Macroeconomic Effects on Poverty Rate: A Case Study of Northern Ghana

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Introduction

The prevalence of extreme poverty is externally determined by the established poverty line. In recent years, it has been based on a daily per capita expenditure of $1.25, measured in 2005 Purchasing Power Parity (PPP). Using PPP aims to eliminate the effect of exchange rates.

PPP is based on the Law of One Price – in the absence of transaction costs and trade barriers, identical traded goods will have the same price in all markets when the prices are denominated in the same currency. This implies that in the presence of transaction costs and trade barriers, identical traded goods do not have the same price in all markets.

PPP is calculated in three stages:

- Product stage: Estimation of the relative prices for individual goods and services
- Product group stage: Estimation of relative prices for products in the same group, often an average of the PPP for each of the products in the group
- Aggregation level: Weighted averages of the PPP of the product groups where weights are the expenditures on the product groups as established in national accounts

The basket of goods used in the estimation of the PPP is a sample of goods and services used in the estimation of GDP. Final list is approximately 3,000 consumer goods and services, 30 government occupations, 200 equipment and 15 construction projects. They also often generate a significant portion of their domestic public revenues through imposed barriers to trade such as tariffs.

From the foregoing, the prevalence of poverty may be influenced by the changes in the prices of goods in a country's basket of goods when the assumption of zero transaction costs and absence of trade barriers fail to hold. Most developing countries experience significant transaction costs in traded goods because of their dependence on imports. The extent of the violation of the law of one price is

[1] This discussion paper has been developed solely to facilitate quality dialog among the staff at the Economic Growth Office of USAID/Ghana and their development partners. It has not been peer reviewed yet and, therefore, must not be quoted or referenced. The authors welcome any comments and observations that may contribute to enhancing the value of the paper makes to its target audience.

exacerbated by the proportion of consumption that is imported and changing foreign exchange situation in the country.

Research Question

To what extent do macroeconomic conditions in a developing country influence the prevalence of poverty? The macroeconomic conditions of interest are exchange rates and inflation, measured by the consumer price index (CPI). For simplicity purposes, the research question ignores the non-trivial effect of population growth on the prevalence of poverty.

The question is important because the performance of intervention projects aimed at reducing poverty may be adversely affected by inimical macroeconomic conditions over which the projects have no control. Understanding and measuring the effect of these macroeconomic conditions allow project managers to make the necessary adjustments to their achievements to help effectively monitor and evaluate project performance.

Background

Suppose the perfect world where the real exchange rate is constant over time between two countries, say U.S. and Ghana. Suppose also that a basket of goods produced in U.S. and Ghana were identical and completely tradable. The law of one price would suggest that net of transportation costs, arbitrage would insure that the dollar price of the basket is identical between Ghana and the U.S. – this is the basic theory of PPP determination.

Let us begin with an illustration of the changing PPP measured as national currency per U.S. dollar in the Euro Zone and the UK (Figure 1). Between 2009 and 2014, UK's PPP has been increasing while the EU's has been declining. This implies that for people living in the UK needed a declining quantity of British Pounds to purchase the same basket of goods as would be purchased in the U.S. for given price in U.S. dollars while those living in the Euro Zone needed an increasing quantity of Euros. A declining PPP is, therefore, an indicator of a worsening economic condition for residents in a particular country.

Let us define the real exchange rate, *Q*, as follows:

