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Interest Rate Determination and Liberalization of International Capital Movements: Israel 1973-1990*

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This study examines how the regulation of foreign exchange transactions affected the "actual openness" of the Israeli capital account. The integration between foreign and domestic financial markets is measured via the effect on domestic interest rates of changes in world interest rates and in domestic monetary conditions.

As expected, we find that the transition between an extremely tight regulation regime to a more liberalized one increases the dependence of the domestic interest rate on world rates. Yet, surprisingly, no such clear difference exists between a partially and a fully liberalized policy regime. This may reflect that once financial channels are opened agents find their way around existing regulations.

I. Introduction

At present, Israel is engaged in a program of liberalization which gradually eases controls over capital movement to and from the country. The liberalization program aims to allow more options and flexibility in foreign currency transactions and thus to strengthen the link between the domestic financial market and world markets.

Liberalization of the capital account of the balance of payments reduces administrative restrictions on foreign transactions such as lending and investment (financial and direct) by foreign agents in the

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domestic market and by domestic agents in the foreign market. Reducing these controls, in so far as they are effective, increases efficiency in the allocation of capital between the home country and the world.

The purpose of this study is to examine how changes in regulation of foreign exchange transactions affected the "actual openness" of the Israeli capital account. The study examines the relationship between partial and full liberalization of the capital account of the balance of payments and the degree of integration between world and domestic financial markets. The integration between foreign and domestic financial markets is measured via the effect on domestic interest rates of changes in world interest rates and of changes in domestic monetary conditions. The respective influences of these factors are analyzed for various policy regimes during the period 1973-1990.

The determination of domestic interest rates depends on the degree of effective openness of the capital account. An open capital account implies the existence of an arbitrage connection between world interest rates and domestic interest rates given expected currency devaluations and risk factors. A closed capital account implies that domestic monetary conditions are primarily responsible to the determination of domestic interest rates. We would therefore expect that the more liberalized is the regulation regime, the stronger will be the integration between foreign and domestic financial markets.

As expected, we find that in the transition between an extremely tight regulation regime to a more liberalized one, the act of liberalization of controls over foreign exchange transactions increases the dependence of the domestic interest rate on world rates. Yet, perhaps surprisingly, we find that no clear difference exists between a partially and a fully liberalized policy regime in terms of the degree of actual integration between the domestic and world financial markets. Namely, the extent of policy liberalization does not affect the degree of actual financial integration. This surprising finding may reflect that once some financial channels are opened agents find their way around existing regulations. However, caution is advisable in interpreting this result since it depends on the specific functional forms assumed in the model, and on the division of the period under study into policy regime subperiods.

In this paper, Section II reviews some of the recent literature on the subject of international capital mobility. In Section III a short historical summary of the policy regimes regarding capital controls in Israel is presented. The theoretical model is presented in Section IV.

Empirical tests of the model are discussed in Section V, and finally, Section VI concludes the paper.

II. Recent Literature

In recent years there have been various attempts to test the degree of financial integration between countries. These works provided the analytical background for the present study which measures the effect of financial liberalization of foreign exchange transactions on the determination of the domestic interest rate. Feldstein and Horioka (1980) and Feldstein (1983) test for capital mobility across countries by using the theoretical result that in an environment of perfect capital mobility there should be no correlation between a country's domestic saving rate and its domestic investment rate. In a world of perfect capital mobility saving in each country should respond to the worldwide opportunities for investment, while investment in a given country is financed by the worldwide pool of capital. The authors find that between 1960 and 1979 capital is relatively immobile within the OECD countries. Yet, as Tesar (1991) points out, a variety of models are able to generate a positive correlation between domestic savings and domestic investment in a manner unrelated to international capital mobility. Permanent exogenous shifts in the rate of technological progress or population growth with imperfect labor mobility can explain the long run co-movement between savings and investment. Temporary demand and productivity shocks can produce short-run co-movements between savings and investment. Obstfeld (1986) argues that the tests most likely to be informative about the extent of international capital mobility involve assets denominated in the same currency but issued in different countries. In his 1986 study, Obstfeld tests for capital mobility based on a consumption based model of asset pricing. For the time period of the 1970s and early 1980s, Obstfeld finds that capital mobility is substantial among OECD countries. Various authors, such as Mankiw, Rotemberg and Summers (1985), claim that postwar aggregate data provides no support for this type of a consumer behavior model. A third approach of testing the integration of world markets is undertaken in Cumby and Mishkin (1986) who test for co-movements of real interest rates across countries. This approach, however, rests on an assumption that purchasing power parity holds. Frenkel (1981), among others, sheds serious doubts on whether this is in fact the case.

