Brunel University West London

Department of
Economics and Finance

Economics and Finance Working Paper Series

Working Paper No. 09-11

Tomoe Moore

A critical appraisal of McKinnon's complementary hypothesis: Does the real rate of return on money matter for investment in developing countries?

February 2009

http://www.brunel.ac.uk/about/acad/sss/depts/economics

A critical appraisal of McKinnon's complementary hypothesis: Does the real rate of return on money matter for investment in developing countries?

Tomoe Moore

Department of Economics and Finance, Brunel University

Uxbridge, Middlesex, UB8 3PH, United Kingdom

Tel: +44 189 526 7531

Fax: +44 189 526 9770

tomoe.moore@brunel.ac.uk

A critical appraisal of McKinnon's complementary hypothesis: Does the real rate of return on money matter for investment in developing countries?

Abstract

McKinnon's (1973) complementary hypothesis predicts that money and investment are complementary due to a self-financed investment, and that a real deposit rate is the key determinant of capital formation for financially constrained developing economies. This paper critically appraises this contention by conducting a vigorous empirical approach by using panel data for 108 developing countries over the sample period of 1970-2006. The long-run and dynamic estimation results based on McKinnon's theoretical model are supportive of the hypothesis. However, when the investment model is conditioned by such factors as financial development, different income levels across developing countries, external inflows, public finance and trade constraints, the credibility of the hypothesis has been undermined.

Keywords: Real deposit rates, Capital formation, Developing economies, Money, McKinnon's complementary hypotheses

JEL Classification: E4, O1

1. Introduction

The assertion of self-financed capital formation for financially constrained developing economies led McKinnon (1973) to develop a complementary hypothesis whereby a high real return on money induces the accumulation of a real money balance, and this, in turn, finances the costly, indivisible fixed capital. The hypothesis formulates a dual process, in which the demand for real money balances depends directly, *inter alia*, on the average real return on capital, and the investment ratio to GDP rises with the real deposit rate of interest. This process provided a plausible empirical framework for researchers in analysing investment decisions and a demand for money function for developing countries. Most literature engages in a single equation framework, either a money or an investment equation. See, for example, DeMelo and Tybout (1986), Edwards (1988), Morriset (1993), which focused on the investment equation, and Harris (1979), Thornton and Poudyal (1990), who modelled a demand for money function. The study of Fry (1978), Laumas (1990), Thornton (1990) and Khan and Hasan (1998) has tested the complementarity hypothesis by estimating both investment (or savings) and the demand for money functions. Pentecost and Moore (2006) investigated the interdependence between the investment and money legs of the joint hypothesis in a simultaneous system of equations for India. In all, the coverage of a sample country is either single country or a group of several countries, and the empirical literature tends to support the complementary hypothesis.

This paper critically appraises McKinnon's complementary hypothesis by conducting a vigorous empirical approach using panel data for 108 developing countries with the sample period of 1970 to 2006. First, we test a panel cointegration for the key variables of money, investment, real return on money, aggregate income and credit. The presence of cointegration is a pre-requisite for the acceptance of the hypothesis. Then, the long run relationship is modelled in a panel system of equations, followed by an error correction dynamic model. We further extend the theoretical model by conditioning the investment behaviour by incorporating the effect of financial development, different income levels across developing countries, external inflows, trade constraints and public finance. These variables are mostly predicted to raise the capital formation independently of the hypothesis.

We find a cointegration relationship among the key variables, providing a necessary condition for the complementarity hypothesis. The long-run and dynamic estimates are supportive, too, since we find a statistically significant effect of return on capital on the demand for money model, and also a significant positive impact of real deposit rates on investment. Evidence reveals that financial development and the status of a middle-income level among developing economies are factors, which reduce self-financed capital formation by mitigating financial constraints. The conditional variables are found to boost the economy by accumulating the physical capital independently of the self-finance hypothesis. Although, even after augmenting the investment model with the conditional variables, real deposit rates are found to be statistically significant, the size of the coefficients is numerically too marginal to provide vital evidence of self-financed capital formation. The empirical result highlights the key role of financial intermediation through the conduit of credit for increased capital formation.

The structure of the paper is as follows. In Section 2, McKinnon's (1973) complementarity hypothesis is specified. Section 3 describes the data employed for estimation, and Section 4 spells out the panel unit root and cointegration tests. Long-run and dynamic models are estimated in Section 5. In Section 6, the investment long-run model is augmented with conditional variables. Section 7 concludes.

2. McKinnon's complementarity hypothesis

McKinnon (1973) asserts self-finance and lump-sum expenditure or indivisibilities of investment for financially-constrained developing countries, hence investors are obliged to accumulate money balances prior to their investment project. Meanwhile, in many developing countries, the decades of high budget deficits had resulted in high domestic borrowings by the government. Government securities at low interest rates were one of the major causes of financial repression, where interest rates were set by administrative decision, which were likely to be below the market-determined levels (Fry 1980). McKinnon emphasises that the removal or relaxation of the administered interest rates would boost capital formation, since the high deposit rates attract the accumulation of money, and stimulate investment.

The complementary hypothesis is examined using the dual models. First, the demand for real money balances (*M/P*) depends positively upon real income, Y, the own real rate of interest on bank deposits, $d - \pi^e$ (d = deposit rates and π^e = expected rate of inflation), and the real average return on capital, c. The positive association between the average real return on physical capital and the demand for money balances represents the complementarity between capital and money as given by (time scripts are omitted for simplicity).

$$M / P = \Psi(Y, c, d - \pi^e) \qquad \Psi_Y > 0, \Psi_c > 0, \Psi_{d-\pi^e} > 0 \qquad (1)$$

The equation (1) suggests that the demand for money is given not only by the transactions and speculative motive of holding cash but also by the need to finance real capital formation in countries, where institutional credit or alternative finance are constrained. There is also the need to hedge against inflation in such a way as to preserve the real value of money balances.

The complementarity works in both directions: money supply has a first order impact in determining investment, hence the complementarity can be accomplished by specifying an investment function given by:

$$I / Y = F(c, d - \pi^e) \qquad F_r > 0, F_{d-\pi^e} > 0 \qquad (2)$$

The investment to income ratio, *I/Y*, must be positively related to the real rate of return on money balances. This is because if a rise in the real return on bank deposits, $d - \pi^e$ raises the demand for money, and real money balances are complementary to investment, it must also lead to a rise in the investment ratio. The complementarity hypothesis specifically requires that $\Psi_c > 0 \quad and\ F_{d-\pi^e} > 0$ [1].