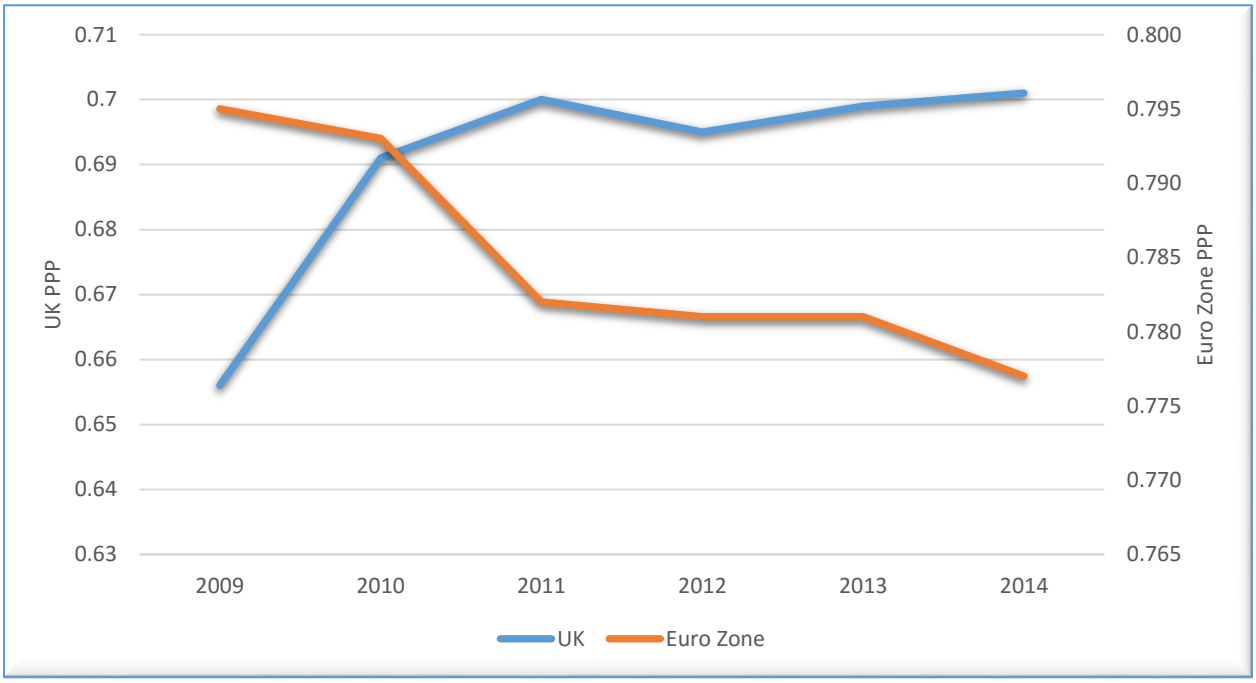
$$Q = SP^{*}/P \tag{1}$$

where S is the nominal exchange rate, P is the U.S. price level and P* is the price level in the country of interest, say Ghana. When the real exchange rate is appreciating, it means the U.S. price of the bundle of goods in the basket is increasing relative to the Ghanaian price. Now, when the real exchange rates appreciates, then the real value of the dollar has depreciated, suggesting a decline in its purchasing power, relatively speaking.

To get to know how Q affects the poverty level, it is necessary to try to understand the factors that influence changes in Q. The real exchange rate between the currencies of the two countries may change when there is a change in the relative demand for U.S. goods as a result of preference shift, leading to total expenditure on U.S. goods increasing. The shift may arise from two principal sources. An increase in global private and public demand for U.S. goods is one source of such shifts. This shift is exacerbated when the relative increase in demand for U.S. goods is much higher than the increase in demand for Ghana goods. In an increasingly interconnected world, imports tend to account increasing

share of development countries' consumption. Another source of the shift is an increase in U.S. Government expenditure on U.S. goods, an event that increases during recessionary periods in attempts to boost demand as an economic stimulant. When these events shift the demand for U.S. goods, equilibrium can only be restored if the relative price of U.S. goods vis-à-vis Ghana goods rose. From Equation (1), this implies a decline in Q, i.e., the purchasing power of the U.S. dollar has increased relative to the Ghana cedi. The corollary is true: that the purchasing power of the Ghana cedi has declined and its purchasing power has fallen.

Figure 1: Purchasing Power Parities for UK and Euro Zone per US Dollar (2009-2014)



Another source of change in the real exchange rate is a change in relative output supply in the U.S. significantly exceeding that of Ghana. Output supply changes are a function of resource productivity-enhancing technologies, such as those for labor and capital. Tractors and other farm production equipment are some of the visible productivity-enhancing technologies that allow U.S. agriculture, for example, to dwarf that of Ghana. One outcome of increasing productivity is increasing incomes and the country with the highest relative productivity increase will also have the highest relative income increase. Because the higher incomes often lead to increased consumption of imports, relative prices in the U.S. need to fall to restore equilibrium. This fall in relative prices lead to an increase in Q and a fall in the U.S. dollar in real terms. Conversely, Ghana's relative productivity disadvantage suggests the need for appreciation of the Ghana cedi in order to restore equilibrium, leading to an increase in Ghana's prices relative to those in the U.S., i.e., the Ghana cedi rises in real terms. The foregoing works well if the goods and services in the basket of goods being compared between the two countries are all traded. However, a fair proportion of goods in the basket of developing countries tend to be non-traded.

Purchasing Power Parity

Equation (1) may be re-specified to focus on the nominal exchange rate instead of the real exchange rate because the real exchange rate is assumed fixed or constant over time. Thus, the nominal exchange rate is:

$$S = \overline{Q}P \big/ P^* \tag{2}$$

where $Q = \overline{Q}$ when Q is constant over time. Equation (2) suggests that any changes in the national price level will alter the exchange rate. The genius of PPP is that it determines the exchange rate merely by the movement in relative prices. Given that Ghana's inflation rate is higher than that of the U.S., exchange rate has to appreciate and the cedi will depreciate relative to the U.S. dollar, implying more Ghana cedis are required to purchase a U.S. dollar.

Suppose we take the logs of both sides of Equation (2), using the lower-case letters to represent a variable's log form, then we have:

$$s_t = \overline{q} + p_t - p_t^* \tag{3}$$

Taking the first differences in Equation (3), we get:

$$\Delta s_t \equiv s_t - s_{t-1} = \Delta p_t - \Delta p_t^* \tag{4}$$

The story Equation (4) is telling is that the percentage in nominal exchange rate is equal to the difference between the inflation rates in Ghana and the U.S. What we find here is that when price levels are changing rapidly, i.e., the inflation rate is high, those rapidly changing price levels tend to dwarf everything else, giving the PPP its effectiveness in explaining exchange rate movements.

