Monetary Policy in an Open Economy: The Differential Impact on Exporting and Non-Exporting Firms[1]

By

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Abstract

Using firm-level data, we provide evidence that, although monetary policy affects real investment, the effect operates differentially: *the greater its export intensity the less a firm is affected by tight money*. We examine several interpretations and conclude that the impact is transmitted primarily through the supply side due to differential access to credit markets. This finding lends support to the commonplace view that *monetary policy is less effective the more open the economy*.

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1. Introduction

We are concerned with two empirical questions: (1) does monetary policy have real effects; and (2) are these effects smaller the more liberalized and open the economy? It is well understood that in a frictionless economy, monetary policy has no real effects and the literature has identified, theoretically and empirically, potential frictions that render money non-neutral.[1] For money to be neutral in a setting with open economies, markets within countries *and* international markets must be frictionless. In such a world, frictions in both types of markets are potentially relevant for understanding whether and why monetary policy has real effects. For example, if the domestic and foreign currencies are not perfect substitutes, a rise in the domestic interest rate may affect the real activity of agents who must transact in the domestic currency, but those who can transact in foreign currency are shielded from potential real effects of domestic monetary policy.

To address this issue empirically, we study a panel of firm-level data in Israel - a small and open economy that since the early 1990s also qualifies as a liberalized economy. We conjecture that tight money should have little or no effect on the real investment of firms that have access to foreign currency denominated funds. To test this conjecture, we exploit the heterogeneity in our sample using export intensity as a measure of accessibility to foreign currency denominated credit, and find that monetary policy has a significantly smaller effect on export-intensive firms.

The differential response of export-intensive and non-intensive firms to monetary policy helps rule out several explanations. For example, it is hard to argue that monetary policy affects the investment of firms because it signals to them information about prices that the central bank has. Such a theory does not explain why exporting and non-exporting firms respond *differently* to the *same* monetary policy. We consider potential explanations that do account for such a differential response. These explanations

[1] This literature is too vast to cite properly. In what follows, we will mention several papers that are most relevant for our analysis.

correspond to various channels of monetary transmission. For example, tight money may affect the real activity of non-exporting firms by directly reducing the domestic demand for their products. Alternatively, tight money may induce an inflow of foreign capital that generates an appreciation of the exchange rate, and this in turn may affect the real investment of firms through the price of exported goods and imported raw materials.[2] Finally, productivity differences across exporting and non-exporting firms may account for the differential response to monetary policy. Our empirical analysis suggests that these are not the driving forces behind the results.

We believe that our findings are best interpreted as evidence for a supply-side effect that operates via credit markets. When domestic money is tight, firms that can raise less expensive foreign currency credit (or foreign currency denominated credit) do so and, as a result, are not obliged to cut down on their investment. Export intensity proxies for ease of access to foreign currency credit because exporting firms are more likely to have contacts and reputation in foreign credit markets, and can obtain trade credit from suppliers or customers abroad. Furthermore, since part of their sales revenue is in foreign currency, they face less exchange rate risk and local banks are willing to extend them foreign currency denominated credit.[3]

Our analysis and empirical findings are consistent with the line of argument of a related literature, centered on imperfections in domestic credit markets. This literature promotes the idea that monetary transmission operates through the balance sheets of firms. In a *closed* economy, the effect works as follows: a higher interest rate reduces the discounted value of a firm's collateral, diminishing banks' willingness to lend (and possibly resulting in credit rationing).[4] In an *open* economy, the following consideration

[2] See, e.g., Devereux and Engel (2001) for a theoretical analysis of the potential interaction of monetary policy and the exchange rate.

[3] Foreign banks should also be more inclined to supply funds to export intensive firms. (Therefore, exporting firms also have more bargaining power vis-a-vis domestic banks.)

[4] Bernanke, Gertler, and Gilchrist (1996) show that small US manufacturing firms respond more strongly to tight money than larger firms. A central element of their interpretation is the differential response of small and large firms to tight money, where small firms are regarded as

becomes relevant: the discounted value of the collateral of export-intensive firms is less affected by the domestic rate. Therefore, such firms should be affected less by tight domestic monetary policy.[5]

Our findings are also consistent with the empirical micro literature that deals with liquidity constraints more generally. In that literature, economic agents are identified as liquidity constrained on the basis of characteristics that proxy for ease of access to bank credit, and the general conclusion is that liquidity constraints affect real economic activity.[6] We extend this conclusion by providing evidence that even in an open and liberalized economy, domestic monetary policy affects the real activity of firms that do not have good access to foreign currency credit markets.