The degree of financial integration between the Israeli domestic

market and the international capital market was recently studied by Meridor and Pessach (1989) and Elkayam and Tal (1990). Both studies measured the effectiveness of domestic monetary policy. To do so, an offset coefficient to domestic monetary policy is derived. From the derived offset coefficient one can infer the degree of openness of the Israeli financial sector. These studies tackled the problem of the effectiveness of monetary policy by looking at the extent to which it is offset by capital flows.

The present study mesures directly the extent by which the Israeli financial sector is integrated with the world via the effects of capital mobility on prices. Namely, the present paper measures the extent by which world interest rates determine the nominal domestic lending rate. This paper applies to Israel a slightly revised version of the model developed by Edwards and Khan (1985) to study the degree of capital mobility via a model of interest rate determination. Such model is selected because it allows one to measure the degree of financial integration between the Israeli domestic market and the international capital market irrespective of the exchange rate policy regime. In Israel, during the period investigated, several exchange rate regimes were enacted. Other models measuring capital mobility by flows, as in Kaas (1986), rely on mechanisms specific to a given exchange rate regime. As an example, under a fixed rate policy regime, a change in the foreign rate of interest is linked to the domestic interest rate via changes in capital flows, reserves, money supply, and the determination of the equilibrium interest rate in the domestic money market.

The present work applies a modification of Edwards and Khan's (1985) money demand function. More importantly, this work divides the period under study into subperiods reflecting various policy regimes, in order to test the effect of changing policies on the degree of financial integration.

III. Supervision over Foreign Exchange Transactions in Israel

The model put forth is used to analyze the degree of financial integration between Israel and the world from the last quarter of 1973 to the last quarter of 1990. This period may be roughly divided into four subperiods of distinct policy regimes defining the extent of administrative controls over the country's capital account of the balance of payments.

From the period immediately following the 1973 war until 1977

there was a strict regulation of foreign currency transactions. In light of the 1973 war and the world's oil crises, Israel experienced a rapid growth in security and energy related expenditures. Both factors deepened the country's current account imbalance, and contributed to the emerging inflation. During that period all foreign currency loans to the Israeli private sector were under the full control of the government.

Following the change in government, in October 1977 a radical capital account liberalization annulled most of the controls over foreign currency transactions. The ceiling limiting the amount of foreign currency loans and the supervision over such loans were abolished. Allowances were expanded for local residents to include in their financial portfolio foreign securities and other assets indexed to foreign currencies. Investments of Israelis abroad increased from $8.5 million in 1977 to $157 millions in 1979. Unilateral transfers of individuals abroad increased from $51 million in 1977 to $90 million in 1979.[1]

During 1979 attempts were made to limit the liberalization. The cost of foreign currency transaction was substantially increased by new taxation, and new limitations were imposed on these transactions. Due to a tax on foreign funds, the cost of foreign credit expressed in US dollars increased from 14 percent in the first quarter of 1979 to 25 percent in the second quarter of the year. Moreover, in November of 1979, a temporary prohibition was declared on the ability of Israeli residents to accept direct foreign currency loans.