However, in the short run, the PPP does not perform very well at all. Recognize that the PPP is based essentially on trade and trade flows and a critical assumption that transaction costs and trade barriers are zero. Yet, in the short run, tariffs and transportation costs are real barriers to trade that influence the profitability of arbitrage opportunities. Again, because Ghana and the U.S. differ significantly in the composition of their outputs, shifts in term of trade can cause Q to change. For example, being a net importer of fertilizers, a positive shock on oil prices would affect Ghana's productivity very differently than the U.S., if we assume it to be a net exporter of fertilizers. More realistically, prices tend to be sticky in the short run, causing the law of one price to fail to hold. This implies that changes in the nominal exchange rate would also affect the real exchange rate.

What really challenges the PPP is the presence of non-traded goods in the basket of goods because non-traded goods do not flow across national boundaries. Non-traded goods include such items as firewood, thatch roofing material, education and medical services, housing, etc. When the proportion of goods in the basket are non-traded, then the use of PPP becomes suspect.

Let us show the effect of non-traded goods in the following model. Let P define the price index in Ghana and α as the proportion of non-traded goods in the basket of goods consumed in the country, then:

$$P = P_n^{\alpha} P_t^{1-\alpha} \tag{5}$$

where the subscripts *n* and *t* refer to non-traded and traded respectively. The real exchange rate may now be represented as:

$$Q = S\left[\frac{P_n^{*\alpha^*} P_t^{*(1-\alpha^*)}}{P_n^{\alpha} P_t^{1-\alpha}}\right] = S\left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*}}{\left(\frac{P_n}{P_t}\right)^{\alpha}} \quad \frac{P_t^*}{P_t}\right] \tag{6}$$

When Equation (6) is simplified, then we get:

$$Q = S\left(\frac{P_t^*}{P_t}\right)\left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*}}{\left(\frac{P_n}{P_t}\right)^{\alpha}}\right] \tag{7}$$

Assuming the PPP holds for traded goods implies that the first part of Equation (7) equals one, which implies that the real exchange rate is defined as follows:

$$Q = \left[\frac{\left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*}}{\left(\frac{P_n}{P_t}\right)^{\alpha}}\right] \tag{8}$$

Equation (8) is saying that the real exchange rate will change if the relative price of non-traded goods in either countries changes. If we assume that the basket of goods in the U.S. has only traded goods, then $\alpha = 1$, transforming Equation (8) to say that the real exchange rate changes with the relative price changes between the traded and non-traded goods in Ghana, i.e.:

$$Q = \left(\frac{P_n^*}{P_t^*}\right)^{\alpha^*} \tag{9}$$

If we take the logs of Equation (9), then we can state that the real exchange rate in Ghana will appreciate if the relative price of non-traded goods to traded goods increases. That is:

$$\Delta q = \Delta p_n^* - \Delta p_t^* \tag{10}$$

The Balassa-Samuelson effect provides evidence that this is a common occurrence in explaining differential economic growth. It argues that economic growth is associated more with increased productivity in traded goods. When liberalization policies are being pursued, it is expected that the

price of non-traded goods will rise relative to traded goods, leading to a rapid changes in the real exchange rate. Indeed, it is the proportion of non-traded goods in the basket of good consumed in Ghana that allows the poverty line in Ghana to be so dramatically different from that in the U.S., say.

Effect of Exchange Rate on Poverty

From Equation (10), we noted that the larger the proportion of non-traded goods in the basket of consumed goods, the lower the rate of economic growth *even* when productivity in those non-traded goods increase. This is merely a result of the lack of arbitrage opportunities for those goods to exploit the productivity gains.

Let us assess the potential effect of the exchange rate on the poverty level using consumption expenditures given the foregoing analysis and using data collected from the study area in 2012 and are described in Zereyesus et al. (2014).[2] Consumption expenditures are defined to encompass expenditures on four product categories: food; housing; durables; and non-durables. Durables are products lasting longer than a year, such as radios, bicycles and clothing. Non-durables are defined by elimination, i.e., they are all the goods that are not food, housing or durables. They include education, health care, beauty care and grooming services, firewood, roofing thatch, household fuel and transportation. It is obvious that for the study location, the durable goods category have the most traded goods while the other product categories comprise essentially non-trade goods.

Consumption expenditure data in Ghana cedi were collected from about 4,410 households in the study area. To present the average daily household per capita expenditure in U.S. dollar denominated PPP (X^{P}_{2005}) required two variables: (a) the consumer price index (CPI); (b) the PPP conversion factor. Using World Bank International Comparison Program's estimates, the 2005 PPP conversion factor (ρ_{2005}) was determined to be 0.447. Bank of Ghana data indicated that Ghana's CPI in 2005 (I_{2005}) and in 2012 (I_{2012}) were respectively 183.7 and 412.4, with 2000 = 100. To convert the estimated average daily household per capita expenditure in 2012 Ghana cedi into 2005 PPP, used the foregoing coefficients and the following equation:

