



➤ Estimating the Natural Rate of  
Interest for Jamaica

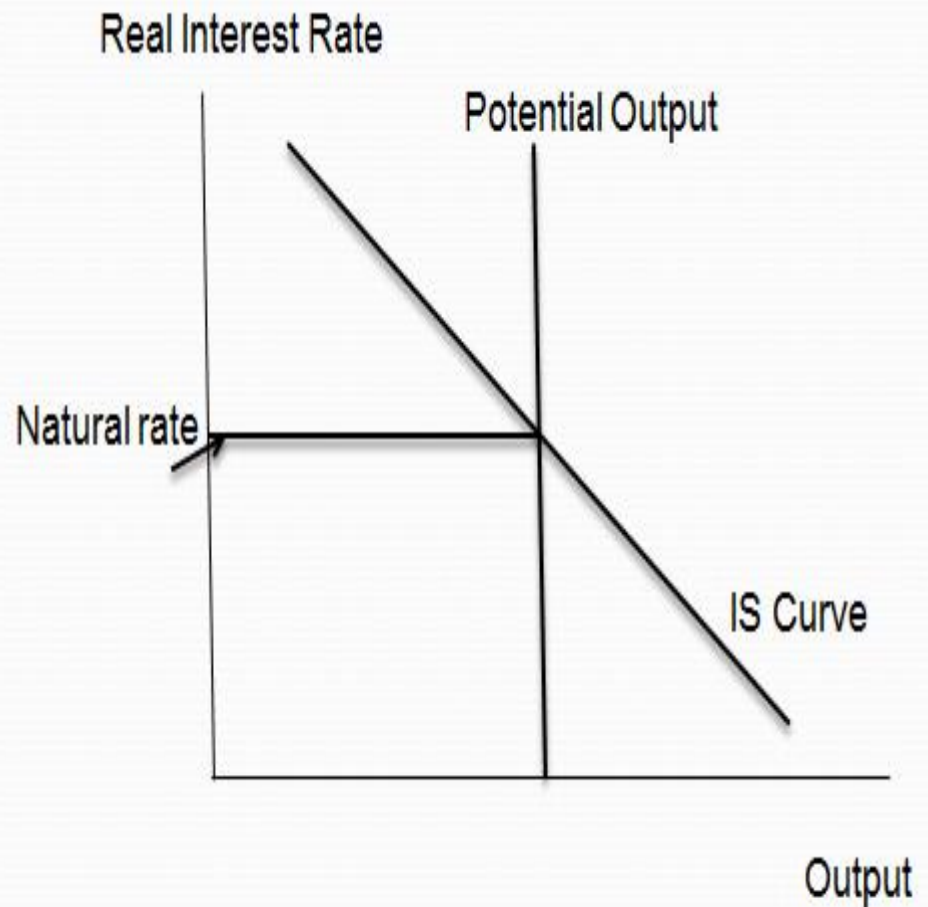
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# Outline

