work in progress

MONETARY TRANSMISSION MECHANISM IN CYPRUS: A FIXED EXCHANGE RATE CASE

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Abstract

Recent changes in the financial environment in Cyprus have created the need for monetary policy tools that will assist policy makers in forecasting and estimating the fundamental economic variables. This paper presents a small structural macroeconomic model that has been developed to describe an environment of a fixed exchange rate. We argue that in this environment monetary policy can still be effective through prices and the real effective exchange rate. Subsequently, we allow for an interest rate risk premium in order to gain more inside in the liberalisation process.

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Introduction

Monetary policy has long been ascribed a crucial role in the stabilisation of prices and the promotion of maximum output and employment. Despite the fact that there is a consensus on the importance of central bank decisions, the scientific community disagrees on how these actions translate into real effects. Studying the monetary transmission mechanism can enable us to better understand the links between the financial and real sector of the economy and the effects of monetary decisions, while it can also help in making a better choice of a monetary target. Due to the availability of data and clear procedures within central banks, most studies on the transmission mechanism focus on industrial countries with liberalised markets and floating exchange rate regimes. Undoubtedly the focus has been on flexible exchange rates since at least theoretically under fixed exchange rates and free capital flows the central bank cannot follow an independent monetary policy. However, in a number of countries capital flows are not completely free and/or the exchange rate is not totally fixed, allowing monetary authorities some degree of monetary independence.

It is, perhaps, even more important to understand the workings of the transmission mechanism in developing countries due to the uncertainty surrounding monetary decisions. In Cyprus, the financial system, until recently, was dominated by fixed exchange rates and capital controls. The existence of capital controls allowed the authorities, at least to a certain degree, some room for monetary policy. With the gradual lifting of capital controls the authorities find it increasingly difficult to draw a wedge between foreign and domestic interest rates and thus proceeded in allowing greater flexibility in the exchange rate. The Cyprus pound band with the euro extended from the 2,25% on either side of the central parity to 15%.

The purpose of this paper is to model the transmission mechanism of Cyprus to gain a better understanding of the liberalisation and its effect on monetary policy effects. We model a benchmark case of fixed exchange rate in a free of capital controls regime. In this case changes in the domestic interest rate can only come about as a result of fluctuations in EU interest rates. Even in this case we argue that the exchange rate channel is present and operational through the effective exchange rate or prices. Through an interest rate risk premium we allow for some monetary independence and a short run wedge between domestic and foreign interest rates.

This paper focuses not only on how economists believe that monetary policy influences a Central Bank's goals but also on the peculiarities of a small open

economy. Once the theory is presented, we discuss the macroeconomic peculiarities of Cyprus, and a model that captures the aforementioned features of the Cypriot economy. In particular, the paper is organised as follows. The first section reviews the literature and presents current transmission mechanism theories. The second section highlights some stylised facts concerning the economy of Cyprus in general. An explanation and an overview of the model are given in section three, while each estimated equation is individually analysed. In section four a number of simulations are presented. Finally, section five contains concluding remarks.

1. Literature Review

The monetary transmission mechanism is generally defined as the process through which monetary policy decisions are transmitted into changes in income and inflation (Taylor, 1995). Understanding the mechanism through which monetary shocks exert real effects has been one of the most enduring goals of monetary economics. It has captivated the field because it is widely understood that for monetary authorities "to be successful in conducting monetary policy, [they] must have an accurate assessment of the timing and effect of their policies on the economy" (Mishkin, 1995). Thus, the transmission mechanism consists of the channels through which monetary policy can affect both real variables and inflation. These include the interest rate channel, the credit channel, and the exchange rate channel. According to most theories, monetary policy can at least have short run effects since changes in money affect interest rates and, thus, the demand for money. Since, over short periods of time, wages and prices are assumed sticky, contractionary policy will decrease both employment and production, while in the long run real economic activity will return to potential.

A standard textbook view of the transmission mechanism uses an IS/LM model to explain the effects of a change in interest rates. Under this view, the transmission works through the liability side of a bank's balance sheet where contractionary monetary policy increases the demand for bonds and decreases the demand for money. As a result of the tightening policy and in combination with sticky prices and rational expectations, real money balances decline, pushing up real interest rates, decreasing investment and consequently, output. In the end, the real interest rate returns to its fundamental level and GDP returns to its potential, underlying the ineffectiveness of monetary policy in the long run. It is important to

note that the interest rate channel is not just restricted to business decisions but works just as well for consumer spending, where investment decisions by households imply spending in residential housing and consumer durables (Taylor, 1995).

Empirical evidence on the above conventional view seems to be conflicting. Bernanke and Gertler (1995) argue that empirical studies find the cost-of-capital effect on spending not to be strong[1] implying that the interest rate channel is rather weak, while Taylor (1995) argues that econometric work has found a strong negative effect[2] of changes in the short term interest rates on real GDP. Moreover, Taylor argues that sticky prices and rational expectations are the reason why changes in the nominal interest rate are translated into changes in the real interest rate since price rigidities will hold inflation expectations constant.

The credit channel can be seen as an independent channel although it is not truly independent of interest rates. Bernanke and Gertler (1995) explain that the credit channel rests on the assumption of the existence of an external financial premium, which is "a wedge between the cost of funds raised externally and the opportunity cost of internal funds". In order for credit to be a significant channel of monetary policy, bank intermediated credit must be an important source of funds (Fountas and Papagapitos, 2001). This is usually true in countries, as in the case in Cyprus, where the secondary bond market is not fully developed. The strength of this channel will depend negatively on the depth of financial markets, the size of the firms and the degree of financial innovation. The credit channel depends on the existence of asymmetric information and it works either through the balance sheet or loanable funds.

The balance sheet channel is based on the presumption that the external finance premium depends on the borrower's financial position, i.e. the greater a borrower's net worth the lower the premium should be. Contractionary monetary policy, by raising interest rates, reduces a borrower's net worth since first, it increases interest expenses thus reducing net cash flows, second, it reduces asset prices and third, it reduces consumer spending while fixed costs do not change, at least in the short run. In turn, the worsening of firms' net worth implies decreased investment opportunities, in the case were external funding is difficult to obtain, lower output and lower inflation. The evidence supporting this view is vast. Borio, Kennedy, and

[1] Citing papers such as Blinder and Maccini (1991), Chirinko (1993), and Boldin (1994).
[2] Taylor finds support in papers such as Romer and Romer (1994), and Taylor (1993).