McKinnon's model is, however, restrictive in that it is assumed that there is no role of intermediation by financial institutions from saving (money includes current and time savings) to the creation of credit. This is very unlikely even in under-developed financial markets. Since the indirect effect of real deposit rates on investment is due not only to self-finance, but also to the credit creation from money, where the real supply of credit increases *pari passu* money demand (Fry 1980). Moreover, the level of credit may contain two types of information about the process of financial intermediation. First, changes in credit may reflect an ability of financial intermediaries to make loans perhaps due to changes in monetary policy. In this case, firms, which are unable to obtain funds in the capital market may become credit-constrained leading to lower levels of investment. Second, changes in credit may reflect shocks to the intermediation system itself. In particular, financial liberalisation undertaken in many developing countries initiates various forms of deregulations in financial markets, the creation of financial innovations, or changes in the solvency of borrowers or lenders, which has implications for economic activity that may be transmitted through changes in the quantity of credit (Mallick and Moore 2008). In this respect, the availability of credit to business will affect the investment ratio independently of the self-finance motive of holding money, hence the variable of 'credit' is specified in the investment equation (2). By specifying credit along

[1] Shaw (1973) argues that complementarity has no place here because investors are not constrained to self-finance. Shaw had the debt-intermediation view by specifying a vector of real opportunity costs (real yields on all types of wealth) of holding money in equation (1).

with the real rates of deposit in the investment equation, the two channels of funding sources could be identified: one is self-finance portrayed by the effect of real deposit rates, and the other channel is through credit intermediated by financial institutions.

From an empirical perspective, since it is impossible to compute a sensible measure of the real return on physical capital, McKinnon (1973) suggests that it could be replaced by the investment to income ratio, *I/Y*, which is likely to vary directly with the average real return on capital (see also Pentecost and Moore 2006). The models now become:

$$m/p = \psi(y, i/y, d - \pi^e) \quad (3)$$

$$i/y = f(d - \pi^e, dc) \quad (4)$$

where *m/p= ln(M/P), i/y=ln(I/Y) y=ln(Y/P)* and *dc* is the ratio of domestic credit to private sector to GDP. The models (3) and (4) form a basis for empirical estimation.

3. Data

The data set used to estimate models (3) and (4) are annual data of 108 developing countries covering the period 1970 to 2006. The time series per country contain a minimum of 7 years in sequence. See Appendix 1 for the detailed countries. Note that the study covers more than 70% of all developing countries, as a total of 149 countries are classified as developing countries based on 2006 GNI per capita.

The broad money (*M*) includes money and quasi money (demand and time deposits), and the deposit rates (*d*) are the rate paid by commercial or similar banks for demand, time, or savings deposits. The consumer price index (*p*) is used as the deflator for nominal GDP (*Y*) and the broad money stock, and it is also used for inflation. The capital formation for the private sector (I) is derived from the gross fixed capital formation[2]. All these data are taken from World Development Indicators.

Expected inflation in $d\text{-}\pi^e$ is not directly observable. For a volatile rate of inflation in developing economies, where the future prediction of the variable is extremely difficult, an autoregressive type of expectation seems to be reasonable[3]. We take a naïve expectation, i.e. $\pi_{t+1}^e = \pi_t$. The descriptive statistics are found in Appendix 2.

4. Panel unit root and cointegration tests

The complementarity hypothesis predicts the linkage between money and investment, and that the dependent and independent variables in equations (3) and (4) are likely to form a stable long-run relationship. Hence, we conduct a unit root and cointegration tests in this section.

Unit root tests

It is argued that Fisher's ADF and PP tests proposed by Maddala and Wu (1999) would fit for unbalanced panel data. Maddala and Wu (1999) assume individual unit root process, and combine the *p*-values from individual unit root tests. The test statistics are the asymptotic χ^2. We also conduct two other types of panel unit root tests, developed by Levin et al. (2002) and Im et al. (2003) for the robustness check. Levin et al. (2002) assume that there is a common unit root process so that coefficients on the lagged dependent variables are homogeneous across cross-sections, though incorporates a degree of heterogeneity by allowing for fixed effects and unit specific time trends. In contrast, Im et al. (2003) allow for heterogeneity of

[2] The gross fixed capital formation includes plant, machinery, office, equipment purchases, private residential dwellings, commercial and industrial buildings and also the construction of roads, railways, schools and hospitals. There is no data available exclusively for the private investment for many of these developing countries. Hence, we take a ratio of private sector consumption expenditure to total consumption expenditure (private and government sectors), as a weight on the gross fixed capital formation to derive the private sectorinvestment.
[3] An earlier study by Khan (1988) found that the results were not sensitive to alternative expectations including perfect foresight, static expectations and adaptive expectations.

the coefficients on the lagged dependent variable with the slope coefficients to vary across cross-sections. The null is that all series are nonstationary, whilst the alternative is that at least one cross-section is stationary. See Table 1 for the results.

[Table 1 around here]

The variables of *m/p*, *dc* and *y* in levels are found to be insignificant at the 5% level implying that they are non-stationary. The first difference of these variables rejects the null of unit root[4]. It follows that these variables are characterised as integrated of order one, I(1). The null is rejected for *i/y* and $d\text{-}\pi^e$ in levels, hence they are stationary, I(0).

The unit root test result means that there are I(0) and I(1) mixed in analysing cointegrating relationship. The presence of some I(0) variables in the regressions does not vitiate the test for cointegration. I(0) variables might play a key role in establishing a long-run relationship between I(1) variables, in particular, if theory a priori indicates that such I(0) variables should be included [5].

Panel cointegratin test

The cointegration test is conducted for the five variables of *m/p, y, i/y*, *dc* and $d\text{-}\pi^e$. Since we are analyzing the cointegrating properties of a n >2 dimensional vector of I(1) variables, in which up to n-1 linearly independent cointegration vectors are possible. Hence, the Johansen cointegration test is appropriate. Fisher (1932) derives a combined test that uses the results of the individual independent tests. Maddala and Wu (1999) extend the Fisher's test by developing a Johansen panel cointegration test, which combines tests from individual cross-sections for the full panel. If ω_i is the *p*-value from an individual cointegration test for cross-section *i*, then under the null hypothesis for the panel, we have $-2\sum_{i=1}^{N}\log(\omega_i) \rightarrow \chi^2_{2N}$.

