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BCTL Inflation Modeling Framework:

"Explaining and Forecasting Timor Leste's Inflation"

Synopsis:

This paper upgrades BCTL's inflation modeling framework, incorporating recent research output to better explain and forecast Timor Leste's near term inflation trends. Our models assume that domestic inflation fluctuates, around its long-term average, according to regional inflation developments and domestic economic activity trends. The models' estimates do a reasonably good job in terms of tracking past domestic inflation trends, while allowing us to quantify inflation projections consistent with likely and relevant macroeconomic scenarios.

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1. Introduction

This working document is the third of a series of technical documents prepared by the Economics Division that intends to progressively upgrade BCTL's analytical framework to assess economic trends and policy options in Timor Leste. This specific paper makes use of recent research works to update the Bank's inflation modeling and forecasting framework.

In fact, BCTL has already available several econometric models, which have been used to explain and forecast near term inflation trends in Timor Leste. This new modeling framework builds on existing models and incorporates recent empirical advances, specifically in terms of inflation monitoring tools and economic activity indicators, as discussed in BCTL's working documents nº1 and nº2. We consider that this new inflation model thus greatly benefits from the work done in terms of better measuring inflation trends and having a timely and up-to-date measure, even if crude, of economic developments for Timor Leste's economy.

Core Inflation used as modeled variable

On the one hand, as our work on core inflation shows, CPI based inflation measures - official inflation data, as published by DNE - seem to be, at times, heavily distorted by price developments for a small number of CPI basket's items. The prices of this small number of items, mostly food related - such as rice, vegetables, meat and fish - have justified, at times, a substantial increase in overall official inflation rates, not in line with price developments for the majority of CPI items. A clear case of this is the 2006-2007 socio-political crisis, where the massive rise in domestic rice prices caused the official inflation rate to spike over 25% in the 1st quarter of 2007, whereas most CPI's categories registered only small increases. Another example of this situation seems to be 2013, when the price rises of this small number of food items has maintained a high level of inflation throughout 2013, whereas the inflation trends for most items was already slowing since the beginning of the year. We have then suggested in other previous papers, that a more accurate monitoring of inflation trends in Timor Leste needs to complement official inflation data with other measures more robust to such 'single-item' influences, which we can call 'core inflation measures'. In general, these indicators downplay the importance of items, which have a more 'volatile price nature' and thus better capture the price trends across the majority of consumer items of the CPI.

In our approach, we have chosen to use 'core' inflation measures to estimate our models, instead of official DNE data compiled using CPI's basket. In particular, we opted for using core inflation, instead of CPI based inflation, for the following specific reasons:

- Core inflation is computed using a trimmed mean of all CPI 'digit 2' categories, which corresponds to the average inflation rate across these categories, excluding the most 'price volatile' ones – 4 in the case of total core inflation and 2 for both food and non-food core

inflation rates. As such, it gives every item the same weight and excludes the most 'price volatile' categories. Using this core inflation measure is especially useful in the case of Timor Leste, where certain individual food categories (ex. rice, vegetables, meat) have both substantial weights, in overall CPI, and tend to be affected by extreme price changes. These items, due their price volatile nature and large CPI weights have, in the past, in 2007 and also in 2013, materially impacted overall CPI based inflation rates, putting them on diverging path from broader inflation trends.

- Given the above reasoning, 'core inflation' rates are less prone to being influenced by 'idiosyncratic' or individual price changes than CPI based inflation. Thus, we expect core inflation measures to be more in line with broader macroeconomic developments and consequently more easily modeled econometrically.
- Another relevant justification for using core inflation is related to the overwhelming importance of food inflation in driving overall official inflation rates. Since total food expenditure weight is higher than non-food and that food inflation rates have been substantially higher than non-food[1] throughout the decade, overall official CPI based inflation rates have been mostly driven by food inflation patterns. Although this is naturally true and relevant for the average household, if we are really more concerned with assessing generalized price trends in the economy, we should also focus our attention on non-food inflation trends. In fact, the new CPI basket includes 22 'digit 2' non-food classes, but only 13 'food type' expenditures. Total food weight is 62% for Dili CPI and 38% for non-food, which clearly obscures the trends for non-food inflation. All in all, our measure of total core inflation gives the same weight to each category and, consequently, balances the influence of food and non-food items' prices in the overall inflation indicator. This is also particularly relevant because non-food inflation is typically, around the world, a better indicator of true overall inflation pressures, as research in this field has clearly showed[2].
- A third point, which has forcibly to be taken into account while building a model for domestic inflation, is the introduction of a new CPI basket and methodology at the end of 2012. In fact the substantial changes made to the previous CPI have caused a statistical break for the historical inflation time series, which technically downgrade the statistical quality of models

[1] Another conclusion of our previous work was that food and non-food inflation patterns have diverged, at times, along the last decade in Timor Leste. Naturally, the difficult logistics in warehousing, sourcing and distributing food staples in the country, coupled with the 'necessary nature' of such items, make food items' prices particularly 'reactive' to domestic logistic and supply and demand imbalances, which, if acute, are normally resolved with massive rise in market prices for these items. As non-food items are not as much affected by such factors, food inflation has clearly outpaced non-food inflation in the last decade in Timor, which was particularly evident during inflationary spikes in 2007-2008 and 2011-2013.

[2] Many researchers and Agencies, in developed markets, normally exclude food and energetic items from their 'relevant' inflation measure, as they consider these items to introduce significant distortions and volatility in overall inflation measures. While this is easly done for developed economies, because food expenditures account only for under 20% of the consumer baskets, this is not recomendable in the case of Timor Leste, due to the extreme importance of such expenditures.

calibrated using the old CPI data. A possible way around this issue would be to recalculate historical CPI values consistent with the new CPI basket, so as to have a time series compatible with the data recorded after the end of 2012. Unfortunately, such approach is presently unfeasible as we do not have sufficient granular data – whereas prices or weights – to conduct such a recalculation. In view of this issue, we consider that basing our model in terms of core inflation measures seems to be preferable to using historical overall CPI data, as our core inflation indicators are consistently computed throughout the time – as a trimmed average of inflation rates across CPI's basket items – and we estimate separate food and non-food inflation models.

Taking into account these 3 factors, we preferred to use a core inflation measure instead of official inflation figures (CPI based) as our modeled variable. Note also that we estimated 3 models, for overall, food and non-food inflation based in the more appropriate core inflation indicators. As you may find in the technical appendix, core inflation measures have tracked overall patterns for CPI based inflation, but have importantly diverged in some sub-periods such as 2007-2008 and 2013, for which we consider core inflation indicators a better measure of relevant price pressures across the economy.

BCTL Economic Activity Indicator

Another major upgrade to our inflation model is to incorporate a more accurate measure of domestic economic activity. Domestic economic developments are a clear substantial driver of inflation in Timor Leste, as is to be expected from standard economic theory. Earlier models estimated at the BCTL used GDP data, or more frequently, domestic public expenditure as measures of domestic economic activity and, consequently, as a driver of domestic inflation trends. GDP data is naturally a more appropriate measure of economic activity than domestic public expenditure. Nonetheless, domestic GDP data has only been compiled and disclosed by "*Direcção Nacional de Estatística*" (DNE) with a significant lag and only for an annual frequency, despite great recent improvements[3]. This data restriction causes severe limitations in terms of monitoring and tracking near term domestic economic developments and is especially limitative in terms of forecasting macroeconomic variables such as inflation.

