Is there a Phillips Curve in Pakistan?

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1. INTRODUCTION

Since the publication of A.W. Phillip's (1958) influential paper on the relationship between unemployment and the rate of change of the money wage rate, countless studies have appeared to refine, reformulate and re-estimate structural equations explaining the rates of change in the wage rates and the price level or inflation rates.[1] The empirical findings of the Phillips curve relationships during the past two decades have been considered to be a contentious issue particularly in developed countries.[2] Despite the fact that the original hypothesis of the Phillips curve has been questioned and challenged,[3] nevertheless, the importance of this subject has been preserved by its continued relevance for policy. Not only that, Friedman (1970, 1971) claimed that the Phillips curve plays the important role of the "missing equation" separating his own quantity theory of money from the Keynesian theory.

Although the lessons on the Phillips curve dynamics which talk of a trade-off between inflation and unemployment might be applied by policy-makers in developing economies, the empirical implementation of such a relationship in such countries has not been very successful (particularly in Pakistan) as opposed to developed economies. To my knowledge not a single study has been done on estimating the Phillips curve for the Pakistani economy. The general reasons given for such an argument are that (a) the unemployment and/or vacancy rate variables are, in general, not available, (b) specification errors arising from the omission of exogenous variables (e.g., weather and foreign trade variables) which would be of greater relative importance in developing countries than developed economies, (c) there are greater measurement errors in developing economies than in developed ones, and (d) simultaneity bias.

[1]This type of functional relationship is commonly known as the Phillips curve in the literature.

[2]Frisch (1977) and Johnston (1980) offer an excellent survey of the relevant theoretical and empirical literature on Phillips curve for the post-1967 period in developed countries.

[3]It was challenged on the basis that (a) its justification is at best ambiguous, (b) the relationship is unstable, and (c) it is only a short-run relationship.

In this paper we argue that most of the problems cited above in the impelmentation of the Phillips curve can be resolved and a meaningful empirical Phillips curve relationship for Pakistan can possibly be estimated. We adopt the suggestion in McCallum (1974) which simply argues that the use of unemployment and/or vacancy rate "proxies" for excess demand in the labour market is unnecessary as well as undesirable and that one can derive an expression for excess demand from the standard equilibrium theory which incorporates only observable variables. Further, we estimate the expectations-augmented Phillips curve within the framework of a complete macro model that recognizes the dependence of Pakistan's domestic economy on the foreign sector and avoids the problems of simultaneity biases. In addition, we assume that price expectations are rational in the sense of being true mathematical expectations computed using the equations of the model and the values of all relevant variables realized in periods $t-1$ and earlier.

The empirical implementation was conducted using quarterly data over the period 1972-1 to 1981-4. The expectations-augmented Phillips curve along with other equations of the model was estimated using a single equation instrumental variables (SIV) technique [e.g, McCallum (1976 and 1976a) and Hasan (1987)] and a full system FIML generalized errors-in-variables (FGEV) method [e.g., Wickens (1982) and Hasan (1987)].

The structure of the Phillips curve model to be estimated is presented in Section 2. Section 3 deals with the econometric methodology. The estimations results are reported in Section 4 and finally Section 5 offers some conclusions.

2. THE BASIC MODEL

The small open economy (SOE) macro model is set in a discrete time. The SOE is assumed to trade in both goods and financial assets with the rest of the world. Domestic production consists of a single composite commodity which is both exported and domestically consumed. A different composite good is imported from abroad. The SOE is small in import markets and in world financial markets but has some market power in the market for its own produced good.[4] As a result, the price of domestic output can be determined endogenously.

The flow of financial capital is assumed to be imperfectly mobile in Pakistan or, for that matter, in most of the other developing economies. This has two aspects, firstly, that the financial asset markets in Pakistan are heavily controlled and strictly administered by the government and secondly that international transaction costs and exchange controls are not negligible. Consequently, in our macro model, the

foreign financial component is assumed to play an insignificant role.