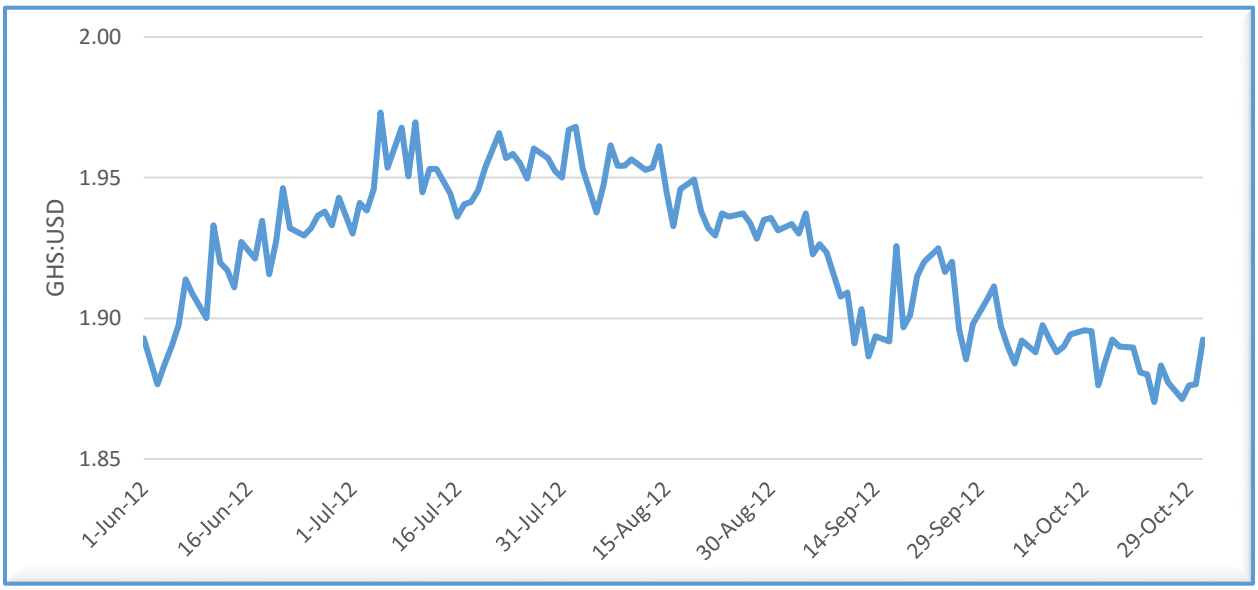
$$X^{P}_{2005} = \frac{X^{G}_{2012} I_{2005}}{I_{2012} \rho_{2005}} = \frac{183.7 X^{G}_{2012}}{0.447 * 412.4} = 0.9965 X^{G}_{2012} \qquad (11)$$

The proportion of households for whom X^{P}_{2005} is less than $1.25 defines the poverty prevalence. Based on the data collected in the study area, the foregoing approach yielded a poverty prevalence of 22.2 percent reported above for the study area. The question of interest in this research is this: What effect do the changing exchange rates and inflation have on the estimated poverty rate? In other words, based on the approach described in Equation (11), how would the poverty rate have been if the local currency conversion rate (which we have shown to be influenced by the nominal exchange rate) and the inflation rate prevailing today had been in place when the study was conducted? The more important question is to what extent do these macroeconomic factors influence the performance of poverty reduction intervention projects?

[2] Zereyesus, Y., K. Ross, V. Amanor-Boadu and T. Dalton. *Baseline Feed the Future Indicators for Ghana, 2012*, Manhattan, KS: Kansas State University Press, 2014.

Before we begin our attempt to answer these questions, let us look at the changes that have been occurring in the macroeconomic environment in Ghana. The daily market (nominal) exchange rate between the GHS and the USD for June 2012 to December 2012 is presented in Figure 2. It shows that the Ghana cedi was appreciating against the USD at an average daily rate of approximately 0.02 percent.

Figure 2: Daily Market Exchange Rate of the Ghana Cedi to the US Dollar (June 2012-October 2014)



Data Source: Investing.com (http://www.investing.com/currencies/ghs-usd-historical-data).

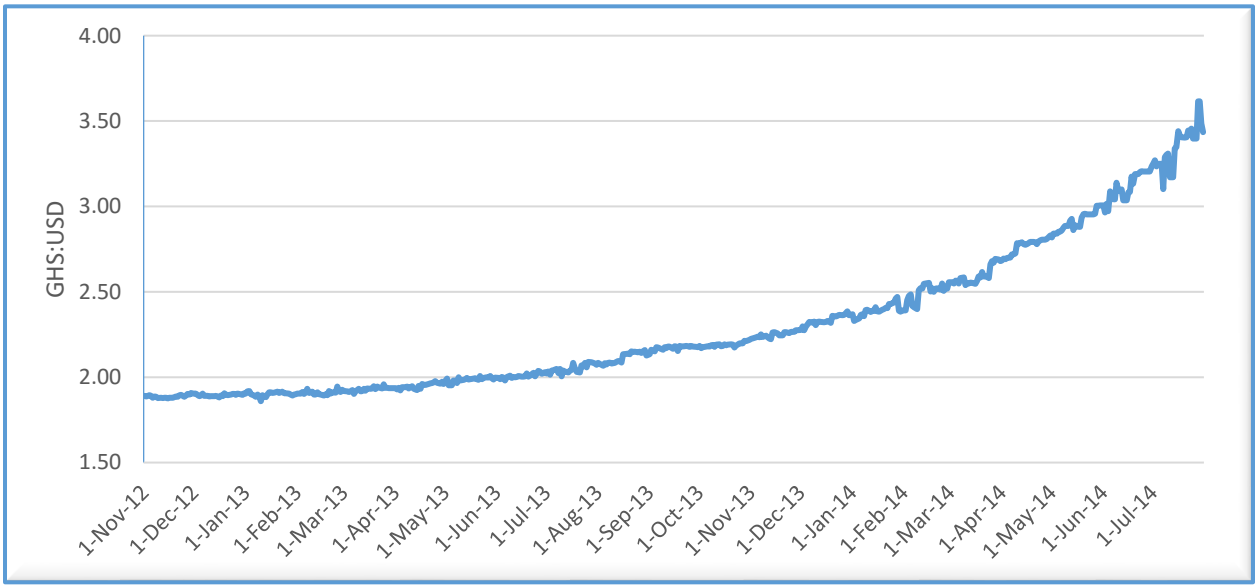
However, the trend reversed, as shown in Figure 3, with the cedi depreciating against the USD at an approximate daily rate of 0.03 percent between November 2012 and July 2014. Indeed, Dzawu and Brand (2014) noted that the Ghana cedi as the world's worst-performing currency against the U.S. dollar in the first and second quarters of 2014.[3] It is this reversal that presents significant adverse effect on the poverty rate independent of what intervention project managers do, *ceteris paribus*.

