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Degree of price rigidity in LICs and implication for monetary policy

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DEGREE OF PRICE RIGIDITY IN LOW INCOME COUNTRIES :
IMPLICATIONS FOR MONETARY POLICY

Sahawal ALIDOU

ABSTRACT

Using semi-aggregate data on price and a methodology based on dummy indicator, we assess price rigidity in Ghana and discuss its implications for monetary policy. Price features in Ghana are compared to that of South Africa which is a similar country both in terms of economic structure and monetary policy framework. Our results suggest higher price rigidity in South Africa than in Ghana. Therefore, the same monetary policy is likely to have ceteris paribus, more real effects in South Africa and more nominal effects in Ghana.

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I) INTRODUCTION

Price variations affect agents in the economy in different ways. At the microeconomic level, consumers tend to reduce their purchasing when prices increase while from producers perspective, prices increase is an incentive to produce more goods and services. In the same way, changes in both consumers demand and producers supply are likely to influence prices. Of course, economic agents do not instantaneously change their behavior in response to price changes and it also take time before prices adjust in response to changes in demand and supply conditions. The delay of the responses depends inter alia on agent's anticipations, wage rigidity, cost of adjustment, structure of the economy and price-elasticity. One can intuitively think that higher level of savings and better access to credit allow consumers in developed countries to take more time to adjust to an increase of prices while consumers in developing countries adjust more rapidly. The literature has used the terminology of *price stickiness* to define the duration it takes for price to change or the frequency at which price change (Carlton, 1986; Bils and Klenow, 2004; Nakamura and Steinsson, 2008; Dhyne et al, 2009).

There are many theories trying to explain price stickiness. It is commonly admitted that nominal rigidity is determined by wage rigidity, implicit or explicit contracts, menu costs, attractive prices, fair pricing and costly information¹. An important body of literature has been developing about price settings in developed countries and some notable contributions come from Bils and Klenow (2004); Nakamura and Steinsson (2008), Klenow and Kryvtsov (2008), Dhyne, Alvarez and al. (2006).... In comparison, price settings are quite less known in developing countries. Mamello Nchake's (2012) work on Lesotho; Creamer and Rankin's (2008 and 2012) for South Africa; Julio and Zarate (2008) for Colombia; Gouvea's (2007) for Brazil) and Kovanen's (2006) for Sierra Leone can be considered as pioneers in such field for developing countries. Differences in price behavior between developed and developing countries would come at least from differences in economies structure². For instance, agriculture still plays a major role in developing economies whereas it's not anymore the case in developed economies dominated by industrial and services sectors. Given that prices of services change far less frequently than others (see Nakamura and Steinsson (2008), Klenow and Kryvtsov (2008), Dhyne, Alvarez and al. (2006)),

¹ See Dhyne et al (2006) and Dhyne et al,(2009)

² Agriculture value added represents 28% of GDP in low income countries in 2012 while it's only 1% in high income countries in 2011 (World Bank data base)

one would expect prices changes to be on average less frequent in developed countries than in developing one. Finally, price rigidity also depends on market structure as models of price adjustment predict greater frequency of price changes in markets with more competition because firms therein face more elastic demand (Bils and Klenow, 2004). Given that market failure is more prevalent in LICs and the nonmarket institutions that ameliorate its consequences are not very successful in doing so (Stiglitz, 1989), frequency of prices changes in that respect may be higher in developed countries.

The importance to properly assess price stickiness come from the fact that “most economies including the developing countries have adopted monetary policy as a means of regulating and stabilizing the economy, based on the acclaimed short run non-neutrality of money due to sticky prices and wages, and market imperfections” (Urama et al, 2013). Then, price rigidity and speed of price adjustment are crucial elements to understand business cycle fluctuations and the effects of monetary policy. Actually, the effects of monetary policy shock on prices and output is very specific to countries depending on the size of the price rigidity but also on the relative significance of cost channel effect and negative demand effects³ (Creamer and Rankin, 2008). As such, price stickiness has several implications for the design of monetary stabilization policy. That’s probably why monetary authorities focus in general on inflation as a good signal for prices instead of the price level itself. But “inflation may disguise different underlying patterns of price changes, such as price rigidities, which may cause real effects in the economy. Therefore, analyzing prices at a unit level⁴ facilitates an understanding of actual pricing conduct at the most basic level” (Creamer and Rankin, 2008).

Our work is a part of a broad research agenda on Ghana that aims to determine to what extent models and policies designed for South Africa’s economy can be adapted in Ghana. This approach is motivated by similarities between the two countries in term of production structure and monetary policy framework and also the relatively poor quality of data in Ghana. In particular, we here compare price settings in the two countries to see whether one can assume price in Ghana to be as stickier as in South Africa. The methodology is inspired from Dhyne, Alvarez and al (2006)

³ As a rising interest rates put upward pressure on prices (firms perspective) and put downward pressure on prices (consumers perspective).

⁴ Unit level analysis means looking at price of each good or each type of goods instead of the general level of price through inflation

but given data constraints, we used consumer price indexes instead of micro data on price. Our results suggest highest price rigidity in South Africa than in Ghana and therefore the need of some adjustments when trying to adapt South Africa's economic models and policies for Ghana.

II) LITERATURE REVIEW

There are two main ways to investigate price settings. The first consist on “vector autoregressions (VAR) based on aggregate data (see for example Christiano, Eichenbaum and Evans, 1999) and typically finds stickiness in the aggregate price level”⁵. The second way is to exploit individual level data from survey of firms (Fabiani et al, 2005), or from Producer Price Index (Vermeulen and al, 2007) or from Consumer Price Index (Bils and Klenow, 2004; Nakamura and Steinsson; 2008). Former studies using micro data focused on specific wholesale or retail items (see for instance Carlton, 1986) but recent papers⁶ deal with larger dataset of products and analyze price settings both from consumer perspective (CPI) and producer perspective (PPI). According to Dhyne et al (2009), the most popular approach to explain price rigidity at individual level is the menu cost model. But studies based on CPI data widely used a dummy indicator to count for changes and compute frequency of changes (for instance Nakamura and Steinsson,2008 ; Dhyne et al, 2006; Bils and Klenow, 2004). Also, the methodology has been improving with the distinction between regular price and temporary price, the role of temporary sales and product substitutions in price changes, the distinction between state and time pricing, and several transformations of the initial menu cost model introduced by Barro (1972)⁷. As this study is based on CPI data, we focus our literature review on studies at individual level in particular those using CPI data.