From mid-1979 until 1987, the extent of regulation on foreign currency transactions fluctuated in short periods with no clear direction. While some restrictions were eased, others were imposed. We therefore examine the period as one "average" rather than divide it into short subperiods.[2] In August of 1982, regulations disallowing long term foreign credit via the banking system were eased. In addition, importers were allowed to undertake abroad trade related credit guaranteed by foreign banks. The rate of extra interest paid on foreign currency loans undertaken via the israeli banking system was reduced from 9 percent to 1 percent. In 1983, the amount of foreign currency which an Isareli resident was allowed to hold or to take abroad while traveling was reduced. In 1984, a new regulation forbade resident of Israel to hold foreign securities except for a number of securities issued by Israeli firms. It was no longer allowed for Israeli residents to hold

1 Source: Bank of Israel, Annual Report, Various years.

2 Most importantly, even within this average of mixtures of policies no period resembled the fully liberalized regime instituted in 1977.

foreign currency in foreign banks. In 1985, the amount of foreign currency which an Israeli resident was allowed to take abroad was reduced further. In 1986, an earlier repayment of trade credit was allowed.

From 1987 until present,[3] a period of gradual reforms slowly lifted controls over foreign currency transactions. During the period, the minimal term for direct foreign currency credit from abroad was reduced from 30 to 6 months. The interest ceiling on direct foreign credit, which used to be 2 percent above Libor, was cancelled. The quantity ceiling restricting the amount of foreign credit taken via the banking system was lifted. Direct investment abroad was allowed under a general "special permission" guideline.

Thus, four policy regimes regarding control over foreign currency transactions are identified. A period of tight controls: 1973-1977; a period of a liberal regime 1977-1979; a period of changes with no clear direction 1979-1987; and a period of gradual reform 1987-1990.

IV. The Model

In order to measure the effect of liberalization on the degree of financial integration between Israel and the world, we apply a revised version of the model proposed by Edwards and Khan (1985). The model tests the degree of financial integration by evaluating the relative explanatory powers of foreign and domestic factors in determining local interest rate. The model stems from two basic models of interest rate determination: one of a fully closed economy, and the other of an economy integrated with the world via an interest parity condition. The two models are later combined. As stated, in comparison with Edwards and Khan, the model applies a modified money demand function. More importantly, this work divides the period under study into subperiods reflecting policy regimes to test the effect of partial and full liberalization on the degree of financial integration.

A. The Closed Economy Model of Interest Rate Determination

The nominal interest rate is characterized by the Fisher equation explaining the nominal interest rate by the real rate of interest and inflationary expectations:

[3] For a recent review of internal capital market reforms undertaken to increase competition between the government and the private sector, during that period, see Ben-Bassat (1990).

$$(1) \qquad i_t = r_t + \pi^e_t$$

where i, r, and π^e_t are the nominal interest rate, real interest rate and inflationary expectation at time t, respectively. (A key to notations appears in Section V.) The real rate of interest, in turn, is specified as:

$$(2) \qquad r_t = \rho - \lambda EMS_t + u_t$$

where ρ is a constant representing the long run equilibrium interest rate and λ, ($\lambda > 0$), is a parameter, and EMS stands for excess money supply, u represents a random error term.

Deviations from the long run equilibrium real interest rate are explained by excess money supply (demand) and by a random error. An excess supply (demand) of real balances will lower (increase) the current interest rate below (above) its long run equilibrium value. The liquidity effect (Mundell 1963) specified in this form allows inflationary expectations to influence the nominal rate of interest but not the long run real rate. In the long run equilibrium, the excess money supply will play no role in the behavior of the real interest rate. The liquidity effect itself affects short run real interest rates and may also affect inflationary expectations. The excess supply of money is defined as:

$$(3) \qquad EMS_t = \log m_t - \log m^d_t$$

where m_t is the actual real money stock and m^d_t is the desired equilibrium stock of real balances.

In the short run, the quantity of real balances, m_t, may be directly determined as a policy variable or indirectly determined via reserve requirements, interest paid on bank deposits in the central bank, or via the interest offered for central bank lending to banks and to the public. In the longer run, due to the price effect, an adjustment rule regarding the dynamic behavior of m_t is presented below (equation 5).