[Table 2 around here]

---

[4] Note that Levin et al. (2002) suggests that *y* and *m/p* in levels are significant at the 5% level, implying the variables is I(0). Yet, the Im et al. (2003) and Fisher tests are not rejected, and that we treat them as I(1).
[5]I(0) variables may contribute to a sensible long-run relationship among I(1) variables (Harris, 1995).

The test result is shown in Table 2. The trace and maximum eigenvalue tests suggest that there are 4 cointegrating vectors at the conventional significance level. Note that the inclusion of I(0) variables (i.e. i/y and $d\text{-}\pi^e$) increases the number of cointegration vectors, since each I(0) variable is stationary by itself, and it forms a linearly independent combination of the variables, which is stationary[6]. The presence of cointegration suggests that there is a long-run stable relationship existing amongst these variables. If the real deposit rates affect money, which in turn affect credit, hence investment, then the cointegration relationship is a conventional standard result. If there is a direct effect of money on the formation of physical capital, the presence of cointegration is a prerequisite for the complementarity hypothesis[7].

5. Long- run and dynamic error-correction model

Long-run model

In panel estimations, the existence of unobservable determinants can be decomposed into a country-specific term and a common term to developing countries. The unobservable country-specific determinants can be taken into account in the estimation procedure, and the models (3) and (4) respectively become:

$$m/p_{\,it} = \beta_{i,0} + \beta_1 y_{i,t} + \beta_2 i/y_{it} + \beta_3\,(d-\pi^e)_{it} + \varepsilon_{it} \qquad (5)$$

$$i/y_{\,it} = \alpha_{i,0} + \alpha_1\,(d-\pi^e)_{it} + \alpha_2\,dc_{it} + \varepsilon_{it} \qquad (6)$$

[6] Dickey et al. (1994) argue that cointegration vectors may represent constraints on the movement of the variables in the system in the long-run, and consequently, the more cointegrating vectors there are, the more stable the system is.
[7] Some empirical literature finds cointegration (see Table 4 in this paper) and claims it as compelling evidence of the complementarity hypotheses. This overrates the finding.

$\beta_{i,0}$ and $\alpha_{i,0}$ are a time-invariant individual country effect term and ε_{it} is an error term[8]. It is possible that country specific terms improved the estimates by absorbing country specific errors and reducing heteroskedasticity.

The cross-country regressions are subject to endogeneity problems. For example, the correlation between real deposit rates and money could arise from an endogenous determination of real rates, that is, real rates themselves may be influenced by innovations in the stochastic process governing the variable of money. Also any omitted factors may increase both real rates and money simultaneously. In these circumstances there would exist a correlation between real deposit rates and the country-specific error terms in equation (5), which would bias the estimated coefficients. The endogeneity problem can be mitigated by applying instrument variable (IV) techniques. A good instrument would be a variable which is highly correlated with regressors, but not with the error terms. We use the lagged values of regressors and dependent variables in each equation. Besides, money is included as an instrument variable in the investment equation, and credit is in the money equation. This is not only due to the complementarity consideration, but also to the following reasons: Under disequilibrium financial conditions, where real deposit rates could be administered, being below equilibrium level, real credit supply is determined by real money demand and there is likely to be little direct feedback mechanism from investment demand to real credit. As there is limited supply (of savings), the volume of investment is determined solely by conditions of supply. In this respect, the use of money, as an instrument variable deals with any simultaneous equation bias in the investment estimate. However, where interest rate ceilings are relaxed or removed, a larger demand for investible funds will elicit an increase in quantity

[8] The period effects are found to be insignificant by the likelihood ratio test, therefore we do not specify the period dummy. It is possible that the regressors may capture some of the shifts in the economy over the sample period. In the next section, when the model is augmented, such period effects are likely to be subsumed in the controlled variables, hence there is not much concern.

supplied through higher returns to savers. This consideration dictates the inclusion of credit as an instrument variable in the money equation.

By using the IV techniques, we estimate the models in two ways: one is in a single equation framework, where money and investment are modelled separately, and the other is in a system of simultaneous equations, where both equations are simultaneously estimated. The estimates of the long-run models are shown in Table 3. An estimator that uses lags as instruments under the assumption of white noise errors would lose its consistency if, in fact, the errors were serially correlated. It is, therefore, essential to satisfy oneself that this is not the case by reporting test statistics of the validity of the instrument variables. We present the first and second order residual serial correlation coefficients and the Sargan test of over-identifying restrictions together with the Breusch-Pagan-Godfray heteroskedasticity test. We also conduct the residual-based panel coingegration test of Pedroni (1999, 2004) and Kao (1999) for each single equation (see Appendix 3 for the specification). It is shown in Table 3 that these residual tests are, in general, satisfactory, and the evidence of stationarity of the residuals seems to steer clear of 'spurious' regression.

[Table 3 around here]

The signs of all the coefficients agree with *a priori* expectations with a statistical significance, except for the real deposit rate in the system of money equation, which fails to reach the 5% significance level. In the money model, the magnitude of the coefficients tends to be larger in the single equation, as compared with that in the system equation. The investment model shows a remarkably similar size of coefficients between the system and single equations.

The positive relationship of the demand for money with the level of aggregate income accords with the transactions demand for money hypothesis. The sizes of the coefficient at 0.86 and 1.37 in the system and single equations respectively are quite plausible, being similar to those found in the empirical literature on the demand for money for developing economies[9]. The positive impact of the investment income ratio on money supports the assumption of self-finance and indivisibility. Thus where self-finance is important, a rise in i/y increases rather than decreases m/p. The estimated coefficient suggests that one percentage point increase in the investment ratio would increase the real money stock by about 0.20 to 0.13 percentage points. In the investment model, it is evident that the availability of credit raises the investment ratio, and the positive relationship with $d\text{-}\pi^e$ highlights the importance of high real rates of interest for capital accumulation. A crucial finding is the significant positive sign on i/y in the money function and $d\text{-}\pi^e$ in the investment function, which provide robust empirical support for the complementarity hypothesis according to McKinnon's (1973) theory.