The empirical analysis is performed using firm-level year-by-year flow of funds data for publicly traded manufacturing firms on the Tel Aviv Stock Exchange. These data combine information from two sources: (1) flow statements that publicly traded companies are required to provide since 1990; and (2) profit and loss and balance sheet data. The flow statements allow us to compute firm-level year-by-year investment in fixed assets and investment in inventory.[7] We also compute Tobin's q, the ratio of

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more likely to be liquidity-constrained or credit rationed. See also Whited (1992), Oliner and Rudebusch (1996), and Hu (1999). Carlino and DeFina (1998) explain the differential *geographic* impact of monetary shocks (across US states) by differences in the concentration of small firms. Barth and Ramey (2000) and Dedola and Lippi (2000) study related issues in a dynamic framework at the sectoral level finding, too, that monetary policy affects real economic activity, and that the transmission of monetary policy operates through the supply-side.

[5] The firm balance sheet monetary transmission channel belongs to the "credit view" of monetary transmission. Another variant of the "credit view" is the loanable funds monetary transmission channel. When money is tight, *banks* are liquidity constrained and, as a result, supply less credit to firms. This effect is less relevant for our study because when domestic money is tight, banks can import funds from abroad. This was the case in Israel during the relevant sample period (see Section 2).

[6] For example, in Zeldes (1989) poor consumers are regarded as credit constrained and it is shown that they do not succeed in smoothing consumption intertemporally. In Fazzari, Hubbard, and Petersen (1988) firms that do not distribute dividends are regarded as cash constrained and it is shown that their investment is more sensitive to cash flow.

[7] For example, the flow statements report gross rather than net investment thus avoiding errors in the measurement of investment generated by price changes and vintage effects.

market value to replacement cost, for each firm in our sample on a year-by-year basis. Using this panel data set, we estimate the determinants of firm-level investment controlling for firm characteristics such as size, age, leverage, and sub-industry.[8, 9]

In several studies, e.g., Bernanke and Blinder (1988), the short-term interest rate is used to proxy for monetary policy. We take this approach in most of the analysis, and explain why the short-term rate can be regarded as reasonably exogenous to firm-level investment during the sample period under consideration.[10] In other studies, "monetary shocks" are identified through analysis of historical records. This methodology was suggested by Friedman and Schwartz (1962), revived by Romer and Romer (1989), and applied to the study of monetary transmission by Romer and Romer (1990). The sample is too short for applying this method systematically. (Our analysis relies mainly on the cross-sectional heterogeneity of firms in the sample.) Nevertheless, we identify one conspicuous "tight money event" and analyze the investment of the firms in the sample before and after this event. The empirical findings hold up very clearly; see Section 6.

Another commonly used method for identifying "monetary shocks" is to estimate a "Taylor-type rule" for the central bank's nominal interest rate policy, and to use the residuals from the estimation as a proxy for monetary surprises; see, e.g., Rudebusch and Svensson (1998). We apply this methodology to our data and find that, again, the empirical results hold up; see Section 6.

We also obtain interesting (and robust) results regarding the empirical

[8] It is worth remembering that our sample consists of publicly traded firms, so the effect should be even stronger for privately held firms that are on average smaller.

[9] We further split the sample according to whether a firm is listed only in Israel or dually (in Israel and the US) finding that the latter firms are also less affected by tight money. Again, this is consistent with the view that firms with access to alternative financing sources are less likely to face liquidity constraints or credit rationing. The dually listed firms in our sample exhibit above average export intensity, so the two proxies of accessibility to foreign currency denominated funds are not independent.

[10] Long-term rates are, of course, endogenous as they equilibrate the demand for new capital and the supply of saving.

performance of several theories of investment. For example, we find that Tobin's q positively affects firm-level investment in fixed assets but not in inventories. We further find that there is a significant "accelerator" effect (firm-level investment and growth are positively related), and that greater firm-level liquidity is associated with higher investment.

In the next section, we present the relevant macroeconomic background focusing on monetary policy and foreign capital flows to the country during the 1990s. In Section 3, we survey four central theories of investment that our empirical work addresses. In Section 4, we describe the data, in particular the flow of funds and the computation of Tobin's q. In Section 5, we report and interpret the main empirical results, in Section 6 we study alternative interpretations that may account for the differential response of exporting and non-exporting firms to monetary policy, in Section 7 we display results of two alternative empirical methodologies, and Section 8 concludes the paper.