The demand for real balances (equation 4) is a function of the opportunity costs of the two alternatives to money holdings: the opportunity cost of purchasing goods (the expected inflation) and the opportunity cost of holding financial assets (the rate of interest). In addition to the two opportunity costs, real income also determines the demand for money. We assume here a form of learning about interest rate behavior which is described as a weighted average between past and

current interest rates. The model is built with the behavioral equation describing the desired equilibrium stock of real balances, narrowly defined to include demand for currency plus demand deposits, as specified[4]:

$$(4) \quad \log m_t^d = \alpha_0 + \alpha_1 \log y_t - \alpha_2\{\mu(\rho + \pi_t^e) + (1-\mu)[ci_t + (1-c)\, i_{t-1}]\} - \alpha_3 \pi_t^e$$

where y represents real income (output), μ and c are weight parameters between zero and one.

Thus, as stated, the level of economic activity and returns to alternative uses of holding money enter into the specification above. The substitution between money and financial assets is assumed to be a function, (weighted by μ and $1-\mu$), of the long and short run components of the nominal interest rate, rather than of merely the current nominal interest rate. The long run component of the nominal interest rate is defined as the long run equilibrium interest rate augmented by expected inflation. The short run component of the nominal interest rate is simply given by a weighted average of the current rate of interest and the rate of interest in the past period (c, 1-c). This modelling of the nominal interest rate describes the process of learning of interest rate behavior.

The specification of a dynamic process for adjustments provides an implicit price mechanism which stabilizes the money market around the equilibrium nominal interest rate. Such specification, as given by equation (5), closes the model:

$$(5) \quad \Delta \log m_t = \beta[\log m_t^d - \log m_{t-1}]$$

where β is a parameter.

Thus, starting from a long run equilibrium in the money market, a given increase in real balances at time t-1 will create an excess money supply in that time period (equation 3). As a consequence, at time t-1 the real rate of interest will go down (equation 2), which in turn will lower the nominal rate of interest (equation 1). This is in fact the short run liquidity effect. The decrease of the nominal interest rate at time t-1 will raise the current money demand (equation 4). To the extent that the weight of the short run nominal interest rate $(1-\mu)$ is very

[4] Various alternative specifications of the demand for money in Israel are presented in Ben-Bassat and Marom (1985), Leiderman and Marom (1985), and Melnick (1985).

small, the long run component of the nominal interest rate will dominate the money demand equation. Then, the effect of the decrease of the nominal interest rate at time t–1 on the demand for money will be negligible, and the demand for money will be virtually unchanged. The increase in money supply at period t–1 combined with the unchanged period's 't' demand for money will begin a process by which the nominal interest rate returns eventually to its long run equilibrium level via an implicit price adjustment mechanism (the change in the log money supply is negative in equation 5).

From the first five equations, we derive the reduced form equation for the nominal interest rate in the closed economy:

$$(6) \qquad i_t = \gamma_0 + \gamma_1 \log y_t - \gamma_2 \log m_{t-1} + \gamma_3 \pi^e_t - \gamma_4 i_{t-1} + v_t$$

where;

$$\gamma_0 = [\rho + \lambda(1-\beta)(\alpha_0 - \alpha_2 \mu \rho)]/A$$
$$\gamma_1 = [\lambda(1-\beta)\alpha_1]/A$$
$$\gamma_2 = [\lambda(1-\beta)]/A$$
$$\gamma_3 = [1-\lambda(1-\beta)(\alpha_2 \mu + \alpha_3)]/A$$
$$\gamma_4 = [\lambda(1-\beta)\alpha_2(1-\mu)(1-c)]/A$$
$$v_t = u_t/A$$

where $A = 1 + \lambda(1-\beta)\alpha_2(1-\mu)c$

B. The Mixed Economy Model of Interest Rate Determination

In an open economy with risk neutral agents and no transaction costs, but with an adjustment lag, the following interest parity arbitrage condition links domestic interest rates to the world:

$$(7a) \qquad \Delta i_t = \theta(i_t^* + \dot{e}_t - i_{t-1})$$

or after a simple manipulation:

$$(7b) \qquad i_t = \theta(i_t^* + \dot{e}_t) + (1-\theta)i_{t-1}$$

where $\dot{e}$ is the expected exchange rate change, and θ is a lagged response adjustment parameter, $0 < \theta < 1$. i_t^* is the foreign rate of interest. That is, domestic interest rates respond with a lag to foreign interest rates and expected exchange rate changes.

