Written Exam for the B.Sc. or M.Sc. in Economics, Winter 2013/2014

# Advanced development economics: Applied Macroeconomics and Policy Analysis

Master's Course

09/01/2014

(3-hour closed book exam)

**The exam has 9 pages in total (including this cover page)**

**ADVANCED DEVELOPMENT ECONOMICS: APPLIED MACROECONOMIC AND POLICY ANALYSIS**

**WINTER 2013/2014**

**MASTER'S COURSE EXAM**

**3HRS CLOSED BOOK**

**INSTRUCTIONS**

- There are three primary questions in this exam.
- Each question has a set of sub-questions; these are labelled (a), (b), etc..
- You should attempt to answer all three questions and all corresponding sub-questions.
- When answering, please refer to the equations and notations given in the text (where relevant).
- Answers to each sub-question should be concise (i.e., relatively brief).

**QUESTION 1**

**Overview**

The text below summarises the method and results of an empirical investigation into the macroeconomic policy 'trilemma' for two countries -- China and India. It is taken from an article by Joshua Aizenmann & Rasjesawri Sengupta (2013), 'Financial trilemma in China and a comparative analysis with India', *Pacific Economic Review* 18(2):123-146.

The objective of the analysis is to trace the evolution of the financial trilemma in China and India over time from 1990 to 2010 and analyse the extent of the trade-offs faced by policy-makers in both countries. To do so, the authors calculate a trilemma index for each of the two countries separately, using a methodology developed for a cross-section of countries presented in Aizenman et al. (2008, 2011, 2013).

**Data**

The authors follow the methodology of Aizenman et al. (2008, 2011, 2013) in constructing indices for each of the trilemma policy objectives; namely, monetary independence, exchange rate stability and capital account openness. However, while Aizenman et al. analyse the trilemma configurations for a host of countries and study the associated implications, the authors do so individually for two key emerging market economies, China and India, and compare results. In order to have more observations in the data set and, hence, more time variation for a single country, the authors use quarterly data as opposed to annual data used in previous analysis.

The authors measure monetary independence (MI) as the reciprocal of the correlation of quarterly interest rates in the home country (here, China and India, respectively) and the base country (the United States). They calculate quarterly correlations using weekly interest rate data. The precise formula is as follows:

$$\mathrm{MI}_i = 1 - \frac{cor(i_i, i_j) + 1}{2} \tag{1.1}$$

where $i_i$ is the interest rate in the home country and $i_j$ is the interest rate in the base country. By definition, the index lies between 0 and 1. The highest value indicates the greatest degree of monetary independence.

The authors calculate the exchange rate (ES) index using quarterly standard deviations of the weekly change in the natural logarithm of the local currency unit–US$ exchange rate (in this case, the RMB-US$ exchange rate for China and the rupee-US$ exchange rate for India). The formula used for the construction of the index is as follows:

$$\mathrm{ES}_i = \frac{0.01}{0.01 + stdev(\Delta \ln(e_{ij}))} \tag{1.2}$$

where $e_{ij}$ is the bilateral exchange rate. Like the MI Index, by definition, the ES index ranges from 0 to 1 and the higher the value the greater is the exchange rate stability.

The authors depart from Aizenman et al. (2008; 2013) for the construction of the capital account openness (KO) index. Instead of using the Chinn–Ito index (that gives a number between 0 and 1 for a country's financial openness), they use a simple *de facto* measure of capital account openness. They define the KO index as the ratio of the sum of inward and outward foreign investment flows to GDP. In doing so, they consider three types of capital flows: FDI, portfolio and others, as reported by SAFE for China and the IFS for India.

One drawback of this new approach to measuring capital account openness is that the KO index is not bound between 0 and 1 by definition. To resolve this, the authors rescale the KO index [rescaled index = (Actual index - Minimum value of the series)/(Maximum – Minimum of the series)], such that it lies between 0 and 1. Hence, the range of the rescaled KO index (used below) is comparable to that of the other two indices.