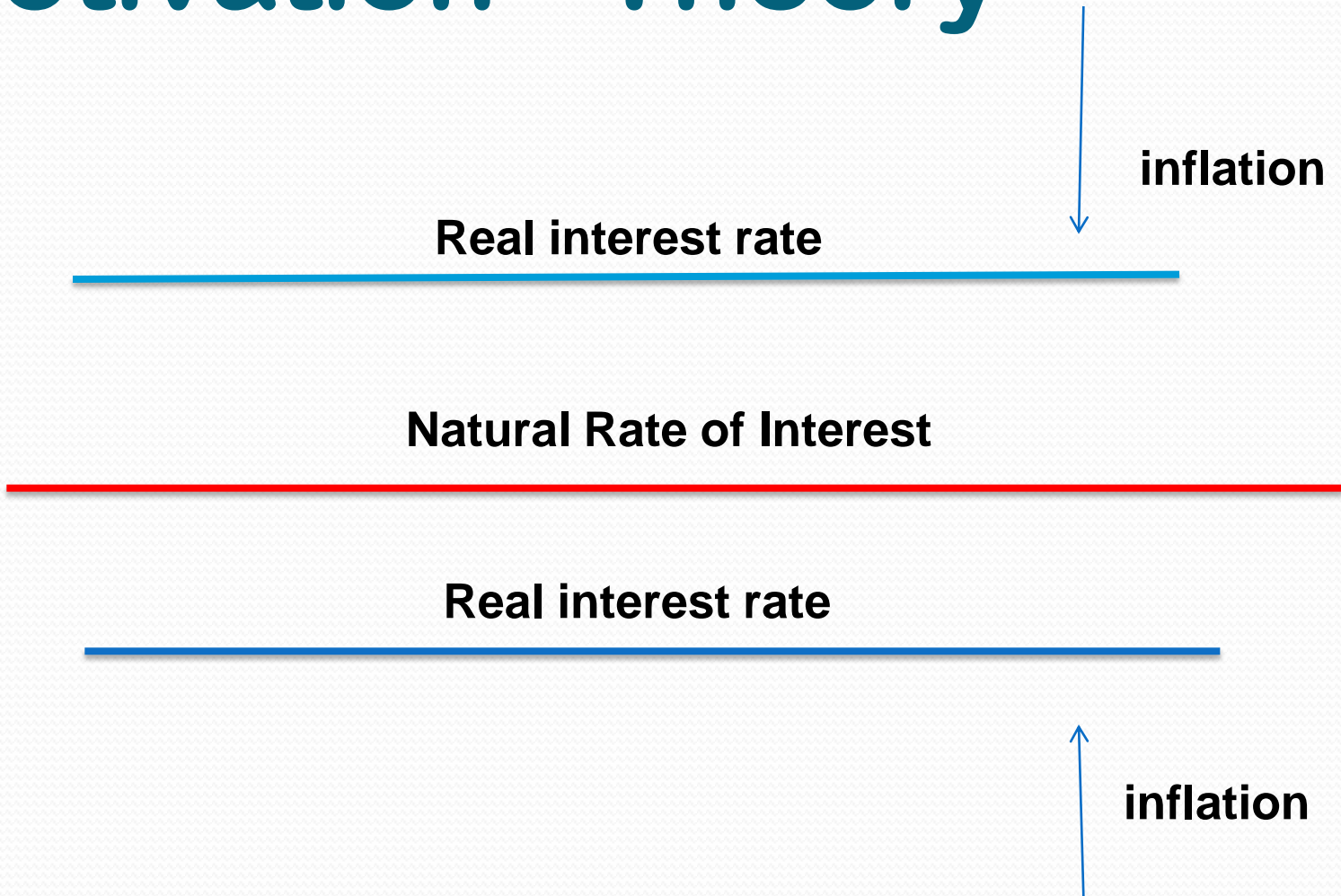
- Definition of the Natural Rate of Interest
- Motivation and Objectives
- Stylized Facts
- Review of Literature
- Methodology
- Results
- Conclusion and Policy Implication

# Definition of the Natural Rate of Interest

- The natural rate of interest, is the real interest rate consistent with an output gap of zero and stable inflation at its target



# Motivation - Theory



# Motivation

- For the last two decades Jamaica has been caught in a vicious cycle of **low growth and unsustainable fiscal debt**.
- The **2008 global financial crisis worsened economic conditions** and with severe demand pressures in the foreign exchanges market, the central bank increased interest rates.
- In the aftermath of the 2008 global financial crisis, the BOJ effected significant reductions in its policy rate