Prowse (1994) show that fluctuations in asset prices led to real variations for many industrialised countries in the 80s. Bernanke and Gertler (1995) find that increases in the federal funds rate translate almost immediately into increases in the coverage ratio[3] indicating higher interest payments and thus weaker balance sheet positions. Gertler and Gilchrist (1993, 1994) find that large firms can be less vulnerable to higher interest rates by finding other short-term sources of revenue, while smaller firms exhaust their inventories due to their limited access to short-term credit markets. Domac (1999) supports the above findings for the case of Malaysia. However, unlike the interest rate channel, Christiano, Eichenbaum, and Evans (1996) find that the balance sheet channel does not work for both business and consumers since business and household sectors do not adjust their financial assets and liabilities similarly after a monetary shock.

Monetary policy may also affect the external finance premium by influencing the supply of loanable funds. In particular, the bank lending channel implies that tight monetary policy through the use of open market operations, restricts intermediated credit by absorbing liquidity, and, thus, raises the cost of borrowing associated with finding a new lender and establishing a new credit relationship, as long as bank dependent borrowers are not completely shut off from credit (Bernanke and Gertler, 1995). Moreover, "if banks are able to offset a monetary tightening by attracting non-deposit funding the bank lending channel becomes impotent. Hence, if a bank lending channel is relevant transmission mechanism, this implies that both the asset and the liability side of banks' balance sheets consist of imperfect substitutes" (Kakes, 2000).

Empirical studies have shown that several conditions must hold for the bank lending channel to be effective. First, bank loans must be an important source of funds for firms, second, Kashyap et. al. (1993, 1994) find that there should be no perfect substitute for this kind of credit, third, Gerlter and Gilchrist (1993, 1994) and Christiano et. al. (1996) find that there must exist bank-dependent borrowers. Finally, as is the case for all channels, there must be imperfect price adjustments for monetary policy to affect real variables. Bernanke and Blinder (1992) find that the transmission of monetary policy works through bank loans as well as bank deposits. However, tight monetary policy may lead to a reduction in the volume of deposits and a short run sell-off of banks' security holdings, with little effect on loans. Other research has

[3] The coverage ratio is defined as the ratio of interest payments by non-financial corporations to the sum of interest payments and profits.

shown that there are significant sectoral differences concerning the effect of the credit channel.

The exchange rate channel examines the relationship between net private capital inflows and monetary policy. Under a flexible exchange rate regime an interest rate rise makes domestic currency deposits more attractive leading to a currency appreciation. The high value of the currency makes domestic goods more expensive than foreign goods, and causes a fall in net exports and aggregate output. However, under a system of fixed exchange rates with no capital controls, a rise in interest rates will cause capital inflows that will put upward pressure on the exchange rate. The central bank will have to respond by increasing its foreign exchange reserves to bring the interest rate down to its original level. It is thus understood that when the exchange rate is fixed or heavily managed, the effectiveness of monetary policy is reduced but not entirely eliminated (BIS, 1998).

There are two ways in which monetary policy can maintain a degree of independence with the exchange rate channel present in the case of a fixed exchange rate regime. Specifically, the exchange rate might not be completely fixed but have a small variation and secondly, monetary policy can influence the real exchange rate by working through the price level.

An exchange rate system that allows some fluctuation within a target zone along with some capital controls and/or a system where domestic and foreign assets are imperfect substitutes may give the central bank some scope for domestic interest rates to deviate from the levels set by the interest rate parities. This is true for as long as the exchange rate does not reach the zone's boundaries, since when this happens "maintaining [the boundaries] in the face of speculative pressure presents all the problems of a fixed exchange rate … as in the 1992 attacks on the EMS, Britain, Spain and Portugal were all forced out of target zones 12 per cent wide" (Obstfeld and Rogoff, 1995). Moreover, if domestic and foreign assets are imperfect substitutes, domestic interest rates may deviate from international levels. Hence, monetary policy may affect the real exchange rate through prices while holding the nominal exchange rate fixed. Through this channel the monetary authorities may affect net exports although to a much lesser degree and with much longer lags (BIS, 1998).

It is important to note that economic research on the monetary transmission mechanism has concentrated on industrial countries, for which not only the availability of data but also the clear structure of the financial system make the

analysis easier and clearer. In the case of Cyprus monetary transmission works through the aforementioned three channels (see appendix 1 for a flow chart). Interest rate changes affect prices through the standard interest rate channel supported by the existence of sticky prices and wage rigidities, while the importance of bank intermediated credit makes the credit channel significant. Capital controls and imperfect substitutability of domestic and foreign assets along with a target zone regime create a channel for monetary policy to affect output and prices despite a fixed exchange rate system.

2. Stylised Facts

During the sample period of 1991-1999 monetary policy was geared towards establishing price stability. Taking into account the built-in rigidities of the economy, such as the legal interest rate ceiling, full and automatic wage indexation, and the economy's high level of openness, the Central Bank has, since 1967, pursued a stable exchange rate policy pegging the local currency to different anchor currencies. Initially, the Cyprus pound was linked to the Sterling pound at a fixed parity. The collapse of the Bretton Woods System and the "generalised floating" that resulted from it, forced the Bank to peg the currency to a trade-weighted basket in order to avoid excessive currency fluctuations. In 1992 the basket was abandoned in favour of a new anchor, the ECU, and consecutively, in 1999, the Euro with a margin of 2,25% around the central parity. This was done explicitly as a step towards the integration of the Cyprus economy with the European. As of 2001 there is greater flexibility in the exchange rate and the movement of capital.

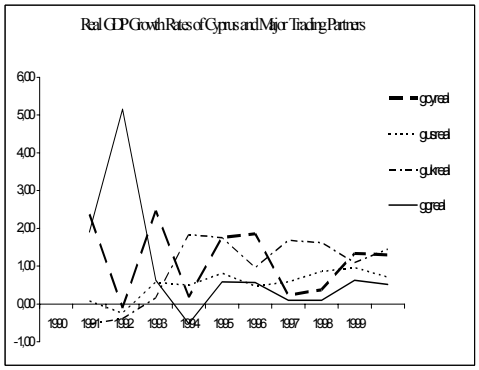
One of the rigidities that guided monetary policy towards a fixed exchange rate regime was the interest rate ceiling of 9,0%, which was established in 1944 and reconfirmed in 1977 with the Interest Law (sec.150). Given the aforementioned limitation, the Central Bank Law empowered the Central Bank of Cyprus to set the maximum (or minimum) interest rate commercial banks were allowed to charge (or pay). There were only two official interest rate changes during the 1944-2000 period, both of which took place within our sample period. The first took place in 1994 and decreased the maximum interest rate banks could charge from 9,0% to 8,5% and the second, in 1997, decreased interest rates further at 8,0% Due to the interest rate ceiling the Bank resorted to direct controls, such as minimum reserve requirements and credit growth ceilings. At the same time, and in order to avoid interest rate and

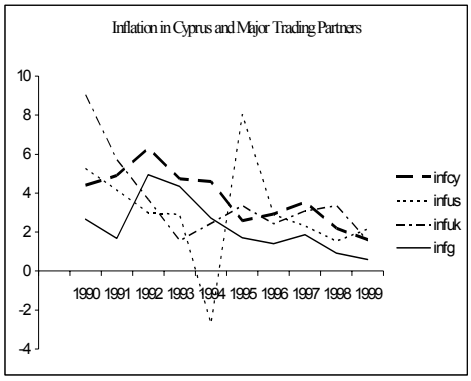
inflationary pressures, strict controls on capital movements were adhered to. These controls were placed on both inward and outward investments of all kinds. The liberalisation of interest rates was finally achieved on January 1, 2001, while the liberalisation of capital movements is expected to be completed by the year 2003.