These considerations have forced us in the past to use overall public expenditure as a crude measure of domestic economic developments, given that it is available on a frequent and real-time basis, and that public spending has been the most important economic driver of Timor Leste's economy. We have nonetheless noted that this approach is only a 'second-best' solution for the problem, as it fails to a capture other important economic developments, equally relevant towards understanding inflation

[3] Note, for example, that in February 2014, we had only available annual GDP data from 2000 until 2011, thus a dataset of 11 annual observations for nominal and real GDP.

patterns[4]. This limitation was flagged early on and justified a substantial effort in terms of better measuring economic developments in Timor Leste.

As shown in the paper that details BCTL's economic activity indicator, we have developed a measure that incorporates developments across various economic sectors - imports, public expenditure, fiscal and non-fiscal public revenue as well as banking trends – and distills them into a single number that allow us to track economic activity on a timely and frequent basis. As also shown in that paper, BCTL activity indicator has reasonably tracked GDP trends along the last years – up to 2011, the latest available data point for GDP - and shows a remarkable correlation with inflationary developments for the same period. This new indicator was thus used as a macroeconomic driver of our inflation model, as we consider it reasonable captures the domestic economic cycle and, consequently, should be a main determinant in explaining inflation trends.

Document Overview

This document first offers a summary description of our model, proceeding later to present our data selection options and chosen econometric methodologies to estimate the models. The latter sections present the estimated models and respective relevant coefficients, subsequently illustrating its usefulness to forecast the future and explain recent inflationary trends in Timor. We conclude with some broad conclusions and suggest further steps towards improving this framework.

This upgraded inflation model intends to reinforce BCTL's statistical tools and analytical framework put in place to monitor macroeconomic developments and better inform the Bank's views on future near term economic trends. Despite serving BCTL's internal needs, we hope that it may foster active and productive debate with other national institutions and relevant partners, whose views we kindly invite, so as to improve its general usefulness.

[4] Note here that using overall public expenditure fails to rank the economic importance of each type of public expenditure and the relationship with other sectors of the economy.

2. Model Description

Our approach builds on our previous approach and incorporates recent developments in terms of economic and econometric research carried out at the BCTL. As such, we continue to use a very simple approach, which is broadly used across Central Banks, to estimate a model able to explain and forecast inflation for Timor Leste. This is generally designated as "The Mark-Up Model" approach, which assumes that companies set the prices for their products based on their production costs, to which they apply a profit margin to derive the final market price.

Based on this microeconomic assumption, it can be derived that the overall inflation rate of the economy is positively influenced by production costs – which may include labor and capital costs, as well as import costs - and by aggregate profit margins for the companies. Naturally, aggregate supply and demand imbalances may affect overall inflation rates through various channels, specifically: through production inputs markets and prices (rising wages tend to pressure production costs and contribute towards an overall increase inflation rates); or through direct price effects caused by supply and demand imbalances in final goods markets.

Given this succinct presentation of the economic reasoning behind our approach, the practical implementation of such models always depends on the availability of accurate time series that can adequately measure production and importation costs as well as companies' profit margins. In the case of Timor Leste, many of the required statistics, generally used to estimate this sort of models, are not available. This problem is further compounded by the fact that our economy is still very dependent on imports, as most products, especially goods, have to be source outside of Timor Leste, specifically from a broad range of regional trading partners. It thus complicates our approach and forces us to extensively consider and identify the most appropriate external macroeconomic drivers of our inflation trends.

2.1 Inflation Drivers

Given existing restrictions, our approach consists of a pragmatically implementation of the "Mark-up Model", where we consider domestic inflation is explained by 2 main drivers:

- external developments, specifically trading partners inflation and foreign exchange rates;
- and domestic economic activity, as measured by BCTL indicator.

In terms of external drivers, given the high level of imports to Timor Leste's economy is natural to expect that our trading partners' inflation and foreign exchange rates play a substantial influence in terms of the domestic inflation trends. If we could measure accurately the import costs of the items included in CPI basket, it should be expected that the prices of the imported goods and services should

rise proportionally to the increase in import costs, that is the foreign production costs - adjusted for foreign exchange movements versus the dollar – should be fully reflected in Timor Leste's prices. Nonetheless, since we do not have an accurate measure of import prices in Timor Leste, we had to 'build' a variable that we consider appropriate to track import costs. As we detail in the following section, we use, as proxy for import prices, the average inflation rate of ASEAN top 4 largest economies and China, adjusted for foreign exchange movements. In fact, since we want to explain the domestic inflation rate, we use as external driver the average inflation rate of these 5 economies measured in dollars, which is obtained by compounding local inflation rates with foreign exchange rate appreciation/depreciation rates versus the dollar.

As for the domestic driver of inflation, we consider that BCTL's economic activity indicator does a good job in tracking the domestic economic cycle. In general, economic activity, specifically the dynamic between aggregate demand and supply is expected to be a major driver of inflation in a market economy, according to standard economic theory.

In Timor Leste, this seems to be also true. In fact whenever aggregate demand growth exceeds supply growth we expect to have price pressures in an economy, as there is 'too much money chasing fewer goods'. The converse is also true, as whenever aggregate demand is below production potential of an economy, we expect to have lower and, eventually, negative inflation rates. Even if economic theory is quite clear and definitive on this result, the problem arises when we want to quantify such supply and demand aggregates as well as their empirical relationship. GDP is often used as a measure of total aggregate demand in an economy, but measuring aggregate supply is not straightforward, especially so for Timor Leste, where we face several data restrictions. In more advanced economies, aggregate supply or an economy production potential is generally estimated using the following 2 methods: use of aggregate production functions, which involves quantifying factor inputs and productivity coefficients; or employing statistical filters, such as the standard 'Hodrick-Prescott filter', to estimate potential GDP based on actual GDP data.

In our case, given the natural difficulties in quantifying aggregate supply capacity for our economy, we consider that the long-term average growth rate of the economy to be a simple but effective measure of "inflation neutral" growth[5], that is the actual capacity of the economy to grow without additional inflation pressures. Whenever aggregate demand growth exceeds such 'potential', we will have rising price pressures in the products market, as has been clearly the case of 2011 and 2012 in Timor Leste. Note that, as we explain in the following section, we measure aggregate demand growth based on BCTL

[5] Technically, the term 'inflation neutral" growth rate is used here with a broad meaning, since it refers to the growth level consistent with non-acelerating inflation rate. This means that if the economy grows according to its long-term average growth rate, domestic inflation should be stable arround its respective long-term mean rate.

economic activity indicator and consider its' long term growth rates to be the potential growth rate of the economy.

2.2 Inflation Adjustment Process

In addition to the macroeconomic drivers of inflation, our model assumes 2 important features to describe inflation's dynamical adjustment process to shocks affecting its drivers:

- inflation is affected by its past values;
- and inflation will tend to revert to its long-term mean, as shocks dissipate.

The economic rationale behind the incorporation of past values of inflation in our model refers to the need to capture the dynamic relationship between the macroeconomic drivers and inflation, as economic systems do not adjust instantaneously to economic shocks, but tend to adjust only slowly to these shocks. In fact, the speed of the adjustment will depend on the various characteristics of the economy, such as the existence of nominal rigidities (wage indexing for example), price setting mechanisms and even, economic policy reaction functions. A very important element in this regard is economic agents' expectations, which tend to play a major relevant role in terms of inflation trends. In Timor Leste, it seems that these nominal rigidities and expectations, be they related to companies or consumers' behavior, do contribute to explain inflationary developments, as our estimations point towards a substantial importance of auto-regressive terms for inflation in Timor Leste. The existence of nominal rigidities or of slowly changing economic agents' expectations explains why it may take longer for shocks in macroeconomic drivers to cause changes in domestic inflation.