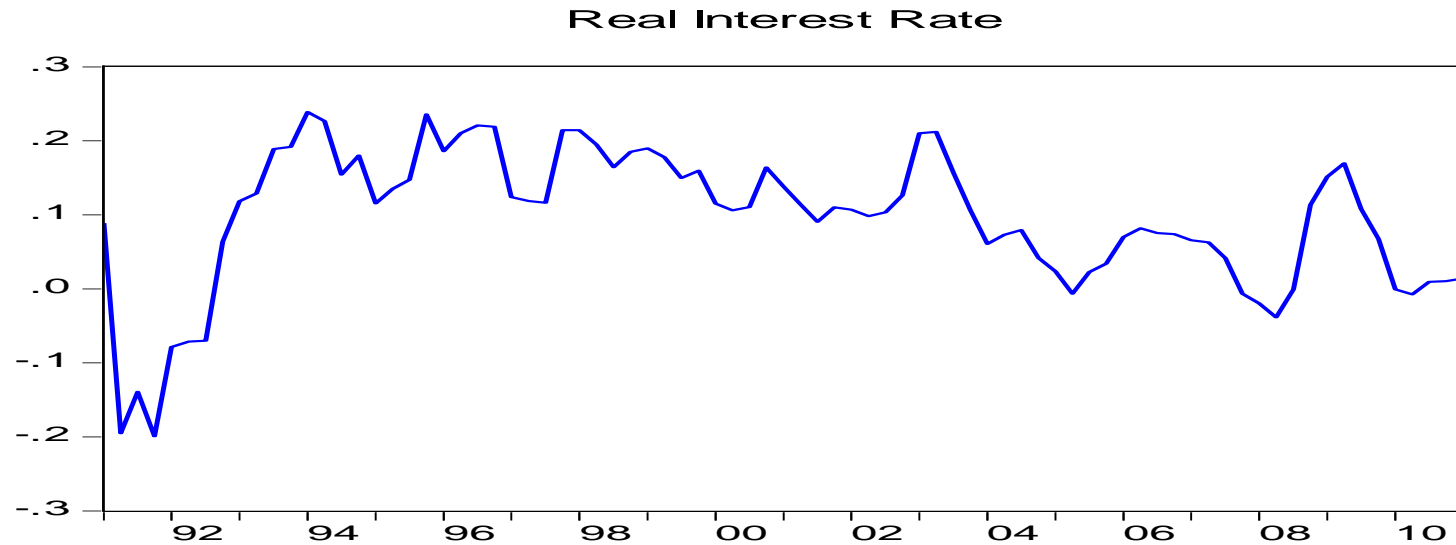
# Objectives of the Paper

In light of the theoretic relationship between the interest rate gap and inflation and the continuous decline in interest rate in Jamaica, this study seeks to assess

- **What is the natural rate of interest for Jamaica?**
- **Based on the assessed level of the natural rate of interest, can our rates be lowered further?**
- **What is the nature of the credit channel**



# Stylized Facts



	Core Inflation	Headline Inflation	Real Interest Rate	Growth rate (Real GDP)	Imported Inflation
Mean	0.020	0.041	0.095	0.002	0.037
Median	0.017	0.025	0.109	0.002	0.020
Maximum	0.063	0.218	0.239	0.052	0.330
Minimum	0.004	-0.002	-0.199	-0.058	-0.057
Std. Dev.	0.012	0.041	0.094	0.014	0.065
Obs.	84	84	82	81	84

# Review of Literature

The concept of the natural rate of interest dates back to the seminal work of Wicksell (1898)

- Ophanides and Williams (2002)
- Laubach and Williams (2003)
- Garnier and Wihelmsen (2005)



# Review of Literature

## Laubach and Williams (2003)

- Aim to estimate the natural rate of interest given the importance of short-term interest rate in the conduct of monetary policy in the United States.
- Define the natural rate of interest as real interest rate consistent with output equaling potential and stable inflation
- Specify the natural rate of interest is a function of the trend growth rate of potential output
- Use Kalman filter to jointly estimate potential output, trend growth and the natural rate of interest for the period 1961:1 to 2002:2
- Found a strong negative relationship between interest rate gap and inflation in the United States.