**Methods**

Following Aizenman et al. (2008; 2013), the authors employ a regression-based approach to test whether the trilemma is binding. Specifically, they regress a constant (value = 2) on all three indices at the same time, omitting an intercept term on the right-hand side of the equation. This yields the following linear specification:

$$2 = a_i \mathrm{MS}_{it} + b_i \mathrm{ES}_{it} + c_i \mathrm{KO}_{it} + \varepsilon_{\mathrm{it}} \tag{1.3}$$

where *i* refers to China or India; the parameters (coefficients) to be estimated are *a, b* and *c*.

**Results**

The main (baseline) results for each country – as per equation (1.3) -- are reported in Table 1.1. In addition, the authors split the sample into sub-periods and run separate regressions for each period. These results are reported in Tables 1.2 and 1.3, (for China and India respectively).

Table 1.1. Trilemma estimations: China and India, 1990–2010

| Variables | China | India |
|---|---|---|
| MI | 0.843** (0.383) | 0.823*** (0.217) |
| ES | 1.644*** (0.245) | 1.837*** (0.137) |
| KO | 0.190 (0.168) | 1.000*** (0.315) |
| Observations | 84 | 84 |
| R2 | 0.974 | 0.926 |

Newey–West standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. ES, index of exchange rate stability; KO, de facto capital account openness; MI, index of monetary independence.

Table 1.2. Baseline estimations for China: Truncating sample into sub-periods

| Variables | 1990Q1–1994Q1 | 1994Q2–1997Q4 | 1998Q1–2005Q3 | 2005Q4–2010Q4 |
|---|---|---|---|---|
| MI | 2.292*** (0.871) | 0.388 (0.246) | 0.222 (0.248) | 0.119 (0.092) |
| ES | 0.817*** (0.327) | 1.550*** (0.253) | 1.903*** (0.126) | 2.310*** (0.125) |
| KO | 0.748** (0.446) | 0.419*** (0.166) | 0.049 (0.075) | -0.233 (0.357) |
| Observations | 17 | 15 | 31 | 21 |
| R2 | 0.955 | 0.998 | 0.996 | 0.992 |

Newey–West standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. ES, index of exchange rate stability; KO, de facto capital account openness; MI, index of monetary independence.

Table 1.3. Baseline estimations for India: Truncating sample into sub-periods

| Variables | 1990Q1–1994Q1 | 1994Q2–1997Q4 | 1998Q1–2005Q3 | 2005Q4–2010Q4 |
|---|---|---|---|---|
| MI | 0.442*** (0.166) | 1.817*** (0.530) | 0.197 (0.129) | 1.315*** (0.408) |
| ES | 1.760*** (0.187) | 0.921*** (0.206) | 2.235*** (0.144) | 3.154*** (0.238) |
| KO | 1.936* (1.088) | 1.565*** (0.650) | 0.534** (0.242) | -0.606 (0.404) |
| Observations | 21 | 21 | 21 | 21 |
| R2 | 0.899 | 0.938 | 0.980 | 0.955 |

Newey–West standard errors are in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. ES, index of exchange rate stability; KO, de facto capital account openness; MI, index of monetary independence.

**Sub-questions**

1.(a) What does the 'impossible trinity' (macroeconomic policy trilemma) refer to? In your answer, give examples of macroeconomic policy configurations that are **not** considered feasible under the trilemma hypothesis.

The impossible trinity refers to that notion that **certain configurations or combinations of macroeconomic policy may not be feasible** (sustainable) due to the operations of international arbitrage. Specifically, it corresponds to the impossibility of having all three of: (i) a fixed exchange rate; (ii) independent or sovereign monetary policy; and (iii) capital market (account) openness. Thus, an example of a configuration that is not deemed possible or sustainable is that of having a fixed exchange rate plus sovereign monetary policy (with free capital flows).

1.(b) Using your knowledge of international parity conditions, explain the theoretical rationale as to why the trilemma may be binding.

The main theoretical rationale as to why the trilemma may be binding derives from the **uncovered interest parity condition**. Intuitively, if a given country has a credible fixed exchange rate and is open to international capital flows, then if it pursues a tight monetary policy – such that nominal interest rates are above world interest rates (ignoring any risk premium) – rational investors would shift money to that country, in turn driving down domestic interest rates. Thus, there would be no scope for independent monetary policy.