A second important element of our model is that we assume that inflation will revert to its long-term average, when shocks affecting its drivers fully dissipate from the system. According to the specification of our models, inflation will diverge from its long-term average only when macroeconomic drivers deviate from their respective long-term equilibrium values. In other words, if external prices or domestic economic activity are growing according to their 'steady-state' levels, *ceteris paribus*, domestic inflation should stick to its long-term level. In practice, this means that inflation will fluctuate around its long-term mean, only when regional inflation trends and domestic economic activity diverge from their longer term trends.

3. Data Sources and Methodology

After this brief overview of the model, drivers and dynamic specification, this section presents the data and the econometric methodology used in the estimations.

Inflation

We estimated 3 models for total, food and non-food inflation, using 'core-inflation' measures, instead of DNE's official inflation data, based on CPI basket. We preferred to use as 'core-inflation' trimmed mean rates, computed using CPI prices for 'digit 2' categories, which include 30 items for the old CPI and 35 categories for the new CPI. The trimmed average computes the average inflation rate across these 'digit 2' categories, excluding the most volatile items in terms of prices/inflation. We have used only data for Dili CPI, as it has a longer history than National CPI as well as monthly observations[6]. The monthly Dili CPI data was then used to compute quarterly average CPIs for each 'digit 2' category.

Our measure of core total inflation includes all 35 categories (for the new CPI), but excludes the 4 most volatile categories for each quarter - the top 2 and lower 2 – in order to prevent the average inflation rate to be affected by outliers. In the case of core food inflation, the trimmed mean is based on 13 food items, but excludes the 2 most volatile items. Lastly, our non-food core inflation measure is computed using the trimmed mean of 22 non-food inflation rates (17 for the old CPI), excluding also the 2 most volatile items. We compute our 3 core-inflation measures on a quarterly basis and then compute a price index consistent with these quarterly inflation series to back out our calculation of annual inflation rates.

External Drivers

In terms of external variables, we consider that the average inflation rate of ASEAN top 4 economies and China, adjusted for foreign exchange rate changes, is a reasonable proxy of Timor Leste's import price changes and, subsequently, an important driver of our domestic inflation rate. ASEAN top 4 economies include Indonesia, Malaysia, Singapore and Thailand. We prefer to use "ASEAN4+China" mean inflation rate expressed in dollars, because we consider that inter-regional trade and economic dependencies cause regional inflation and foreign exchange trends to be broadly aligned and interdependent. Timor Leste's main trading partners have been, for the last decade, Indonesia, Singapore, Australia, China and Malaysia[7]. Indonesia is clearly the leading country in terms of sourced

[6] National CPI data do not materially differ from Dili CPI data up to the end of 2013. The most important differences relate to total food expenditure weight which is higher in National CPI basket than Dili's basket, as rural population allocates a proportionally higher budget slice to these expenditures. This fact was also confirmed during 2012's review of CPI's methodology.

[7] Finland ranks 3rd in terms of total imports from 2003 until 2013, but its importance is due exclusively to the import of machinery equiment to buil the country's powerplants. Although Australia ranks 4th in overall imports from 2003 to 2013, various evidences suggest that this is mostly due to the extensive presence of security and peacekeeping forces in Timor Leste for the

imports from 2003 until 2013, but it might be useful to note that many consumer goods and food imported from Indonesia may be originally sourced from other countries in the region, as Indonesian companies may be only performing as international traders. Considering that it is difficult to control the actual origin of imports and that trading partners' importance – imports weight - is hardly stable from 2003 to 2013, we prefer to use 'ASEAN4+China' mean inflation rate as a simpler proxy of Timor Leste's imported inflation.

We computed our external inflation variable based on monthly total and food-only CPI prices for these 5 economies, downloaded from International Labor Organization's statistical database. We then computed a non-food CPI for each country, using total and food CPIs as well as non-food expenditure weights in each of these 5 countries[8]. Upon having the total, food and non-food CPI monthly series, we computed average quarterly CPIs and, subsequently, quarterly and annual inflation rates. Foreign exchange rates of these countries versus the dollar were obtained from Bloomberg on a monthly basis (end of month), which were then used to calculate average quarterly foreign exchange rates for the 5 countries and, later, quarterly and annual appreciation/depreciation rates versus the dollar.

Each of our 3 models uses only one external variable, which corresponds to local currency inflation rate compounded with foreign exchange rate change[9]. Since we had 3 'Asean4+China' inflation time-series - for total, food and non-food inflation – we then used each series consistently with the model's purpose. Note for example that the model estimated for Timor Leste's non-food inflation only used, as its external driver, 'Asean4+China' average non-food inflation rate expressed in dollars.

Domestic Economic Activity

We used BCTL's economic activity indicator as a proxy of domestic economic developments. This indicator averages the changes registered for 9 relevant domestic economic time series, covering data related to imports, public spending, fiscal revenue, banking and international payments data. Although we already pointed our rationale behind the use of this indicator, instead of actual GDP or public spending data, it might be useful to state again that GDP series is only disclosed on a 'non-timely' basis and that total public spending only covers a narrower part of the economy than BCTL's indicator does.

period as well as a substantial expatriate population, as many of the products imported from Australia are not consumed by Timorese population or companies.

[8] Non-food weights were obtained from a range of international institutions such as the IMF, World Bank and Asian Development Bank and, casuistically, from national statistical agencies.

[9] Foreign inflation rates expressed in dollars were computed using the following equation: fgn. Inflation = ((1+local inflation) x (1+fx change))-1.

BCTL's economic activity indicator allows us to compute real quarterly and annual growth rates in both percentage and absolute (in million dollars) terms. We preferred to use absolute growth rates, as percentage growth rates are highly 'explosive' and unstable throughout the available sample, as the domestic economy has grown from a low absolute point from 2005 to 2013. In terms of economic rationale, it also relevant to state that having a substantial growth rate in percentage terms might also be a poor indicator of increasing inflation pressures, especially when the economy is growing from a level substantially below potential capacity. Since it is extremely difficult to compute Timor Leste's economic potential level using this short data sample, we think that the most reasonable method to estimate this potential is to calculate the long-term average of annual/quarterly growth rates and then compare them with actual growth rates. Note that we should expect rising inflation pressures when economic activity is growing significantly above its long-term growth 'potential', being the inverse also true.

Model's Equation

As we already pointed out, we estimated 3 models for total, food and non-food inflation in Timor Leste. Each of these models can be synthetically[10] represented by the following equation:

$$\textbf{Inflation}_{t} = \textbf{Long-Term Inflation} + a_1 \textbf{ x Inflation}_{t-1} + a_2 \textbf{ x Foreign Inflation}_{t} + a_3 \textbf{ x Economic Growth}_{t}$$

a_1, a_2 and a_3 are the coefficients of the model and correspond to the direct impact of each driver, as well as past inflation values, on current period inflation rate. Note also that we removed the average of each macroeconomic driver, foreign inflation and domestic economic growth. Under this specification, coefficients a_2 and a_3 express domestic inflation sensitivity to changes in each driver relative to each long-term average. Note also that, according to this same specification, as long as domestic economy growth or foreign inflation stick to their long term average, we should have no inflationary impact in Timor Leste's economy.