The trends in the relative price ratio (see Equation (1) and Equation (2)), presented as the local current unit rate and the consumer price index or inflation are presented in Figure 4. Unlike the exchange rate which was depreciating against the U.S. dollar, both the local currency unit rate and the inflation rate are increasing very rapidly. The correlation coefficients between the exchange rate and total inflation as well as housing, food and beverage, transportation and non-food inflation for January 2012 through May 2014 were all high (above 84 percent), positive and statistically significant at the 1 percent level. Energy prices, for example, are directly influenced by the exchange rate because petroleum products are imported. Depreciating exchange rates increases the local cost of these products, which in turn influence the cost of food, transportation, clothing and other goods and services in the consumer's basket. The increase in local cost of fuel, because of its ubiquitous effect on numerous segments of the economy, can even lead to increases in housing costs as rents are increased by property owners to address their income effects resulting from inflationary pressures. For the CPI for all items in Ghana, during the 2003 to 2012 period, the CPI had been increasing at an annual rate of 13.7 percent.

[3] Dzawu, M.M. and R. Brand. World's Worst Currency Drops as Ghana Pulls Back from IMF Aid, June 30, 2014, 9:03 AM. Available at http://www.bloomberg.com/news/2014-07-30/world-s-worst-currency-drops-as-ghana-pulls-back-from-imf-aid.html.

Regarding the LCU in Ghana and the international dollar conversion factor, the LCU has been depreciating by an average of 17 percent annually during the 1990 to 2013 period. Historical data on the LCU conversion rate show that the LCU in Ghana has been steadily declining in value in relation to the international dollar (Figure 4). For example, using the private consumption conversion factors, one international dollar was equivalent to 0.03 and 0.93 LCUs in 1990 and 2013, respectively (World Bank).

Figure 3: Daily Market Exchange Rate of the Ghana Cedi to the US Dollar (November 2012-July 2014)



Data Source: Investing.com (http://www.investing.com/currencies/ghs-usd-historical-data).

The foregoing graphs support the non-independence between the nominal exchange rate and inflation. The exchange rate elasticity of inflation is estimated as 0.49 (t-value = 12.19; $p > |t| = 0.00$). This suggests that a percentage change in exchange rate would result in about one-half percent change in the CPI. A critical observation is that the rapid inflation in Ghana during this period relative to that in the U.S., for example, contributes to the exacerbating exchange rate trend.

Let us assume that people qualifying for the minimum wage in Ghana have a very low non-traded goods content in their consumption basket. This is because to be earning the minimum wage, the person is probably living in an urban area and have some form of regulated employment. The effect of the exchange rate depreciation on this group of people provides an illustration of how the depreciating exchange rate pulls down the overall consumption environment to exacerbate the risk of poverty. Figure 5 shows that the Government of Ghana over the past several years has responded to the changing U.S. dollar exchange rate by increasing the minimum wage. However, the rapid depreciation of the Ghana cedi in recent years has positioned the U.S. dollar equivalent of the minimum wage in April 2014 at about the same level it was five years' earlier, without the attendant effect of inflation discussed earlier. If inflation is accounted for, then we would have a situation where the minimum wage is significantly lower in its purchasing power equivalent in 2014 than it was in 2010. If we assume that people earning minimum wage are the most vulnerable to economic vicissitudes, then it is plausible to conclude that the depreciation of the GHS against the USD may be having some adverse effect on the poor.

