*"

This is used as motivation for the usage of their Green GDP index, which excludes spending on

various “negative” activities.

GDP measures the value of all market activity, irrespective of the end use of that activity. There is a tendency to consider this a drawback of GDP, since it includes “bads” in its measure. For example, when a firm produces tractors, but pollutes the groundwater, both the market value of the tractors and the cleanup of the groundwater is included in GDP. The objection that is raised is that the cleanup of the groundwater should not be included in GDP, since it is activity created directly in response to a bad (the pollution).

This criticism of GDP as a measure of economic value is not as strong as it may seem at first glance. It helps to remember that economic value represents the creation, but also the preservation, of benefits.

The production of many goods and services generates pollution, or more generally costs, for society, and sometimes firms bear the cost themselves of cleaning (or preventing) such pollution. For goods that internalize these costs, they are reflected in the market outcome for that good (price will probably be higher and quantity will be lower). The issue is not that the cost of pollution cleanup is included in the GDP, the issue is that the pollution costs are not being internalized in the market price of the tractor, and thus overproduction (and over-pollution) may be occurring. The purpose of a marketed good is not relevant (whether it is used to produce a good or reduce a bad is not relevant), it is simply its relative value to the market that determines how much it is worth.

Non-tradeables

The set of goods and services that generate benefits to society clearly includes items that are explicitly traded, but it also includes others that are not traded, such as the natural environment, safety, and cultural amenities. Tradeable goods by definition are an easier class of items to quantify and value than non-tradeables, however this does not imply that non-tradeables be

discounted as less important than their tradeable counterparts.

For example, when a woman marries her accountant, GDP decreases, even though overall benefits stay the same (or potentially increase!). Similarly, as a direct consequence of the “marketization” of society (the fact that more and more activities are the result of explicit transactions), even though overall welfare may not be changing, GDP may increase. It also does not account for people who engage in non-monetary transactions. If at least parts of these activities include consumption benefits, then GDP will not accurately reflect welfare.

A slew of indicators have been created to address the absence of non-tradeables in the GDP. The HDI and other closely related development indices (GPI - Genuine Progress Indicator; ISEW - Index of Sustainable Economic Welfare) are essentially slightly adjusted GDP indices (Neumayer, 2001; Lawn, 2003). These indices attempt to combine GDP with various measures of non-tradeable benefits to arrive at a “green” measure of GDP, so-called because one of the most important non-tradeables is the environment. For example, the GPI adjusts for income distribution, household labor, and damage to environmental resources. The HDI instead combines GDP with data on life expectancy and education.

These indices are all meant to address the exclusion of non-tradeables. The approaches taken with these indices is less of a market based approach, and hence somewhat more difficult to defend on conceptual grounds. It is perhaps for this reason that GDP has held for so long as a popular measure of progress.

In fact, there is a long tradition of considering how non-tradeables may still have an important effect on prices in an economy. The *Balassa-Samuelson* effect describes how differences in productivity in sectors producing non-tradable goods may have an effect on prices in tradeable goods (Faria and Leon-Ledesma, 2003).

Omitting non-tradeables from the calculation of value clearly has the potential to

introduce a bias. However, standard microeconomic theory teaches that demand for (and hence the utility from) a good may depend on many other factors other than its own price. In particular, it may depend on the prices (and availability) of other goods. To the extent that availability of non-tradeables are reflected in trade prices, the bias from not observing non-tradeables will be mitigated.

However, by the same token, the inter-dependence of prices raises a new issue. Now the value of a good may increase because the properties of *other* goods change. This implies that measures of price inflation should take such linkages into account. The following model illustrates such a situation.

Model 1: Simple model of non-tradeables

Consider a world with two states *A* and *B*. In each state, agents consume two goods, a general consumption good *c* and housing *h*. It is possible to trade the consumption good across states, but not housing. Furthermore, the demand for goods is interdependent. In particular, the higher the quality of housing, the more people are willing to pay for consumption.

Suppose the quality of housing is higher in state *A*, and quality of housing is perfectly observable. The higher quality of housing means that housing itself has a higher price, but also means that the consumption good will have a higher price. The price index may be adjusted directly for the quality of housing, this would still leave prices higher in *A* than in *B*. Since the direct attributes of the consumption good are the same in both

A similar effect may be caused by the selection of households into locations.

Model 2: Household location choice

Consider two locations, *A* and *B*. *A* is endowed with units of the consumption good, *x*. The consumption good is transferable between locations for a fraction τ of the units transferred.

Households are endowed with an income i that they spend on housing and consumption goods. Households must purchase a residence (house) in one of the two locations. Houses in A will be preferred since they are located closer to the source of production (and hence incur zero transportation costs). Normalize the cost of a house in B to 0, so that μ denotes the premium of purchasing a house in A compared to B. The firm that sells the consumption good may price differentiate based on location (p_A and p_B).