The monetary base consists of a domestic and a foreign reserve component. The domestic component is controlled by the monetary authority while the foreign reserves component is kept constant by allowing the exchange rate to float freely. The nominal money balances, assumed for simplicity to be a constant multiple of the base, can thus be treated as an exogenous variable. Also, for simplicity reasons the government budget constraint is ignored in the model. The three equation macro model for Pakistan's SOE can be written as follows:

$$y_t = \alpha_0 + \alpha_1 (m_t - p_t) + \alpha_2 (m_{t-1} - p_{t-1}) + \alpha_3 (p^e_{t+1,t} - p_t) +$$
$$\alpha_4 (p_t - e_t - p^f_t) + \mu_{1t}; \qquad \alpha_1, \alpha_2 > 0, \alpha_3, \alpha_4 < 0 \quad \dots \quad (1)$$

$$w_t - w_{t-1} = \beta_0 + \beta_1 (y_{t-1} - n_{t-1}) + \beta_2 (w_{t-1} - p_{t-1}) + \beta_3 (p_{t-1} - g_{t-1})$$
$$\beta_4 (p^e_{t,t-1} - p_{t-1}) + \mu_{2t}; \qquad \beta_1 > 0, \beta_2 < 0 \quad \dots \quad (2)$$

$$p_t - p_{t-1} = \gamma_0 + \gamma_1 y_t + \gamma_2 w_t + \gamma_3 p_{t-1} + \gamma_4 T_t + \mu_{3t} \quad \dots \quad (3)$$

$$p^e_{t+i,t-j} = E(p_{t+i}|I_{t-j}); \quad ; \qquad i = 0, 1; j = 1, 0 \quad \dots \quad (4)$$

$$p_{t+i} = E(p_{t+i}|I_{t-j}) + \eta_t \quad \dots \quad (5)$$

where the magnitudes of all variables are in logarithms and they are defined as:

y_t = is the real aggregate expenditure on domestic output;

p_t = is the price of domestic output;

m_t = is the domestic nominal stock of money balances;

w_t = is the domestic nominal wage rate;

g_t = is the domestic cost of living;

p^f_t = is the foreign price of imports;

e_t = is the exchange rate (domestic currency price of foreign currency);

T_t = is the simple time trend;

n_t = is a population measure; and

$E(p_{t+i}|I_{t+j})$ is the mathematical expectation of p at time $t+i$, conditional on information set (I) available at time $t-j$.

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[4] In the small open economy literature, goods are sometimes partitioned into domestic-foreign and also tradeable-nontradeable. Turnovsky (1977) and Prachowny (1981) are examples of the above partitioning, respectively.

Aggregate Demand

Equation (1) is the familiar aggregate demand function which is obtained from the following ISLM framework:

$$y_t = a_0 + a_1 [r_t - (p^e_{t+1,t} - p_t)] + a_2 (p_t - e_t - p^f_t) + a_3 Z_t; \quad a_1, a_2 < 0, \quad (6)$$

$$m_t - p_t = b_1 y_t + b_2 r_t + b_3 (m_{t-1} - p_{t-1}) \qquad b_1 > 0, b_2 < 0, \qquad \ldots \qquad (7)$$

Equation (6) is the conventional IS curve that characterizes aggregate demand for the domestic good as function of the expected real interest rate, relative prices of foreign and domestic goods and a vector of exogenous variables. The expected real interest rate is in terms of the domestic cost of living since it is intended to capture the effect of substitution between consumption and saving. A rise in the domestic price relative to the foreign price (an increase in the terms of trade) decreases aggregate demand. In the case of perfect substitution between domestic and foreign goods, a_1 becomes infinite in size and this aggregate demand equation reduces to the familiar purchasing power parity relationship.

The demand for real cash balances, Equation (7), is expressed as a function of real income and the nominal interest rate excluding real wealth and incorporates the assumption that the demand for and supply of real cash balances are equal in every time period. Given (6) and (7) and ignoring Z_t, for the sake of convenience, it is a trivial matter to eliminate r_t and obtain the aggregate demand for real output as represented by Equation (1).

Aggregate Supply

The supply side of the model consists of an expectations-augmented Phillips curve, Equation (2), and a price-setting behavioural relationship as represented by Equation (3).

In Equation (2), $(w_t - w_{t-1})$ represents the proportionate change of money wage rate from period $t-1$ to period t, and $(y_{t-1} - n_{t-1})$, $(w_{t-1} - p_{t-1})$ and $(p_{t-1} - g_{t-1})$ together represent excess demand for labour.

As for the specification of a measure of labour market tightness in Equation (2), we adopted McCallum's suggestion that the use of unemployment and/or vacancy rate "proxies" for excess demand in the labour market is unnecessary as well as undesirable. Therefore, following McCallum (1974) we have derived from the standard equilibrium theory an expression for excess demand that incorporates only observable variables.[5]

[5] For a detailed discussion on the derivation of the proxy for the excess demand for labour, readers may refer to [McCallum (1974) pp. 57-58].