# Methodology – Estimation Techniques

- Both Kalman filter and HP filter were used to generate estimates of the Natural rate of interest
- The HP filter, a purely statistical technique extracts the trend component of particular series.
- The Kalman filter is a multivariate method used to estimate unobservable variables by specifying them as a function of observed variables in a state space form. Kalman filter combines economic theory with time series techniques, hence it has the ability to provide economic interpretation for the unobserved variable.

# Methodology

1. Estimate potential output, its growth rate and the output gap.
2. Estimate the natural rate of interest and the interest rate gap.

In so doing we put proposed a model of Neo-Keynesian inspiration which defines the behaviour of the interest rate gap, inflation and the output gap through variants of the IS and Phillips curves.

# Methodology – Stage One

## Potential Output and the Output Gap

### Signal Equations

$$Y_t = \tilde{Y}_t + Y_t^*$$

where  $Y_t$  represents actual output,  $Y_t^*$  represents potential output and  $\tilde{Y}_t$  represents the output gap

$$\pi_t = \beta_\pi \pi_{t-i}^{(+)} + \beta_{\tilde{Y}_t} \tilde{Y}_{t-i}^{(+)} + \beta_x x_{t-i} + \varepsilon_{\pi t}$$

where  $\pi_t$  represents inflation,  $\tilde{Y}_t$  represents the output gap and  $x_t$  captures all other determinants of inflation as a proxy we use imported inflation.

### State Equations

$$Y_t^* = c + Y_{t-1}^* + \varepsilon_{Y_t^*}$$

$$\tilde{Y}_t = a_{\tilde{Y}} \tilde{Y}_{t-1} + \varepsilon_{\tilde{Y}_t}$$

# Methodology - Model

OLS regressions were used to obtain starting coefficient values for the state space model as well as to identify the functional form of the unobserved variables.

- The output gap was subsequently defined as a AR(3) process.
- Two lags of inflation, one lag of the output gap and one of imported inflation were used in the Phillips curve.

# Methodology–Stage Two

## Natural rate of interest and interest rate gap

### Signal Equations

$$r_t = \hat{r}_t + r_t^*$$

where  $r_t$  represents real interest rate,  $\hat{r}_t$  represents the interest rate gap and  $r_t^*$  represents the natural rate of interest.

$$\tilde{Y}_t = \alpha_{\tilde{Y}} \tilde{Y}_{t-i} + \alpha_r (r_{t-i} - r_{t-i}^*) + \varepsilon_{\tilde{Y}t}$$

where  $\tilde{Y}_t$  represents the output gap

### State Equations

$$r_t^* = cg_t + z_t$$

$$z_t = \phi_1 z_{t-1} + \phi_2 z_{t-2} + \varepsilon_{zt}$$

OLS regressions were used to obtain starting coefficient values and to identify the functional form of the interest rate gap equation. It was defined as an stationary AR(2) process

# Methodology - Data

The sample consists of quarterly observations from 1990:1 to 2011:1

The set of variables include

- Real interest rates – 180-day Treasury Bill rates adjusted for inflation
- Inflation – changes in CPIFF and CPI
- Real gross domestic product - Real GDP
- imported inflation
- Dummy variables for structural breaks

All variables except interest rates were logged and adjusted for seasonality

Chow Breakpoint test was used to assess the statistical significance of structural breaks