This same model specification was used for each inflation model, whether it refers to total, food and non-food inflation. Note, however, that we always used foreign inflation series consistent with domestic inflation being modeled, which means that, for example, for the food inflation model we only used foreign food inflation series.

[10] This is only a simplified presentation of the model valid exclusively for annual models. In the case of 'quarterly models' it would be more accurate to present the model in its auto-regressive distributed lag form (ADL), but it would not change the core ideas of this presentation.

Estimation Methods

We estimated our models using quarterly and annual data available from March 2004 until December 2013. Our 'annual models' were estimated using 10 observations, from 2004 until 2013, while 'quarterly models' were estimated using 38 data points. Although we used both frequencies, this paper only reports the results obtained for annual models, to avoid confusing the reader with a wide range of models and estimates.

In terms of estimation we used the following 2 methods: ordinary least squares (OLS) and partial least squares' based regression (PLS). OLS, often called the 'linear regression model', is a simple and intuitive estimation method that is commonly used in many econometric applications, which is only robust if the model or its variables meet a standard set of conditions[11]. However, in real-world applications these conditions are many times difficult to meet or to prove. PLS estimation method improves on this method and is especially designed to overcome eventual regressors' 'collinearity' problems, allowing also estimating models where the number of observations compares poorly with the number of parameters than need to be estimated. PLS method was also used to estimate the previous version of this inflation model, which incorporated 7 different repressors with as many as 4 lags each. In general, PLS is a more powerful method than OLS to estimate the specific parameters of the model, especially if the +regressors' show a high degree of correlation amongst themselves. On the downside, it is not straightforward to compute test statistics useful to analyze variables' degree of significance or to test restrictions on the parameters, while also introducing some empirical problems in terms of selecting the appropriate number of principal components, a required step of the methodology.

All in all, we employ an eclectical approach to the problem and proceed to estimate various models, using different: data frequencies, quarterly and annual; estimation methods, PLS and OLS; target variables, total, food and non-food inflation; and alternative regressor specifications[12]. All together we have estimated more than 64 models.

[11] These conditions demand that the model's residual errors be homoscedastic and serially uncorrelated, and that the regressors are exogenous and non-perfectly collinear. In addition, it is required that the models' variables be stationary

[12] We have experimented different specifications for external drivers, estimating models which also included indonesian inflation rates in dollars, besides 'Asean4+China' data, and models where foreign exchange changes were used together with local currency inflation rates. However, none of this specifications improved substantially the model based on our basic specification, despite forcing us to have more parameters to estimate.

4. Estimation Output

This section presents the results of our estimations. We proceed first with an overview of the model estimated for total inflation discussing later the models quantified for food and non-food inflation. We have used quarterly and annual data to estimate these models, but will only present estimation output in this section for annual based models, to avoid confusing the reader. The quarterly models and respective parameters do not differ materially from the results obtained for annual data, which is a confirmation of the robustness of our approach. Note also that these quarterly models allow us to project inflation on a quarterly basis and may be updated at the end of each quarter, which could be very useful to track overall developments and official projection trajectories as the new relevant macroeconomic data is disclosed.

4.1 Total Inflation Model

The model for total inflation was estimated using OLS and PLS, but the 2 models do not differ substantially. Table 1 details the parameters and the models' "R-Squared" coefficient.

Table 1 – Total Inflation Model

			+10% for Foreign Inflation and 100 million usd for Domestic Economy:			
	Model Parameters:		*1Year Impact:*		*Full Long-term Impact:*	
	OLS	***PLS 2 Factors***	**OLS**	***PLS 2 Factors***	**OLS**	***PLS 2 Factors***
Inflation Long-Term Mean	4.75%	4.75%				
Past Inflation Values	59%	58%	5.9%	5.8%		
Domestic Economy	0.04%	0.05%	4.4%	4.6%	10.7%	11.0%
ASEAN4+China Inflation.	36%	29%	3.6%	2.9%	8.7%	6.9%
Models R^2	83%	82%				

Source: *BCTL calculations*

In order to facilitate the understanding of the figures displayed in the table, note the following:

- the first 2 columns refer to the models' parameters. Inflation's long-term mean is the same in the 2 models, as it corresponds to inflation mean value in the period, which was 4.75% on an annual basis. This is also, in case there are no shocks foreseen for the macroeconomic drivers, the models' forecast for the year ahead, or what we can call the 'steady-state' equilibrium inflation rate. One year before inflation value substantially determines current year inflation rate, as 58-59% of the previous value is transmitted to current period inflation[13]. The last 2 rows of the

[13] Note that it is more rigorous to say that 58-59% of the difference between previous year inflation and its long-term average inflation rate will be transmited to current year inflation.

first 2 columns display the parameters relative to domestic economy (0.04%-0.05%) and foreign inflation (29-36%), which are better explained below.

- In order to better understand the impact of the drivers in Timor Leste's inflation, we present additional estimates on columns 3 and 4. These columns quantify the 'current year' impact of the increase of foreign inflation by 10%, or a boost to the domestic economy of real 100 million dollars, above their mean/trend values. As you can see, in case foreign inflation expressed in dollars, rises 10% above its mean value, Timor Leste's inflation will rise, in the same year, by 2.9%-3.6%. In case the domestic economy expands by 100 million dollars above its trend growth, inflation will increase by 4.4-4.6% in the same year. As you can see, OLS and PLS estimated models only differ substantially in terms of the effects of foreign inflation, as other parameters are practically identical.
- Columns 5 and 6 further present the full long-term of impact of shocks to the models' drivers. Since inflation is influenced by its past values, which maybe due to nominal rigidities or inflation expectations mechanisms, shocks to the models' drivers will affect inflation in current year and in the years ahead. Note that, if Timor Leste's economy grows 100 million dollars above its annual trend growth level (80 million usd), inflation will increase by 4.6% in the same year (PLS model). In the year ahead, since 58% of past inflation value is transmitted to current inflation rate, inflation in Timor Leste will increase by '58% x 4.6%', or 2.7%. This shock will continue to be felt 2 years later, which will create an additional inflation '58% x 2.7%', or 1.6%. As you can see, the impact is felt in current year and subsequent years but will slowly decay until its impact is fully dissipated. This is a consequence of the presence of the auto-regressive term in our model, or past inflation values, which amplifies the initial impact of shocks to our macroeconomic drivers. Luckily, the full long term effect of a shock, or multiplier size, is easily quantifiable for auto-regressive distributed models as this. Columns 5 and 6 quantify the long-term impact of shocks to each of the 2 drivers. As you can see, domestic economy has an initial 'current-year' impact of 4.4%-4.6%, but will have in the end a cumulative impact on inflation of 10.7% to 11%. In case foreign inflation rises 10% above its long-term average, this will create a total cumulative rise in domestic inflation of 6.9%-8.7%, for the PLS and OLS model respectively.

In order to further complement this reasoning, the table below breaks down the impact on inflation, year by year, arising from a pickup in economic activity of 100 million US dollars above its long-term trend. Columns 1 to 3 present 'single year' impacts, as well as absolute and percentage cumulative effect in domestic inflation.