Despite the relatively controlled economic environment in which monetary policy was to be implemented, the Cyprus economy exhibited a robust performance of income growth and socio-economic indicators during the sample period. Since 1990 real GDP growth has remained on average above 1,0%, a level that is higher than the rate of its major trading partners. Inflation has been converging towards the levels of its European trading partners and contained well below 5,0% for most of the sample period (see chart 1). Indicative of the downward trend followed by inflation is the fact that average CPI growth for the period 1990-2000 was 3,8% in contrast to 2,9% for the period 1995-2000. The spike observed in 1992 was primarily due to the introduction of a 5,0% value added tax, while in the years 1997 and 2000 the observed jump in inflation was mainly due to a rise in energy prices and an increase in the price of agricultural products. Exogenous factors are, thus, the driving force of inflationary pressures[4]. In general, most of the volatility observed in the CPI is the result of the variability exhibited by locally produced products and especially agricultural products, due to weather uncertainties, and inconsistencies in energy prices. Moreover, Cyprus is a small open economy with the ratio of exports and imports of goods to GDP exceeding 50%[5]. As a result, world price developments also had a significant impact on domestic inflation. At the same time the high degree of openness of the economy implies that domestic price developments are also influenced by exchange rate movements. Chart 1 also reveals the close relationship between the German and Cyprus economy. In fact the correlation coefficient of the two countries real GDP growth is close to 0,83 and for inflation 0,86[6].

[4] For more details see G. Kyriakou, October 2000.
[5] The yearly average for the period 1990-1999 is in fact closer to 58,0%.
[6] This fact supports our choice of Germany as a representative for the Euro zone economy, as we will explain in section 3.1.

Chart 1





Wage expansion is also a dominant factor in the inflation process in Cyprus. Wage growth, both in nominal and real terms, during the period 1963-99 exceeded productivity gains, which averaged 4,4% during the last forty years. The upward trend in wages can be linked to two prominent features of the Cyprus economy, low unemployment and wage indexation, which have characterised the economy since independence. The COLA system of backward looking wage indexation adjusts wages semi-annually (January, June) for the past six months change in consumer prices. This further increases any inflationary pressures caused by anyone of the CPI components. Finally, it should be noted that another indication of a healthy environment is the fact that Cyprus has been ranked within the high human development group for the last 10 years in the Human Development Index.

3. The Model: Estimated Equations and Key Parameters

3.1 The Model Summary

With Cyprus moving into a newly liberalised environment the need for a model of the transmission mechanism has become obvious. The resulting system does not necessarily describe every possible channel of the transmission mechanism. Rather, it is a modest effort to try and understand the basic relationships between different variables and to see the effects of certain changes on the economy as a whole. It captures the unique features of the Cyprus economy in a controlled environment era and, as such, is considered as a forerunner of a model for a liberalised financial system.

In this model we have taken three countries as Cyprus' major trading partners. These are the US, in an effort to capture oil price variation, the UK, due to the importance of tourism from that country, and Germany, to represent the Euro area

Box 1: The Model

Ri_sa = I – inf(+4) - inf(+3) – inf(+2) - inf(+1)	Real interest rate seasonally adjusted
Rdd_sa = f_1(ri_sa, rg_sa(-1), rdd_sa(-1), ΔCredit)	Real domestic demand seasonally adjusted
Exp(y) = exp(dd) + exp(g) + exp(x) - exp(m) + ds + gdpres	Output identity
Rx_sa = f_2(lyf, rer(-1), rx_sa(-1))	Real Exports seasonally adjusted
Reus = p + eus – pus	Real foreign interest rates
Reg = p + eg – pg	
Reuk = p + euk – puk	
Rer =0,4*reus + 0,5*reg + 0,1*reuk	Real exchange rate
Pm = 0,4*pus + 0,5*pg + 0,1*puk	Import Prices
E = 0,4*eus + 0,5*eg + 0,1*euk	Exchange rate
Eus = eus(+1) + i – ius	Interest rate parities
Euk = euk(+1) + I – iuk	
i = ig + rp	
If = 0,4*ius + 0,5*ig+0,1*iuk	Foreign Interest Rates
Rif = 0,4*rius + 0,5*rig+0,1*riuk	Definitions
Rm_sa = f_3(rm_sa(-1), rdd_sa, rer)	Imports
Inf = f_4((p(-1)-w2(-1), pg(-1)-p(-1), (y(-1)-p(-1)-l(-1)), (pus(-1)-eus(-1)-p(-1)), (y-p-yp), inf(t+1))	Phillips Curve
Dw = f_5(inf, (w2(-1)-p(-1), (y(-1)-p(-1)-l(-1)), lgap, trend)	Wage Inflation
M0 = f_6(m0(-1), y(-1), ri_sa, inf)	Money Demand
M2 = a*m0	
Clprvlev = exp(m2)-clpbclev-nfalev-unclasslev	Claims to the private sector identity
Nfalev=nfalev(-1)*(1+if(-1))*(1-e+e(-1))+((exp(x)-exp(m)))+ rp + otherstuff	Level of Net Foreign Assets identity
l = f_7(lp, (y-p-yp)	Labour Supply

countries since data for this group is not readily available for the whole sample. Both the exchange and foreign interest rates have been determined as a weighted average of the corresponding rates of these countries. Initially, we used the trade weights indicated by the IMF, adjusted to sum up to one. However, after some careful experimentation, we found that the subjective opinion of the Central Bank staff created variables that were far more significant in our estimated behavioural equations[7]. Foreign interest rates are also estimated using the same weights as above.

Interest rate parities with the US and UK are included in the model. In order to capture the fixed exchange rate regime we did not include an interest rate parity with Germany. Instead the model makes the assumption that the difference between Cyprus and German interest rates is equal to a risk premium, which is assumed constant and exogenously given. In this respect the Cyprus monetary authorities have to follow German monetary policy, i.e. any changes in the German interest rate must be reflected in the domestic rate immediately. However, the risk premium gives some independence in monetary policy by allowing the domestic and foreign rates to differ for a period of time.