Household i is indifferent between living in A and B when:

$$x_i(A) = x_i(B)$$

$$\frac{i-\mu}{p_A} = \frac{i}{p_B}$$

$$(p_B - p_A) \cdot i = p_B \cdot \mu \quad (1)$$

Arbitrage ensures that:

$$(1-\tau) \cdot p_B \leq p_A \quad (2)$$

so that it is not cheaper for households in B to purchase and ship from A. Profit maximization implies that (2) holds with equality. Therefore equation (1) becomes:

$$\mu = \tau \cdot i .$$

Rich households (with $i > \mu / \tau$) are willing to pay for access to A and cheaper units of the consumption good. Poor households (with $i < \mu / \tau$) gain less from moving to A and hence remain in B and pay a higher per-unit price for consumption. If income is distributed uniformly on an interval between 0 and M, and housing supply in A is fixed at $H < M$, then the equilibrium housing premium is:

$$\mu^* = \tau \cdot H .$$

Average household income in A is $i_A^* = (M - H) / 2$, and in B is $i_B^* = H / 2 < i_A^*$. Prices in A are (μ, p_A), whereas prices in B are (0, p_B). At local prices, the average household in A spends its entire

income $i_A^* = \mu + p_A (i_A^* - \mu) / p_A$ and the average household in *B* spends all of its income on consumption ($x_B^* = i_B^* / p_B$). A correct comparison of spending across the two locations would conclude that spending in *A* is i_A^* / i_B^* times higher than in *B*.

Comparisons using different prices will give different results. For example, valued at the prices in *A*, spending in *B* is worth

$$= \mu + p_A (i_B^* / p_B)$$

$$= \mu + (1 - \tau) i_B^*.$$

This will only coincide with actual spending i_B^* when $i_B^* = \mu / \tau$, or in other words, when the household is exactly indifferent between consuming in *A* and *B*. When the location premium μ is high (low), or transportation costs τ are low (high), the spending of poor households will be over-(under-)estimated.

This model shows how price differentials may exist that are not due to the failure of the law of one price. In this case, transportation costs cause differences in marginal utility per unit of currency across locations. Prices differ across regions because different regions represent access to different consumption possibilities.

More generally, marginal utility of consumption per currency unit is determined by endowments, technology and preferences. Differences in any of these items may mean differences in observed prices across regions.

Future benefits

Arguably the biggest limitation of GDP is that it ignores futures benefits. Since it only considers present consumption flow, it implicitly ignores changes in an economy's asset quantities and values. The magnitude of this effect is large, since future benefits represent the consumption benefits of (many) future generations. It is easy to imagine that they be of the same order of magnitude as the direct benefits of the current generation.

This criticism of GDP also applies to its close Green GDP relatives. In order to address this limitation of using transaction-based data, most international statistical agencies (the United Nations, OECD, the World Bank) have turned to using national wealth, calculated from a system of national accounts, in order to measure economic progress.

National Wealth

Instead of answering the question “How much was earned?”, national wealth answers the question “How much is owned?”. It is quite simply the difference between looking at a firm’s revenues, versus the firm’s balance sheet.

This is the conceptual difference between GDP and National Wealth. National wealth still relies on the use of prices to aggregate goods, but now instead of measuring the flow of goods through the economy over a given time period, it measures the stock of goods in the economy at a particular point in time.

The *de-facto* standard for calculating national income and wealth is the United Nation’s *System of National Accounts* (United Nations, 2009). This 600 page document describes in detail all of the nuances of calculating national accounts. The task of measuring the value of all assets in an economy makes calculating GDP seem relatively simple. Allowances must be made for different types of household consumption and investment, corporate activities, research and development, and so on.

Theoretically speaking, this is an improvement over GDP as it explicitly attempts to measure benefits that will flow to future generations (stored in the form of assets). However, such an approach still focuses narrowly on the realization of benefits in the form of specific goods. The objection quoted at the beginning of this paper - namely that GDP does not capture intelligence, integrity, education quality or health, also applies to national wealth. What can be done to address these concerns?

3. Non-tradeables that are difficult to value

Economic models generally make predictions about prices in an economy. In particular, they make predictions about the *relative* prices of goods in an economy, and these frequently depend on technology, preferences and endowments. Predictions about the *absolute* price level in a particular state are notably absent, since they are, to a certain extent, not important. Prices may double overnight, however this should not affect the real part of the economy. As long as the relative prices of goods stay the same, actual consumption patterns in the economy should not change.