By adding the uncovered interest parity arbitrage condition (7b) to

the Fisher equation (1), we get the combined equation as follows:

$$(8) \qquad i_t = \phi\theta(i_t^* + \dot{e}_t) + \phi(1-\theta)i_{t-1} + (1-\phi)(r_t + \pi_t^e)$$

where ϕ is constructed as an index of financial openness of the country. When $\phi = 0$ equation (8) is reduced to equation (1), i.e., the closed economy case. The value for ϕ, $0 < \phi < 1$, provides us with information as to the degree of financial integration between the given economy and the rest of the world. The closer the value of ϕ is to one, the greater is the influence of the uncovered interest arbitrage condition in determining the domestic interest rate. Keeping equations (2) to (5), the reduced form of equation (8) is expressed in terms of equation (9) below:

$$(9) \qquad i_t = \delta_0 + \delta_1(i_t^* + \dot{e}_t) + \delta_2 \log y_t + \delta_3 \log m_{t-1} + \delta_4 \pi^e{}_t + \delta_5 i_{t-1} + w_t$$

where:

$$\delta_0 = [(1-\phi)[\rho + \lambda(1-\beta)(\alpha_0 - \alpha_2\mu\rho)]]/A$$

$$\delta_1 = [\phi\theta]/A$$

$$\delta_2 = [(1-\phi)\lambda(1-\beta)\alpha_1]/A$$

$$\delta_3 = [-(1-\phi)\lambda(1-\beta)]/A$$

$$\delta_4 = [(1-\phi)[1-\lambda(1-\beta)(\alpha_2\mu + \alpha_3)]]/A$$

$$\delta_5 = [\phi(1-\theta) - (1-\phi)\lambda(1-\beta)\alpha_2(1-\mu)(1-c)]/A$$

$$w_t = (1-\phi)u_t/A$$

where $A = 1 + \lambda(1-\beta)\alpha_2(1-\mu)(1-\phi)c$

In the case when the interest parity condition alone determines the domestic rate, where $\phi = 1$, the expected values are $\delta_0 = \delta_2 = \delta_3 = \delta_4 = 0$. That is, the domestic interest rate is solely determined by the foreign interest rate and exchange rate changes. In a fully closed economy, where $\phi = 0$, the expected value is $\delta_1 = 0$; so that the foreign interest rate and expected exchange rate changes play no role in determining the domestic interest rate. In the above formulation the parameter ϕ is not identifiable. The relative degree of integration of the economy is measured via the coefficients of the domestic and foreign determined variables. The parameter of lagged interest rate, δ_5, is composed of elements which describe interest rate behavior from both the interest parity condition and the Fisher equation, and thus its value is not expected to be zero even in the fully closed economy case.

V. Empirical Test of the Model

The model is used to analyze the degree of financial integration of the Israeli economy using quarterly data from the last quarter of 1973 to the last quarter of 1990[5]. Given the changes in policy regimes of the extent of control over foreign currency transactions, we examine whether the given policies simply transferred capital from more to less restricted channels or whether they were effective in changing the degree of financial integration between the Israeli economy and the world.

Equation (9) was estimated using the Ordinary Least Squares method. There are advantages to estimation of the equation using the method of cointegration. However, cointegration is suitable for large samples. The need to evaluate each of the subperiods of the data separately drove us to use the more classical approach.

The expected rates of inflation and of currency devaluations were replaced by actual inflation and devaluation figures, under the assumption of agents with a perfect foresight. The real income variable used, stemming from a transactional demand for money, was taken as logs of the real GDP of the business sector. This variable describes well fluctuations in economic activity. Money was narrowly defined to include currency plus demand deposits (M1). The domestic interest rate taken was the rate charged on bank overdrafts (Hahad). This rate is readily available and its fluctuations may stand as a proxy for fluctuations of lending rates in Israel. The foreign rate chosen is a Eurodollar interest rate. Changes in the Eurodollar rate provide a good proxy for both borrowing and lending dollar interest rates. The Hahad and Eurodollar rates are calculated on a three months basis. We also included the demand for Patam (directly and with a dummy variable) to account for the possible structural change in the demand for money with the introduction to the market of this indexation instrument to foreign currency. Yet, the coefficients of the Patam variables were not significantly different from zero and thus they were dropped from the regressions.