Figure 4: Trends in the Local Currency Unit Rate and the Consumer Price Index

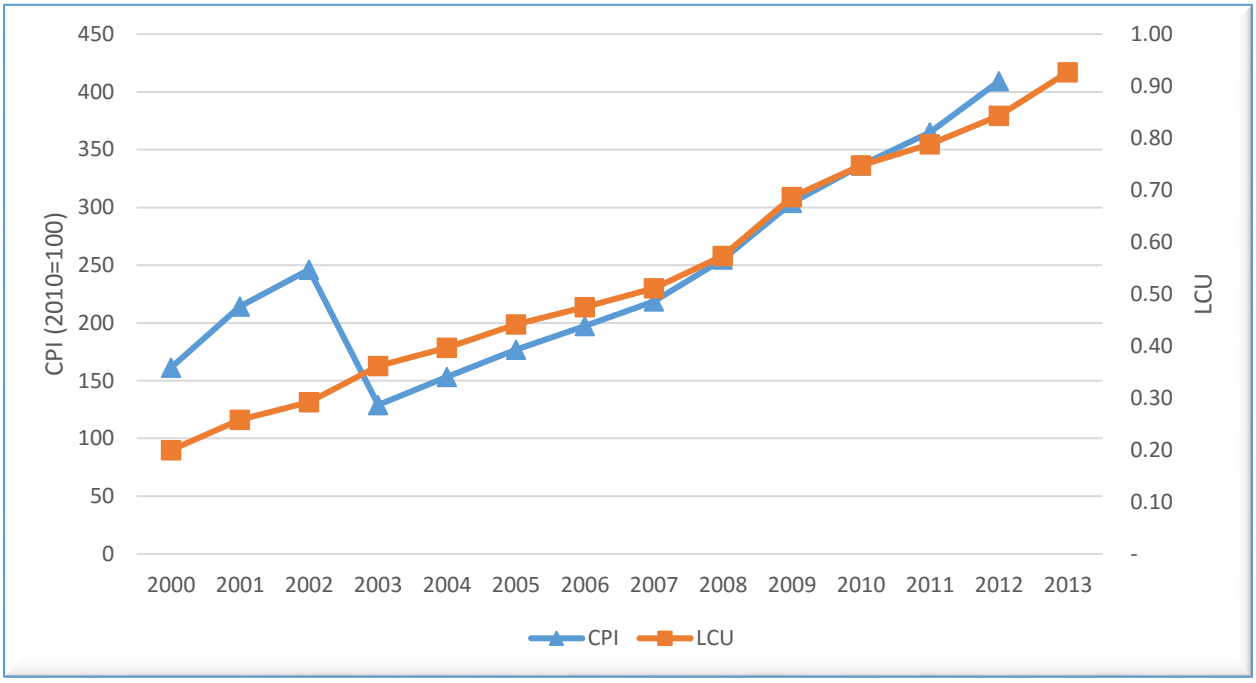
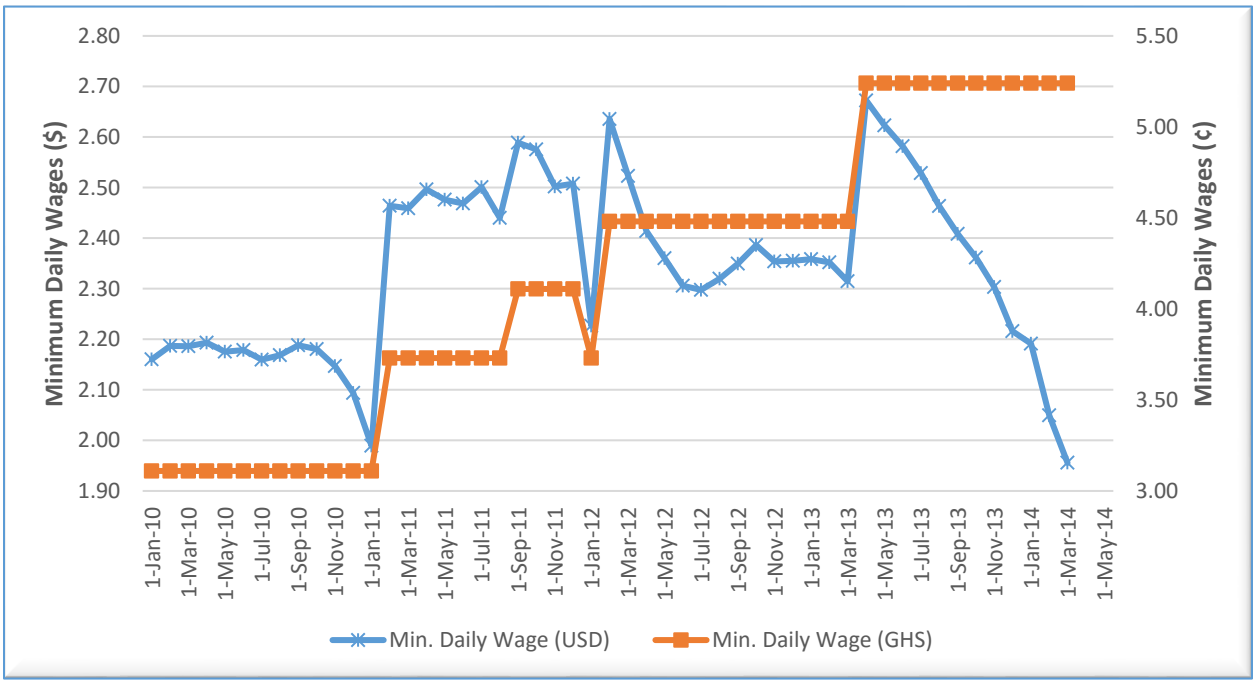


Figure 5: Minimum Daily Wage in Ghana Cedi and US Dollar Equivalent Using Market Exchange Rate (January 2010-April 2014)