Financial repression is deemed to be the holding of institutional interest rates, particularly of deposit rates of interest, below their market equilibrium levels. Our empirical evidence reveals that under disequilibrium interest rate conditions, higher deposit rates raise capital formation via the increase in real money balances, where money is defined broadly to include savings. The supply of credit is also due to the increased deposit rates, yet if there is a credit control prevalent[10] and if we also consider such factors as external inflows and international trade in developing economies, there is a limitation in treating it as solely a direct consequence of the increased rates[11]. In this respect, the positive influence of deposit rates on investment is instinctive in terms of the self-financed fixed capital, and proves to be a credible sign of the complementarity hypothesis.

[Table 4 around here]

[9] See the selected studies in Table 11 in Moore et al. (2005) for the income elasticities of the demand for money.
[10] The monetary authorities may generate new credit independently of domestic saving often in response to government policy.
[11] The supply of real credit is also determined by the balance of payments situation (Leff and Sato 1980) .

For a comparative study, we present selected studies of the complementarity hypothesis in Table 4, where the elasticities of level feedback are available in a similar model specification to that of this paper. The income elasticity (y) ranges from 0.45 to 1.17 in the literature and our estimates are quite comparable. The real deposit rate elasticity is relatively small with at 0.00152 in *m/p* model, which is closer to that of Khan and Hasan (1998). The interest rate elasticity is much smaller in the *i/y* model at around 0.00023. Such a low magnitude is again found for Pakistan at 0.0009 by Khan and Hasan (1998). The study of Fry (1978) rejects the complementarity hypothesis since domestic saving is found to be negative for seven of the less developed countries (LDCs) in Asia in a pooled demand for money regression[12].

Dynamic error correction model

In order to ascertain credibility of the long-run estimates, we investigate the dynamic behaviour of the demand for money and investment. Dynamic modelling in a system of equations is, however, not practically plausible with the small sample size in terms of time series relative to the number of explanatory variables: for example, the total of sixteen variables with one lag for each explanatory variable are to be simultaneously solved. Also given the fact that there is not a sizeable difference in estimates between the system and single equations in Table 3 in the long-run model, we estimated the dynamic model in a single equation with the IV technique.

[Table 5 around here]

Tables 5 presents the dynamic, error correction model, where the lagged error correction terms (e_{t-1}) which are the residuals taken from the single equation of the long-run model, are specified along with the other explanatory variables by taking one lag for each. The

[12] Fry (1978) specified domestic saving in the place of investment on the ground that a self-financed hypothesis excluded foreign saving.

respective error correction terms are found to be highly significant in each equation with the correct negative sign, indicating the appropriateness of the identified long-run relationships.

The explanatory variables are statistically and theoretically well-determined in the money equation: the level feedback from income, investment and real rates of interest is correctly signed. The negative impact from the lagged deposit rates on the real money balance may be interpreted as the adjustment effect. In the case of the investment function, again the level feedback is statistically significant with a correct sign. The size of the coefficient on the real interest rates is halved to 0.00011 when compared with that in the long-run. The overall results appear to strengthen those of the long-run model.

6. Augmented investment model

In the seminal work of McKinnon's (1973) complementarity hypothesis, government fiscal action has little role in affecting directly aggregate capital accumulation, since the public policy is limited to the control of the real return on holding money, i.e. (d-π^e). Further restrictions apply to the simplified assumptions about investment in small self-financing domestic enterprises. The models described are also derived from the assumptions of a closed economy, even though empirical materials are usually drawn from small open economies, and so their rates of capital formation are unlikely to be determined solely by tiny self-financing units. Virtually, many developing countries are highly dependent on foreign trade and are open to corporate investment from abroad. Hence, a rise in investment may not be always due to a rise in the saving ratio when foreign trade or foreign capital flows are brought into the picture. McKinnon (1973) also fails to take account of the effect of financial development and the different income levels across countries, as these are treated as constant. We relax these assumptions or restrictions by augmenting the long-run investment models with several factors, which are likely to contribute to the share of financing in domestic capital formation.

Firstly, we consider financial development, which develops financial innovations and deregulates some restrictions in the capital market widening the scope for alternative investment opportunities, and also removes barriers to foreign banks. This is likely to impact on the transmission mechanism between deposit rates and investment. As a proxy variable, we explicitly include the development of stock market and a broad money[13]. The latter may represent financial sector deepening[14]. Secondly, the model is designed to reflect the different levels of income across developing countries. Depending on the level of institutional capability, the bureaucratic efficiency, technological capability and the quality of labour, deposit rates may affect investment differently. Assuming that these factors are, though in a crude manner, subsumed in the level of income, the estimation is conducted by taking dummy variables for the two income groups of low and upper-middle countries to see if there is any difference in the linkage[15].

Thirdly, external flows such as FDI (foreign direct investment) and ODA (official development assistance) are likely to affect capital formation independently of the level of real deposit rates. Foreign capital takes various forms. FDI implies long-term investment consisting of not only capital *per se*, but also management skill, know-how and technology, and FDI transmits technological diffusion from the developed countries to the developing countries raising capital formation (Balasubramanyam et al. 1999 and Borensztein et al. 1998). Short-term foreign capital flows include portfolio investment and foreign bank lending. FDI is specified separately from the short-term foreign loans, since the latter depend

---

[13] The variable of credit is combined with these variables, so that they capture the financial development in a wider range.

[14] One may prefer to hold monetary assets only when it is felt convenient to keep ones' wealth in monetary instruments with an underlying nature of liquidity, risk, return and efficiency in payment. Such types of instruments are offered by a better developed financial sector.

[15] In the preliminary result, the lower-middle income countries performs poorly, hence we concentrate on low and upper-middle income groups.

on the development of the domestic financial market, thus it is assumed to be captured through the variable of *credit*[16]. ODA includes aid or concessional funds from such institutions as the IMF and the World Bank, and distinguishes itself from FDI, therefore ODA makes a separate entry to the model. Fourthly, we address the extent to which the public spending is transmitted into capital and production[17]. We condition the investment decision in the private sector involving the improvement of infrastructure or purchase of public capital[18].

Lastly, some attention is paid by the literature to the foreign trade constraint to economic growth. Openness and trade policy are important for productivity spill-over and the cost of capital goods. More open economies have experienced faster productivity growth (Edwards 1998 and Diao et al. 2005), and developing countries can boost their productivity by importing a larger variety of intermediate products and capital equipment which embody foreign knowledge (Coe et al. 1997). A variable of the foreign trade is added as a conditional instrument.