In order to derive the price-setting Equation (3) we assume that the prices and wages are related with a mark up, that is, they are high when output relative to its trend value is high:

$$p^*_t = w_t + c_0 + c_1 y_t \qquad c_1 > 0, \qquad \ldots \qquad \ldots \qquad (8)$$

where p^*_t is the equilibrium value of p_t.

Following McCallum (1978), assume that prices adjust to cost with some lags as specified by the partial-adjustment formula:[6]

$$(p_t - p_{t-1}) = \lambda (p^*_t - p_{t-1}) \qquad 0 < \lambda < 1 \qquad \ldots \qquad \ldots \qquad (9)$$

Combining (8) and (9) and introducing a trend variable to reflect technical progress, we get a relationship describing short-run excess demand for output as represented by Equation (3).

Since the main subject of interest in this paper is to empirically determine whether a negatively slopping Phillips curve relationship exists for Pakistan's economy, our focus in the estimation of the macro model will be on the expectations augmented Phillips curve represented by Equation (2). In other words, we would be interested in knowing the magnitude of the estimated coefficient of the expected inflation variable (β_4) in Equation (2). A larger and closer to unity value of the β_4 coefficient would make the Phillips curve vertical and hence supporting the Friedman (1968) and Phelps (1972) accelerationist view that there is no long run trade-off. On the other hand a small and less than unity value of β_4 would support the hypothesis of the existence of a Phillips curve.

3. ECONOMETRIC METHODOLOGY

We observe that the macro model composed of Equations (1) to (5) is block-recursive, with the expectations-augmented Phillips Equation (2) forming the lowest order block. McCallum (1976) proposes that this equation can be consistently estimated in isolation using a single equation instrumental variable (SIV) technique even if its disturbance is contemporaneously correlated with those of other two equations of the system.

[6] The standard justification for gradual price adjustment is the presumption of real resource adjustment costs associated with price changes. Barro (1972) shows that, for a monopolist with uncertain demand and with the assumption that the costs of effecting price changes are lump-sum in nature, the price adjustments will tend to be of the "bang-bang" type. Nevertheless, although the adjustment pattern exhibited by Equation (14) might appear unappealing at the level of the individual firm, it is probably a reasonable depiction of average behaviour in a macroeconomic context.

In order to estimate the complete model with unobservable rational expectations variables, a FIML generalized errors-in-variables (FGEV) method, as proposed by Wickens (1982), can be used. FGEV is a full information method, which though obviously more complex, is conceptually simple. This method is basically a generalized iterative version of McCallum's SIV technique. The usefulness of this method is that it can be implemented at the structural level of the model and therefore, one can avoid the complex cross-equation restrictions as imposed by rational expectations hypothesis. For a more comprehensive discussion on this technique [see Hasan (1987) and Wickens (1982)].

4. DATA AND ESTIMATION RESULTS

The data set used for empirical work consists of forty quarterly observations on various macroeconomic time series variables, spanning over the period 1972-1 to 1981-4. With the exception of wage rate and population variables, all other series were collected from the various issues of the International Financial Statistics published by the International Monetary Fund (IMF). The wage rate data was taken from International Labour Organization (ILO) publications, while the population variable was collected from the Pakistan Economic Survey.[7]

We have estimated the expectations-augmented Phillips curve Equation (2) twice, once in isolation using the SIV technique and the other within the framework of a complete macro model Equations (1) to (5) using the FGEV method.

SIV Estimates

Several different estimates of Equation (2) were obtained, the differences reflecting alternative sets of variables included in the first-state regressions used to compute the instrumental variable. The different options of the instruments and the corresponding SIV estimates of Equation (2) are presented in Table 1. In each of these options all the right-hand side exogenous variables in Equation (2) are included in the first stage of regression.

The estimates presented in Table 1 seems quite plausible with each of the excess demand coefficients having the expected theoretical sign. It is interesting to note that β_3 appears with a negative sign implying a positive elasticity of labour supply with respect to the real wage.[8] This result confirms a positively slopping labour supply curve for Pakistan which is theoretically consistent at least in the developing country context.

[7] Since the wage and population variables are available only on an annual basis, a regression interopolation technique has been used to generate the quarterly observations for these variables.

[8] The analytical derivation and an explanation as to why a negative value of β_3 will imply positive elasticity of demand for labour is given in Hasan (1987a).