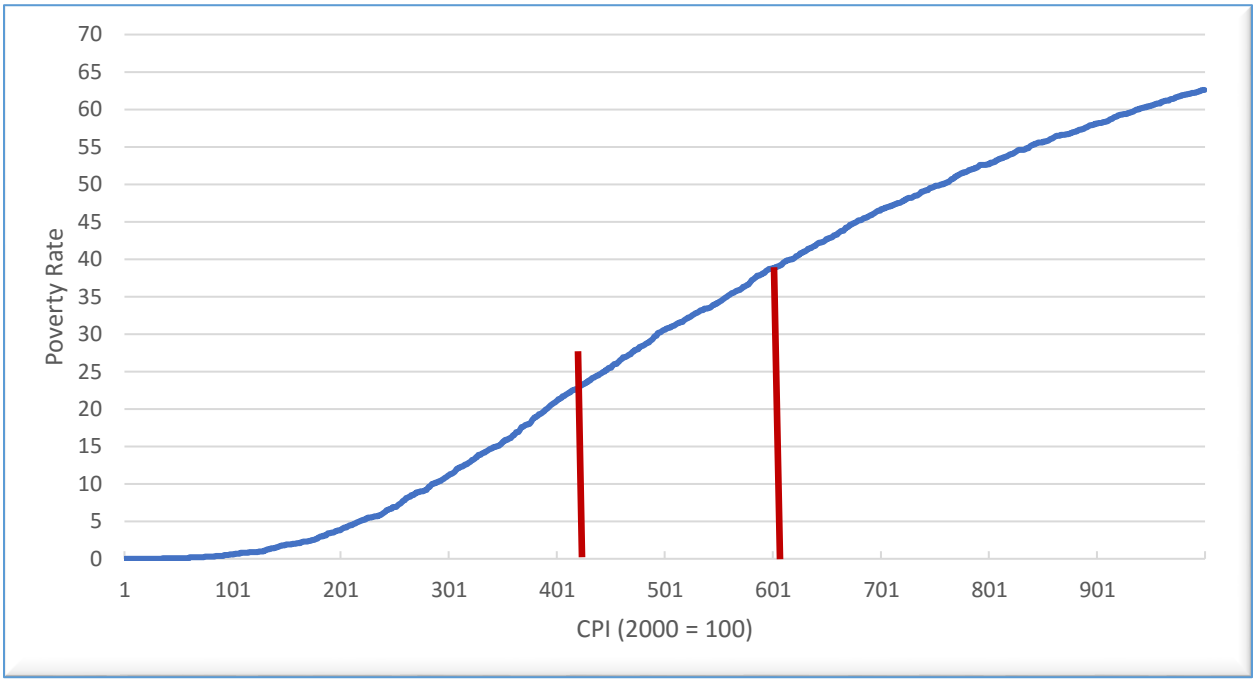
Data Sources: Bank of Ghana (http://www.bog.gov.gh/) and Investing.com (http://www.investing.com/currencies/ghs-usd-historical-data).

Simulating the Effect of Exchange Rate and Inflation on the Poverty Rate

The paper, thus far, shows there is a direct link between the poverty rate and the macroeconomic variables of inflation and exchange rate even when PPP is used because of the relatively high proportion of non-traded goods in the consumption basket of Ghanaians. This proportion of non-traded goods in the consumption basket is directly related to the risk of falling under the poverty line. That is, as average daily per capita household expenditure decreases, the share of non-traded goods in a consumer's basket increases. This is because, for example, they will be more likely to use firewood they gathered from local forests than purchase charcoal for home energy needs, or water collected from rainfall or a local ravine than purchase a tanker of water. We also noted the inability of PPP to perform well in the short run when prices are sticky and transaction costs such as transportation costs which directly influence prices cannot be arbitraged because of location and its effect on competition in the provision of services. We showed the direct influence of the PPP and inflation on the poverty rate in illustrating the approach used in measuring the poverty rate in Equation 11. We use this relationship to explore the empirical effect of the local current unit rate and inflation on the poverty rate.

Figure 6 shows that keeping all things unchanged except the CPI, conducting the study today when the estimated CPI is approximately 605.9 (2002 = 100) would lead to a poverty rate estimate of about 39 percent instead of the 22.2 percent estimated in 2012.[4] The result is not very different when Ghana Statistical Service's CPI estimate of 141.1 (2012 = 100) for January 2015 is used after adjusting the base year back to 2002.