The model contains fairly standard equations for the components of GDP – domestic demand, exports and imports – while government spending is considered exogenous. Due to the assumption of a small economy, world output is also assumed exogenous. Wage indexation can be seen in the price – wage equations block, while the model also contains equations for employment, the monetary base, and the real interest rate. In deflating our variables and in order to simplify further we used only the Consumer Price Index.

In developing a model that describes the monetary transmission mechanism in Cyprus we also had to deal with data inefficiencies. The lack of certain quarterly time series, such as the GDP and its components, was a serious problem in the estimation of model equations. This was dealt with by breaking up the yearly values using a quarterly indicator. Moreover, the fact the interest rates were fixed during the sample period created complications in the estimations.

Our data sample covers the period 1990-1999 by choice since we wanted, at least initially, to avoid the structural break of the liberalisation of the financial system. The data used is quarterly so as to capture the variation of the data, and seasonally

[7] The weights calculated originally using the IMF standards are 0,60 for Germany and 0,20 for both the US and UK, as compared to 0,50 for Germany, 0,40 for the US and 0,10 for the UK used in the model.

adjusted, using the X12 method of the US Census Bureau, in order to eliminate to the highest degree possible the effect of tourism. Our sources were multiple and in many cases some manipulation of the available data was necessary to either avoid missing values, or to break up the yearly values to quarterly[8].

The result of this effort is a small macroeconomic model that deals with Cyprus' particularities with 25 equations, 8 of which are estimated behavioural equations and the rest are identities. Due to the aforementioned data difficulties and the recent liberalisation the results must be treated carefully. The system that models the Cyprus economy is depicted in Box 1[9].

3.2 Empirical Results of the Main Equations of the Model

3.2.1 Components of Aggregate Demand

As regards aggregate demand, real GDP is defined by the standard expenditure identity. Out of the five components three are modelled separately, i.e. domestic demand, exports and imports, and two are assumed exogenous. Due to the fact that quarterly data for GDP are not available, these had to be constructed from the yearly series. As a result, a residual for GDP had to be added in the equation to capture any differences that may exist.

GROSS DOMESTIC PRODUCT
Y = DD + X – M + G + DS
DD = Domestic Demand
X = Exports of Goods and Services
M = Imports of Goods and Services
DS = Change in Stock

Domestic demand is modelled in such a way that it captures both the effects of consumption and capital formation, while the change in stock enters the GDP function directly. Thus, domestic demand is determined by the real interest rate, lagged real government expenditure, lagged domestic demand, and new credit. In future we would like to estimate the two components of domestic demand, i.e. consumption and investment, independently.

[8] Detailed information on the data set used is available upon request.
[9] For a more detailed presentation look at appendix 2.

DOMESTIC DEMAND
RDD_SA=0.92-0.60*RI_SA+0.41*RG_SA(-1)+0.36*RDD_SA(-1)+
0.14*(LCLPRV-LCLPRV(-1))-0.004*ttrend
RDD_SA: Real Domestic Demand seasonally adjusted
RI_SA: Real Interest Rate as defined in model
RG_SA: Real Government Expenditure Seasonally Adjusted
LCLPRV-LCLPRV(-1): New Credit to the Private Sector

The equations for both exports and imports have a simple structure taking into consideration the theoretical foundation. World output and the real exchange rate determine real exports, while real imports depend on the real exchange rate and domestic demand. The real exchange rate enters the export equation in lag. Long run elasticities can be calculated from the above estimations and these are depicted in table 1 along with income and exchange rate elasticities reported by the IMF and other Central Bank of Cyprus studies. It is important to note that the elasticities of the current study are lower than previously estimated ones, probably due to the fact that we have used quarterly instead of yearly data.

EXPORTS – IMPORTS
RX_SA=-2.92+0.84*LYF-0.32*RER(-1)+0.37*RX_SA(-1)
RM_SA=0.26+0.44*RDD_SA+0.83*RER+0.31*RM_SA(-1)
RX_SA: Real Exports of Goods and Services seasonally adjusted
RM_SA: Real Imports of Goods and Services seasonally adjusted
LYF: Foreign Output
RER: Real Exchange Rate

Table 1[10]

	IMF		CBC		Current	
	Inc	RER	Inc	RER	Inc	RER
Exports of Goods and Services	2.30	1.49	1.69	1.16	0.84	0.32
Imports of Goods and Services	1.55	0.81	1.00	1.24	0.44	0.83

[10] Income elasticities of the IMF refer only to services.

3.2.2 Prices and Wages

The wage indexation regime imposes a price/wage system that is not simultaneously determined. Rather, lags of each variable enter as explanatory variables in each equation.

PRICES, WAGES
INF=0.12-0.05*(P(-1)-W2(-1))+0.15*(PG(-1)-P(-1))-0.05*(Y(-1)-P(-1)-L(-1))+
0.02*(PUS(-1)-EUS(-1)-P(-1))+0.04*(Y-P-YP)
DW=INF+1.35-0.6*(W2(-1)-P(-1))-0.09*(Y(-1)-P(-1)-L(-1))+0.10*LGAP
+0.005*TTREND + 0.21*INF(+1)
INF: Quarterly inflation
W2: Wages
PG: German CPI
P: Cyprus CPI
Y: Gross Domestic Product
L: Employment
PUS: US CPI
EUS: Exchange rate with the US dollar
YP: Potential Output
DW: Quarterly Wage inflation
LGAP: Employment Gap

Inflation is modelled as a Phillips curve derived from a CES production function. Inflationary pressures in the above specification are the result of variations in output gap and productivity from the domestic demand side, as well as foreign prices. The US prices enter the equation to capture oil effects, while the German prices represent Euro prices[11]. Real wages also enter the equation as an independent variable while past inflation is significant in the wage inflation equation capturing the full indexation effect. Wages are also affected by a measure of productivity and unemployment measured as the employment gap [12].

[11] Specification tests for the Phillips curve were more supportive when country specific foreign prices were used instead of a weighted average.

[12] Although not significant, productivity and the unemployment gap remained in the equation in order to capture the theoretical background. It would be interesting to see the simulation results with a simpler equation.

MONEY DEMAND
Log(M0-P)=-2.17+0.57*(M0(-1)-P(-1))+0.11*(Y(-1)-P(-1)-Y(-2)+P(-2))- 1.22*RI_SA+2.63*INF M2=5.5*M0 M0: Monetary Base

Following Arestis and Demetriades (1991) we estimate a money demand that uses output, interest rates, inflation and a constant as the basic explanatory variables and report a money demand curve that has the expected characteristics. The interest rate represents the return on bank deposits while expected inflation is a proxy for the return on real assets, thus, capturing the asset motive. The transaction motive is represented by the output variable. Despite the fact that the interest rate is not significant we chose to allow it in the equation to be theoretically correct, knowing that the problem lies mostly with the small variation exhibited since the nominal interest rate was fixed throughout each year. Expected inflation is proxied by current inflation, and, although proportionality is not supported by the estimations, we chose to impose it.