Table 1

Alternative SIV Estimates of the Expectations Augmented Phillips Curve

$$w_t - w_{t-1} = \beta_0 + \beta_1(y_{t-1} - n_{t-1}) + \beta_2(w_{t-1} - p_{t-1}) + \beta_3(p_{t-1} - g_{t-1}) + \beta_4(p^e_{t,t-1} - p_{t-1})$$

	PARAMETER							
	β_0	β_1	β_2	β_3	β_4	$\bar{R}^2$	SSE	DWS
OPTION I								
	0.2118	0.1929	-0.4507	-0.2287	0.4518	0.873	0.006	1.97
	(0.089)	(0.097)	(0.126)	(0.101)	(0.215)			
OPTION II								
	0.2104	0.2205	-0.4508	-0.2931	0.1881	0.892	0.004	1.72
	(0.093)	(0.107)	(0.132)	(0.110)	(0.085)			
OPTION III								
	0.2117	0.1945	-0.4507	-0.2325	0.4364	0.931	0.001	1.71
	(0.089)	(0.087)	(0.126)	(0.109)	(0.211)			

INSTRUMENTS (OPTION I): $[y_{t-1} - n_{t-1}], (w_{t-1} - p_{t-1}), (p_{t-1} - g_{t-1}), m_t, e_t, T_t, p_{t-1}, y_{t-1}]$

INSTRUMENTS (OPTION II): $[y_{t-1} - n_{t-1}], (w_{t-1} - p_{t-1}), (p_{t-1} - g_{t-1}), m_t, e_t, T_t, p_{t-1}, y_{t-1} (p_{t-1} - p_{t-2}), (p_{t-2} - p_{t-3})]$

Table 1 (Continued)

OPTION IV

Coefficient estimates (standard errors in parentheses):

0.2237 (0.098) 0.1974 (0.102) −0.4528 (0.201) −0.2642 (0.113) 0.3134 (0.151) 0.947 0.0007 2.21

OPTION V

0.2104 (0.093) 0.2205 (0.112) −0.4507 (0.132) −0.2931 (0.163) 0.1881 (0.071) 0.958 0.0004 1.74

INSTRUMENTS: $|(v_{t-1} - n_{t-1}),\ (y_{t-2} - n_{t-2}),\ (w_{t-1} - p_{t-1}),\ (w_{t-2} - p_{t-2}),\ (p_{t-1} - g_{t-1}),\ m_t,\ m_{t-1},\ e_t,\ e_{t-1},\ T_t,$
$p_{t-1},\ p_{t-2},\ y_{t-1},\ y_{t-2}|$

INSTRUMENTS: $|(v_{t-1} - n_{t-1}),\ (w_{t-1} - p_{t-1}),\ (p_{t-1} - g_{t-1}),\ m_t,\ m_{t-1},\ e_t,\ e_{t-1},\ T_t,\ p_{t-1},\ y_t,\ (p_{t-1} - p_{t-2}),$
$(p_{t-2} - p_{t-3})|\}$

INSTRUMENTS: $|(p_t - p_{t-1})|$

The natural rate hypothesis ($\beta_4 = 1$) that the Phillips curve is vertical was rejected at the 95 percent level of confidence using Options I–IV. Option I includes all of the predetermined variables in the system [Equations (1) – (5)] as well as other lagged variables as instruments. The other options add more regressors in the first stage of estimation thus producing instrument variables that are increasingly correlated with $(p^e_{t,t-1} - p_{t-1})$. Option V stretches this process to the limit by using $(p_t - p_{t-1})$ as its own instrument; i.e., Equation (2) is estimated by OLS. The effects in this case are an increase in the $\bar{R}^2$ value and a decline in the magnitude of β_4.

McCallum (1976a) argues that since the OLS option can be interpreted as having a first-state regression with $\bar{R}^2 = 1$, one can conclude that the inclusion of

Table 2

FGEV Estimates of the Structural Model (Equations 1, 2, and 3)