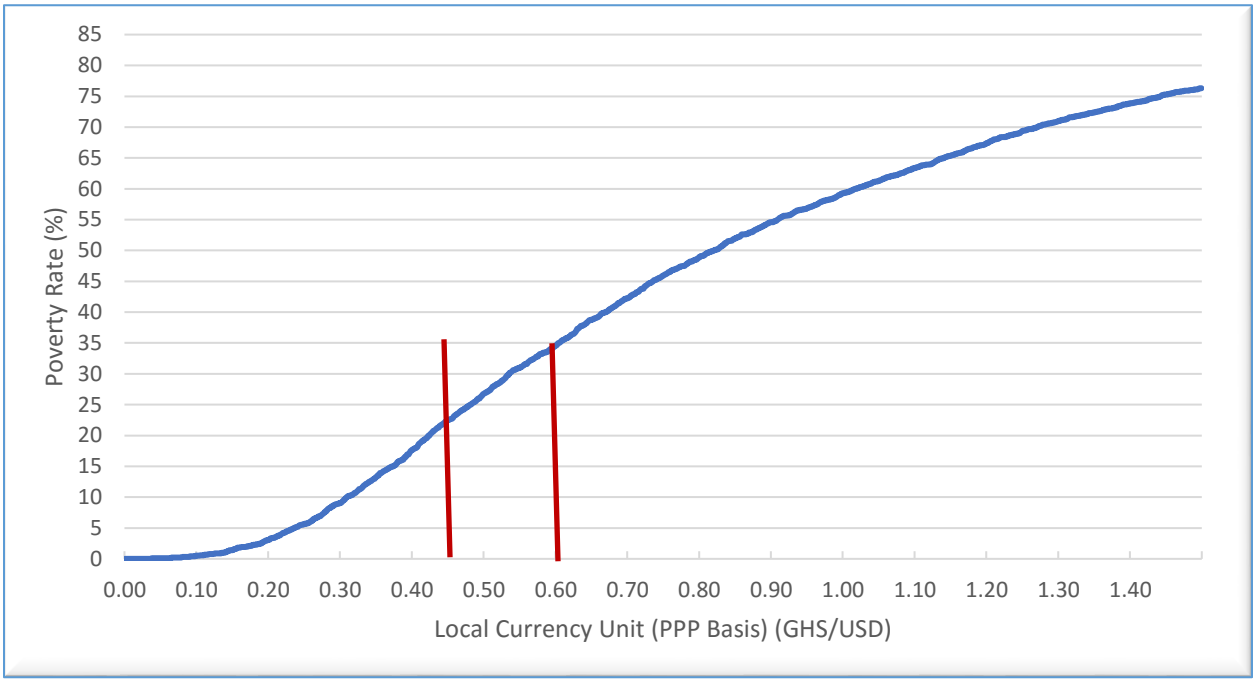
Figure 6: Simulated CPI Effect on Poverty Rates



[4] The estimated CPI assumed that the historical growth in the CPI between 2000 and 2013 will remain unchanged. The applied formula is $414.2(1.137)^3 = 605.9$.

The relationship between the local currency unit rate and the poverty rate is defined in Equation (11). Holding all variables constant, Figure 7 explores the effect of changing local currency unit on the poverty rate. It shows that the local currency unit rate increases (i.e., the cedi weakens) in comparison to the international dollar as we move from left to right on the horizontal-axis. The red line superimposed on the graph at the local currency unit rate value of 0.447 on the horizontal –axis shows the point we were in 2012 when the poverty rate was 22.2 in the study area. With the current weakening of the cedi, if the poverty rate was measured where the local currency unit rate is assumed to be 0.60, the estimated poverty rate would be approximately 35 percent.

Figure 7: Simulated Local Currency Unit Effect on Poverty Rates



Conclusion

The purpose of this paper was to understand the potential effect of changing macroeconomic conditions on poverty even when PPP was the basis of measuring relative prices. We showed that in developing countries that are experiencing rapid inflation and where the proportion of non-traded goods in the consumer goods basket is high in comparison to the U.S., PPP may fail to remain unchanging in the short run. If such is the case, then it is plausible to recognize the potential effect of the relationships between inflation and relative prices on the poverty rate.

We showed that Ghana has been experiencing rapid inflation since 2012 and the nominal exchange rate has been rising rapidly. We showed that because of the relatively large proportion of non-traded goods in the consumption basket of the population in the study area, the relative price of non-traded goods to traded goods may be rising too. If that is the case, then the implied local currency unit rate would be depreciating. The structure of the estimation procedure suggests that poverty rate would increase with either of these events happening. This paper showed the empirical effect of the changes. We, however, did not explore the interaction effect of both inflation and local currency unit rates increasing even

though that is exactly what is happening. However, the model shows that the combo effect the two variables on the poverty rate is multiplicative, not additive.

The Economic Growth Office has made investments in projects that are implementing programs to ameliorate the estimated poverty level in the region and/or in the particular district of activity. The projected target for poverty reduction is 20 percent. That is, the Economic Growth Office expects to attain an average poverty rate of about 17.8 percent by the end of the project. This paper indicates that the estimation method for conducting the evaluation of project objectives must be carefully structured if the uncontrollable macroeconomic effects are going to be neutralized. It is critically important that we construct an internal PPP that recognizes the specific macroeconomic conditions in the intervention areas. This will help do two critical things in terms of reporting performance:

- Understand the unique economic conditions under which the project participants are operating, and hence appreciate the effect of those conditions on project performance; and
- Develop a compelling explanation of any departures from targets which may not be the fault of program managers, program designers or indeed have anything to do with the intervention programs, period.

In this paper, we explored the effect of macroeconomic variables on attaining poverty reduction program targets. We did not consider the demographic variable of population growth. As with the macroeconomic variables, program evaluators must incorporate the changes in population in the models develop to assess the performance of the projects. These uncontrollable variables are very important in providing an accurate assessment of project performance and understanding the impact of the intervention programs being implemented by the Economic Growth Office in Ghana.