An employment equation also enters the model. This follows Okun's Law and the output gap coefficient was calibrated to equal unity.

EMPLOYMENT
L=LP+1*(Y-P-YP) or L-LP-I*(Y-P-YP) = LGAP

4. Simulation Results

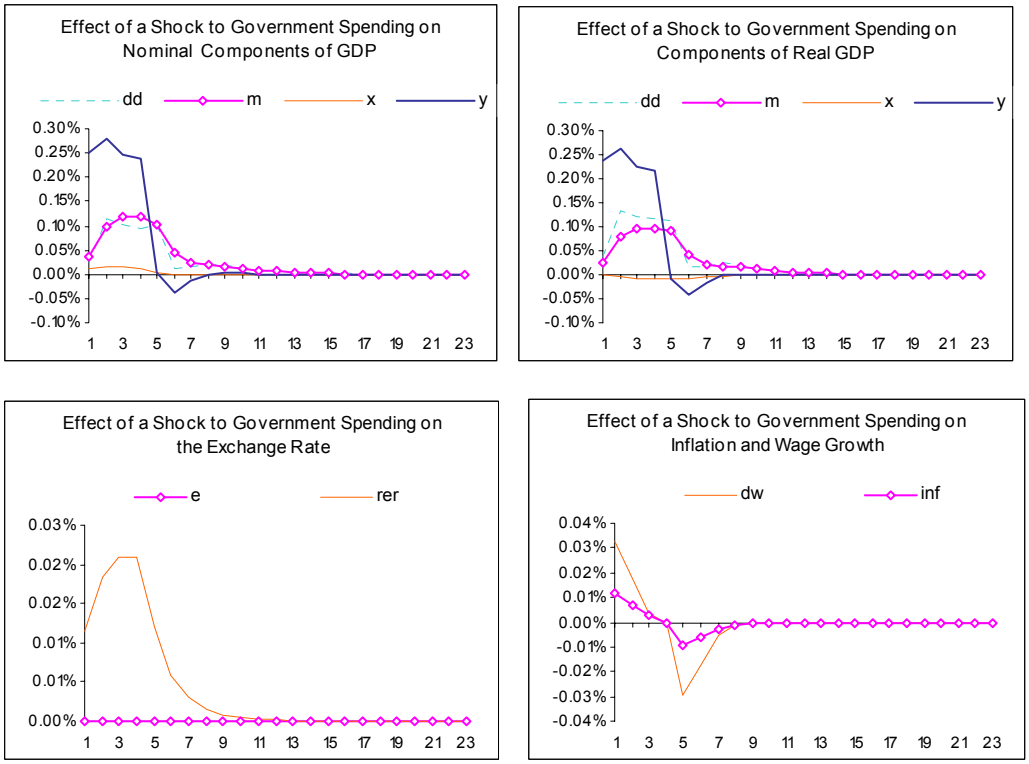
This section outlines the response of key variables in the model to several important shocks that might hit the Cypriot economy. In each case the charts show the difference the shock makes compared with the base value, which is set equal to zero. Consequently, a negative value for GDP does not imply that either the level or the growth rate of GDP is negative. Rather, it means that GDP is below its potential level or that the output gap is negative. In all scenarios we shock a variable by 0,25% per quarter for four consecutive quarters. The shock is unanticipated before it occurs,

but once it happens in the first quarter it is correctly expected to occur in the next three quarters.

4.1 Government Consumption

Chart 1 shows the effects of a shock to government consumption on the different components of GDP. There is no feedback in the model to future government consumption so the only change to its profile is the shock itself. There is a positive effect on nominal domestic demand throughout the path back to its base value. This path is rather protracted: there are effects for approximately four years before returning back to equilibrium, although the effect diminishes after the first five quarters. The rise in domestic demand has a direct effect on output and consequently on inflation and wages. In nominal terms both imports and exports seem to rise above their steady state values, although for exports this change is inconsequential. In real terms, the rise in inflation triggers an appreciation in the real effective exchange rate which, along with the rise in domestic demand, instigates a rise in real imports. This appreciation is also the factor behind the lower real exports throughout the path back to steady state. The ensuing deterioration in the current account balance means that GDP is only initially above its potential level. It is also important to note that the nominal exchange rate is not affected by this shock.

Chart 2



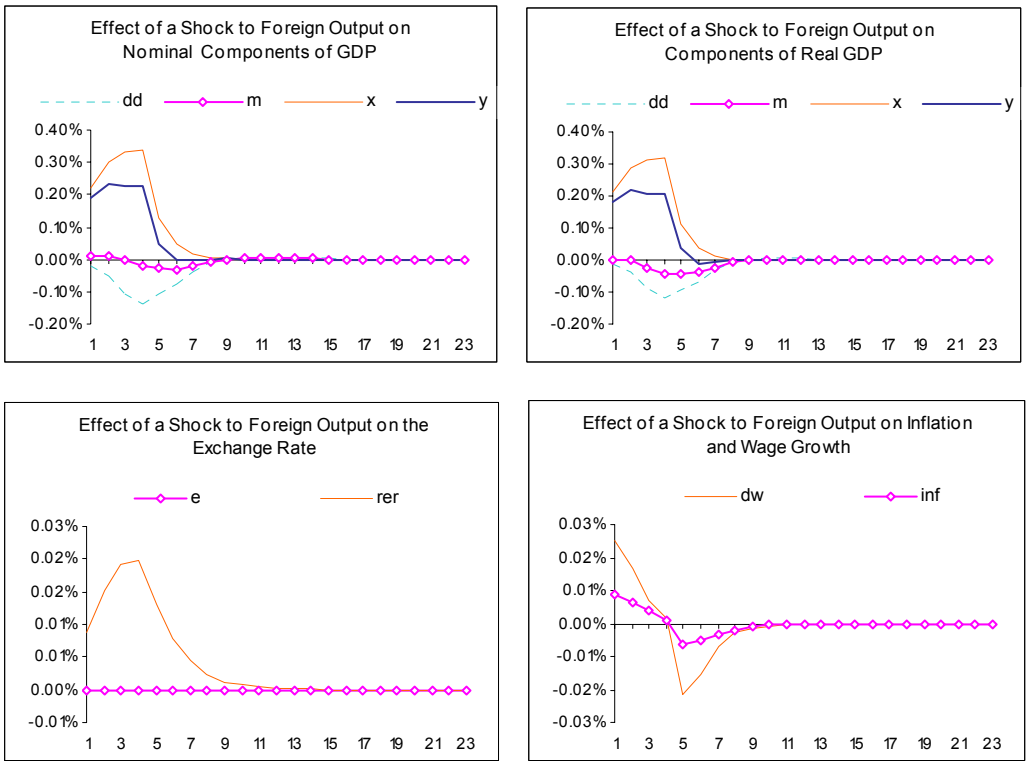
Three features of the model are important and should be mentioned here. First, inflation only moves slightly in the face of domestic shocks, which is explained by a widening of the current account. This is supported by a VAR analysis on yearly data which indicates that excessive money growth is largely offset through the trade account. In other words the trade account acts as a safety valve for inflationary pressures (Spanos et. al., 1997). It is also important to notice that wages generally follow an amplified version of the path of inflation. This means that the relatively sharp movements in both real and nominal wages follow GDP. Second, the original effects of price and wage inflation are eventually reversed before the variables return to equilibrium. This is a feature of the fixed exchange model. Since Purchasing Power Parity must hold and nominal exchange rates are considered fixed, prices must eventually return to their equilibrium value causing inflation below steady state. Finally, the small effect of the shock on all variables might be caused by the small variation found in interest rates and GDP since our sample period covers a period of a controlled financial environment.