1. Price settings in developed countries (USA, EU and Japan)

The work of Bils and Klenow (2004) on price of U.S can be considered as a reference for the recent body of literature on price features. Using a 1995–97dataset of 350 categories of goods and services covering about 70% percent of consumer spending and a methodology based on dummy indicator, they found a median duration of price of 4.3 months. A more detailed dataset⁸ than that of Bils and Klenow (2004) and a mixed methodology (dummy and benchmark menu cost model) allowed Nakamura and Steinsson (2008) to establish the following five facts about price settings in

⁵ Boivin et al (2007)

⁶ For instance Nakamura and Steinsson (2008)

⁷ The menu cost model is based on firm pricing behavior. For further details on methodological evolution, see notably Klenow and Krystov (2008) Nakamura and Steinsson (2008) Dhyne et al (2009) and Kehoe and Midrigan (2010)

⁸ CPI microdata for 360 products on 1988-1997 and for 270 products on 1998-2005 and microdata of PPI on 1988-2005.

US. Firstly, temporary sales and product substitutions⁹ play an important role in generating price flexibility and price changes are heterogeneous among the products. Secondly, price decreases are roughly one-third in both consumer prices excluding sales and finished-goods producer prices. Thirdly, the frequency of price increases covaries quite strongly with the rate of inflation, whereas the frequency of price decreases and the size of price increases and decreases do not. The fourth feature is the high seasonality of price rigidity both for consumer and producer prices. Furthermore, prices are substantially more likely to change in the first quarter than in other quarters of the year. Finally (fifth feature) they calibrated a model to estimate a hazard function of price changes and found an upward sloping hazard function for the first months. But this result is not robust because while changing the model, the hazard function becomes downward sloping.

The results found by Nakamura and Steinsson (2008) are similar to those of Klenow and Kryvtsov's (2008)¹⁰ who used 1988–2004 US microdata on CPI with also a methodology based on dummy indicator. For instance, Nakamura and Steinsson found 7.5 months as time-weighted average of duration of regular prices, including product substitutions. Excluding product substitutions, they found 8.7 months and for regular prices they found 9.6 months. Klenow and Kryvtsov (2008) findings are 7.2 months while including substitutions, 8.7 months while excluding substitutions and 9.3 months based on regular prices. Nakamura and Steinsson (2008) findings about the frequency of price change, the relationship between the frequency of price increases and inflation, and the seasonality of price changes are also consistent with the results of some important works on price settings in Europe (Vermeulen et al. (2007); Fabiani et al. (2005¹¹)).

For the Euro zone, using a common sample of 50 goods or services of CPI observed during the January 1996–January 2001 and a methodology based on dummy indicator, Dhyne et al (2006) found a monthly frequency of price changes of 24.8%, similar to the results in US (26.1 % from Bils and Klenow, 2004 and 29.3% from Klenow and Kryvtsov, 2008). But they suggested a different way to calculate the duration of the average price spell arguing that inversion

⁹ Product substitution is particularly important for durable goods and refers to the introduction of new products. For example seasonally change in clothing products or new model year for cars.

¹⁰ Their article "State-dependent or time-dependent pricing: does it matter for recent US. inflation" was first published in January 2005 by the National Bureau of Economic Research, WP 11043 and in August 2008 by the Quarterly Journal of Economics

¹¹ Using a dataset of 48 items from Italy CPI on January 1996 to December 2003

of the average frequency of the changes is correct only if prices all have the same expected duration. Since prices of some products change very infrequently, they compute duration for each product and then take the average. With this method, prices last on average 13 months in the euro area and the corresponding figure for the US is 6.7 months. Meaning that the average duration of a price spell in the euro area is about twice as long as in U.S. So, prices seem to change far less frequently in the euro area than in the U.S. The differences in frequencies of price adjustment and durations of price spell between the euro area and the United States seems to be a robust and may be explain by greater intensity of information and communication technology and greater competition in retail sector in U.S.

Dhyne et al (2006) also found a substantial variation of the frequency of price changes across products. For example, prices in the energy sector change very often: 78.0% in a given month while prices of processed food and non-energy industrial goods change only for 13.7% per month and 9.2 % per month respectively. The lowest incidence of price changes is observed for services. Those findings support the idea that more labor intensive is a good, less subject to frequent price adjustments it is, because of wages and contracts rigidity. While goods with relatively large intermediate inputs experience more frequent price adjustments because of the volatility of input prices (A´lvarez and Hernando, 2005).

In the line of Klenow and Kryvtsov (2008) who report that 45% of price changes in US are decreases, Dhyne et al (2006) found 40% of the changes are price decreases in Euro area. Another finding is that price changes are greater than the prevailing inflation rate. Price reductions and price increases have a similar order of magnitude: the average price decrease in the euro area is 10% while the average price increase is 8.12%. The same pattern is also found by Klenow and Kryvtsov (2008) with U.S. price data: an average price decrease of 14% and an average price increase of 12.7 %. Otherwise, they established that price changes are not synchronized across products, even within the same country using Fisher and Konieczny measure¹³. Actually, the degree of synchronization of price changes is, except for energy prices, rather low.

¹² The size of price increases and decreases are computed as the difference of logarithms. Thus, during a temporary price cut in which the price returns to its original level, the two successive price changes will be equal in absolute terms.

¹³ The measure take the value 1 in case of perfect synchronization and 0 in case of perfect staggering

Finally, Dhyne et al (2006) assessed the relative importance of different factors on price changes through an econometrical analysis¹⁴. The results suggest that inflation does not significantly affect the overall frequency of price changes but when running separately price increases and price decreases, higher inflation increases frequency of price increases and decreases frequency of price reductions. Similarly, inflation has a positive, but not significant, effect on the size of price increases, but a negative effect on the size of price decreases. Prices subject to some forms of regulatory control are found to change considerably less often but the regulatory control variable does not have a statistically significant impact on the size of price changes.