The augmented investment model is now given by:

$$i / y = f(d - \pi^e, dc, v) \tag{7}$$

where v is the vector of additional explanatory variables: fd_{it} (financial development), fdi_{it} (FDI), oda_{it} (ODA), g_{it} (government expenditure), $trade_{it}$ (foreign trade) and *income dummy* for a low and upper-middle income groups. *fd* and *income dummy* are specified as an interaction with the real deposit rates. Financial development is the sum of the three ratios of stock market capitalization, M2 and domestic credit to GDP. FDI, ODA, foreign trade, and government expenditure are also all percentage of GDP. The country-income groups can be

---

[16] See, for example, Bosworth and Collins (1999) for justification.

[17] For example, Chatterjee and Turnovsky (2007) argue that the effectiveness of foreign capital on investment depends on the condition of the public finance.

[18] In some developing countries, much of the government expenditure could be allocated to government consumption or defence, rather than productive projects, and if this is stronger, public expenditure would have a negative impact on private investment.

found in Appendix 2. The data are all retrieved from the World Development Indicator. The estimation is conducted by the IV model with a country-specific dummy.

[Table 6 around here]

Empirical results are reported in Table 6[19]. The coefficient on the interaction of deposit rates with financial development in Model 1 is negative. As the scope for obtaining funds from capital markets increases, reliance on self-finance may be curtailed. In Model 2 and 3, the interaction between the real deposit rate and the upper-middle income group is shown to be negative, whereas that for the low-income countries is positive. This implies that as the status of a developing country moves from the low to the middle income group, there is less self-finance in investment. These results are not surprising and explain why some empirical literature rejects the hypothesis. For example, Fry (1978) finds that money is not the only financial repository of domestic saving for the seven Asian semi-industrial LDCs. This is because these countries have achieved stages of financial development well beyond the phase in which the complementarity assumptions predominate[20]. Similarly, in the empirical work for 25 Asian and Latin American LDCs, Gupta (1984) did not find a strong support for the complemetarity hypothesis. It is noted that some of the major Latin American countries in Gupta's study are classified as being in the upper-middle income bracket.

The impact of FDI and ODA in Model 4 also accords with *a priori* expectations, indicating that as the external flow increases the amount of investment is raised, being independent of the complementarity hypothesis[21]. Note that the effect of ODA on capital formation is weak, as the coefficient is not significant. Generally, in order for ODA to affect output most effectively, countries need to be equipped with reasonably developed institutions

---

[19] The models, in general, tend to suffer a first-order serial correlation at the 5% level, but it is not rejected at the 1% level. The second-order serial correlation is not rejected at the 5% level in all cases.

[20] In Fry's (1978) study, three out of the seven countries are not even categorised as developing countries now.

[21] Empirically, the impact of FDI on economic growth has remained controversial. Our results are in line with e.g. Blomstrom et al. (1996), Balasubramanyan et al. (1999) and Borensztein et al. (1998), who observe a positive impact.

and legal systems. Moreover, aid could be often misallocated into financing personal consumption expenditure by the government or reserve accumulation (in particular when the exchange rates are fixed), rather than increasing productive capital formation. These factors may, in part, explain the insignificant effect of ODA. Public finance (Model 5) and trade openness (Model 6) had a positive significant impact.

The robust finding is that $d\text{-}\pi^e$ is statistically significant, even when the investment model is conditioned. It is, however, worth noting that there is a sharp fall in the magnitude of the coefficient, when such factors as external flows, trade and public finance are specified in the model. Meanwhile, the size of the coefficient on the credit remains to be robust, e.g. the coefficients of 0.0015 and 0.0013 in Model 4 and 5 respectively in Table 6 are similar to 0.0014 in Table 3. The real rate of return on money matters in the creation of investment opportunities due to a self-financed capital formation, however, given the numerically small coefficient, the complementarity hypothesis is of very limited value.

7. Conclusion

This paper has extensively tested McKinnon's complementarity hypothesis for 108 developing countries using panel cointegration and IV econometric techniques. The empirical results reported, show that the real rate of interest has a positive effect on money and investment, hence McKinnon's stress on the importance of financial conditions in the development process is justified. Our result substantiates the earlier findings for individual countries for self-financed capital formation. However, at the same time, we find that the influence of the real deposit rate on capital formation is numerically marginal, and its' effect fades when the investment model is augmented with conditional variables. It is also found that the complemetarity is not supported in the middle-income group of countries, or when a country reaches a certain stage of financial market development. In this respect, one may have to look much farther down the development ladder, well below the middle-income level of developing economies to the world's least developed countries for recognising the complementary theory.

The evidence highlights the strength of the credit link with the role of financial intermediation. Under the disequilibrium interest rate system characterising most developing countries, a decline in the real deposit rate of interest reduces real money demand, which affects real credit supply, and this, in turn, squeezes new fixed investment. In either self-financed or bank-loan financed capital formation, the real rate of return on money greatly matters in raising the formation of capital. The central banks for developing economies should continue to ensure a policy aimed at changing negative real interest rates to positive levels, or improve the positive rates in order to secure greater levels of investment.

Appendix 1 108 developing countries (out of total 149) used for the empirical analysis

Low-income economies (40)

Bangladesh	India	Rwanda
Benin	Kenya	Senegal
Burkina Faso	Kyrgyz Republic	Sierra Leone
Burundi	Lao PDR	Solomon Islands
Cambodia	Madagascar	Sudan
Central African Republic	Malawi	Tanzania
Chad	Mali	Togo
Congo, Dem. Rep	Mauritania	Uganda
Côte d'Ivoire	Mozambique	Vietnam
Ethiopia	Myanmar	Yemen, Rep.
Gambia, The	Niger	Zambia
Ghana	Nigeria	Zimbabwe
Guinea-Bissau	Pakistan	
Haiti	Papua New Guinea	

Lower-middle-income economies (38)

Albania	Ecuador	Morocco
Algeria	Egypt, Arab Rep.	Nicaragua
Armenia	El Salvador	Paraguay
Azerbaijan	Fiji	Peru
Belarus	Georgia	Philippines
Bhutan	Guatemala	Sri Lanka
Bolivia	Guyana	Swaziland
Cameroon	Honduras	Syrian Arab Republic
Cape Verde	Indonesia	Thailand
China	Jordan	Tunisia
Colombia	Lesotho	Ukraine
Congo, Rep.	Macedonia, FYR	Vanuatu
Dominican Republic	Moldova	

Upper-middle-income economies (30)

Argentina	Grenada	Russian Federation
Belize	Hungary	Serbia
Botswana	Latvia	Seychelles
Brazil	Libya	Slovak Republic
Bulgaria	Lithuania	South Africa
Chile	Malaysia	St. Kitts and Nevis
Costa Rica	Mauritius	St. Vincent and the Grenadines
Croatia	Mexico	Turkey
Dominica	Panama	Uruguay
Gabon	Poland	Venezuela, RB

Economies are divided according to 2006 GNI per capita,. Low income countries ($905 or less) 40 out of 53, Lower-middle income countries ($906-$3,595) 38 out of 55 countries and upper-middle income countries ($3,596 -$11,115) 30 out of 41 countries (World Development Indicator).