Measurements are only useful insofar as they can be compared to one another. However, given that progress measures rely on comparing values across states, this means that a link between states is required to account for the arbitrariness of absolute price levels. In order to say something about the relative economic value in different states, it is necessary to measure value in all states using a common unit of measurement. When the different states describe different countries, this implies converting between two different currencies. When the different states describe the same country at different points in time, some measure of a currency's value over time is needed. Thus exchange rates and inflation rates become key factors in the measurement of progress.

The measurement of both exchange rates and inflation rates relies on price indices. Price indices are typically measured as the cost of a fixed bundle of goods across different states, and then differences in this index are used as the basis for calculating relative purchasing power across currencies or of a single currency over time.

Constructing accurate price indices can be tricky. For example, current theory suggests ways of dealing with substitution bias, the new goods problem, quality change, and outlet bias. On top of these concerns, a further possibility is that the relative supply and quality of

non-traded goods may also affect prices of tradeable goods

To illustrate the point, consider two cafes A and B, where A is located in the center of the city and B on the periphery. The price of a coffee may be more in A than it is in B. Of the many factors that may explain this price discrepancy, location is one of them. While the direct utility derived from drinking the coffee may be the same in both locations, the fact of the matter is that drinking the coffee in a particular location also means access to other goods in that location. The center may provide certain amenities at lower prices than in the periphery (art, cultural highlights, safety, sanitation, etc..). This suggests that when prices overall are lower in one location, the willingness to pay for any *given* good in that location may be higher. This can explain why at first glance prices in city centers appear more expensive: implicitly they imply access to lower prices to other goods (and hence a higher willingness to pay for the good relative to other locations).

Naturally, prices in one state may also be higher in one particular state because of general price inflation. Typically this is measured as the price difference that remains after accounting for traditional price index adjustments. But when other goods, some of which may not be traded, have an effect on the utility generated by traded goods, this creates an identification problem. Without further information, it is impossible to say how much of the remaining difference is due to actual price inflation versus differences in availability and quality of non-traded goods. By this reasoning, price differentials are potentially rather important, not only because they signal in that they may signal differences in relative quality and abundance of non-traded goods.

It has long been debated whether the law of one price (and implicitly, purchasing price parity, PPP) holds. A naive interpretation of PPP assumes that it implies that prices be the same across states; this is not the case. Rather, it implies that marginal utility per dollar spent be

constant across states. As long as marginal utility is not the same across states, PPP makes no prediction that prices be the same either. Marginal utility may be different across states because different states imply different preferences, technologies, and endowments that may not be possible to arbitrage across states.

A necessary condition for price differentials to exist is that some costs to arbitrage exist that make it impossible to completely arbitrage all goods across all locations. If it were possible to arbitrarily ship goods between states, arbitrage should ensure that price levels themselves are the same in all locations. For classes of goods where transportation costs are negligible, for example electronic purchases, the law of one price does appear to have more support than in other circumstances (Baffes, 1991; Goodwin, 1992; Batista and da Silveira, 2010).

This suggests that changes in non-tradeables should be correlated with changes in inflation net of money supply growth. Specifically, in countries in which non-tradeables (for example, “environmental quality” increase in value, the price of tradeables should also increase. Since this increase in the price of tradeables is in fact due to non-tradable factors, this price increase would not be captured by standard methods. Standard inflation measures should therefore be higher, and hence a correlation should be observed between increases in non-tradeables and the inflation index.

4. Empirical results

This section tests empirically whether changes in general features of a state (such as education, health, and public institutions) affect the general price level. In order to test this claim, a set of indicators from the World Bank and Freedom House International for various countries are regressed on general price inflation, as measured by changes in the GDP deflator. Due to data availability, the period of analysis is restricted to 2005-2010, and the set of countries is restricted to high and middle income countries as defined by the World Bank. Full details are available in

the appendix.

The full set of regressors is given in Table 1.

Table 1 - Explanatory variables

Name	Description	Source	Expected sign
CELLULAR	Mobile cellular subscriptions, per hundred people	World Bank	> 0
CO2	CO2 emissions (kt)	World Bank	< 0
FOREST	Forest area (sq. km)	World Bank	> 0
FREE_CL	Civil liberties (lower is better)	Freedom House	< 0
FREE_PR	Political rights rating (lower is better)	Freedom House	< 0
INFANT	Infant mortality rate, per thousand live births	World Bank	< 0
M2	M2 money supply	World Bank	> 0

The World Bank Database is available online at http://databank.worldbank.org. Freedom House is available online at http://www.freedomhouse.org/report-types/freedom-world.