# Estimation Results - Estimates

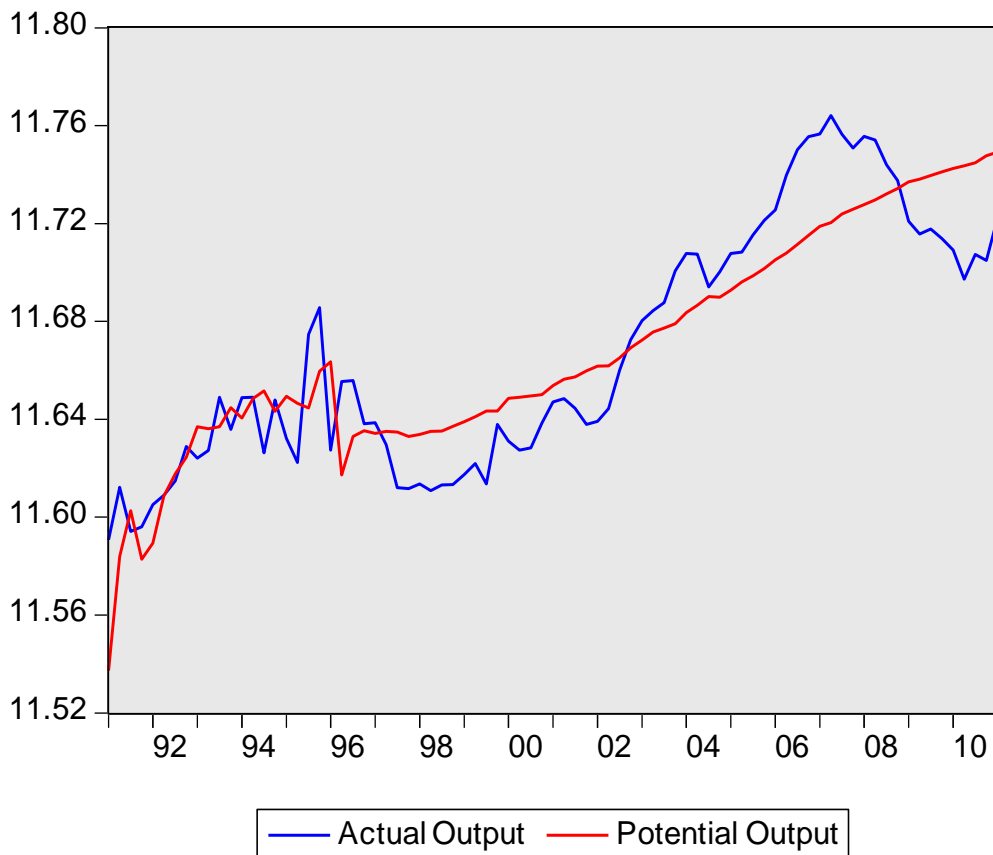
Name of Variables	Symbols	Estimates	Standard Errors
	constant	0.002**	0.001
	<b>Parameters</b>		
Coefficient on the lag of Inflation	$\beta_{\pi}$	0.483***	0.102
Sum of coefficient on lag of Output Gap	$\sum \alpha_y$	0.860	
Coefficient on the Output Gap (PC)	$\beta_{\tilde{Y}}$	0.041*	0.058
Coefficient on the Imported Inflation(PC)	$\beta_x$	0.071***	0.017
	<b>State variables</b>		<b>Root MSE</b>
Potential Output	$Y^*$	11.752***	0.009
Output Gap	$\tilde{Y}_t$	-0.024**	0.016
Sample	1990:1 2011:1		
Included observations		85	
Convergence achieved after		42 iterations	

Where Asterisk \*\* represents 5% and\*\*\*indicates significance at the 1% level of significance