Using 493 of the 598 item of Japan CPI micro data from 1989 to 2003 and a methodology based on dummy indicator, Masahiro and Saita (2007), found lower frequency of price change in Japan than in the U.S and in the Euro area namely is 21.4% per month. But as in U.S and E.U, prices of good change far more frequently than those of services (31.1% for 4.5%). In line with the results of Dhyne et al (2006) and Alvarez and Hernando (2005), their findings also suggest a negative correlation between the frequency of price changes and the share of labor costs in the production costs.

To sum up, both the U.S, the Euro zone and Japan are subject to an important degree of nominal price stickiness. But prices seem to change less frequently in Japan and in Europe than in the U.S, suggesting *ceteris paribus* more real effects of monetary policy in Japan and Euro area and more nominal effects in the U.S. There is a consensus about monthly price changes frequencies between 21.4% and 29.3%. However, there are substantial variations of frequency of price changes from a type of product to another (for example energy and unprocessed food versus service, non-energy industrials goods and non processed food). Furthermore, there is no evidence of general downward price rigidity and the degree of synchronization of price changes seems to be low.

¹⁴ The estimation method is ordinary least squares applied to the log-odds transformation of the frequency of price change. Inflation is calculated as the month-on-month rate of change. Authors ran separate regressions for frequency of price increases and decreases. To measure the marginal effects of each variable on the frequency, the coefficients from these linear regressions were transformed back through the formula for the log-odds ratio according to $(\beta_k = b_k \text{freq}(1 - \text{freq}))$.

2. Price settings in developing countries

In developing countries, theoretical and empirical works in the field of price settings are sparse. For example, using CPI micro-level prices on 229 products in Lesotho for the period 2002-2009 and a methodology based on dummy indicator, Nchake (2012) found that on average, 39% of prices of food products change every month while the corresponding for non-food products and services are respectively 33% and 28%. Pricing is time-dependent mainly because of weather, the timing of sales, and institutional factors such as changes in regulated prices at specific periods of the year (for example at the end of the year such that household can afford more goods for celebrations). On average 44% of prices in rural areas change every month while the corresponding in urban area is 36%. The implied duration of a price spell is then 2.3 months in rural areas while it is 2.8 months in urban areas. Also, price increases are more frequent than price decreases and price increases generally follow the overall increase in inflation. Otherwise, there is a positive and significant correlation between inflation (both current and previous period inflation) and the frequency of price change in Lesotho.

Using CPI and PPI micro data on the period 2001-2007 and a methodology based on dummy indicator, Creamer and Rankin (2008 and 2012¹⁵) have been conducting a broader research to analyze the implications of price setting behavior for monetary policy in South Africa. They established stylized facts of price settings in South Africa and provide empirical evidence about either pricing conduct is state- dependant or time-dependant using time-series regressions. Furthermore, they introduced micro-founded results about price settings into the open economy Dynamic Stochastic General Equilibrium (DSGE) model for the South African economy developed by Steinbach et al. (2009) to compare their results with those obtained from the DSGE model : the observed prices (micro data evidence) are less sticky than assumed in the DSGE model¹⁶. In details, their main findings are: (i) the frequency of price changes is 17.1%. Price increases occurred on average more than price decreases (monthly 10.50% for 5.47%) and the average price duration is 5.0 months; (ii) from CPI perspective, price of goods changes more frequently (17.0%) than that for services (14.9%). From the PPI micro data, the frequency of price changes for imported products (23.2%) is higher than for local products (18.8%) and for

¹⁵ The paper of 2012 involved also Greg Farell ; South African Reserve Bank Working Paper July 2012

¹⁶ For the CPI microdata, the average price duration is 5.0 months while the DSGE model's estimate is 6.5 months for domestic consumer goods. For the imported component of PPI microdata, the average price duration is measured at 6.1 months and the corresponding of DSGE model is 9.14 months.

exported products (18.7%); (iii) the weighted average magnitude of price change is 2.91%. For the prices that rose, the average magnitude is 12.26% and for the prices that declined, it's -15.05%. The econometrical analysis showed a time pricing evidence as there is seasonality in the frequency of price changes. But the frequency of price changes is also affected by inflation, increases in the repo rate and increases in the nominal effective exchange rate, denoting state-determined pricing evidence.

With a methodology based on menu-cost model on Nigeria's data, Urama et al (2013) conclude on low price rigidity in Nigeria because the cost of non adjustment to a 5% increase in money supply is too high for firms: price rigidity is optimal decision for firms in Nigeria only when the menu cost is well above 2.28% of the firm's revenue.

More generally, results found for developing countries about price facts are the following: Sierra Leone has the highest average frequency of price change of 51% mainly due to inflation uncertainty (Kovanen, 2006). In Brazil, the frequency is about 26-37%, exhibiting however a large degree of product and sector heterogeneity (Gouvea, 2007). In Columbia the frequency of price changes in a given month is 46.1% (Julio, Zarate and Hernandez, 2008) implying a stickiness duration of 4.7 months. The results found in Chile are 40% for price changes in a given month and a synchronization index of 0.437 for price movement. These results, based on dummy methodology, suggest a huge heterogeneity among developing countries about price behavior.

The implication of disaggregated price's rigidity in term of monetary policy is an evolving debate as it concerns a key assumption of Keynesian-type macroeconomic models that is price stickiness in the short-run. Bills, Klenow and Kryvtsov (2003) exploited difference in price flexibility across goods to check through a VAR specification, whether monetary shocks have predicted effects. Their findings suggest that sticky price models do not represent well U.S economy and monetary policies based on this assumption do not have the expected effects. However, using also a VAR model based on quarterly data of federal funds rate, real GDP, GDP deflator, and an index of spot commodity prices covering the period 1966:Q1 to 2002:Q4, Olivei and Tenreyro (2005) found that monetary policies in U.S have various effects according to the timing of the shock. For instance, a monetary