Apart from the money supply, which is included to allow for general price inflation, the set of regressors is meant to include indicators that might affect general well-being, while at the same time be difficult to associate directly to benefits. Such indicators would be the most likely to be affect general price levels, given that they are not themselves associated with a price. In the words of Mr. Kennedy, they allow for:

- “the health of our children” (infant mortality rate),
- “the joy of their play” (civil liberties),

- “the integrity of our public officials” (political rights),

and considerations for the value of the natural environment (CO2 emissions and forest area). The model that is estimated is a linear regression of the percentage change in the GDP deflator on changes in the regressors (changes being measured for the period 2005-2010). This period is chosen since many indicators are not available over longer periods of time. If the hypothesis of non-tradeables affecting inflation is correct, then improvements in non-tradeables create positive inflation. Therefore the expected sign of the coefficient estimate of cellular coverage and forest coverage is positive, whereas it is negative for all other regressors.

Table 2 - Regression results

Regressor	Coefficient	Std. Error	Prob.
CONSTANT	1.003.870	0.490188	0.0451
CELLULAR	-0.081790	0.177311	0.6463
CO2	0.012999	0.009250	0.1653
FOREST	-0.001285	0.001694	0.4510
FREE_CL	0.752385	1.571.009	0.6338
FREE_PR	0.252117	0.885257	0.7768
INFANT	-0.188173	0.499185	0.7076
M2	-5.69E-05	0.000100	0.5726

The results of the regression, presented in Table 2, do not lend support to the main hypothesis. The only coefficient that is in the predicted direction is infant mortality, and none of the coefficients are significantly different than zero.

While this is bad news for the theory put forward in this paper, this is good news for the validity of traditional growth measures. There appears to be little evidence from the recent past

that would suggest that price inflation is biased from the exclusion of certain non-tradeable assets. Clearly the findings presented here are limited in scope and detail - further work might check for effects over both shorter and longer time intervals.

5. Conclusion

This article has discussed some issues that arise in the measurement of economic progress. Firstly, the limitations of GDP are discussed. Green GDP is found to be a form of GDP that seeks to address the issue of non-tradeables. However, both measures suffer from the fact that they disregard future benefits.

As an alternative, national wealth addresses this shortcoming explicitly by switching to the measurement of stocks of assets, rather than focussing on flows of transactions. The incorporation of non-tradeables into the national accounts also helps address the issue of environmental quality, institutional strength, and so on.

Non-tradeables are, by definition, not associated with any market transactions. Putting a value on their existence therefore requires extra effort on the part of the reporter in developing an appropriate valuation of the asset. If non-tradeable assets have a significant effect on well-being and the demand for tradable goods, this raises the possibility that inflation may be overstated when these assets are excluded from the calculation of national income or wealth.

The empirical results, based on a limited sample of countries and over a relatively short time period, do not find any evidence of such effects. Further work consider longer or shorter time horizons, as well as different regions, to test the robustness of this result. In light of this lack of evidence, for the time being the measurement of inflation through methods such as the GDP deflator appear to remain valid.

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Appendix

Table A1 - List of countries

Albania	Cyprus	Jordan	Seychelles
Angola	Czech Republic	Kazakhstan	Slovak Republic
Australia	Denmark	Korea, Rep.	Slovenia
Austria	Dominica	Kuwait	South Africa
Azerbaijan	Dominican Republic	Latvia	Spain
Bahamas	Ecuador	Luxembourg	Suriname
Barbados	Estonia	Macedonia, FYR	Sweden
Belarus	Finland	Malaysia	Switzerland
Bosnia and Herzegovina	France	Maldives	Thailand
Botswana	Germany	Mauritius	Tonga
Brazil	Greece	Netherlands	Trinidad and Tobago
Brunei	Iceland	Norway	Tunisia
Canada	Iran, Islamic Rep.	Panama	United Arab Emirates
Chile	Ireland	Poland	United Kingdom
China	Israel	Romania	United States
Colombia	Italy	Saudi Arabia	Uruguay
Costa Rica	Japan		

Table A2 - Full regression results

Dependent Variable: INFLATION
Method: Least Squares
Sample: 1 66
Included observations: 66

	Coefficient	Std. Error	t-Statistic	Prob.
C	1.003870	0.490188	2.047929	0.0451
CELLULAR	-0.081790	0.177311	-0.461279	0.6463
CO2	0.012999	0.009250	1.405169	0.1653
FOREST	-0.001285	0.001694	-0.758860	0.4510
FREE_CL	0.752385	1.571009	0.478919	0.6338
FREE_PR	0.252117	0.885257	0.284795	0.7768
INFANT	-0.188173	0.499185	-0.376960	0.7076
M2	-5.69E-05	0.000100	-0.567400	0.5726

R-squared	0.046076	Mean dependent var	1.060686
Adjusted R-squared	-0.069052	S.D. dependent var	3.239390
S.E. of regression	3.349367	Akaike info criterion	5.368632
Sum squared resid	650.6589	Schwarz criterion	5.634045
Log likelihood	-169.1649	Hannan-Quinn criter.	5.473509
F-statistic	0.400215	Durbin-Watson stat	1.124607
Prob(F-statistic)	0.898352		