2. Macroeconomic Background

Monetary policy in Israel in the 1990s

Monetary policy in Israel during the 1990s was in some periods expansionary and in others tight. Since 1992 the government has been announcing inflation targets every year. At the end of 1993 and until mid-1995, nominal interest rates were raised to fight inflation. During that period, real short-term rates also rose. Tight monetary policy was implemented at the end of 1996 and during 1997 as well. The top panel of Figure 1 displays two measures of the "real short-term interest rate" - the rate on monetary loans to commercial banks announced monthly by the Bank of Israel,[11] and a weighted average (across banks) of the interest rate on non-indexed overdraft credit for businesses.[12] The fluctuations of the real short-term interest rate over time during the period 1990-1998 are clearly visible. Since the real short-term interest rate that firms pay is the real interest rate

[11] Every week, the Bank of Israel provides loans to the commercial banks (or obtains deposits from them). The trading procedure is complex but, essentially, the interest rate at which this market clears is that announced by the Bank of Israel.

[12] We provide more details in Section 4.

on non-indexed overdraft credit to businesses, we mainly use this measure in our analysis.[13] The high correlation between the two rates during the sample period suggests that the empirical results should not be sensitive to the particular measure used (as we confirm in the actual analysis).

Of course, the policy instrument used by the Bank of Israel is the *nominal* interest rate. An important input (among other indicators[14]) to the Bank's rate-setting decision process are inflation expectations, calculated as the yield differential on non-indexed and indexed tradable Israeli government bonds of the same maturity. Since inflation expectations are calculated using public information, firms know the real interest rate after the central bank sets the nominal rate. Thus, in most of the analysis, we use the real interest rate (the nominal interest rate deflated by inflation expectations), but to check the robustness of the results, we re-estimate some of the regressions using the nominal interest rate and inflation expectations as separate regressors.[15]

During much of the sample period, monetary policy in Israel was directed mainly towards reducing inflation, and responded primarily to nominal variables and inflation expectations.[16] Real economic conditions affected monetary policy only to the extent that the fight against inflation was not impaired. Moreover, during most of the 1990s, GDP was smaller than estimated "potential" GDP. As a result, there were no perceived inflationary pressures from the product market that might have affected monetary policy (contrary to the US, where there have been several episodes of the Fed deliberately attempting to slow down the economy to fight inflation). We conclude that during the time period examined here, the short-term interest rate is (certainly to a first

[13] Moreover, visual inspection of the series suggests that the rate on monetary loans to commercial banks may not be stationary whereas the interest rate on non-indexed overdraft credit to businesses is clearly mean-reverting.
[14] For example, monetary aggregates, exchange rates, capital flows etc.
[15] During most of the sample period, inflation expectations decreased from year to year, and most of the displayed variation in the real interest rate originated in fluctuations of the nominal interest rate (not shown).
[16] This was particularly true since late 1993; see Section 6.

approximation) exogenous to the real investment of firms.[17] Nevertheless, to verify that our results are robust, we estimate in Section 6 "Taylor-type rules" for the Bank of Israel's monetary policy, and calculate the unexpected component of the short-term interest as an alternative measure of monetary policy.

Because the Israeli economy is very open, a nominal devaluation of the domestic currency has meaningful consequences for the price level (and for inflation) through its effect on the nominal price of imported raw materials and final goods. Therefore, the Bank of Israel's monetary policy takes into account changes in the nominal exchange rate. In the analysis in Section 6, where we estimate "Taylor-type rules" for the central bank, we address this issue.

Financial liberalization and the use of foreign currency denominated funds

During the 1990s, as a result of financial liberalization and tight monetary policy, many firms obtained foreign currency denominated credit (mainly from local banks). The middle panel of Figure 1 displays foreign currency denominated credit as a fraction of the total credit extended to the private sector.[18] This share increased during the years 1994-1997 when domestic interest rates rose sharply. In fact, from the top two panels of Figure 1 it appears that the short-term interest rate and the share of foreign currency denominated credit are positively correlated suggesting that firms *responded* to tight money by obtaining financing abroad (directly or via local banks).[19]

Initial public offerings of stocks abroad, mainly in New York, were another

[17] The 3-digit inflation of the early 1980s was a traumatic event that shapes monetary policy in Israel to this day. During the early 1990s, the Governor, Michael Bruno, made a genuine effort to loosen monetary policy in order to facilitate the absorption of the immigration wave from the former Soviet Union, but his successor in late 1991, Jacob Frenkel, shifted the emphasis towards the view that monetary policy should be directed primarily towards reducing inflation. See Leiderman (1999) and Leiderman and Bar-Or (1999) for analyses and a discussion of monetary policy in Israel.