Appendix 2 Descriptive statistics

	m/p	*i/y*	*dc*	*y*	$d\text{-}\pi^e$
Mean	20.973	-1.576	34.299	25.593	-21.627
Median	21.388	-1.571	24.672	26.023	0.769
Maximum	29.688	-0.193	234.180	35.154	6449.490
Minimum	14.145	-3.251	-72.994	0.595	-23754.040
Std. Dev.	2.981	0.411	34.474	3.477	634.004

Sample period 1970-2006 with 108 countries. Observations 2078. The minimum real Deposit rate records at -23754 percent, which is due to the Congo Democratic Republic in 1994.

Appendix 3 Residual-based cointegration

Pedroni (1999 and 2004) proposes to allow for heterogeneous intercepts and trend coefficients across cross-sections. The residuals test involves as given by:

$$e_{it} = \rho_i e_{it-1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta e_{it-j} + \varepsilon_{it} \qquad \text{(a1)}$$

For i = 1,……N, N=108. There are two alternative hypotheses in Pedroni's test: the homogenous alternative, $(\rho_i = \rho) < 1$ for all i, and the heterogeneous alternative, $\rho_i < 1$ for all i. The asymptotic distributions for the statistics can be expressed in the form of $\frac{k_{N,T} - \mu\sqrt{N}}{\sqrt{v}} \Rightarrow N(0,\ 1)$ where $k_{N,T}$ is a standardized form with respect to the values of N and T for each statistic, and the μ (mean) and v (variance) are functions of the moments of the underlying Brownian motion. The statistics are then compared to the appropriate tails of the normal distribution. The Kao's (1999) test follows a similar approach to that of Pedroni's, but specifies cross-section specific intercepts and homogeneous coefficients across cross-sections, and sets all of the trend coefficients to be zero. The residual test is the pooled specification:

$$e_{it} = \bar{\rho}\, e_{it-1} + \sum_{j=1}^{p_i} \varphi_{ij} \Delta e_{it-j} + \varepsilon_{it} \qquad \text{(a2)}$$

Kao's statistics can be shown as given by $DF_\rho = \frac{T\sqrt{N}(\hat{\rho}-1)+3\sqrt{N}}{\sqrt{10.2}}$.

References

Balasubramanyam, V.N., M. Salisu, and D. Sapsford (1999). Foreign Direct Investment as an Engine of Growth, *Journal of International Trade and Economic Development* 8, 27-40.

Blomstrom, M., R. Lipsey and M. Zejan (1996). Is fixed investment the key to economic growth? *Quarterly Journal of Economics*, 111(2), 269-276.

Borenszstein, E. J. G and J.W. Lee, (1998). How Does Foreign Direct Investment affect Economic Growth?, *Journal of International Economics* 45, 115-35.

Bosworth, B.P. and S.M. Collins (1999). Capital flows to developing economies: implications for saving and investment, *Brookings Papers on Economic Activity*, 1, 143-180.

Chatterjee, S. and S.J. Turnovsky, (2007) Foreign aid and economic growth: The role of flexible labor supply, *Journal of Development economics*, 84, 507-533.

Coe D., E. Helpman, and A. Hoffmeister (1997). North-South R & D spillovers, *Economic Journal* 107, 134-149.

De Melo, J. and J. Tybout. (1986). "The Effects of Financial Liberalisation on Savings and Investment in Uruguay," *Economic Development and Cultural Change* 34 (April): 561-587.

Diao X., J. Rattsø and H.E. Stokke (2005). International spillovers, productivity growth and openness in Thailand: an intertemporal general equilibrium analysis, *Journal of Development Economics*, 76, 429-450.

Dickey, D.A., D.W. Jansen and D.L. Thornton (1994). A Primer on Cointegration with an Application to Money and Income, in ed. Rao, B.B., *Cointegration for the Applied Economist*, St. Martin's Press, Inc.

Edwards, S. (1988). Financial Deregulation and Segmented Capital Markets: The Case of Korea, *World Development* 16 (1):185-194.

Edwards, S. (1998). Openness, productivity and growth: what do we really know? *Economic Journal*, 108, 383-398.

Fry, M.J. (1978), Money and capital or financial deepening in economic development, *Journal of Money, Credit and Banking*, 10 (November), 464-475.

Fry, M.J. (1980). Saving, investment, growth and the cost of financial repression, *World Development*, 8, 317-327.

Gupta, K.L. (1984). *Finance and economic growth in developing countries*. London: Croom Helm Ltd.

Harris, J.W. (1979). An Empirical Note on the Investment Content of Real Output and the Demand for Money in the Developing Economy, *Malayan Economic Review* 24: 49-59.

Harris, R. 1995. *Using Cointegration Analysis in Econometric Modelling*. Hemel Hempstead, UK: Prentice Hall.

Im, K.S., M.H. Pesaran and Y. Shin (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115(1.2) 53-74.

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data, *Journal of Econometrics*, 90, 1-44.

Khan, A. (1988). Financial repression, financial development and the structure of savings in Pakistan, *Pakistan Development Review,* 27(Winder), 701-711.

Khan, A.H. and L. Hasan. (1998). "Financial Liberalisation, Savings and Economic Development in Pakistan," *Economic Development and Cultural Change* 46 (April), 581-597.

Laumas, P.S. (1990). "Monetisation, Financial Liberalisation and Economic Development," *Economic Development and Cultural Change,* 38 (January), 377-390.

Levin, A., C.F. Lin and C.S. Chu. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties, *Journal of Econometrics*, 108(1), 1-24.

Leff, N.H. and K. Sata, (1980). Macoeconomic adjustment in developing countries: instability, short-run growth and external dependency, Review of Economics and Statistics, 62 (2) May, 170-179.