To see this more clearly, the uncovered interest parity (UIP) condition can be stated as follows:

$$I_d - I_f = \frac{\tilde{E}_{t+1} - E_t}{E_t}$$

where $I_d$ refers to domestic interest rates (at time $t$), $I_f$ to foreign rates; $E_t$ is the spot nominal exchange rate at time $t$; and $\tilde{E}_{t+1}$ is the expected exchange rate in the future, which we can assume is given. Under credible fixed exchange rates, the RHS of the equation equals zero, implying there can be no deviation between domestic and foreign nominal interest rates. Alternatively, if the home country pursues an independent monetary policy then current exchange rates must adjust (immediately) to bring the LHS and RHS into equality.

1.(c) With reference to the empirical test of the trilemma given by equation (1.3), what is the main hypothesis of interest?

The main hypothesis of interest is that the equation provides a very strong fit to the data, implying that at least two of three estimated coefficients are significantly different from zero. If the **goodness of fit of the regression is high** (e.g., indicated by the regression R-squared statistic) this would imply that **a linear specification is sufficient to account for the trade-off faced by policy-makers among the three policy objectives** represented by the variables in the equation.

1.(d) Comment on the strengths and weaknesses of the testing approach adopted by the authors.

(NB. It is not expected that students provide ALL of these).

Strengths of the approach include:

- it is an intuitive and simple means to verify whether there really is a policy trade-off between the objectives of exchange rate stability, monetary policy independence and capital account openness.
- the authors use normalised *de facto* measures of the policy variables. This is as opposed to using *de jure* measures that have been employed in the past (e.g., the Chinn-Ito index), but can be misleading.
- in contrast to previous analyses by the same authors, in this study they undertake country-specific tests, thereby allowing inference to be undertaken at the country-level.

Some weaknesses are:

- measures of the policy variables may not fully capture the effective policy stance of each country. For instance, exchange rate stability may be sensitive to choice of the base/reference country (typically the USA).
- beyond the attraction of simplicity, there is no *a priori* reason why we should expect a linear trade-off between the policy variables. Other specifications may be appropriate.
- R-squared statistics are often high when regressions are run without a constant, which derives from the omission of the intercept term. This may be misleading.
- More generally, a concern is that it is not clear exactly *what* constitutes a strong goodness of fit of the model. For instance, the authors do not propose a specific null hypothesis against which rigorous inference can be undertaken.
- The period-specific regressions suffer from very small samples.

1.(e) Interpret the results in Tables 1.1 to 1.3. In doing so comment on: what the results suggest about the macroeconomic policy stance (priorities) of China and India on average over the period; and how these choices have evolved over time (if at all).

The results of Table 1.1 indicate a **very strong goodness of fit of the model for both China and India over the full period**, thereby suggesting **there has been some trade-off between the policy objectives over time**. Interpreting the magnitude of the coefficients as the relative weights of each policy objective, it appears both China and India have placed **greater emphasis on maintaining exchange rate stability** (on average). A contrast between the two countries is that **China has placed much lower weight on capital account openness** (the estimated coefficient is not different to zero), whereas India has tried to achieve some balance (a middle ground) between capital account openness and monetary policy sovereignty, alongside exchange rate stability.

Tables 1.2 and 1.3, although based on much smaller samples, suggest that Chinese policy has evolved toward placing increasing weight on exchange rate stability and lower weights on both

monetary policy independence and capital account openness. For India, we also see a growing importance of exchange rate stability as well as a reduction in the importance (weight) on capital account openness, which is insignificant in the final period.

1.(f) Briefly discuss what other factors (policy variables) may mitigate the extent to which the trilemma is binding for any given country.

A number of factors may mitigate the extent to which the trilemma is binding, these include:

- **Policy instability** and/or a very **high risk premium**: countries with non-credible policies and/or high risk premia, such as very low income countries or fragile states, may be effectively ignored by international investors, regardless of their policy stance. As a result, international arbitrage activities will have minimal force.
- **Accumulation of international reserves**: this can provide some short-run insulation (a buffer) from the effects of international capital flows, at least when financial integration is moderate. For instance, international reserves can be used to under-write (manage) the exchange rate and to protect the domestic banking sector, and domestic credit markets more generally, from sudden shifts in capital flows.