[18] There are no data regarding the amount of foreign currency denominated credit to the manufacturing sector or to individual firms.

[19] This is particularly true for the interest rate on non-indexed overdraft credit to businesses.

important financing source for Israeli companies. By 1995, the number of NASDAQ-listed Israeli firms nearly equaled that of all other foreign firms combined (excluding Canadian companies).[20] A minority of these firms was dually listed, in New York and in Tel Aviv, and is included in our sample.

Investment

The bottom panel of Figure 1 displays investment in fixed assets, and in inventories, aggregated over the firms in our sample (publicly traded manufacturing firms excluding software firms and holding companies) during the 1990s. In the first half of the decade, the displayed rise of investment in fixed assets was no doubt driven by the immigration wave from the former Soviet Union. Figure 1 further suggests that, in the second half of the decade, there was a negative relation between investment and the short-term interest rate. Yet, we cannot conclude on this basis that the decline in investment was *caused* by the rise in short-term rates since it may reflect a "natural" fall in investment due to the decline in immigration, or to a change in investor sentiment caused by political factors. A micro data analysis that exploits cross-sectional heterogeneity of firms can help assess whether short-term rates affected investment.

We argue that not all firms have equal access to foreign currency denominated funds. In particular, export-intensive firms can more easily obtain such financing. Indeed, during the 1990s, local banks often required firms seeking foreign currency denominated credit to provide foreign currency denominated assets as collateral, or to demonstrate foreign currency denominated revenue sources as a hedge against exchange rate risk. These considerations lead us to investigate whether the investment of export-intensive manufacturing firms responds differently to domestic short-term interest rates.

3. Theories of Firm-Level Investment

We briefly survey four major theories of investment, all potentially relevant for

[20] See Blass and Yafeh (2001).

explaining firm-level investment in fixed assets.[21]

The accelerator

The accelerator model, associated with Paul Samuelson, assumes that firms hold capital stock (K) in proportion to the level of output (Y) so that K = v * Y, where v is a parameter reflecting the capital/output ratio that firms wish to maintain. Thus, I = (ΔK) = v *ΔY, where I denotes investment. The most straightforward interpretation is that K represents factors of production such as plants and equipment, and v is a technological parameter. A similar interpretation may apply to investment in inventories of raw materials and intermediate goods that are used in the production process, but not to inventories of finished goods.

Tobin's q

According to q theory, associated with James Tobin (1969), firms invest according to the ratio of the stock market value of their assets and the cost of replacing them. If this ratio (Tobin's q) exceeds one, more capital will be installed. As in the accelerator model, the most natural interpretation is that the theory applies to investment in plants and equipment (and maybe also in inventories of raw materials and intermediate goods) since these investment items affect the productive capacity of the firm.

The cost of capital

According to this theory (see, e.g., Jorgenson 1996), a firm's decision whether to add to its capital stock or let it depreciate depends on the difference between the cost of capital and its marginal product. As long as the marginal cost of capital exceeds its rental or opportunity cost there will be investment. An increase in the real interest rate raises the cost of capital and reduces investment.

For many investments, the relevant cost of capital is the long-term interest rate. In this study, as in others related, we are not interested in the effect of long-term rates on

[21] Most of these theories are less relevant for investment in inventories.

investment. Rather, we want to gauge the potential effect of monetary policy - proxied by short-term rates - on firm-level investment. Short-term rates may affect investment in the presence of capital market imperfections because firms may have limited access to long-term funds and must finance investment with short-term loans. Another possibility is that short-term rates have a direct effect on long-term rates (e.g., by affecting the public's expectations regarding long-term rates in a self-fulfilling manner).[22,23]

Capital market imperfections

Often, firms face financing constraints that can prevent them from undertaking profitable investments. These constraints can arise from capital market imperfections due to asymmetric information. For example, young unknown firms cannot obtain financing by issuing securities on anonymous markets and therefore tend to borrow from banks that provide screening and monitoring services (see, e.g., Fama 1985 and Diamond 1991). In such situations, financing constraints induce firms to determine their investment on the basis of their cash flow rather than on expected future profits. Indeed, numerous studies following Fazzari, Hubbard, and Petersen (1988) have found that cash flow and other financial variables are positively associated with investment at the firm level.