4.2 Foreign Output

In this example foreign output has been increased by 0.25% for four consecutive quarters. Implicitly, this rise in foreign output could be seen as a temporary productivity shock abroad or an increase in relative demand for Cypriot exports. Given that foreign output is determined as a weighted average of US, UK and German income, the same shock can be reproduced by raising US income by 0.625% per quarter. In both real and nominal terms the effects of this shock on the components of GDP are similar. Exports increase despite the appreciation in the real exchange rate due to a high estimated elasticity of income (see table 1). All other components of GDP exhibit very small changes so that the paths of GDP and exports are very similar. The aforementioned appreciation in the exchange rate causes a marginal rise in the demand for imports.

Inflation and wage growth exhibit similar patterns with those observed in the case of the government expenditure shock. That is, inflation is only marginally affected and wages move in line with it, although the effect on wages is much more noticeable. However, it should be noted that in our estimations foreign output does not enter directly the inflation equation.

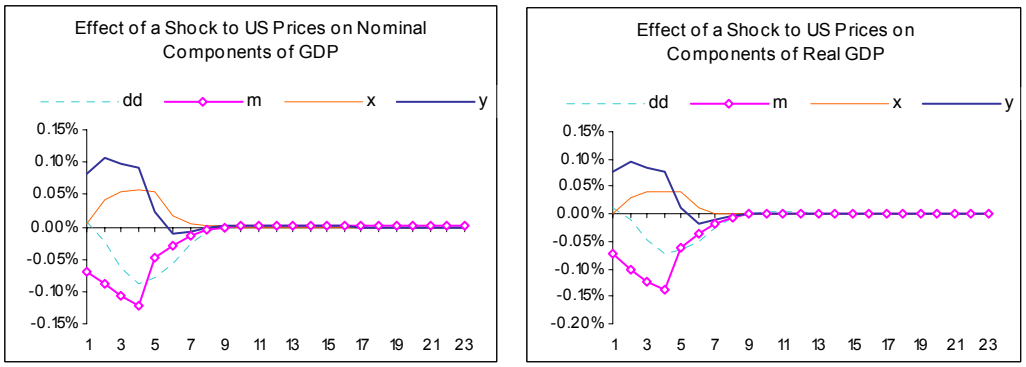
Chart 3

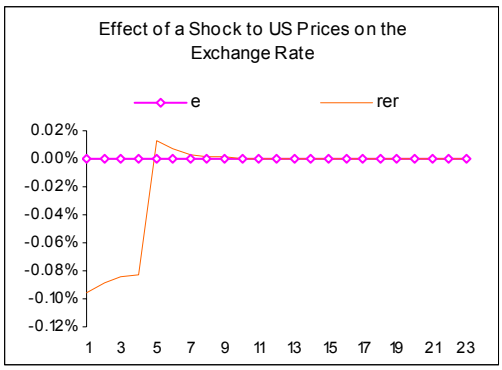


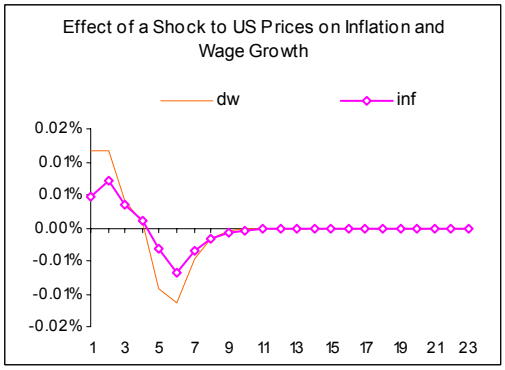
4.3 US Prices

The shock of US prices applies to all prices denominated in dollars, for example, oil prices. Thus, this type of shock affects relative prices and, assuming that there is no reaction by US monetary policy, domestic goods become relatively cheaper, while the initial real exchange rate depreciation makes the domestic economy more competitive. The result is a rise in exports and a decrease in imports.