**QUESTION 2**

**Background**

Consider the following situation: an analyst wishes to evaluate the behaviour of real exchange rates in developing countries. To investigate this, she uses the latest version of the Penn World Tables (v 8.0).

As a first stage of the investigation, she calculates the following two variables for use in further analysis:

$$ppp = \ln(P_d/P_f) = (p_d - p_f) \quad (2.1)$$

$$q_{df} = \ln(E_{df}) + \ln(P_f/P_d) = e_{df} + p_f - p_d \quad (2.2)$$

where *E* is the bilateral nominal exchange rate with the USA (expressed as the number of domestic currency units required to purchase one US Dollar); $P_f$ is the general price level of GDP in the USA; and $P_d$ is the domestic price level of GDP. Lower case variables indicate that a natural log. transformation has been applied.

As an attempt to assess whether Purchasing Price Parity (PPP) holds for a selection of individual countries, the analyst runs separate OLS regressions of the form:

$$e_{df} = \alpha + \beta(ppp) + \varepsilon \quad (2.3)$$

where $\alpha$ and $\beta$ are parameters to be estimated; and $\varepsilon$ is residual error. Results from this exercise for China, South Africa and Brazil are reported in Table 2.1.

As a next step, the analyst investigates whether the real exchange rate of these countries is over- or under-valued. To do so she runs the following OLS regression, using all countries in the sample over the period 1980-2011:

$$q_{df,t} = \alpha + \beta\ln\left(y_{d,t}/y_{f,t}\right) + \gamma t + \delta t^2 + \varepsilon_t \quad (2.4)$$

where $\alpha$, $\beta, \gamma$ and $\delta$ are parameters to be estimated; $t$ is a time index ranging from 0 (1960) to 31 (2011); $y_{d,t}$ is domestic real income per capita at time *t*; $y_{f,t}$ is real income per capita in the USA at time *t*; and $\varepsilon$ is residual error. Results for these estimates are reported in Table 2.2.

Table 2.1: Summary OLS estimates of equation (2.3), for China, Brazil and South Africa

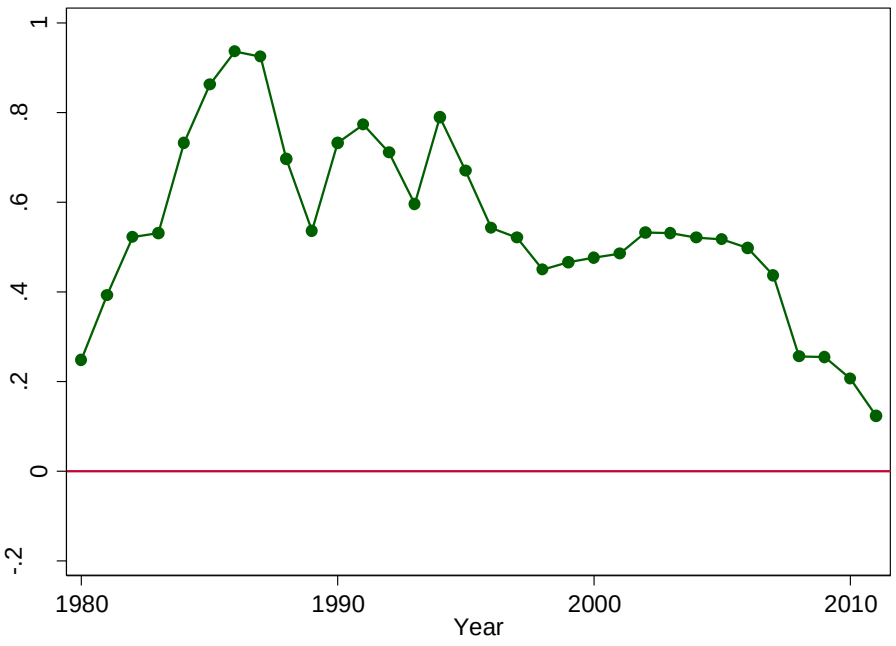
| Parameter → | $\alpha$ | | $\beta$ | | Summary statistics | |
|---|---|---|---|---|---|---|
| Country ↓ | Coef. | (s.e.) | Coef. | (s.e.) | R-squared | RMSE |
| Brazil | 0.384 | (0.057) | 0.991 | (0.005) | 0.999 | 0.256 |
| China | 1.229 | (0.058) | 0.813 | (0.073) | 0.806 | 0.247 |
| South Africa | 0.347 | (0.053) | 1.018 | (0.045) | 0.944 | 0.176 |