shock occurring in the first quarter of the year in USA increases significantly output level and the response dies out 12 quarters after the shock. Whereas prices respond by declining but at a not statistically significant level and start rising seven quarters after the shock. When the monetary shock takes place in the second quarter, the response of output is faster, more sizable and dies out more quickly (eight quarters after the shock). Then prices start rising faster: three quarters after the shock. By contrast, the response of output to a monetary policy shock either in the third or in the fourth quarter is small and insignificant. Here, prices start to increase immediately after the shock. They explain their findings by wage rigidity features, precisely the seasonality in the flexibility of wage which Nakamura and Steinsson (2008) linked to seasonality in prices changes. Using a factor-augmented vector autoregression model (FAVAR) on a panel of 653 monthly series on macroeconomic indicators, personal consumption expenditure, consumer prices, real consumption and producer prices covering the period 1976:M1 to 2005:M6 for U.S, Boivin et al (2009) reconciled flexibility of disaggregated price with price sticky assumption by assessing the relative importance of the sector-specific and macroeconomic shocks in prices series fluctuations. They found that disaggregated price fluctuations are driven by sector-specific shocks and remain sticky after monetary shocks. Hence, the implication of micro price's flexibility in term of monetary policy effectiveness depends on the relative importance of monetary shocks in disaggregated price fluctuations. Moreover, Kehoe and Midrigan¹⁷ (2010) argued that, the changes in price must be decomposed in temporary price changes and regular price¹⁸ changes to get a sharper insight of the link between micro price flexibility and aggregate price stickiness. The point is that 72% of price changes are temporary and in about 50% of cases, after the change in a temporary price change, the nominal price returns to its initial nominal level (which is the old regular price). The frequency of regular price changes is found much smaller at 7% per month (corresponding to an average duration of 14.5 months) and thus price are sticky overall. Their model takes into account both temporary and regular price and reproduces the main evidences from micro price data (notably in term of frequency of changes). The key result is that frequent temporary price changes do not translate in changes of aggregate price and monetary policies still have real effects notably on output and consumption.

¹⁷ They introduced micro evidence from Nakamura and Steinsson's dataset in a macroeconomic menu cost-model with temporary price which they estimated with a SVAR

¹⁸ Regular price is determined by the trend of nominal price's fluctuations and temporary price is the temporary deviation from this trend.

In overall, it's established in the literature that: (i) prices changes are heterogeneous among products; (ii) price stickiness varies from rural to urban areas in developing countries, (iii) prices changes are both prices increases and decreases, (iv) synchronization in price changes is rather low, (v) it seems to be a positive relationship between inflation and the frequency of price change. In term of monetary policy implications, basically low rigidity of price implies more nominal effects than real effects. But this implication is not straightforward as it depends on the relative importance of sector-specific shocks (Boivin and al, 2009) and on the importance and the features of temporary and regular prices (Kehoe and Midrigan, 2010). Also, the findings of Olivei and Tenreyro (2005) suggest differential effects of monetary policy according to the timing of monetary shocks.

III) METHODOLOGY AND DATA SET

1. Methods

a) *Frequency of price changes*

Following Nakamura and Steinsson (2008), Dhyne et al (2006) and Medina et al (2006), the method is based on dummy indicator to count for price changes. The frequency of price changes is calculated for each item as the ratio of the number of price changes to the number of valid price records. Given that we are dealing with monthly price index, we introduce a parameter e in the basic specification to avoid systematic 100% frequency of changes. Let I be the set of items of CPI and let $p_{i,t}$ denote the logarithm of the price index of category i at time t , we define a dummy variable as the following:

$$d_{i,t} = \begin{cases} 0 & \text{if } p_{i,t-1} - e \leq p_{i,t} \leq p_{i,t-1} + e \\ 1 & \text{if not} \end{cases}$$

The frequency of price change for variety i is then:

$$f_i = \frac{\sum_{t=1}^T d_{i,t}}{\text{Total number of price observations of variety } i}$$

f_i can also be computed for each year.

b) *Measurement of the direction of price change*

We here simply compute the number of price increases and the number of price decreases throughout the sample for each item in order to assess that either increases are likely more frequent or the contrary. We distinguish price increases from price decreases as following :

$$\begin{aligned} \text{Decreases: } d^-_{i,t} &= \begin{cases} 1 & \text{if } p_{i,t} < p_{i,t-1} - e \\ 0 & \text{if not} \end{cases} \\ \text{Increases: } d^+_{i,t} &= \begin{cases} 1 & \text{if } p_{i,t} > p_{i,t-1} + e \\ 0 & \text{if not} \end{cases} \end{aligned}$$

c) *Econometrical analysis framework*

The aim of this part of the analysis is to check the relative importance of the various variables which will appear having an influence on the changes in price from the results obtained with points 1, 2 and 3 of the methodology. The frequency of changes for each variety is regressed on the explanatory variables. Since frequency of price change is a fractional variable (bounded between 0 and 1), linear models are not appropriate. The most common way to deal with this issue in the literature is to use the log-odds ratio as a linear function and run the regression using heteroskedasticity-consistent estimation.

$$\log\left(\frac{f_i}{1-f_i}\right) = b_0 + \sum_{\theta} b_{\theta} x_{i\theta}$$

where $x_{i\theta}$ is a set of explanatory variables for the variety i .

The marginal effect of each variable on the frequency is then: $\beta_{\theta} = b_{\theta} \bar{f}(1 - \bar{f})$

With \bar{f} : average frequency of price change in the sample.

Dhyne et al (2005) discussed alternative specifications and methods to this procedure and conclude on its consistency. A common explanatory variable used in the literature is inflation. Then, there is potential endogeneity problem as product inflation appears somehow in f_i and is also included in the general level of inflation. Dhyne et al (2006) suggested to use an inflation rate variable computed at a disaggregated sectoral level rather than at a product level to attenuate this problem.

2. Data set

The data used here are monthly price indexes of CPI and its sub-components. Ghana's CPI categories are food, food and beverage, non-food, clothing and footwear, household goods, operations and services and miscellaneous goods and services. The data set comes from the Ghana Statistical Service and the time span is 1997:M9 to 2013:M7. Food and non-food price indexes are available only from 2005:M1. The indexes measure every month, the general price level of goods and services that households acquire for the purpose of consumption, with reference to the price level in 2002, the base year, which has an index of 100. The CPI is calculated on the base of a basket of goods and services of 242 items. Prices are collected on 40 markets across the country and CPI is also computed regionally. The CPI will be rebased in 2015 with 2012 as base year to reflect changes

in household expenditure patterns displayed by the Ghana Living Standards Survey 5 (realized in 2005-2006) and national accounts. The new basket will comprise 272 commodities and data will be collected on 42 markets. Also, new weights will be assigned to the commodities to reflect their relative importance in current household consumption.