# Estimation Results

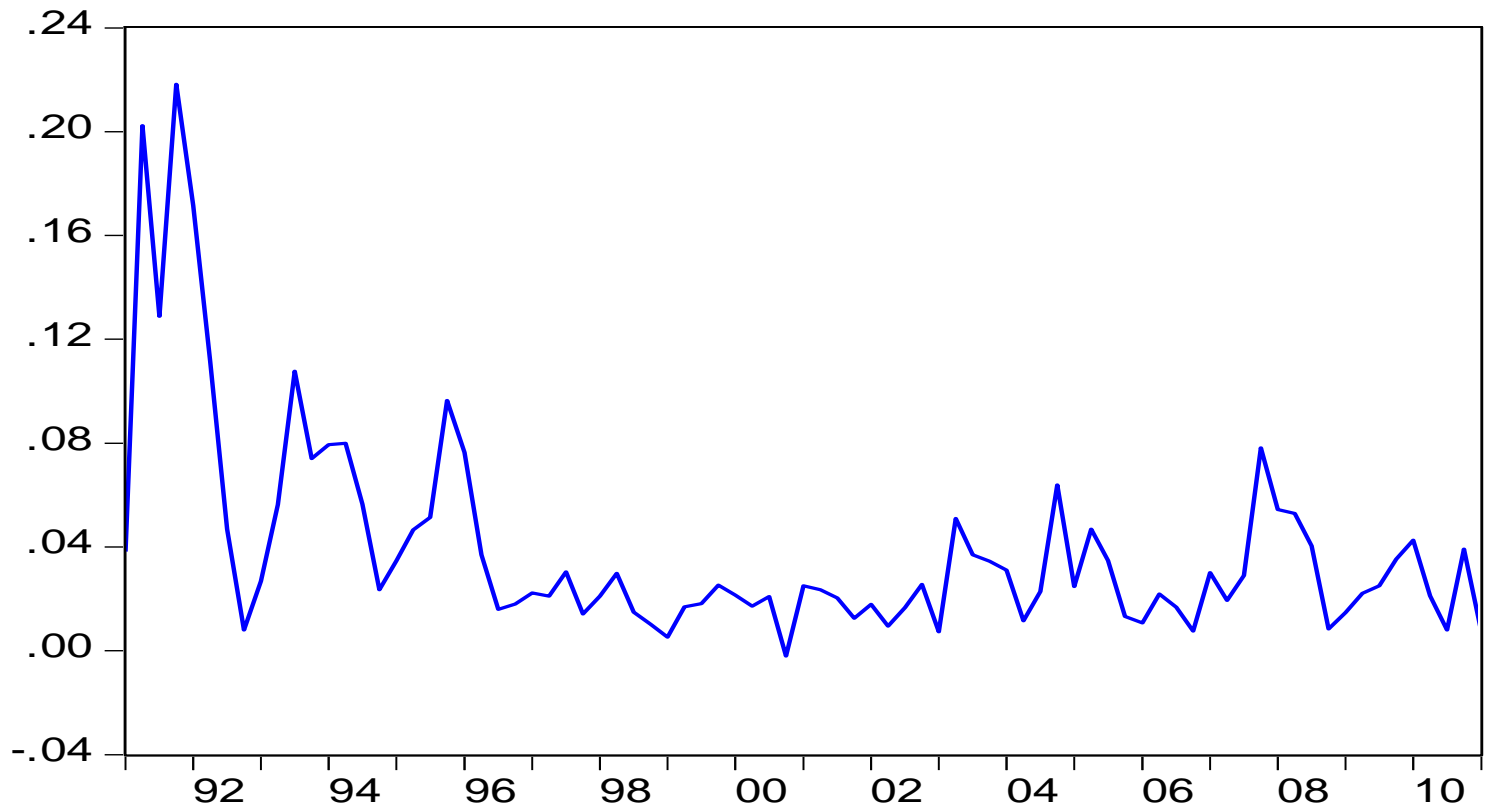
## Actual and Potential Output



## Correlation Analysis

	Output Gap	Core Inflation	Headline Inflation
Output Gap	<b>1.000</b>		
Core Inflation	<b>0.341</b>	<b>1.000</b>	
Headline Inflation	<b>0.215</b>	<b>0.685</b>	<b>1.000</b>