Note: '(Coef.)' is the estimated regression coefficient; '(s.e.)' gives the estimated standard error of the coefficient estimate; 'RMSE' is the root mean square error of the regression.

Table 2.2: OLS estimates of equation (2.4)

```
Linear regression                               Number of obs =     5105
                                                F(  3,   166) =    41.52
                                                Prob > F      =   0.0000
                                                R-squared     =   0.2158
                                                Root MSE      =   .44184
------------------------------------------------------------------------------
             |               Robust
           q |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    Constant |  -.0425949   .0496738    -0.86   0.392    -.1406688     .055479
      y_d/y_f|  -.1681385   .0245425    -6.85   0.000    -.2165942   -.1196828
           t |   .0353242   .0046048     7.67   0.000     .0262327    .0444157
          t2 |  -.0010073    .000132    -7.63   0.000    -.0012679   -.0007467
------------------------------------------------------------------------------
```

Figure 2.1: Estimates of Chinese exchange rate misalignment (based on estimates in Table 2.2)



**Sub-questions**

2.(a) Outline the theory of Purchasing Price Parity (PPP). Describe the assumptions required for PPP to hold in absolute form.

The theory of PPP reflects the notion of the **law of one price**. In its strong form, PPP holds that international trade in goods and services should ensure that prices of these goods (taken as a basket) cannot differ systematically between any two countries. Taking the definition of the real exchange rate:

$$Q = E \times P_f / P_d$$

then, if price levels are effectively the same across countries then $Q$ = 1 and the spot exchange rate ($E$) must equal the ratio of domestic to foreign prices.

For PPP to hold in absolute form for a basket of goods, at least two assumptions must hold: (i) **all goods in the basket are traded**; and (ii) there are **negligible transport or storage costs**.

2.(b) Interpret the results in Table 2.1, making reference to the principal hypothesis being tested. Comment on the suitability of this approach as a means to test for PPP.

The principal hypothesis being tested is that the **coefficient beta is equal to one**, which would be consistent with either absolute or relative PPP. With regard to the estimates for each country, applying a confidence interval of around +/-2 standard errors, we can conclude that PPP holds for both India and South Africa but not for Brazil. (One may also note that estimates for alpha are significantly different to zero, which would not be consistent with absolute PPP).

The main concerns with this approach to testing for PPP refer to the **time series properties of the data**. Both the dependent and the independent variables may not be stationary implying the regression estimates could be spurious. If nothing else, serial correlation in error terms would imply that the standard errors are biased. Lastly, prices may not be exogenous to the exchange rate implying simultaneity bias (see Krugman, 1976).

2.(c) What is the Balassa-Samuelson effect? Explain how equation (2.4) can be used to test for this effect as well as how it can be used to evaluate exchange rate misalignment.

The Balassa-Samuelson effect is a theory that explains the stylized fact that the consumer price level in developed (rich) countries tends to be higher than those in less developed (poorer) countries, in turn implying that real exchange rates in richer countries are stronger (more appreciated) than those in poorer countries. The Balassa-Samuelson effect proposes that this divergence is driven by **differences in productivity in the traded goods sector**, which leads to higher prices for non-traded goods (and thus a higher price level in developed countries). As such, the Balassa-Samuelson effect provides an explanation of why we might find systematic divergences from PPP exchange rates.

Equation (2.4) can be used to test for the Balassa-Samuelson effect under the assumption that **differences in per capita income proxy for differences in productivity** (in the traded sector). Thus, if the Balassa- Samuelson effect holds we would expect a significant coefficient on the income ratios term. In this case, as the USA is chosen as the reference country – assumed to be at the productivity frontier – **the coefficient is expected to be negative**. The null hypothesis is that the coefficient is equal to zero.