The data for South Africa have been gathered from the website of South Africa Statistical Agency. The data set covers the period 2002M1-2013M12 with 15 sub-components of CPI weighted according to the Income and Expenditure Survey of 2010-2011. We made some little computations to harmonize the base year of all the indexes to 2012.

IV) BACKGROUND ON GHANA

1. Recent socio-economic development

Ghana is located along the Gulf of Guinea in West Africa. It is a member of the main economic integration organizations of the region namely the ECOWAS (Economic Community Of West African States) and the WAMZ (which is a step monetary union formed by Ghana, Nigeria, Guinea, Gambia, and Sierra Leone that will merge later on with West African Economic and Monetary Union). Ghana has experienced strong GDP growth over the last 20 years with acceleration in 2008-2012 (notably a growth rate of 15¹⁹% in 2011) due to investment in oil extraction. As a result, Ghana reached lower middle-income status with the challenge to sustain improvements in growth. However the economy has not undertaken strong diversification. Although declining, an important share of GDP comes from agriculture (32% in 2009 and 23% in 2012; World Bank Indicators) while the informal sector still plays a major role in the economy and remains the main source of employment and job creation (IMF country report, June 2013).

Tax revenues increased from 11.1% of GDP in 2009 to 14.5% in 2012 following Ghana Revenue Authority reforms and revenue-enhancing measures. Current Account Balance remains negative over 2004-2013 and even deteriorates from (-3.9% of GDP in 2004 to -14.4% in 2013) and the Public debt increased from 45.7% of GDP in 2010 to 50.2% in 2012 mainly because of weaker external outlook and fiscal slippages in 2012 (African Economy Outlook, Report on Ghana, 2013).

The monetary policy in Ghana is characterized by a shift from a monetary targeting during the period 1992-2002 to an inflation targeting formally²⁰ announced in 2007, the same year of a currency redenomination. Also, a limit has been put on government's borrowing in any fiscal year to tackle the issue of fiscal dominance. An evaluation of these changes concluded that the inflation targeting regime has been successful in bringing inflation down. Indeed, headline inflation reduced from 20% percent levels in 2004 to 10.7% by end-2010 and the interest rate channel, a key channel of inflation targeting policy, seems to function in a standard way. However, the evaluation stresses that the monetary framework must be more transparent and more accountable (IMF country report, June 2013).

¹⁹ World Bank Indicator, WDI tables

²⁰ Actually the Inflation targeting started in 2002 (Monetary policy framework in Ghana, Bank of Ghana, 2012)

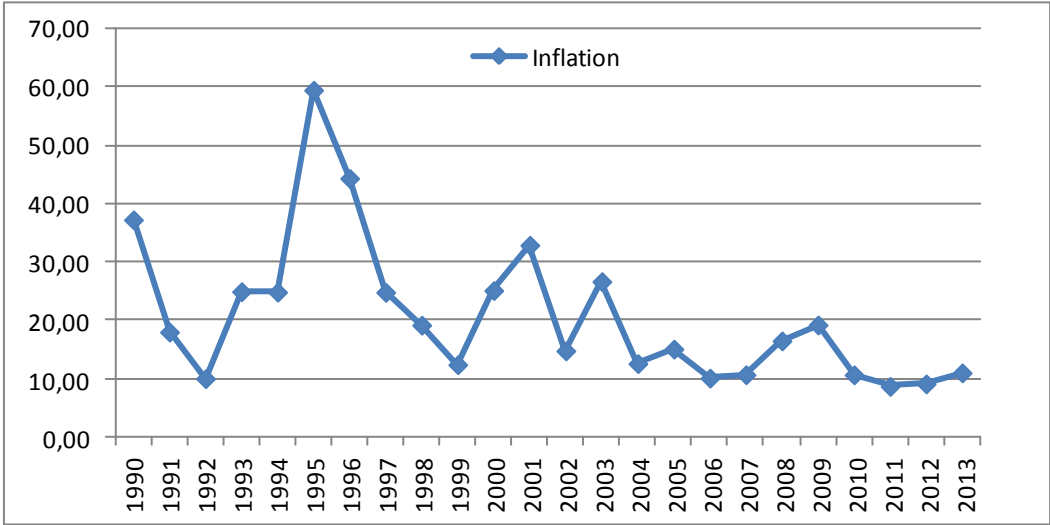
The strong economic performances have been followed by improvements in standards of living. Indeed, Ghana's Human Development Index ranking is 135th out of 183 countries in 2012 and the incidence of extreme poverty reduced from 52% in 1991 to 28.3% in 2006. The net school enrolment rate increased from 59% in 2001-2002 to 81.7% in 2011-2012. Child mortality fell from 111 to 78 per thousand live births between 2003 and 2011 and maternal mortality ratio declined from 206 to 164 per one hundred thousand live births between 1990 and 2010 (Ghana MDG Report, 2012).

In the medium-term the three main challenges for Ghana economy are : (i) restore macroeconomic and debt sustainability by fiscal consolidation ; (ii) economic diversification to create a robust job-creating manufacturing sector; (iii) social inclusion to ensure that the benefits of growth are widely shared and to build a workforce ready to take on higher-skilled jobs (IMF country report, June 2013).