The general form of Equation (9) allows the specification to be suitable for the various policy periods. By letting the coefficients of the equation to vary between periods, in accordance with the Lucas criti-

[5] We estimate the model using quarterly data because this is the shortest time period for which output data is available.

que, we allow for systematic changes in response to the changing government policies.

We attempted to identify the policy subperiods from the data given our prior knowledge about the policy regimes. The first subperiod is clearly identifiable. This period of strict supervision over foreign currency transactions began with the 1973 structural change in the demand for money[6] and ended with the dramatic 1977 liberalization. The timing of the other three regulation regimes is less a priori clear due to the gradual policy changes between regimes. Moreover, the subperiods are less clearly identifiable because a greater variation occurred in the regulation of foreign currency transactions within the subperiods. Therefore, we searched for the exact timing of the various policy regimes by evaluating the stability of regression coefficients around times of expected changes in the degree of financial integration.

Results of the linear estimation of equation (9) by linear OLS procedure are presented below: (numerals below the regression coefficients are the t statistics).

Table 1

ESTIMATION OF REGRESSIONS

Regression 1:

$$
\begin{aligned}
i_t = {} & -1.162 + 1.21DI + 0.140D2 + 1.400D3 + 0.393(i_t^* + \dot{e}_t) \\
& (2.93)\ (0.65)\ (0.01)\ (0.96)\ (2.63) \\
& - 0.387D1(i_t^* + \dot{e}_t) + 0.837D2(i_t^* + \dot{e}_t) - 0.485D3(i_t^* + \dot{e}_t) \\
& (1.95)\ (0.08)\ (1.08) \\
& + 0.096\log y_t - 0.077D1\log y_t - 0.115D2\log y_t - 0.102D3\log y_t \\
& (2.84)\ (0.50)\ (0.42)\ (0.63) \\
& + 0.032\log m_{t-1} - 0.035D1\log m_{t-1} + 0.145D2\log m_{t-1} \\
& (1.81)\ (0.60)\ (0.08) \\
& - 0.027D3\log m_{t-1} + 0.267\pi_t^e - 0.252D1\pi_t^e - 0.004D2\pi_t^e - 0.216D3\pi_t^e \\
& (0.41)\ (2.43)\ (1.14)\ (0.00)\ (0.22) \\
& + 0.809(i_{t-1}) - 0.014D1(i_{t-1}) - 0.501D2(i_{t-1}) + 0.086D3(i_{t-1}) \\
& (8.12)\ (0.02)\ (0.08)\ (0.39)
\end{aligned}
$$

Adjusted R-Squared = 0.938 DW = 2.254 H = 1.3
Number of Observations = 68

6 See Ban-Bassat and Marom (1985).

Regression 2:

$$i_t = \underset{(1.84)}{-0.287} + \underset{(2.69)}{0.441}D1 + \underset{(3.58)}{0.398}(i_t^* + \dot{e}_t) \underset{(2.57)}{-0.386}D1(i_t^* + \dot{e}_t) + \underset{(1.79)}{0.022}\log y_t$$

$$\underset{(2.31)}{-0.012}D1\log m_{t-1} + \underset{(2.17)}{0.170}\pi_t^e + \underset{(16.32)}{0.692}(i_{t-1})$$

Adjusted R-Squared = 0.944 DW = 2.00 H = 0.00

Symbols

i_t	= nominal rate of interest
i_t^*	= world interest rate
ϕ	= openness coefficient
θ	= coefficient of adjustment
r_t	= real (ex-ante) rate of interest
π_t^e	= expected rate of inflation
ρ	= long run equilibrium interest rate
EMS	= excess money supply
u_t	= random error
m_t^d	= desired money demand (real stock)
m_t	= actual real money balances
y	= output
λ, μ, c, β	= constants
$\dot{e}$	= expected rate of devaluation
D1	= Dummy variable taking the value of 1 for 73(4)-77(3); 0 otherwise.
D2	= Dummy variable taking the value of 1 for 77(4)-79(1); 0 otherwise.
D3	= Dummy variable taking the value of 1 for 87(3)-90(4); 0 otherwise.