Estimates of exchange rate misalignment can be derived as the **difference between the expected (fitted) value from equation (2.4) and the observed value**.

2.(d) Briefly interpret the results of Table 2.2. Does it provide evidence for the Balassa-Samuelson effect?

Table 2.2 indicates a **negative partial correlation** between the (domestic to foreign) income ratio and the real exchange rate. That is, **an increase in domestic productivity relative to the USA is associated with a decline in the real exchange rate – i.e., an appreciation**. As discussed above, this is consistent with the Balassa-Samuelson effect. It merits highlighting, however, that the estimated effect is moderate – a 10% relative increase in domestic productivity is associated with an appreciation of under 2% in the real exchange rate.

2.(e) Figure 2.1 shows the results of estimates of exchange rate misalignment for the specific case of China. These are based on the cross-country estimates of Table 2.2 (equation 2.4). Interpret these findings and discuss whether they are consistent with other estimates of Chinese misalignment found in the literature.

In Figure 2.1 the estimates of exchange rate misalignment are consistently above zero, suggesting that the Chinese currency (renminbi) has been **consistently under-valued relative to the dollar** over the period 1980-2010. Between 2000 and 2005, the extent of under-valuation has been around 40%; however recent years, during which the Chinese government has allowed the currency to strengthen, has shown a **reduction in the extent of under-valuation** to below 20% in 2011.

**Academic estimates of Chinese currency valuation vary significantly**, depending on the method and period studied. In a summary of studies, Cline and Williamson (2008), suggest a weighted estimate of 40% under-valuation of the bilateral exchange rate with the dollar for the early 2000s. More recently, Subramanian (2010), using data from 2005, concludes the renminbi is about 31% under-valued against the dollar. Thus, **the present results are consistent with other studies for the earlier period**, but they differ in pointing to substantive re-alignment more recently.

2.(f) Why have Chinese authorities resisted letting their currency float freely? Does this have policy implications for other countries?

The Chinese authorities have resisted letting their currency float freely for a number of reasons (e.g., as discussed by Goldstein and Lardy, 2006). Principally, these refer to the **economic consequences of a significant appreciation** of the currency that might occur under a free float. These include:

- since China has very large holdings of international reserves (e.g., US debt), any appreciation would lead to large valuation losses on these holdings;
- the concern that (export-oriented) manufacturing may move to more competitive locations (e.g., Vietnam / Cambodia), leading to job losses and possibly social unrest; and
- weakness of the banking system – any reduction in export profits could lead to an increase in non-performing loans and thus banking sector difficulties.

There is significant debate on the impact of Chinese under-valuation on other countries. On the one hand, **countries importing from China benefit from cheaper goods** thus keeping domestic prices low. On the other hand, competition from China may **undermine manufacturing exports and associated jobs** in other developing countries, and even in some developed countries. The net effect of these two dynamics is not clear, but there is certainly likely to be a **compositional shift in economic activity away from export sectors**. This may be especially **important for developing countries** if we believe that productivity growth (learning-by-doing) in export sectors has positive externalities for the rest of the economy. A further aspect is that Chinese under-valuation, combined with international reserve accumulation, has contributed to global imbalances including the rise of the US trade deficit.

**QUESTION 3**

**Sub-questions**

3.(a) What are the primary instruments used by government to pursue (implement) monetary and exchange rate policies?

The 'primary instruments' refer to the **immediate policy tools employed by governments and Central Bank to implement monetary and exchange rate policies**. These are principally:

- **Foreign exchange rate interventions:** these are official purchases/sales of reserve assets, which may be sterilized or unsterilized
- **Changes to monetary aggregates (money supply):** such as through commercial bank reserve-deposit requirements, open market operations and capital requirements (of banks).
- **Changes to the prime lending rate:** that is the rate at which the Central Bank lends to commercial banks, typically for overnight operations.

3.(b) Describe one way in which economists have attempted to estimate the welfare costs of inflation.