2. Inflation facts

The period 1990-2002 is characterized by a highly volatile inflation with a peak at almost 60% in 1995. This situation is due to strong fiscal dominance in which persistent fiscal deficits were financed largely by monetary accommodation (generating high inflation tax). As a result, money had an instable and high velocity (hot potatoes phenomenon) and inflation expectations became difficult or impossible to predict (Monetary policy framework in Ghana, Bank of Ghana, 2012). In 2002, the monetary framework is completely changed and the new one is designed to lower inflation and ensure exchange rate stability, through increased coordination with fiscal policy. More precisely, the monetary policy shift to an inflation targeting regime and fiscal dominance has been significantly reduced. Consequently, inflation progressively decreased but with a transition period from 2002 to 2009. As the new monetary framework gains in credibility, inflation is stabilized around 10% since 2010. [Figure 1]

Figure 1 : Inflation in Ghana over 1990-2013



Source: Data from IMF World Economic Outlook Database

V) RESULTS

1. Indicators of price rigidity

a) *Frequency of changes*

The average frequency of changes is 93.72% meaning that prices indexes change almost every month in a year. Food index display the lowest frequency of change (75.73%) while Household goods, operations and services index and Miscellaneous goods and services index have the highest one (99.48%) [Table 1]. The corresponding figure for South Africa is an average frequency of price changes of 61.81%. The lowest frequency of changes is that of Education (8.33%) and the highest is that of Transport (84.03%) [Table 3].

The level of disaggregation is not the same from Ghana CPI to that of South Africa but they have two common items²¹ (Food and Clothing and footwear). For both, frequency of changes is higher in Ghana. Indeed, Food index changes 8 months out of 12 (i.e a frequency of changes of 68.06%) in South Africa while it changes 9 months out of 12 in Ghana. Meanwhile the frequency of changes of Clothing and footwear is 87.96% in Ghana and 56.25% and South Africa.

Table 1 : Frequency of price changes by item for Ghana

Items	Frequency of change (%)
Food	75.73
Food and beverage	81.68
Non-Food	97.09
Clothing and footwear	87.96
Household goods, operations and services	99.48
Miscellaneous goods and services	99.48
CPI	93.72

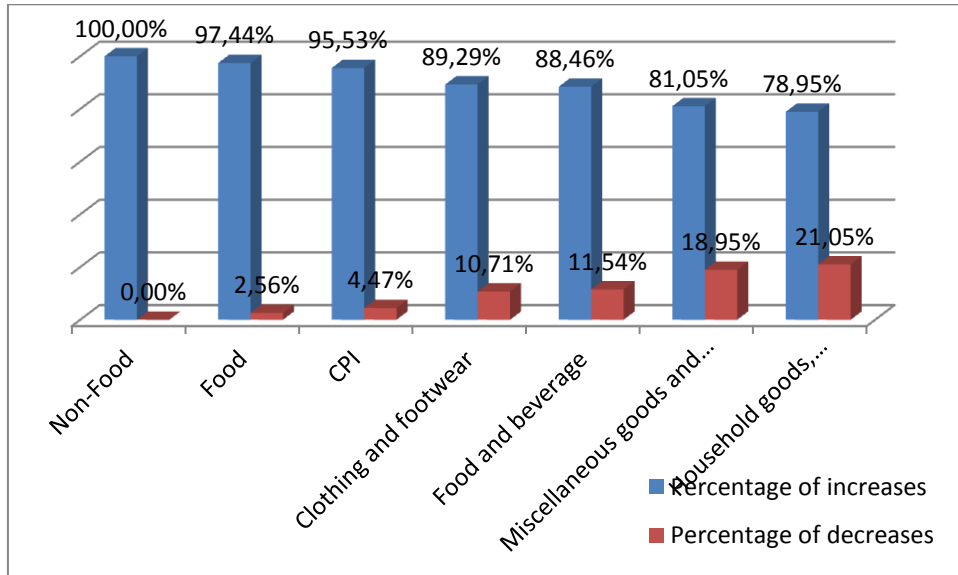
b) *Direction of price changes*

The price changes are far more increases than decreases in Ghana. Less than 5% of changes are decreases for the CPI and 100% of changes are increases for non-food index. However,

²¹ Miscellaneous goods and services is also common but the contents are not the same because that of Ghana includes Health, Transport, Communication, Education, Recreation and Culture while for that of South Africa those categories are separated items.

decreases represent 21% of changes of Household goods, operations and services index and almost 19% for Miscellaneous goods and services index [Figure 3].

Figure 2 : Frequency of price increases and decreases for Ghana



The global figure for South Africa is pretty much the same: changes in price are far more increases and less than 5% of changes are decreases for the CPI. But for Clothing and footwear, Communication and Recreation and culture changes are increases and decreases almost in the same proportion [Table 4].

c) Amplitude of price changes

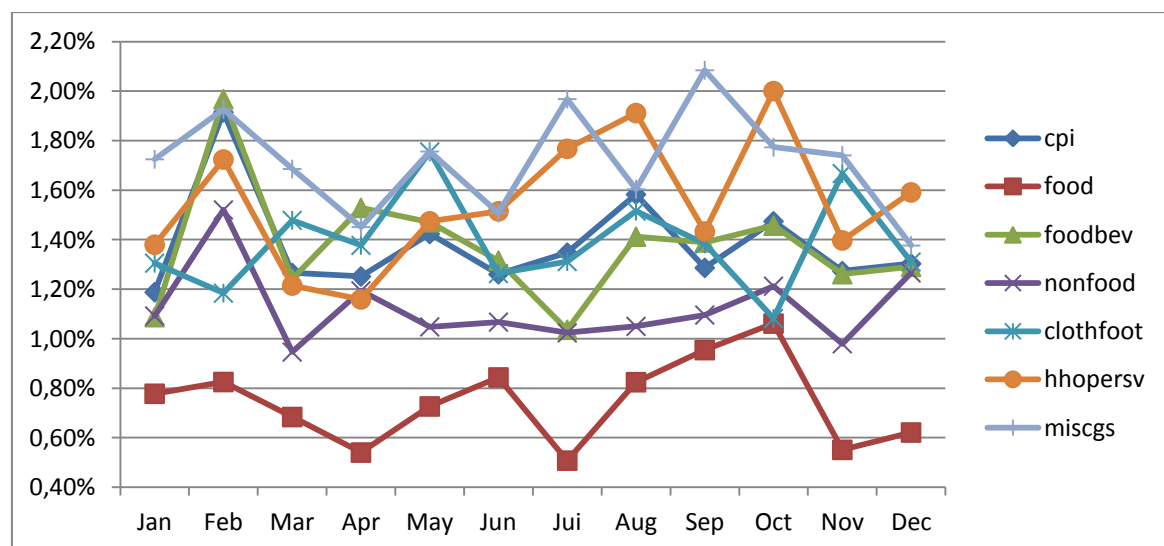
For Ghana, the CPI average amplitude of changes is 1.38%, the lowest average amplitude is that of Food and the highest is that of Miscellaneous goods and services [Table 2]. The average amplitudes of changes are quite lower of South Africa in comparison to those of Ghana. The CPI average amplitude of changes is 0.21%, the highest value is 0.37% (Transport) and the lowest is 0.17% (Household contents and equipment) [Table 5].