Table 2 - Full Impact on Inflation if domestic economy grows 100m. usd above its long-term trend

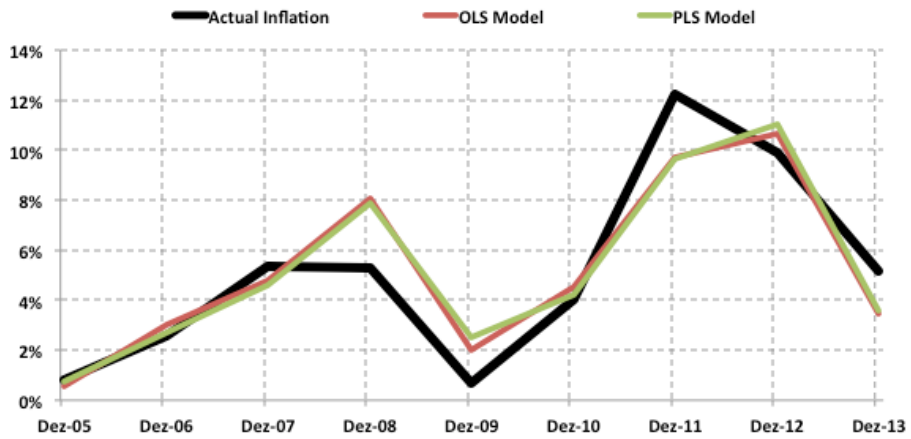
	current year	1 year	2 years	3 years	4 years	5 years	*Total*
Impact each Year	4.6%	2.7%	1.6%	0.9%	0.5%	0.3%	-
Cumulative Impact	4.6%	7.3%	8.9%	9.8%	10.3%	10.6%	*11.0%*
Cumulative Impact in % of Total	42%	66%	81%	89%	93%	96%	*100%*

Source: *BCTL calculations, using PLS model*

As can be seen, 3 years after the shock, 89% of the total impact has already been transmitted to domestic inflation. This means that the substantial size of the auto-regressive component (58-59%) significantly lengthens the response time of inflation to changes in the drivers, as it takes 2 years to get at least 81% filtered through to inflation.

Given this succinct description and discussion of the models' parameters, it is also relevant to assess whether the models do a reasonable job in tracking overall inflationary developments. In fact, as we already pointed out, the models have a substantially high 'R-Squared' coefficient[14], which means the models actually explain 82%-83% of total inflation from 2004 until 2013. The chart below compares actual annual inflation series with the values estimated by the model. Overall, it can be said that the models do a reasonable job in tracking annual inflation throughout the sampled period, although we observe some divergence in 2008 and 2011.

Chart 1 - Actual Inflation versus Models forecasts



Source: *BCTL calculations*

[14] We focus our discussion here on simplistic R-Sqaured coefficeint, but it should be stated that we computed a set of standard statistical tests to assess the models' quality, including correct specification tests, residual normality, auto-correlation and heteroskedasticity tests.

4.2 Food and Non-Food Inflation Models

This section presents the results regarding the models estimated for food and non-food inflation. Building on the explanations offered before, the 2 tables below synthetize the models' main parameters, illustrating also the year and full cumulative impact of changes to the macroeconomic drivers – 10% for foreign inflation and 100 millions boost to domestic economy, above their long term average. Note also, that each food or non-food models used a foreign inflation series consistent with the model's purpose, which meant using 'Asean4+China' food inflation for food inflation model and non-food foreign inflation for non-food inflation model.

Table 3 presents the models estimated to explain food inflation, detailing also the parameters estimated using OLS and PLS methods. The statistical quality of the models is lower than in the model for total inflation, as the models' 'R-squared' coefficient is only around 60%, versus the higher 82-83% obtained for total inflation models. Although the macroeconomic drivers do a relatively poorer job in explain domestic food inflation, the models still account for a major proportion of food inflation and the estimated parameters are in line with economic theory. An increase of 10% in foreign food inflation above its average value along the period will reflect itself in a rise of 3.5%-4.2% of food inflation in the same year, while over the longer term – total cumulative impact – it will increase domestic food inflation by 6-7.3%. When compared with total inflation models, foreign inflation has a higher short-term impact on domestic inflation, but a slightly lower one, over the longer term.

Table 3 – Food Inflation Models

			+10% for Foreign Inflation and 100 million usd for Domestic Economy:			
	Model Parameters:		*1Year Impact:*		*Full Long-term Impact:*	
	OLS	*PLS 2 Factors*	OLS	*PLS 2 Factors*	OLS	*PLS 2 Factors*
Inflation Long-Term Mean	6.61%	6.61%				
Past Inflation Values	42%	41%	4.2%	4.1%		
Domestic Economy	0.05%	0.05%	4.7%	5.2%	8.2%	8.8%
ASEAN4+China Inflation.	42%	35%	4.2%	3.5%	7.3%	6.0%
Models R^2	60%	60%				

Source: *BCTL calculations*

As to what concerns the influence of domestic driver, if the economy grows 100 million dollars above its average growth rate, the models estimate that food inflation will increase 4.7%-5.2% in the same year and 8.2%-8.8% over the longer term. When compared with total inflation models, this impact is broadly in line for the same year horizon, but lower over the longer term. It should be said that the lower longer term impact of both macroeconomic drivers is due to the lower estimate for the lagged term of

inflation, which leads to a faster but less substantial adjustment of food inflation from shocks in both drivers.

It might be also relevant to point out that the lower 'R-Squared' coefficient and higher long-term mean inflation rates of the food models compared with total inflation models, means that the chosen macroeconomic variables are relatively less important for food inflation and that probably we are still missing out on some other factors that could be added to the models to improve their quality. An additional very important factor is naturally related to the domestic logistical constraints in terms of producing, importing, distributing and warehousing food products in Timor Leste. Although important, it is currently very difficult to measure accurately this factor, both in absolute or dynamic terms, but further work could be done in the future to incorporate this factor into our model.

Table 4 presents the models estimated for non-food inflation. As can be seen, the models statistical quality is in line with total inflation models, as 'R-squared' coefficients (80%) are broadly the same. Accordingly, the 2 macroeconomic drivers seem to explain a substantial part of non-food inflation, especially when we compare these models with those estimated for food inflation. In terms of estimates, the non-food inflation models estimate a lower overall impact of foreign inflation, than what was obtained for total and food inflation models.

Table 4 – Non-Food Inflation Models

			+10% for Foreign Inflation and 100 million usd for Domestic Economy:			
	Model Parameters:		*1Year Impact:*		*Full Long-term Impact:*	
	OLS	*PLS 2 Factors*	**OLS**	*PLS 2 Factors*	**OLS**	*PLS 2 Factors*
Inflation Long-Term Mean	3.72%	3.72%				
Past Inflation Values	38%	35%	3.8%	3.5%		
Domestic Economy	0.05%	0.05%	4.9%	5.1%	8.0%	7.8%
ASEAN4+China Inflation.	9%	6%	0.9%	0.6%	1.5%	0.9%
Models R^2	80%	80%				

Source: *BCTL calculations*

According to our results, a rise of 10% in foreign non-food inflation will only cause a rise of 0.6%-0.9% in domestic non-food inflation in the same year, while the total long-term impact of this shock will only be of 0.9%-1.5%. As for domestic economic growth, it can be seen that a surge in economic activity of 100 million dollars will cause a rise in non-food inflation of 4.9-5.1% in the same year and a total longer term rise in inflation of 7.8%-8%. It is also relevant to point that long-term average non-food inflation rate of 3.72%, the level to which inflation will revert when no shocks are present, is substantially below total and food inflation models, as historical non-food inflation rates have been lower than food or total

inflation. In addition, note that the size of the lagged inflation value (35-38%) is in line with the degree of persistence estimated for the food inflation models (35-42%), a level substantially below the parameter for the total inflation models (58-59%), which causes inflation adjustments to be relatively more fast and less substantial in both food and non-food models.