A theoretical basis for estimates of the welfare costs of inflation derives from the work of Bailey (1956). This approach focuses on the **inverse demand function for (real) money balances**, noting that as the nominal interest rate falls (but remains above zero) social benefits increase. This occurs because the nominal interest rate captures the opportunity cost of holding money (i.e., an inflation tax). A nominal interest rate of zero will equalise returns to holding real money balances with the costs of their production, which is zero. Put differently, higher rates of interest lead agents to hold sub-optimal (insufficient) real money balances. The welfare cost of inflation is then the **size of the deadweight loss due to non-zero nominal interest rates**. Note that this approach relates to the rate of inflation via the Fisher effect, which says that higher (expected) rates of inflation are associated with higher nominal interest rates.

Empirically, this approach can be implemented **by estimating the parameters of the long-run inverse money demand function, for instance by using cointegration econometric techniques**.

3.(c) Discuss the advantages and disadvantages of adopting a strict "inflation targeting framework" in lower income developing counties. (*You may wish to provide a slightly longer answer here*).

(NB.: This answer is relatively comprehensive. Shorter, more selective answers are very appropriate. However, students should explicitly recognise the difference between strict and flexible/other forms of inflation targeting).

Adoption of an inflation targeting framework involves **pursuit of price stability as an overriding objective of monetary policy**, typically by an independent Central Bank. Above all it involves a public commitment to **specific, pre-announced price stability objective(s)** and regular communication with the public as regards its activities and achievement of this goal. Strict

inflation targeting implies that **zero weight is placed on output (gap) variability**. This can be seen from a stylized Central Bank loss function:

$$L = \omega(y - \bar{y})^2 + (\pi - \bar{\pi})^2$$

whereby under strict inflation targeting one would set parameter (weight) $\omega = 0$.

In lower income countries, the **advantages** of adopting a strict inflation targeting framework include:

- Enhanced **accountability** of the Central Bank to monetary policy goals, as opposed to discretionary policy.
- Pre-commitments to well-defined specific goals can **tie the hands of the Central Bank** (and government), thereby helping to avoid inflationary bias. (This relates to the benefits of rule-based policy versus discretion).
- The high degree of **observability** of prices as well as the corresponding **simplicity** of a single inflation target, which contrasts to the greater difficulty of observing and communicating output objectives or combined price and output objectives.
- Under certain specifications of New Keynesian models, typically based on a closed economy framework, it can be shown that a **focus on inflation is sufficient to achieve both price and output stability**. That is, including output in the objective function is redundant.

The **disadvantages** of adopting a strict inflation targeting framework include:

- A main problem of strict inflation targeting is that it can lead to very high output variability, especially where the economy faces large nominal shocks. As shown by Ball (1999), among others, Central Banks typically face an **output-inflation trade-off**. This means that allowing a very small weight on output variability can lead to substantial reductions in variability. This is pertinent where there are large welfare losses from output (business cycle) variations, as suggested by Pallage and Robe (2003).
- There are severe difficulties in **correctly estimating appropriate parameters of a policy reaction function** that might guide policy responses. That is, for inflation targeting to operate effectively there must be a consistent and reliable link running from monetary and exchange rate policy instruments to final outcomes. In many lower income countries the evidence for stable relationships, such as suggested by a **Philips or Lucas supply curve**, is not clear.
- Estimating such a policy reaction function is made substantially more difficult in small open economies as **monetary policy cannot ignore the exchange rate**. Indeed, the possibility of **contractionary depreciations** (e.g., see Bleaney and Vargas, 2009) can lead to 'conflicts' between interest rate and exchange rate movements, thereby weakening the effectiveness of monetary policy tools.
- A critical precondition for credible inflation is the **absence of fiscal dominance**. This condition often is not met in lower income countries where Central Bank's are politically obliged to fund government deficits.
- A danger of inflation targeting is that – by focusing on prices alone – it can prompt **unsustainable reactions to terms of trade shocks**. For instance, a negative terms of trade shock (e.g., an increase in the price of a country's imports) could lead the Central Bank to

raise interest rates, in turn appreciating the exchange rate. However, a more sustainable response would be to shift spending away from imports toward domestic products.