Table 2 : Average amplitude of changes by item for Ghana

Items	Average amplitude of price changes (%)
Food	0.74
Food and beverage	1.37
Non-Food	1.13
Clothing and footwear	1.39
Household goods, operations and services	1.55
Miscellaneous goods and services	1.72
CPI	1.38

Especially in Ghana, the average amplitudes of changes are more important in February and in October for CPI while the peaks for Miscellaneous goods and services occur in September and November. July seems to be the month in which the amplitude of changes is generally low for all categories in particular for food index. The specific pattern of foods indexes reflects the seasonality in agricultural production: the new crops come in July and there is a minor crop in November. Also, the increase of the amplitude for almost all the items (5 out of 7) in December may reflect usual holiday season's inflation [Figure 4].

Figure 3 : Amplitude of price changes by month for Ghana



Altogether, the average frequency of changes is higher in Ghana than in South Africa. The changes are far more increases than decreases in both countries but the average amplitudes of changes are higher in Ghana. Also, there is a relatively important heterogeneity in frequency of changes across items in South Africa (from 8.33% for Education to 84.03% for Transport) while in Ghana frequencies are concentrate in the interval 75-100%. Overall, the results suggest that price change less frequently in South Africa than in Ghana implying a lower rigidity of price in Ghana.

2. Econometrical analysis's results

The econometrical analysis is done with Ghana's data. We used yearly frequency of changes of each item in a panel data approach. We ran both fixed effects and random effects models and check after their quality with a Hausman's test. We reported below the results of random effect model which appears to be better after the test.

$$\text{regression } \log\left(\frac{f_i}{1-f_i}\right) = \beta_0 + \beta_1 \text{inflation} + v$$

Number of obs = 98
 Number of groups = 7
 Wald chi2(1) = 8.00
 Prob > chi2 = 0.0047
 Hausman Test
 Prob>chi2 = 0.8299

Dependant variable: log (fi/1-fi)					
Variable	Coef	Std. Err.	z-statistic	P> z	[95% Conf. Interval]
inflation	.0135678	.0047971	2.83	0.005***	.0041657 .02297
_cons	.5445077	.0914795	5.95	0.000 ***	.3652112 .7238043

*** Significant at 1% ** Significant at 5% * Significant at 10%

The correlation coefficient between the frequency of price change and inflation is positive and significant in line with the findings of Bils and Klenow (2004) and Nchake (2013). The results suggest that prices change more frequently in situation of higher inflation. This result is consistent with more frequent renegotiations of wages in inflationary conditions particularly in economies with important informal sector like Ghana (see footnote 22). It is also consistent with the fact that price changes are far more often price increases in Ghana.

VI) DISCUSSION: THE IMPLICATIONS FOR MONETARY POLICY

The main concern of the discussion is how effective can be a monetary policy given the level of price rigidity. Our results suggest a high frequency of price adjustment in Ghana and therefore a low rigidity of price. The first implication for monetary policy is that it may have more nominal effects than real effects. Also, we found higher price rigidity in South Africa, suggesting that the same monetary policy will have *ceteris paribus* more nominal effects in Ghana and more real effects in South Africa.

More nominal effects of monetary policy can be both good and bad news depending on the main objective of the monetary policy. Indeed when monetary policy targets nominal variable such as inflation or nominal exchange rate, lower rigidity is an advantage but when targets are real output and employment, low rigidity appears to be a disadvantage. As in Ghana, the main objective of monetary policy is to achieve lower inflation and ensure exchange rate stability, low rigidity of price improves effectiveness of monetary policy. Indeed, price may quickly respond to a contractionary monetary policy and negative effects on real variables may be low. In line with this interpretation, inflation targeting monetary framework adopted by Bank of Ghana in 2007 resulted in a progressively decrease of inflation in Ghana.

But low rigidity of price reduces the effectiveness of monetary policy to overcome demand shocks. For instance in case of negative demand shock, a depreciation of exchange rate to stimulate demand will quickly translate into higher price and an upward shift of supply curve. Therefore, the monetary policy would have less effect on output. In this respect, Al Hajj et al (2013) concluded that to be fully effective in adjusting to a negative demand shock, monetary policy needs to be supported by fiscal policy in Ghana while in South Africa, monetary policy alone is enough. In case of positive demand shock with inflationary pressure, a rise of interest rate to reduce demand will also quickly translate into high level of price and higher nominal wages²² that would sustain the inflationary bubble and result also in less effect on aggregate demand.

Moreover, since May 2013 Ghana has been facing an increasing monthly inflation (from 11.3% in May 2013 to 14% in March 2014, Ghana Statistical Service), casting doubt on the nominal effects

²² As the economy remains largely informal with daily and weekly contracts. The contribution of informal enterprises to the GDP is 58% in Ghana according to International Labour Organization, Women and Men in the Informal Economy 2002.

and the effectiveness of the inflation targeting monetary policy in a context of low rigidity of prices. But as highlighted by Boivin and al (2009) and Kehoe and Midrigan (2010) the effectiveness of monetary policies in a context of flexible disaggregated price depends on the relative importance of sector-specific shocks on disaggregated prices and on the importance and the features of temporary and regular prices.

Hence, questions are: (i) how do monetary shocks affect disaggregated prices in Ghana and (ii) is there evidence of temporary and regular pricing in Ghana and what are their features? In terms of comparison between South Africa and Ghana, lower rigidity of price in Ghana suggests that one should be careful when trying to adapt macroeconomic models and economic policies designed for South Africa in Ghana.