Aggregate Demand

$$y_t = 0.2643 + 0.4855(m_t - p_t) - 0.1043(m_{t-1} - p_{t-1}) -$$
$$(0.413)^* \quad (0.043) \qquad\qquad (0.052)$$

$$0.0319(p^e_{t+1,t} - p_t) - 0.0886(p_t - e_t - p^f_t)$$
$$(0.015) \qquad\qquad (0.044)$$

$$SSE = 0.012, \qquad DWS = 1.919$$

Expectations-augmented Phillips Curve

$$w_t - w_{t-1} = 0.1493 + 0.2924(y_{t-1} - n_{t-1}) - 0.4173(w_{t-1} - p_{t-1}) -$$
$$(0.083) \quad (0.163) \qquad\qquad (0.118)$$

$$0.1404(p_{t-1} - g_{t-1}) + 0.4108(p^e_{t,t-1} - p_{t-1})$$
$$(0.072) \qquad\qquad (0.142)$$

$$SSE = 0.0016 \qquad DWS = 1.892$$

Excess Demand Equation

$$p_t - p_{t-1} = -0.5433 + 0.4238y_t + 0.0314w_t - 0.3464p_{t-1} + 0.977T_t$$
$$(0.213) \quad (0.175) \quad (0.015) \quad (0.099) \quad (0.052)$$

$$SSE = 0.0159 \qquad DWS = 1.688$$

*The numbers presented in the parentheses are standard errors.

"too many" first-stage regressors will lead to systematic underestimation of β_4. He further argues that the result is predictable on the basis of asymptotic theory: as the frame is equivalent to an errors-in-variables model, the OLS estimates of β_4 is asymptotically biased toward zero.

FGEV Estimates

In terms of the complete macro model, it is interesting to estimate the structural parameters by using the FGEV method as discussed earlier. These estimates are reported in Table 2. The FGEV estimates of β_4 are now greater than the corresponding SIV estimates but the natural rate hypothesis that the Phillips curve is vertical is still rejected at the 95 percent confidence.

The coefficients β_1, β_2 and β_3 together represent the short-run "trade-off" between excess demand for labour and wage inflation in the present model. All three coefficients are statistically different from zero. Interestingly, rationality of expectations built into the model does not wipe out the short-run "trade-off". As a matter of fact, since β_4 is statistically different than unity, a long-run trade-off seems to exist.

5. CONCLUSIONS

This paper has provided some structural evidence indicating a substantial degree of inertia in commodity prices in Pakistan within the context of a complete rational expectations macroeconomic model. The evidence also supports the existence of a short-run Phillips curve for Pakistan for the period 1972-1 to 1981-4. What is more interesting is the existence of a long-run "trade-off" between excess demand for labour and inflation despite the fact that inflationary expectations are assumed to be rational. The latter result is probably due the rigidities present in the labour markets in terms of the existing long-term wage contracts.

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Comments on
"Is there a Phillips Curve in Pakistan?"

The Phillips Curve has been at the centre of macroeconomic debate since the mid-Sixties. During the 1960's policy-makers in developed countries exploited this curve to find if a trade-off existed between inflation and the unemployment rate. Because of its central importance to macroeconomic policy the relationship between inflation and unemployment (i.e. Phillips Curve) has been tested empirically for many developed countries. Very little attention has been devoted to this issue in developing countries in general and Pakistan in particular.

Aynul Hasan's paper is indeed a first attempt for Pakistan. He has not only estimated a Phillips Curve for Pakistan but has attempted to bring the rational expectations (RE) revolution to Pakistan. He has estimated the Phillips Curve using the framework of the RE macroeconomic model and, in this regard, this is indeed a fine attempt. I have one major comment and two suggestions.

Major Comment

My major comment deals with the price-setting equation of the model (i.e., Equation (3). This is a RE model where the author has assumed that the price expectations are rational in the sense of John Muth. However, in deriving Equation (3) the author became a typical Keynesian. In his Equation (15), he relates prices and wages with a *mark up*, i.e., they are high when output relative to its trend value is high. This is typically a Keynesian way to relate prices.

My comment is that since the model is a RE macroeconomic model, let it remain a RE model. What the author can do is that instead of writing an *ad hoc* Keynesian type Equation (15), the market clearing (equilibrium) price (P*) can be derived by equating aggregate demand Equation (1) and aggregate supply Equation (2) and then using the partial adjustment mechanism Equation (16) the price-setting equation, like Equation (3), can be derived.

Suggestions

1. The author has used a RE model and found results which are completely anti-RE, i.e., both the short-run and the long-run Phillips Curves are found to exist in the case of Pakistan. This finding is heartwarming for the Keynesians. However, before we allow the Keynesians to be happy over this result a little exercise can be done.

It has been suggested in the literature that if we change from 'fully' RE to 'partly' RE the results change drastically. I suggest that the author use the 'partly' RE model and check the sensitivity of the results.

2. The author has used quarterly data. In my view, the seasonally adjusted series should be used or seasonal dummies can be incorporated in the regression equation.

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