The time in which regulation of foreign exchange transactions was between the polar regimes of "tight controls" and of "full liberalization" was selected as the base period for the model. Thus, the two more extreme policy regimes are compared to a "mixed" regulatory period. Of course, once periods are defined, the choice of the base period does not affect regression coefficients. Yet, the determination of the regression coefficients as significantly different across periods does depend on the choice of base.

The determination of the starting and ending time of the base period, in which supervision over foreign currency transactions was neither the most strict nor the most liberal, defines the timing of the rest of the periods (given that the first period ended in 1977). The

beginning of the base period marks the end of the fully liberalized regime while its end marks the beginning of the gradual reform period.

In the first regression, in addition to the explanatory variables derived from the model, three dummy variables appear separately and multiplied by the explanatory variables. These dummy variables are included in order to define the timing of the policy subperiods and to test the hypothesis whether the degree of integration of the domestic financial system with the world varied across the four policy regimes. We searched for the time of the beginning of the base period from 79(2) until 84(1), i.e., from the second quarter of 1979 to the first quarter of 1984, given that this period ended in 87(2). Also tested was the possibility of ending the base period in 1990(4), i.e. of no separate period for the gradual reform undertaken since 1987. Regression 1 reports the results for the base period 79(2) until 87(2). For the base period, the relevant coefficients are these of the explanatory variables as they appear separately. The remaining subperiods are compared to the base period: D1 takes the value of one for the period 73(4)-77(3), D2 for the subperiod 77(4)-79(1), D3 for the subperiod 87(3)-90(4); all dummies are zero otherwise. Changing the base period, as described above, did not change the basic result. Namely, the D1 coefficients were the only coefficients among the dummy variables which for some variables were significantly different from the base year coefficients. None of the dummy variables for the other periods could be accepted as being statistically significant.

Indeed, the foreign interest rate was of a significant influence on the domestic interest rate during the base period with a coefficient of 0.39. The influence of the foreign rate of interest was substantially lower during the first subperiod, with a coefficient of 0.006 (not significantly different from zero). This finding expresses that from the 1973 war and until the 1977 liberalization there was no influence of foreign interest rates on the domestic rates, and that the degree of integration between the domestic and foreign financial markets was poor. The influence of foreign interest rates on the domestic financial market between the periods 77(4)-79(1) and 87(3)-90(4) was not significantly different than its influence during the base period. That is, in periods of a partially and fully liberalized policy regimes, we find a strong integration of the domestic financial market with the world. In the period of tight controls, the controls were effective, and thus the foreign and domestic financial markets were not closely integrated.

The economic activity and inflation variables were accepted with a 95% level of confidence for the base period. The lagged real money

supply coefficient could be accepted only with a 90% level of confidence during the base period. Both variables were not significantly different from the base period during any of the subperiods. The signs of the coefficients were as expected except the sign of the log of the lagged real money supply coefficient. It was to be expected that δ_3 should be negative, while in fact, it is small but positive. In fact, in regression 2 the sign of the log of the lagged money supply coefficient is negative. Although surprising, a positive value for this coefficient is possible within the model when, implicitly, there is a strong price response to changes in the excess money supply. Finally, it should be said that due to the existence of a lagged dependent variable, an H test was performed to test the possibility of a first order autocorrelation; and with a 95% degree of confidence we reject that possibility.