# Inflation

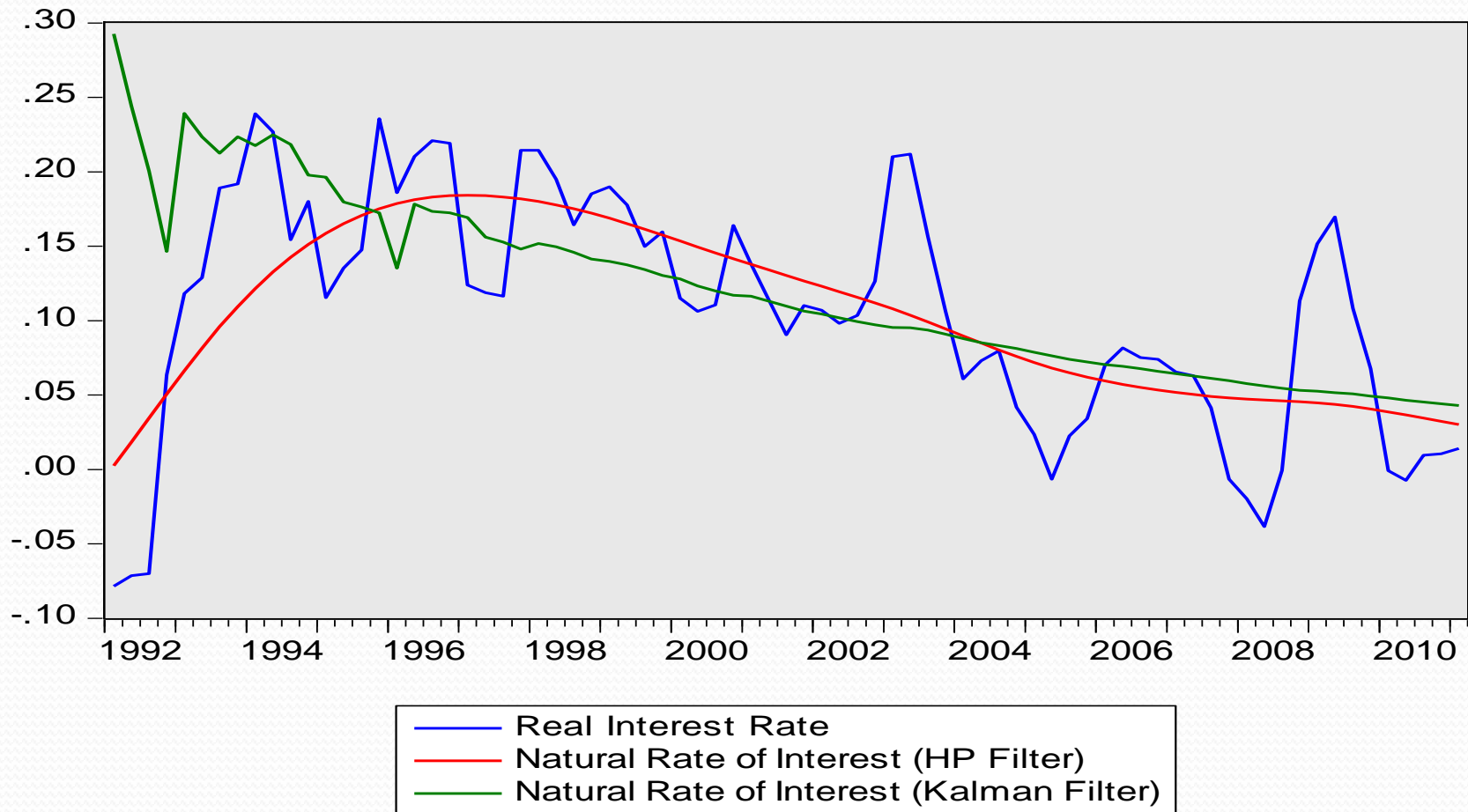


# Estimation Results - Estimates

Name of Variables	Symbols	Estimates	Standard Errors
Coefficient on growth rate	$c$	-0.448	0.627
	<b>Parameters</b>		
Coefficient on 1 <sup>st</sup> lag of $\tilde{r}_t$	$\delta_{\tilde{r}_1}$	0.774***	0.115
Coefficient on 2 <sup>nd</sup> lag of $\tilde{r}_t$	$\delta_{\tilde{r}_2}$	-0.010	0.034
Persistence of output gap	$\alpha_y$	0.860***	0.095
Coefficient on 1 <sup>st</sup> lag of $z_t$	$\Phi_1$	0.975***	0.014
Coefficient on 2 <sup>nd</sup> lag of $z_t$	$\Phi_2$	0.0001	0.008
Coefficient on 1 <sup>st</sup> lag of $\tilde{r}_t$ (IS)	$\alpha_{r1}$	0.0136	0.014
Coefficient on 2 <sup>nd</sup> lag of $\tilde{r}_t$ (IS)	$\alpha_{r2}$	-0.0139*	0.008
	<b>State variables</b>		<b>Root MSE</b>
Natural Rate of Interest (NRI)	$r_t^*$	0.042***	0.005
Interest Rate Gap	$\tilde{r}_t$	-0.022	0.036
Other determinants of NRI	$z_t$	0.041***	0.005
Sample: 1991Q1 2011:1			
Included observations: 81			
Convergence achieved after 35 iterations			

# Estimation Results

Actual Interest Rate and the Natural Rate of Interest (HP Filter and Kalman Filter)



# Estimation Results – Statistical Properties of the Interest Rate Gap

	<b>Interest Rate Gap</b>	<b>Core Inflation</b>	<b>Headline Inflation</b>
<b>Interest Rate Gap</b>	<b>1.000</b>		
<b>Core Inflation</b>	<b>-0.224</b>	<b>1.000</b>	
<b>Headline Inflation</b>	<b>-0.544</b>	<b>0.497</b>	<b>1.000</b>

# Estimation Results – Statistical Properties of the Interest Rate Gap

We also investigate the leading indicator properties of the interest rate gap for inflation. Following the approach of Neiss and Nelson (2003) and Garnier and Wilhelmsen (2005) we estimate the following equation:

$$\pi_t = \alpha + \rho_1 \pi_{t-1} + \rho_2 \tilde{r}_t + \sum_{i=1}^4 \beta_i \tilde{r}_{t-i} + \varepsilon_t$$

where inflation ( $\pi_t$ ) is regressed on a lag of itself, the contemporaneous values of the interest rate gap as well as lags of the real interest rate gap.