To conclude this section we present below 2 charts that compare actual food and non-food inflation with the models' estimates. These charts further confirm that the non-inflation models seem to have a better explanatory power of inflationary developments in Timor Leste, than food inflation models.

Chart 2 – Food Inflation vs Model Estimation

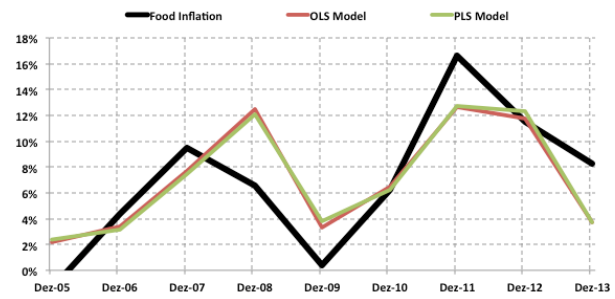
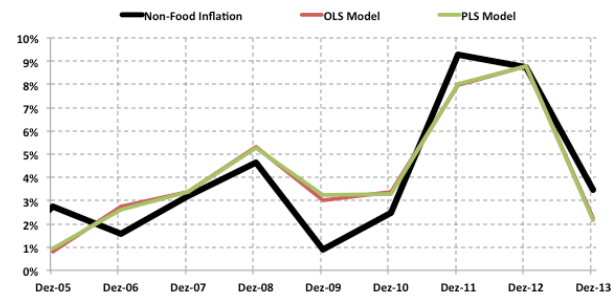


Chart 3 – Non-Food Inflation vs Model Estimation



Source: *BCTL calculations*

5. Applications and discussion

This section further discusses our results and presents some simple applications of the models, so as to facilitate their understanding. We first compare inflation with the macroeconomic drivers we used throughout our work and then proceed to decompose inflation in terms of its macroeconomic drivers, in order to compare the inflationary importance of each driver. We finish with a simple illustration of the models' usefulness to forecast near term trends for inflation in Timor Leste.

Inflation and its drivers

In terms of drivers, we have chosen to consider 2 very broad, but relevant, macroeconomic variables in each model to explain domestic inflation. The charts below compare total domestic inflation with foreign total inflation, expressed in dollars and domestic economic activity's growth.

As can be seen, overall domestic inflation, measured using a trimmed mean rate of CPI's 2 digit components[15], seems to track domestic economic activity growth rates, which further confirms our estimation's results. Although not surprising, this is an encouraging result, which is in line with economic theory and with what is generally observed in most economies.

Chart 4 - Total Inflation vs Economic Activity

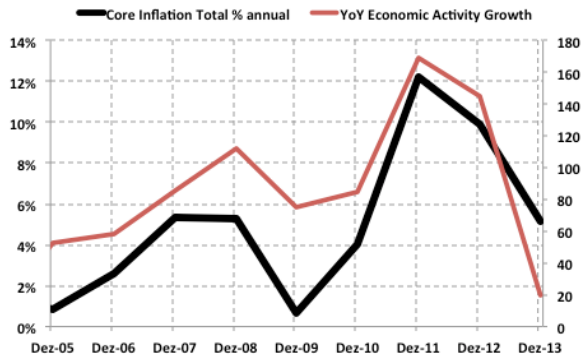
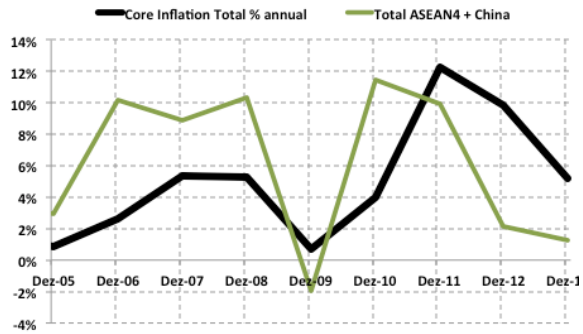


Chart 5 - Total Inflation vs Foreign Inflation



Source: ***BCTL calculations***

Economic activity measured in year-on-year average growth rates, expressed in real millions of dollars (right hand scale chart 4).
Foreign Inflation corresponds to average 'ASEAN4+China' Inflation Rates, converted to dollars.

On the external side, foreign inflation - measured here as the average 'Asean Top 4 economies and China' inflation rates converted to US dollars – also seems to have some impact on domestic inflation, but the relationship does not seem to be as 'close' as for domestic economic activity, according to chart 4. On the one side, foreign inflation seems to be well higher than domestic inflation up to 2010,

[15] Note again that we prefer to use core inflation as our explained variable, computed as the average inflation rate across digit 2 CPI categories, excluding, every period, the 4 most 'price-volatile' categories. Using this measure, instead of CPI based inflation rates, better reflects the broad price trends affecting most CPI categories and downplays the importance of certain food items, whose price volatility or measurement errors might influence, or even distort at times, overall CPI based inflation rates.

which reflects the broad dollar depreciation trend against Asian currencies, and then undershoots domestic inflation in 2012 and 2013. Additionally, foreign inflation seems to be leading domestic inflation at times, as in 2006 and 2010, where a major pickup in foreign inflation was only followed a year later by domestic inflation. However, we acknowledge that part of this 'external disconnection' in terms of inflation might be due to our choice of the relevant foreign inflation variable, as other specifications could also be used in our model. This is certainly a line of work to be further explored, but note that the 'small-sample' restriction will always limit our options here, especially if we want to add more foreign variables, such as food prices, or split foreign inflation from foreign exchange effects. Nonetheless, it seems to be correct to state that foreign inflation plays a role in explaining domestic inflation trends, which is also in line with economic reasoning.

Domestic and External Drivers

In order to better compare the influence of domestic and external factors over inflation, we have used our models to compute the impact of each factor in terms of annual domestic inflation. As can be seen in charts 6 and 7, foreign inflation has generally contributed to higher inflation pressures in Timor Leste, with the exception of 2005, 2009 and 2013. This pressure has been mostly evident in 2007-2008 and 2010-2011, which coincides with periods of broad dollar depreciation and/or pickup in regional inflation rates. It is also evident from the charts that the foreign inflation factor plays a more substantial role in explaining total inflation developments throughout the period, than for non-food inflation.

Chart 6 – Total Inflation Factor Decomposition

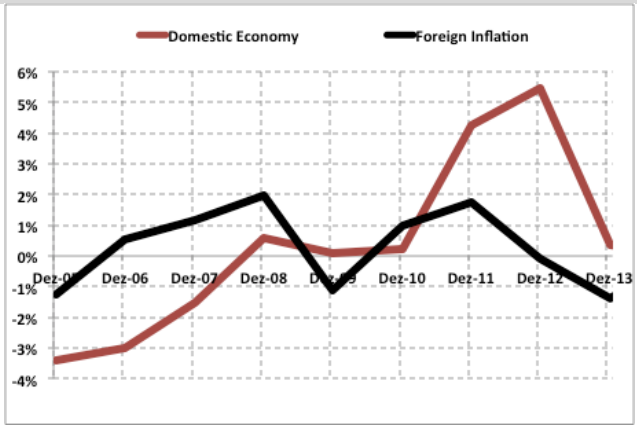
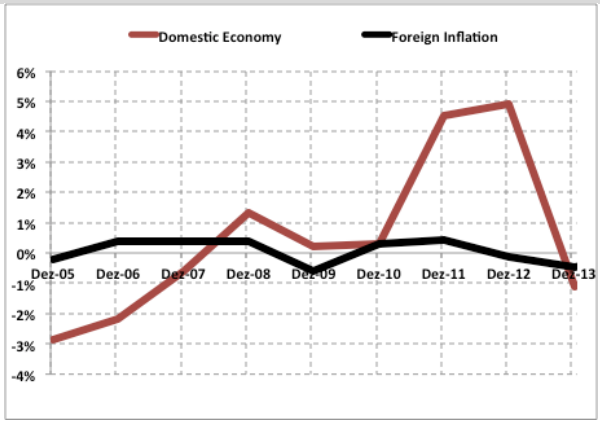