Chart 4



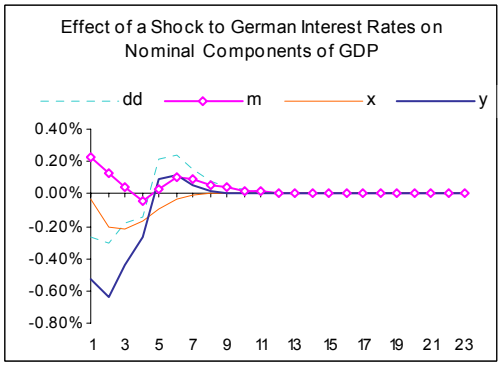


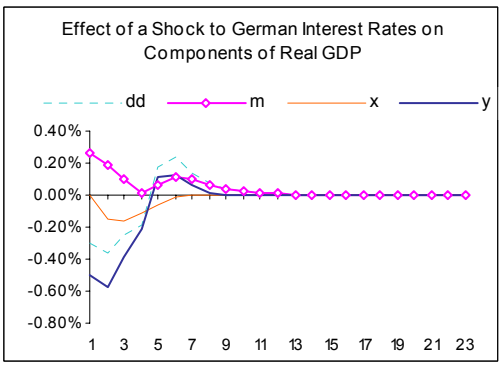


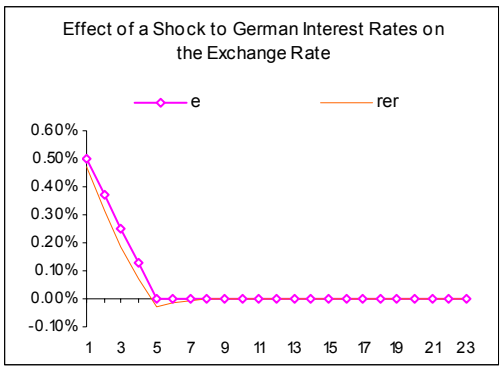
4.4 German Interest Rates

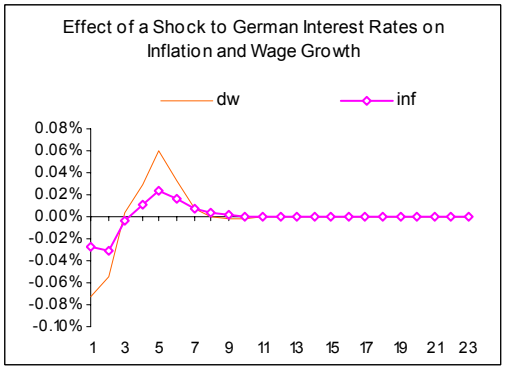
Since the model assumes a perfectly fixed exchange rate regime, a shock in the German (vis Euro Area) interest rates translates into a direct shock in domestic interest rates. That is, for the assumed exchange rate environment the parity between domestic and German interest rates becomes the policy rule of the Central Bank of Cyprus. Since German prices are assumed constant, the shock is effectively an annualised increase of one percentage point for one year in the real interest rate. Uncovered interest rate parity (UIP) implies that the nominal exchange rate against the euro does not move but it appreciates immediately against both Sterling and the Dollar. Thereafter, since the next shocks are anticipated, the nominal exchange rate depreciates steadily for the year that Cypriot interest rates are raised.

Chart 5





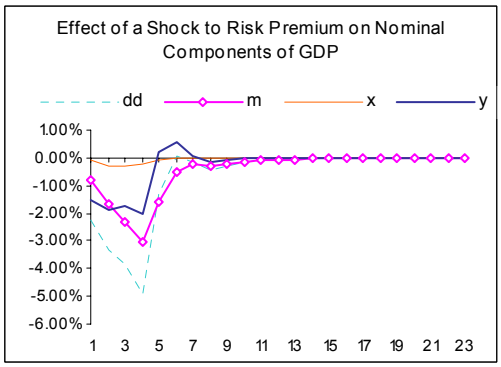


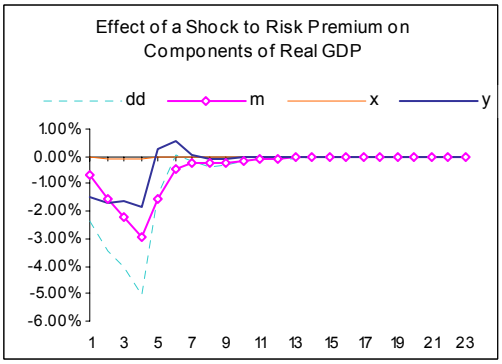


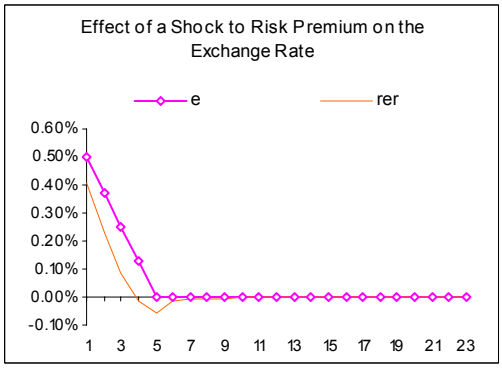
4.5 Risk Premium

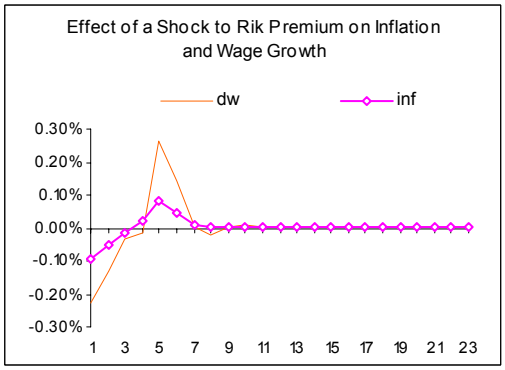
A risk premium enters the interest rate parity between the Cyprus and German interest rates. At the steady state the risk premium is assumed zero and the two interest rates are equal in order to keep the exchange rate fixed. As indicated in the previous subsection, a shock in the German interest rate must be followed by the same shock in Cyprus interest rates. However, a shock in the risk premium allows the two interest rates to differ, giving the authorities in Cyprus some room for monetary policy. Thus, a shock of four consecutive quarters in the risk premium can also be seen as an independent change in domestic interest rates.

Chart 6









The shock in risk premium has all the expected effects of a rise in domestic interest rates. Domestic demand imports and output fall both in nominal and real terms, returning to equilibrium in approximately nine quarters. Inflation and wages fall below equilibrium while nominal and real effective exchange rates exhibit an appreciation. The difference between this direct shock to the economy and the previously analysed indirect shocks is seen in the size of the effect. The maximum drop in output is equal to 2.0 per cent while the nominal exchange rate appreciation reaches 0.5 per cent.