# Estimation Results – Statistical Properties of the Interest Rate Gap

Variables	Estimates	Standard Error
$\alpha$	0.01263***	0.00366
$\rho_1$	0.57477***	0.09743
$\rho_2$	0.05361	0.09524
$\beta_1$	-0.04824	0.12790
$\beta_2$	-0.08833	0.08180
$\beta_3$	-0.00030	0.00018
$\beta_4$	-0.00039***	0.00014

Notes: Estimates were obtained from an OLS regression. Asterisk, \* represents 10% level of significance and \*\*\* indicates significance at the 1% level

# Estimation Results

- **Both the Kalman and HP filter estimates indicate that we are currently below the Natural Rate of Interest, yet Inflation is relatively stable**
- This may be because Changes in interest rate have a weak impact on price stability and the effect is with a lag.

(Allen and Robinson, 2004)

- The exchange rate channel has a direct impact on inflation and exchange rate has been relatively stable over the last year



# Conclusions

- There exists a weak negative relationship between the interest rate gap and inflation
- Changes in the interest rate gap affect the output gap and inflation with a lag.
- At the end of the sample period real interest rate was 1.4%. Results from the HP and Kalman filter indicate that the natural rate of interest should be 3% and 4.2% respectively. Therefore interest rates in Jamaica are **too low** and may increase the level of inflation in the future

# Policy Implications

- Real interest rate is currently below the natural rate of interest which may exert inflationary pressures on the economy. This situation may not reveal any particular concern given the weak state of demand as the economy attempts to emerge from the impact of the global recession. However, inflationary impulses could arise from a pickup in demand over time.
- Therefore we must be cautious, as our efforts to promote growth (through the current easing of monetary policy) may increase inflation in the future.



Thank You