VII) CONCLUSION

To properly assess price rigidity using CPI, micro data on price is needed. In this work, we try to overcome the lack of such data by using price indexes of CPI's items and introducing a parameter in the method described in Medina et al (2007). Our results suggest lower rigidity of price and lower heterogeneity in frequency of changes across items in Ghana in comparison to South Africa. Basically, the implication of low rigidity of price in Ghana is that monetary policy has more nominal effects than real effects and will be less effective to adjust to demand shock notably. Moreover, one would start doubting even on the nominal effects of monetary policy in Ghana as the country is experiencing higher monthly inflation since almost one year despite an inflation targeting monetary framework. However, further studies are needed additionally to this work before strong conclusions can be drawn about monetary policy effectiveness in Ghana. For instance: (i) a detailed analysis of price settings with micro data on price; (ii) a decomposition of price changes in temporary and regular prices changes and (iii) a VAR estimation to assess the impact of monetary shocks and sector specific shocks on disaggregated prices.

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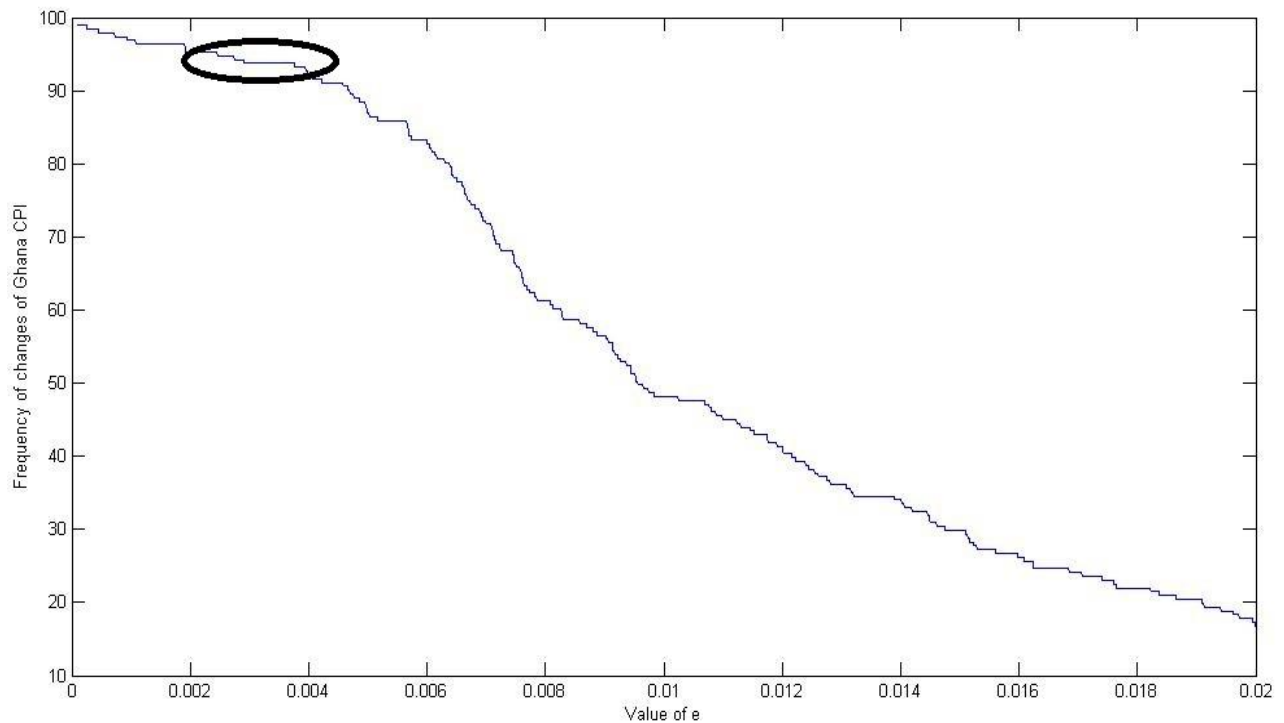
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Appendix 1 : Determination of parameter ϵ

The parameter ϵ is determined by checking whether there is a stagnation of the frequency of CPI for some particular value ϵ . We set the maximum value for ϵ at 2% which is the inflation target of U.S Federal Reserve and European Central Bank as well. This reference value is interpreted as the highest variation of price one can still interpret as price stability and absence of change.

The function of frequency of change of CPI has a downward slope in line with the fact that highest value of parameter ϵ reduces frequency of changes. However, one can see a kind of concentration of frequency of change around the value 0.003 of ϵ . We take advantage of this stability to argue that 0.003 may be the best value to compute the indicators of price rigidity.

Figure 4 : Variations of frequency of change of CPI depending on values of parameter ϵ



Appendix 2 : Price rigidity indicators for South Africa

Table 3 : Frequency of price changes by item for South Africa

Item	Frequency of price changes (%)
Food and non alcoholic beverages	65.97
Food	68.06
Non-alcoholic beverages	60.42
Alcoholic beverages and tobacco	43.06
Clothing and footwear	56.25
Housing and utilities	42.36
Household contents and equipment	41.67
Health	34.03
Transport	84.03
Communication	18.75
Recreation and culture	43.06
Education	8.33
Miscellaneous goods and services	43.75
Processed good	63.89
Unprocessed	76.39
CPI	61.81

Table 4 : Percentage of price increases among price changes for South Africa

Item	Percentage of increases
Food and non alcoholic beverages	88.42
Food	86.73
Non-alcoholic beverages	85.06
Alcoholic beverages and tobacco	98.39
Clothing and footwear	46.91
Housing and utilities	86.89
Household contents and equipment	90.00
Health	91.84
Transport	70.25
Communication	51.85
Recreation and culture	53.23
Education	100.00
Miscellaneous goods and services	90.48

Processed good	93.48
Unprocessed	75.45
CPI	95.51

Table 5 : Average amplitude of price changes for South Africa

Item	Average amplitude of price changes (%)
Food and non alcoholic beverages	0.29
Food	0.31
Non-alcoholic beverages	0.28
Alcoholic beverages and tobacco	0.31
Clothing and footwear	0.26
Housing and utilities	0.33
Household contents and equipment	0.17
Health	0.25
Transport	0.37
Communication	0.20
Recreation and culture	0.20
Education	0.26
Miscellaneous goods and services	0.21
Processed good	0.29
Unprocessed	0.40
CPI	0.21