MacKinnon, J.C., A.A. Huag and L. Michelis (1999). Numerical distribution functions of likelihood ratio tests for cointegration, *Journal of Applied Econometrics*, 14, 563-577.

Maddala, G.S. and S. Wu (1999). A comparative study of unit root tests with panel data and a new simple test, *Oxford Bulletin of Economics and Statistics*, 61, 631-652.

Mallick, S. and T. Moore (2008) Foreign Capital in a Growth Model, the *Review of Development Economics*, 12(1), 143-159.

McKinnon, R.I. (1973). *Money and Capital in Economic Development.* Washington DC: The Brookings Institution.

Moore, T., C.J. Green and V. Murinde. (2005) Portfolio Behaviour in a Flow of Funds Model for the Household in India, *Journal of Development Studies*, 41(4 April), 675-702.

Morriset, J. (1993). Does financial liberalisation really improve private investment in developing countries?" *Journal of Development Economics* 40 (1), 133-150.

Odhiambo, N.M. (2005). Money and capital investment in South Africa: A dynamic specification model, *Journal of Economics and business*, 57, 247-258.

Pedroni, P. (1999). Critical values for cointegration tests in heterogenous panels with multiple regressors, *Oxford Bulletin of Economics and Statistics*, 61, 653-670.

Pedroni, P. (2004). Panel cointegration; Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis, *Econometric Theory*, 20, 597-625.

Pentecost, E.J. and T. Moore (2006). Financial liberalisation in India and a new test of McKinnon's complementarity hypothesis, *Economic Development and Cultural Change,* 54(2), 487-502.

Shaw, E.S. (1973). *Financial deepening in economic development* New York: Oxford University Press.

Thornton, J. (1990). The Demand for Money in India: A Test of McKinnon's Complementarity Hypothesis, *Savings and Development* 14, 153-157.

Thornton, J. and S.R. Poudyal. (1990). Money and capital in economic development: A test of the McKinnon hypothesis for Nepal, *Journal of Money, Credit and Banking* 22 (August), 395-399.

Table 1 Panel Unit Root tests

	Levin et.al (2002)		Im et al. (2003)		ADF - Fisher Chi-square		PP - Fisher Chi-square		obs.	obs (PP)
	statistic	Prob.	statistic	Prob.	statistic	Prob.	statistic	Prob.		
m/p	-1.683	0.046	5.158	0.999	182.960	0.950	177.054	0.975	2854	3018
Δ*m/p*	-26.021	0.000	-30.119	0.000	1311.420	0.000	1857.290	0.000	2790	2902
dc	2.734	0.997	1.668	0.952	272.902	0.005	235.950	0.168	2994	3161
Δ*dc*	-32.598	0.000	-30.088	0.000	1313.570	0.000	1769.660	0.000	2912	3042
y	-2.133	0.016	8.077	0.999	177.126	0.975	152.436	0.999	3237	3418
Δ*y*	-23.981	0.000	-26.890	0.000	1201.270	0.000	1417.810	0.000	3181	3308
$d\text{-}\pi^e$	-1177.36	0.000	-173.752	0.000	1032.050	0.000	890.065	0.000	2226	2310
i/y	-4.246	0.000	-5.947	0.000	380.429	0.000	285.906	0.001	2630	2775

Null: unit root. Selection of lags based on Akaike information criterion: 0 to 8. Obs: observation.

Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table 2 Panel cointegration test of 5 variables: *m/p*, *y, i/y, dc* and $d\text{-}\pi^e$

Johansen Fisher panel test	Trace test	Prob.	Max-eigen test	Prob.
None	1447	0.000	898.2	0.000
At most 1	791.5	0.000	528.5	0.000
At most 2	439.6	0.000	323.1	0.000
At most 3	245.8	0.000	218.7	0.000
At most 4	151.8	0.059	151.8	0.059

Unrestricted cointegration rank test

χ^2 value based on MacKinnon-Haug-Michelis (1999) *p*-values for Johansen's cointegration trace test and maximum eigenvalue test.

Table 3 Long-run IV model: System and single equations

Dependent var.	System		Single		Dependent Var.	System		Single	
m/p	Coef	s.e.	Coef	s.e.	*i/y*	Coef	s.e.	Coef	s.e.
Constant	-1.00536***	0.27959	-14.0109***	1.78356	*Constant*	-1.58796***	0.01477	-1.62029***	0.01998
y	0.86248***	0.01049	1.37302***	0.06854	$d\text{-}\pi^e$	0.00024*	0.00014	0.00023***	0.00007
i/y	0.20202**	0.08091	0.13103*	0.07530	*dc*	0.00141***	0.00031	0.00148***	0.00053
$d\text{-}\pi^e$	0.00071	0.00056	0.00152***	0.00026					
R^2	0.717		0.934			0.530		0.609	
Breusch-God (order=1)	6.22733†		0.97054			4.1847		0.3904	
Breusch-God. (order=2)	5.36868		0.91578			3.2864		0.3258	
Breusch-Pagan	12.93306†		3.2064			8.0534		5.6974	
Sargan	4.58579		1.0101			5.5715		1.8570	

In the system of question, *m/p* and *i/y* models are simultaneously estimated by the maximum likelihood estimation.

*, ** and *** Significant at the 1%, 5% and 10% level.

Instrument variables in *t-1*: *m/p, y, i/y,* $d\text{-}\pi^e$ and *dc* for *m* equation and *m/p, dc, i/y and* $d\text{-}\pi^e$ for *i/y* equation.

χ^2 tests for Breusch-Godfrey serial correlation (AR), Breusch-Pagan-Godfrey hetroskedasticity, and Sargan over-identification. † indicate significant at the 5% level.

Where heteroskedasticiy is found, it is corrected by estimating the White heteroskedastiticy-adjusted standard errors.

Residual-based cointegration test	*m/p* model		*i/y* model	
	Statistic	Prob.	Statistic	Prob.
Pedroni rho-statistics (Common AR coefs., weighted statistics)	10.84768	0.000	9.708027	0.000
Pedroni rho-statistics (Individual AR coefs.)	15.26696	0.000	13.87630	0.000
Kao Test	-6.090196	0.000	-2.150274	0.000

Residuals are taken from single equations. AR: autoregressive. See Appendix 2 for the detailed specification for the tests.