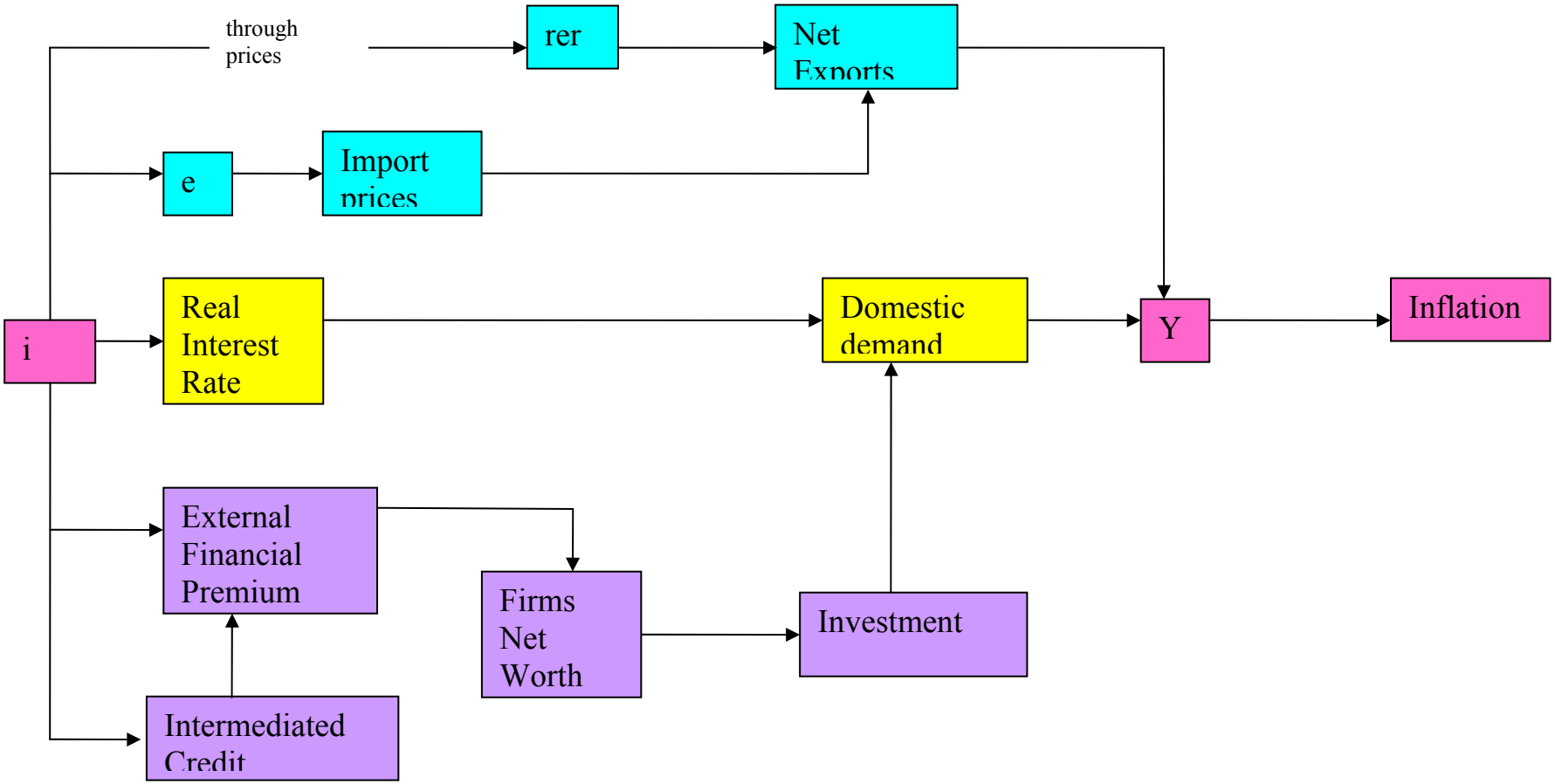
5. Conclusion

In this first effort of modelling the monetary transmission mechanism in Cyprus we estimated a small macroeconomic model with 8 estimated equations and approximately 17 identities. The results are sensible despite the lack of data we had to overcome. In simulating certain shocks, as a first step, we have assumed equilibrium at zero, and tested the deviations of key variables from this base value.

We found that, in general, the effects of any temporary shock are small and brief. This can be explained by the fact that our sample is a period of a fixed exchange rate and capital controls and thus, the resulting equations capture the steadiness of the system. Moreover, as a result of the fixed exchange rate and purchasing power parity, price inflation seems to follow a cycle where the original effects reverse before returning to steady state, while wage inflation follows the same path only with larger effects. The small impact of any shock on inflation is further explained by a widening, or narrowing, of the current account.

The next step would be to loosen the fixed exchange rate assumption in order to capture the liberalised environment. In this way we would also be able to compare our results and draw some conclusions as to the effects of liberalisation. We would also like to expand our model further to include more sectors of the economy. For example, the equation for domestic demand should break down in consumption and investment individually. An equation for income from tourism should also be included, while the credit channel should be further analysed. Other possible extensions include analysing the effects of a permanent shock and isolating the individual effects of all the possible channels. Finally, it would be interesting to see the changes in the results if we allow for a floating exchange rate.

Appendix 1: Cyprus Transmission Mechanism Flow Chart



Appendix 2: The Model of Cyprus Monetary Transmission Mechanism

@WinSolve code

```
*p c1=-0.60;
*p c2=0.41;
*p c3=0.36;
*p c4=0.14;
*p c5=-0.003986;
*p c6=0.84;
*p c7=-0.32;
*p c8=0.37;
*p c9=0.31;
*p c10=0.44;
*p c11=0.83;
*p c12=-0.045;
*p c13=0.14;
*p c14=-0.0047;
*p c15=0.017;
*p c16=0.042;
*p c17=-0.60;
*p c18=-0.085;
*p c19=0.09;
*p c20=0.005;
*p c21=0.57;
*p c22=0.11;
*p c23=-1.22;
*p c24=2.63;
*p c25=5.5;
*p c26=1;
*p c27=45;

Ri_SA=i-Inf(+1)-Inf(+2)-Inf(+3)-Inf(+4);
DD=rdd_sa+P;

Rdd_SA=c1*ri_sa+c2*rg_sa(-1)+c3*rdd_sa(-1)+c4*(lclprv-lclprv(-
1))+0*c5*TTREND;
yreal=y-p;
rg_sa=g-p;

*t
inf=PG-PG(-1);

*t
Rdd_SA=yp;
*t
i=if;

exp(y)=exp(DD)+exp(x)-exp(m)+exp(g)+ds+gdpres;

rx_sa=c6*lyf+c7*rer(-1)+c8*rx_sa(-1);
x=rx_sa+p;

reus=p+eus-pus;
reg=p+eg-pg;
reuk=p+euk-puk;
rer=0.40*reus+0.50*reg+0.1*reuk;
pm=0.4*pus+0.5*pg+0.1*puk;
e=0.4*eus+0.5*eg+0.1*euk;
```

```
eus=eus(+1)+i-ius;
euk=euk(+1)+i-iuk;

if=0.4*ius+0.5*ig+0.1*iuk;
i=ig+rp;

rif=0.40*rius+0.50*rig+0.10*riuk;

*t
infeu=infeu(-1);

m=rm_sa+p;
rm_sa=c9*rm_sa(-1)+c10*rdd_sa+c11*rer;


inf=c12*(p(-1)-w2(-1))+c13*(pg(-1)-p(-1))+c14*(y(-1)-p(-1)-l(-
1))+c15*(pus(-1)-eus(-1)-p(-1))+c16*(y-p-yp);
p=inf+p(-1);


DW=inf+c17*(w2(-1)-p(-1))+c18*(y(-1)-p(-1)-l(-
1))+c19*lgap+c20*TTREND;
w2=dw+w2(-1);
rw2=w2-p;


rulc=w2+l-y;

m0=P+c21*(m0(-1)-p(-1))+c22*(y(-1)-P(-1)-Y(-2)+p(-
2))+c23*ri_sa+0*c24*inf;
vel=exp(m2-y);


m2=c25*m0;

clprvlev=exp(m2-y)-clpbclev-nfalev-unclasslev;
lclprv=log(clprvlev);

nfalev=nfalev(-1)*(1+if(-1))*(1-e+e(-1))+(exp(x)-exp(m))+otherstuff+
c27*rp;

l=lp+c26*(y-p-yp);
LGAP=L-Lp;
```

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