4. The Data

The sample and the data sources

Our sample consists of all the manufacturing firms that are listed on the Tel Aviv Stock Exchange (TASE).[24] We follow the sample for 8 years, from 1991 to 1998. Almost two thirds of the firms in the sample went public during the 1990s, and the number of firms increases from about 45 in 1991 to over 130 in 1998. Virtually all heavily use bank credit, while almost none issued publicly traded corporate debt or

[22] Hall (1977) suggests that short-term rates may mainly affect the timing of investment.
[23] For the sake of robustness, we also ran regressions that include the long-term rate. Our main concern is the edogeneity of long-term rates. We briefly report the results in the text, but not in tables.
[24] In the official TASE classification by industry, the category “manufacturing” includes venture capital firms and holding companies. To preserve the (relative) homogeneity of the sample, these firms are omitted.

commercial paper.[25] 12 firms in the sample are listed dually, in Tel Aviv and the US.

We collected data from several key sources: (1) financial statements, obtained mostly from a Compustat-type database ("Dukas") compiled by the TASE from annual reports; (2) stock price data (for the calculation of Tobin's q); and (3) flow statements compiled by the Bank of Israel Research Department from annual reports. In addition, we collected data on firm age (mostly from firm prospecti).

Flow of funds

The Research Department at the Bank of Israel has collected the 1991-1998 annual reports for listed firms and entered by hand for each firm and each year a "consolidated statement of flows" that decomposes flows into three key components: flows derived from operating activities, investment activities, and financing activities, broken down into about 50 sub-entries.

We focus on investment activities. Since firms report the current value of their investment purchases, we avoid imprecision that arises when standard financial statements are used. For example, if only profit and loss, and balance sheet, statements are available, only net investment can be calculated to which economic depreciation must be added. Such imputation does not take into account vintage effects and price changes. The flow statements also allow us to control for information that cannot be obtained easily from standard financial reports. For example, for each firm-year we construct the variable "Govshare" - the share of government-provided sources out of total sources (total sources = flow from retained earnings + external funding). Since many firms receive government subsidies for investment in fixed assets it is essential to control for such subsidies in the empirical analysis.[26]

[25] In 1998, the firms in our sample constituted 36 percent in terms of sales income of the entire manufacturing sector (publicly traded and privately held firms).

[26] Government subsidies are distributed mainly to firms operating in peripheral areas and to firms that perform R&D. In our sample, "Govshare>0" not only for firms located in the periphery.

From the detailed flow reports we construct firm-level year-by-year flow of funds. Such data are ideal for our purpose since they include high quality information on investment expenditure as well as relevant financial information.

We focus on two types of investment: (1) investment in fixed assets (property, plants, and equipment net of sales of these items); and (2) investment in inventories, defined as outlays for raw materials not yet used in the production process plus the net change in the stock of finished goods.

Removing outliers

We removed from the sample firm-year observations with inconsistency between the Dukas database and the flow statements entered by hand.[27] In this procedure, we used four key variables: net profits, and flows from investment activities, financial activities, and operations. A discrepancy of 5 percent (provided it is greater than 5000 December 1990 NIS) in one or more of these variables led to the removal of the firm-year observation from the sample.

Calculating Tobin's q

We measure average Tobin's q as the market value of assets divided by their replacement value. Replacement value is calculated assuming that fixed assets and inventories appreciate at a rate equal to that of the Consumer Price Index (CPI). The market value of assets equals the market value of common equity (obtained directly using stock price data) plus the value of debt and other liabilities. Since debt is mostly not traded, we estimate its value by subtracting from the replacement value of the assets the sum of (CPI adjusted balance sheet) deferred taxes and employee benefits, and the book value of common equity. Tobin's q so calculated rises dramatically in 1992 and 1993, reflecting the stock price run-up in those years, and then declines precipitously to an average of 0.93 in 1996. In 1997, market conditions improved and market value becomes

[27] Further details can be found in Blass and Yosha (2001).

as large as replacement value.[28]

The short-term interest rate

We use two measures of the real short-term interest rate: (1) the marginal rate on monetary loans to commercial banks announced monthly by the Bank of Israel; and (2) a weighted average (across banks) of the interest rate on non-indexed overdraft for businesses, both deflated by inflation expectations.[29] These expectations are constructed by calculating the yield differential on non-indexed and indexed tradable Israeli government bonds of the same maturity. As already mentioned, we use mainly real interest rates but we repeat some regressions using the nominal interest rate and inflation expectations as separate explanatory variables.[30] All the series are obtained from the Bank of Israel databases.