Chart 7 – Non-Food Inflation Factor Decomposition



Source: *BCTL calculations*

As for the inflationary developments due to domestic economic activity, we can identify 2 different trends. Firstly, up to 2007, given the economy was growing below its potential (average growth rate), this driver had a negative impact on overall and non-food inflation. In the subsequent period, on the back of a sustained and substantial fiscal expansion initiated in 2008, the domestic economy has been a positive contributor to overall inflation, most notably in 2011 and 2012, where the domestic economic

boom seems to have been responsible for the most part of the pickup in inflation pressures. These charts thus offer a quantitative confirmation of the fact that the recent inflationary episode in Timor Leste (lasting from 2010 until 2013) is mostly due to the domestic economic boom, rooted on the substantial fiscal boost to the economy.

Simple Projection Exercise

Another useful illustration of the usefulness of the models is naturally related to the ability to quantify inflation projections consistent with pre-defined macroeconomic scenarios, which policymakers find likely and/or relevant to assess. We present here a simple use of the total inflation model to project inflation for the next 2 years, using historical data available up to the end of 2013 and alternative scenarios for the macroeconomic drivers of our model.

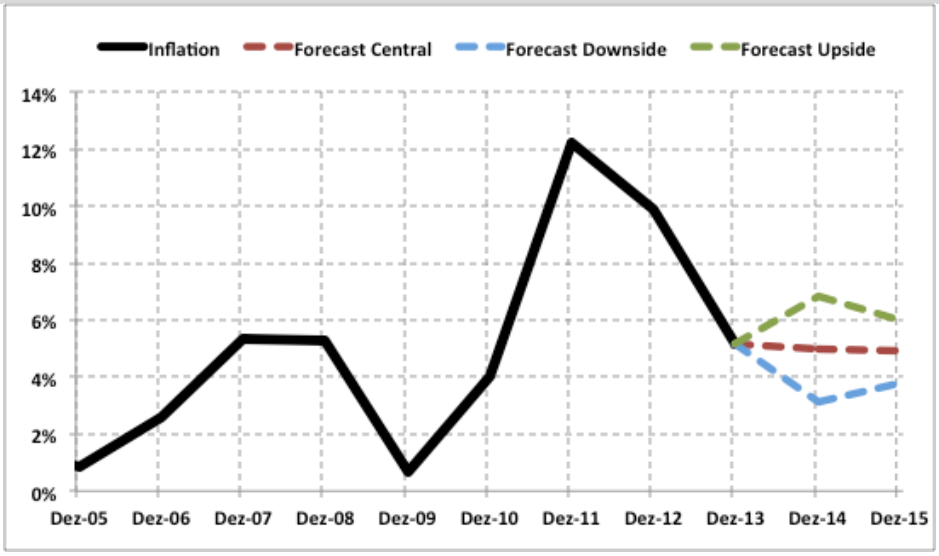
Note also that this is only a simple exercise, which does not include BCTL's official projections or likely scenarios. It merely intends to inform the reader of the possibilities of using this model to quantify possible future developments for inflation, based on expected developments for the macroeconomic drivers of our model. Given that the model formulates its inflation forecast based on the developments envisioned for the domestic economy and foreign inflation, it is necessary to have in pace a framework that allows us to have a qualitative and quantitative view on the future trends of these variables. These trends are, naturally, not easy to predict completely and so substantial effort should be devoted towards design appropriate and probable macroeconomic scenarios for the forecasting horizon, if we are to have a reasonable projection of inflation. International best practice in this field normally focuses on building a central scenario, which is considered more likely, and then examining the impact of eventual alternative scenarios, related to probable, but yet less likely, developments for the drivers.

This simple exercise illustrates this practice. We first built a central scenario for our macroeconomic drivers in 2014 and 2015, where we foresee domestic economy and foreign inflation sticking to their long-term averages in 2014 and 2015. This means that economic activity will grow annually a total of 80 million dollars – which is consistent with an average growth rate of around 8% in each year - and that foreign inflation measured in dollars will be around 5.8% in 2014 and 2015. Since this central scenario is rooted in the drivers sticking to their longer term trends, we expect domestic inflation to converge to its long-term average of 4.75%. In fact, as can be seen below in chart 8 (red line), the model projects inflation to be 5% and 4.86% in 2014 and 2015, according to this scenario.

Additionally, we considered 2 alternative, or 'risk', scenarios, which diverge from the central scenario in only what refers to the developments for the domestic economy, to examine the sensitivity of our projection to changes in this variable. Alternative scenario 1 assumes a slower domestic economic growth scenario, which we designated as 'downside scenario'. On the contrary, alternative 2 foresees a more robust economic growth scenario compared to our central forecast, which we designated as

'upside scenario'. In quantitative terms, our 'downside' scenario sees domestic economic activity's growth in 2014 of 40 million dollars – half the level of our central scenario and consistent with annual 4% growth rate – and our 'upside' scenario assumes economy will expand 50% above its average rate in 2014, or at 120 million dollars – or at a roughly annual 12% real growth rate. Note also that both 'downside' and 'upside' scenarios are the same for 2015, foreseeing that the economy will grow by 80 millions in this year. Chart 8 compares inflation' projections for 'central' (red line), 'upside' (green) and 'downside' (blue) scenarios.

Chart 8 – Simple Inflation Projection Exercise for 2014 and 2015



Source: *BCTL calculations*

According to our calculations and described scenarios, inflation in 2014 could range from 3.1% to 6.8% and between 3.81% and 5.9% in 2015, depending on the chosen scenario. Naturally, a more sluggish economic performance will bring inflation below its long-term value in both 2014 and 2015, while a more robust economic performance will cause inflation to overshoot its long-term average rate (4.75%) in the next 2 years.

Despite its simplicity, this exercise suggests that the model can be effectively used to project future inflation within a consistent macroeconomic framework, which should include reasonable and likely views on developments for the crucial drivers. It also shows that macroeconomic forecasting is an uncertain practice, subject to errors in anticipating 'true' economic scenarios, besides the 'natural' error margin embedded into econometric models' estimates[16].

[16] Two common issues associated with econometric models forecasts are related to parameter estimation errors' and eventual existence of structural breaks.

Despite its potentialities, a model is always a simplified representation of a complex and multidimensional reality, which is 'always right until proven wrong'. As such, it should not be used blindly and uncritically, but on the contrary, as a tool to better frame the discussion on these themes and test arguments that may sometimes be theoretical valid, but not always empirically verified. A model's forecast is never a perfect substitute for an informed and qualitative assessment of macroeconomic developments, but it can contribute to improve the level of discussions and focus these on the most relevant issues.

6. Conclusions

We finish this paper with a brief overview of the estimated models' parameters for total, food and non-food inflation, summarizing also some important considerations and applications, as well as suggesting future steps that could be followed to further improve the inflation modeling framework at the BCTL.