Regression 2 was estimated via a process of elimination of insignificant variables. The only dummy variable remaining in the regression is D1. Therefore, effectively, only two distinct policy subperiods remained: the closed economy subperiod and the rest of time. Once again, the foreign interest rate adjusted by exchange rate changes is found as highly significant in determining the domestic interest rate, except during the closed economy period. The coefficient of this joint variable is estimated to be nearly 0.40 during the base period. During the only time for which this coefficient was significantly different, the closed economy period, the coefficient dropped to 0.01 (again not significantly different from zero). In fact, regression 2 strongly supports the results from regression 1, with an improved description of the role of the domestic money supply. For the period of the closed economy regime, the lagged real money supply becomes highly significant and negative, (a partial price response in the short run to an increase in money supply). Also, only for that closed economy period a distinct constant is significant. The H test rejects, even with a higher degree of confidence than for regression 1, the existence of first order autocorrelation. Results of the Chow test for structural change show that first period coefficients (all D1 variables) in regression 2 are jointly significantly different from the rest of time at the 95% level of confidence.

These results may be compared with Edwards and Khan's results derived from a similar model used to test interest rate determination in Columbia and Singapore. In Singapore, between 1976 and 1983, there were virtually no restrictions on trade and capital flows. Indeed, Singapore, at that time, was found to be an open economy. Only the interest parity condition was significant in determining Singapore's interest rate. This finding for Singapore contrasts with Israel's ex-

perience. Until 1977, in Israel, only the Fisher equation was significant in determining the domestic rate. From 1977 until 1990, both the Fisher equation and the interest parity condition were found significant in determining the domestic rate. As for Columbia, 1968-1982, both the Fisher equation and the interest parity condition were significant in determining the domestic interest rate. The Columbian foreign interest rate coefficient was found to be 0.35; a close resemblance to that of Israel's between 1977 and 1990. Indeed, Columbia during the period studied, may be characterized as a semi-open economy: capital controls were eased but some restrictions, such as minimum maturity on loans obtained from abroad, were maintained.

VI. Conclusions

The empirical testing indicates that from 1973 and until 1977 the nominal interest rate in Israel was sensitive almost entirely to domestic factors alone and from that period onwards the nominal interest rate became sensitive to both domestic and foreign factors. The 1987 reform has not significantly increased the sensitivity of the nominal interest rate to foreign factors.

Despite the difficulty to effectively regulate international capital movements, during the period of tight controls, prior to the 1977 liberalization, foreign factors did not significantly affect the domestic nominal interest rate. Following the liberalization the Israeli economy became more integrated with the world with no one period found as significantly more integrated than others. Indeed, it is harder to statistically establish the period of "full liberalization" as being significantly distinct as more open than subsequent periods simply because it lasted a relatively short period of time.

Nonetheless, these findings support the view that regulation could be effective when it is strictly and widely imposed. However, when the controls are eased, their effectiveness quickly diminishes and the difference between a partially and a fully liberalized regime, in terms of the degree of integration of the economy with the world, is not obvious. Although the cost of financial transactions may be a function of the degree of liberalization of the external capital account, once controls are even partially lifted, agents find ways around existing regulation. Stated differently, the regulation of financial flows may be effective only in a closed economy regime. Once such a regime is liberalized, the degree of effectiveness of controls diminishes and flows are simply transferred into less restrictive channels. Thus, partial

liberalization is not effective in preventing capital movements but it may increase the costs of transactions. The policy implication is obvious. Once the decision to liberalize has taken place, it may then be preferred to proceed faster with the program.

As the liberalization of the Israeli capital account of the balance of payments proceeds, the issue of the effects of the liberalization on the domestic nominal interest rates becomes more important. As Edwards and Khan point out, understanding the determination of the domestic rate is a necessary step in evaluating the effects of liberalization on real variables such as investment and growth. As compared with the state of the economy when the financial sector was not integrated with the world, Israel has experienced a dramatic change in 1977.

Conclusions could be reached based on empirical testing of the basic model presented here. Further research may test various alterations of this model. For example, interest rate sensitivity to money surprises may be tested, alternative ways to formalize the emergence of expectations regarding inflationary and exchange rate changes may be included, and risk aversion may be tested. Alternative money demand functions, which include the technological improvement in the financial sector, or which allow currency substitution with foreign moneys in the open economy case, could be tested. The development of a financial reform index, although difficult, would allow to study the effect of financial control in a more sensitive manner.

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