Export intensity

Publicly traded firms are required to disclose their export income if it exceeds 10 percent of their total sales income. Otherwise, publishing this information is optional. In our sample, the export income is not reported in 36 percent of the firm-year observations. For these firms, we know that the true value of their export income share lies between 0 and 10 percent.

Descriptive statistics and sample selection

Table 1 displays descriptive statistics of the entire sample and of sub-samples constructed according to export intensity. There are no meaningful differences in age, profitability, and leverage across export intensity groups but firms with high export

[28] We also calculated Tobin's q using only fixed assets in the estimation of replacement value (i.e., excluding inventories), and re-estimated the main regressions reported in Section 5. The results are virtually unchanged.
[29] The yearly rates are computed by the Bank of Israel as geometric means of monthly rates.
[30] We verified that the results do not change when a third measure of the interest rate is used (denoted by the Bank of Israel as the interest rate on "other short-term credit").

intensity are considerably larger.[31] Within the low (< 10) export intensity group there are differences in several variables: age, size and, to some extent, profitability and leverage.[32] In the regression analysis, we control for all the firm characteristics in Table 1. For firms that do not report their export income share, we assume that it is zero. We also split the sample into two groups - firms with low (<10) and high (>10) export intensity - comparing the effect of monetary policy on investment across these groups. This method yields qualitatively similar results suggesting that there is no serious bias as a result of export income reporting practices. No outliers were removed on the basis of the export income share.

Our sample includes virtually the entire population of publicly traded manufacturing firms so, in this respect, it is immune from selection bias. Moreover, during the sample period there have been virtually no bankruptcies or de-listings so survivorship bias is not a concern. In 1998, the sales income of firms in our sample constituted 36 percent of sales income in the entire manufacturing sector (publicly traded and privately held firms).[33] In 1998, the average export intensity in our sample is 28 percent while in the entire manufacturing sector it is 31 percent. Our focus on publicly traded firms is not necessarily a drawback for our analysis: if tight money reduces the real investment of (some) *publicly* traded firms, it should *a fortiori* reduce the investment of privately held firms that are on average younger, smaller, less well known, have fewer opportunities for non-bank financing, and are more likely to face liquidity constraints and credit rationing.

5. Empirical Analysis: The Main Result

The basic regression

In our basic empirical specification, the left-hand variable is the ratio of

[31] Leverage may proxy for "bank dependence" (since virtually all corporate debt in Israel's manufacturing sector is bank debt). Thus, we have some indication that bank-firm ties do not vary systematically with export intensity.

[32] In a probit analysis within the low (<10) export intensity group where the dependent variable is 1 if the firm reports its export income, only age and size are significant (not displayed).

investment to lagged fixed assets, I_t / K_{t-1}, where I denotes investment in fixed assets (the first and second columns of Table 2a) or in inventories (the third and fourth columns). We include several right-hand variables. Liquidity is measured as the ratio of the change in cash holdings to sales income, and leverage as the ratio of debt to total assets. Both are included to control for potential credit market imperfections and liquidity constraints. The variable "Govshare" - year-by-year government-provided sources out of total sources - controls for government investment subsidies to firms. We further include the year-by-year percentage change in sales income to control for potential "accelerator" effects, as well as lagged Tobin's q, lagged firm size measured as log-assets,[34] lagged profitability measured as the ratio of profits to sales income, and industry dummies. Finally, we include the lagged value of the variable "Export share" which is central for testing the hypothesis that export-intensive firms are affected less by tight money.[35] The right-hand variables are lagged because investment decisions typically take time to mature and are often implemented with delay.

In the regressions displayed in Table 2a, we use the weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses as a measure of monetary policy. We include the interest rate as a stand-alone regressor, and interacted with other variables. For example, the coefficient on the interaction of the interest rate and firm-level liquidity indicates whether monetary policy affects differently the real investment of firms that have more liquid assets.[36] Most relevant for our study is the coefficient on the interaction of the interest rate and "Export share." It indicates whether

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[33] Moreover, our sample includes 36 of the 50 largest manufacturing firms in Israel.