Models overview

We present below the 3 models estimated for total, food and non-food inflation, using a simple 'regression framework' ('ordinary least squares' method) based on annual data. Although our work included estimating more than 64 models, using both quarterly and annual data as well as estimation techniques and variable specifications, we only present the 3 models which we consider more relevant, in order to avoid confusing the reader. Note, however, that having this broader set of estimated models will allow us to cross check scenarios and projections using other estimates of parameters, thus complementing BCTL's economic forecasts.

Table 5's columns 1 to 3 present the models' parameters, while columns 4 to 6 present the 'same-year' impact of 'stylized' shocks to our variables: a rise of 10% in foreign inflation and a growth rate for the domestic economy of 100 million dollars, above their respective long-term averages. Since the overall impact of such shocks takes time to be fully processed, columns 7 to 9 present the total long-term impacts of these shocks on inflation.

Table 5 – Estimated Models for Total, Food and Non-Food Inflation

				+10% for Foreign Inflation and Past Inflation and 100 million usd for Domestic Economy:					
	Model Parameters:			*Current Year Impact:*			*Full Long-term Impact:*		
	Total Inflation	Food	Non-Food	Total Inflation	Food	Non-Food	Total Inflation	Food	Non-Food
Inflation Long-Term Mean	4.8%	6.6%	3.7%						
Past Inflation Values	59%	42%	38%	5.9%	4.2%	3.8%			
Domestic Economy	0.04%	0.05%	0.05%	4.4%	4.7%	4.9%	10.7%	8.2%	8.0%
ASEAN4+China Inflation.	36%	42%	9%	3.6%	4.2%	0.9%	8.7%	7.3%	1.5%
Models R^2	83%	60%	80%						

Source: *BCTL calculations*

As you can see above, there are significant differences between total, food and non-food inflation models, specifically as to what regards the models long-term average, dynamic adjustment processes and sensitivity to macroeconomic drivers.

The models' fixed components represent the models' inflation forecast in case there are no foreseen shocks to our macroeconomic drivers during the forecasting horizon. This fixed term corresponds to each inflation's long term average - estimated using the data from 2004 up to 2013 – and represents

what we can designate the 'steady state equilibrium rate of inflation, to which the model converges, when no shocks are present. As can be seen, food inflation's model has the higher long-term average, followed by total and then non-food inflation, which reflects the historically higher inflation rates for food items in Timor Leste.

A second interesting dynamical element of our models relates to the importance of past inflation values towards influencing current year inflation. This term incorporates the existence of lagged impacts between macroeconomic 'drivers' and inflation, since economic adjustments normally do not occur instantaneously, but, on the contrary, tend to take some time to fully process the shocks. The significance of these 'lagged impacts' seems to be substantial in the case of Timor Leste's inflation, which can be explained by the specific nature of domestic agents inflation expectations' and general 'nominal rigidities' characteristic of the economy. According to our estimates, this effect seems to be greater for total inflation model, than for disaggregated food and non-food models.

As to what regards the role of the 'macroeconomic drivers' in our models, it is important to note that the estimated parameters are consistent with economic theory, as both foreign inflation and domestic economic activity seem to affect positively domestic inflation rates. Note also that in our models, these drivers only cause changes in inflation if they diverge from their respective long-term average growth levels. As long as they stick to their average growth rates, domestic inflation should converge to its long-term 'steady state' equilibrium levels.

As estimated, a rise of 10% in foreign inflation, above its average level, causes a cumulative increase of 8.7%, 7.3% and 1.5% in domestic total, food and non-food inflation rates. It should then be noted that non-food inflation is relatively less influenced by foreign developments, exhibiting a lower degree of foreign inflation 'pass-through'. As for the role of the domestic economy, the models also confirm that it positively influences domestic inflation, being that a rise in domestic economic activity of 100 million dollars, above the long term average, causes a cumulative long-term rise in inflation of 10.7%, 8.2% and 8% for total, food and non-food inflation rates. It should be highlighted that economic activity impacts prices indirectly, by causing aggregate supply-demand imbalances, which only subsequently cause aggregate price adjustments.

Considerations and applications

These models, which upgrade existing inflation models used by BCTL and incorporate recent research work carried out at the Economic and Statistics Division of BCTL, will be naturally important to better support quantitatively future projection exercises required for BCTL's work. As showed in this paper, they can be used together with 'macroeconomic scenario analysis' to quantify inflation projections consistent with certain pre-defined macroeconomic scenarios, which BCTL may find highly likely or

relevant to explore. As pointed out, these tools could be used to complement and support economic discussion, contributing to better economic assessment and, eventually, to empirically based policymaking decisions.

Additionally, since we now have models for total, food and non-food inflation, we can study and forecast price trends at an aggregate level (total inflation), but also at a sub-component level, that is for food and non-food inflation. This seems to be particularly important in the case of Timor Leste, because food expenditures are relatively more important for the average Timorese household and because food inflation trends have tended to diverge, at times, from non-food inflation. Having separate food and non-food inflation projections can also be used to forecast overall inflation rates, in case we have an estimate of food and non-food total expenditure weights for the relevant household. Using this 'bottom-up' approach to inflation forecasting can allow us to cross check total inflation projections, based on total inflation model, but, more importantly, can also be used to forecast inflation trends relevant for Dili, ex-Dili and average national households, which are the 3 levels currently used by DNE to report inflation statistics. In case we assume the principal difference between the average household, of each 'region', relates only to the total food expenditure weights – notably CPI's food weight is relatively more important for ex-Dili households and consequently for average national household – we can use our food and non-food inflation projections to forecast total inflation for each of the 3 relevant household levels.

A third important consideration, also presented in this work, relates to the need to answer a commonly raised question relative to inflation, specifically 'Which type of factor, external or domestic, is more relevant towards explaining past inflation trends in Timor Leste?". Our estimation work does not intend to offer a definitive answer to such question, but suggests that the correct answer may actually be quite ambiguous. As we showed, foreign inflation seems to be mostly responsible for inflation trends up to 2009, especially for the inflationary episode of 2007-2008. Nonetheless, after 2009, it seems that the domestic economic boom, built on the back of a substantial fiscal expansion policy, was the main driver of the recent inflationary episode of 2011-2013, which only now, in 2014, seems to be dissipating.

Future developments

Since inflation modeling is always a 'work-in-progress', we finish this paper with some suggestions of improvements to our approach, specifically:

- given that the CPI includes many different types of goods and services, we could proceed to estimate models for more granular categories of the CPI. This approach is common within the Central Bank community and may involve estimating models for specific categories of items,

which share common elements. A commonly used approach involves estimating inflation models for more granular categories: raw food items, transformed food items, services, merchandise goods and goods and services with administered prices.

- we estimated our models using 'Dili' CPI data, but could later update our estimation work to incorporate 'ex-Dili' and 'National' CPI data, as more data is added to the new CPI series compiled at DNE. We could then better compare the importance of each driver and dynamical elements across the various regional levels of Timor Leste's economy;

- incorporate future developments from parallel research initiatives, such as an improved estimation of relevant import costs for Timor Leste, price setting behavior surveys' inputs and improved macroeconomic data regarding the domestic economy;

- proceed to re-estimate the models on an annual basis, as new data is disclosed, to check for eventual 'structural breaks' and make sure the models remain useful and adequate to explain and forecast inflation developments.

7. Suggested readings

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