Table 4 Selected studies of the complementary demand for money in developing economies: Elasticities

	Countries	Period (annual data)	Model	*y*	*d*-π^e	*i/y*	Estimation Methodology
Table 3	108 LDCs Panel data	1970-2006	*m/p*	0.86248	0.00071	0.20202	System IV
"			*m/p*	1.37302	0.00152	0.13102	Single IV
"			*i/y*		0.00023		System IV
"			*i/y*		0.00023		Single IV
Pentecost and Moore (2006)	India	1951-1999	*m/p*	0.448	0.057	0.683	System, Cointegration found
"			*i/y*		0.004		System, Cointegration found
Odhiambo (2005)	South Africa		*m/p*	0.45484	0.0106	0.19891 *	OLS, Dynamic level feedback
Khan and Hasan (1998)	Pakistan	1951/60-1994/95	*m/p*	1.02	0.0015 §	1.97 *	OLS, Cointegration found
"			*m/p*	1.07	0.003 §	1.39	OLS, Cointegration found
"			*i/p*		0.0005 §		OLS, Cointegration found
Laumas (1990)	India	1954/55-19971/72	*m/p*	0.143	0.09 §	72.343 §	System IV Time deposit instead of money
"			*i/y*		0.014		System IV
Thornton and Poudyal (1990)	Nepal	1974/75-1986/87	*m/p*	1.1734	-0.0137	0.0708 *	Single IV
Thornton (1990)	India	1964-1984	*m/p*	0.9235	-0.0039	1.0642 *	Single IV
Fry (1978)	7 Asian countries**	1962-1972	*m/p*	0.664	1.883	-0.752 *	Pooled regression Reject the hypothesis

* Domestic saving (s_d/y) specified instead of investment. IV: Instrumental variables.

* *Burma 1962-69, India 1962-72, Korea 1962-72, Malaysia 1963-72, Philippines 1962-72, Singapore 1965-72 and Taiwan 1962-72

§ Insignificant at the 5% level.

Table 5 Error correction dynamic model: IV model

Dependent var.: Δ(m/p)	coef	s.e.	*Dependent var.: Δ(i/y)*	Coef.	s.e.
Constant	0.02309***	0.00545	*Constant*	-0.008	0.00656
e_{t-1}	-0.03544***	0.00691	e_{t-1}	-0.30313***	0.03421
$\Delta(m/p)_{t-1}$	-0.06139***	0.02356	$\Delta\ (i/y)_{t-1}$	0.10503**	0.04228
Δy	0.58885***	0.08553	$\Delta\ (d\text{-}\pi^e)$	0.00011***	2.59E-05
Δy_{t-1}	0.33886***	0.08501	$\Delta\ (d\text{-}\pi^e)_{t-1}$	2.80E-05*	1.72E-05
$\Delta i/y$	0.08027***	0.02417	Δdc	0.02465***	0.00492
$\Delta i/y_{t-1}$	0.01303	0.02369	Δdc_{t-1}	-0.00439***	0.00171
$\Delta\ (d\text{-}\pi^e)$	3.31E-05***	7.03E-06			
$\Delta\ (d\text{-}\pi^e)_{t-1}$	-1.60E-05**	6.79E-06			
R^2	0.200			0.407	
Breusch-God. (order=1)	3.3344			0.1766	
Breusch-God. (order=2)	0.6711			0.4345	
Breusch-Pagan	3.3344			3.8162	
Sargan	4.7815			5.7098	

*, ** and *** Significant at the 1%, 5% and 10% level. Instrument variables in *t-3*and *t-4* in levels: *m/p, y, i/y* $d\text{-}\pi^e$ and *dc* in *Δ(m/p)* equation and *m/p, dc, i/y* and $d\text{-}\pi^e$ in *Δ (i/y)* equation.

χ^2 tests for Breusch-Godfrey serial correlation, Breusch-Pagan-Godfrey hetroskedasticity, and Sargan over-identification, (none is significant at the 5% level).

Table 6 IV estimates of the augmented investment model: dependent variable *i/y*

	Model 1	s.e.	Model 2	s.e.	Model 3	s.e.
Constant	-1.72109***	0.0454	-1.62138***	0.01966	-1.61765***	0.03055
$d\text{-}\pi^e$	0.00145***	0.00025	0.00019***	7.23E-05	0.00103***	0.00016
dc	0.00352***	0.0010	0.00159***	0.00053	0.00182*	0.00081
$d\text{-}\pi^e$ **fd*	-1.46E-05***	2.56E-06				
$d\text{-}\pi^e$ **low*			0.00159***	0.00045		
$d\text{-}\pi^e$ **middle*					-0.00147***	0.000217
R^2	0.243		0.619		0.086	
Breusch-God. (order=1)	2.1776		5.9959†		2.1653	
Breusch-God. (order=2)	2.5080		5.4203		2.1288	
Breusch-Pagan	6.9663		0.9848		14.4229†	
Sargan	2.1441		5.7074		4.4414	

	Model 4	s.e.	Model 5	s.e.	Model 6	s.e.
Constant	-1.67824***	0.020046	-1.78968***	0.03807	-1.99374***	0.04847
$d\text{-}\pi^e$	2.00E-05***	6.92E-06	1.77E-05**	7.48E-06	1.36E-05**	6.05E-06
dc	0.00155***	0.000417	0.00135***	0.00043	0.00062	0.00042
fdi	1.27573***	0.218223	1.33498***	0.21896	1.17805***	0.20679
oda	0.26410	0.169914	0.19999	0.16980	0.18544	0.17085
g			0.00842***	0.00245	0.01004***	0.00251
trade					0.00282***	0.00040
R^2	0.660		0.664		0.671	
Breusch-God. (order=1)	5.23996†		5.20051†		5.16244†	
Breusch-God. (order=2)	5.59462		5.53628		5.49637	
Breusch-Pagan	6.10256		6.04441		6.21266	
Sargan	5.77780		5.66340		5.35554	

*, ** and *** Significant at the 1%, 5% and 10% level.

Instrument variables in *t-1*: *m/p, i/y* and all regressors in each model. χ^2 tests for Breusch-Godfrey serial correlation, Breusch-Pagan-Godfrey hetroskedasticity, and Sargan over-identification. † indicate significant at the 5% level. Where heteroskedasticiy is found, it is corrected by estimating the White heteroskedastiticy-adjusted standard errors. χ^2 (1) critical value: 3.84(5%) 6.64(1%)