[34] The regression results are virtually unchanged if size is included as assets (rather than log-assets). Since the distribution of this variable in our sample is quite skewed, we generate a "bell-shaped" distribution using a log-transformation.

[35] In columns numbered (1), "Export share" denotes the log of one plus the ratio of export income to sales income. We use a log-transformation in order to reduce the skewness of this variable. A drawback of the log-transformation is that interpreting the magnitude of the regression coefficient is harder. In columns numbered (2), we use the non-transformed "Export share" variable, obtaining qualitatively similar results.

[36] Including the interest rate and variables such as liquidity, as stand-alone regressors *and* interacted with the interest rate in the same regression, is not advised due to high colinearity. (The interest rate varies over time but not across firms.)

export-intensive firms are affected differently by monetary policy. The regressions are OLS, corrected for heteroskedasticity.[37] They do not include firm-fixed effects because some variables exhibit very little variation over time. Later, we report regressions with firm-fixed effects that yield similar results.

Geographic location as an instrument for "Govshare"

Since government investment subsidies are potentially endogenous for firm-level investment, we instrument "Govshare" with a dummy variable that equals 1 if all the firm's plants are in peripheral areas that qualify the firm for investment subsidies. The results are virtually identical if this dummy variable is used as an instrument for "Govshare" or not. In the tables, we report the results of regressions without this dummy variable as an instrument.

Results

The coefficient on the lagged interest rate is robustly negative and significant in all the regressions.[38] The coefficient on the interaction between the short-term interest rate and "Export share" is positive and significant confirming our central hypothesis that monetary policy affects the investment of export-intensive firms less.

The impact of the lagged interest rate on investment is substantial. Consider, for example, the regression displayed in the second column of Table 2a where "Export share" is not log-transformed. The coefficient on R(-1) indicates that for a firm that does not export ("Export share(-1)" = 0), an increase of one percentage point in the interest rate on short-term credit (other things equal) reduces the ratio of investment to fixed assets by 1.4 percentage points which is about 4.6 percent of the mean investment share in the sample. The coefficient on "R(-1) * Export share(-1)" indicates that for a firm that only exports

[37] We use White's correction for hetroskedasticity. Later, we report results with a different correction for heteroskedasticity, with similar results.

[38] This finding is consistent with work by Lavi (1990) who uses aggregate Israeli investment data for the period 1962-1988 and finds a negative and significant effect of the short-term interest rate on investment.

("Export share(-1)" = 1), an increase of one percentage point in the interest rate on short-term credit reduces the ratio of investment to fixed assets by only 0.27 percentage points (-1.4 plus 1.13), almost fully offsetting the negative effect of the interest rate on investment. The average value of "Export share" is 0.23. For this "average firm," the net effect of an increase of one percentage point in the interest rate is -1.14 percentage points (-1.4 plus 0.23*1.13), namely, the offsetting effect due to export intensity is about 20 percent. For investment in inventories (the fourth column of Table 2a), the order of magnitude of these coefficients is similar. A similar calculation can be performed for regressions where "Export share" is log-transformed yielding an offsetting effect which is on the same order of magnitude.

We turn to the other regressors. For investment in fixed assets, we find a positive and significant coefficient for the interaction of liquidity and the interest rate. Namely, the interest rate affects less the investment in fixed assets of firms that have more liquid assets. This constitutes support for theories of investment based on capital market imperfections. However, as we will see later, this result is not robust across specifications. Of course, liquidity constraints are potentially more important for privately held firms, so the inconclusive results concerning this variable for our sample of publicly traded firms are not surprising. The results indicate quite strongly that younger and smaller firms invest more as a fraction of fixed assets, which is consistent with the idea that young firms invest in order to grow.

The regressions do not provide evidence that firms with high leverage are more influenced by tight money, and that those with government support are less sensitive to the short-term interest rate. The industry dummy variables are typically not significantly different from zero. We also tried to interact them with the interest rate in order to detect industries that are more affected by tight money finding no significant coefficients.

Finally, the estimated coefficients provide empirical support for other theories of investment. We find that the percentage change in sales income (a proxy for the change

in the level of production) affects investment positively and significantly which is consistent with the accelerator theory of investment. We also find support for q theory: (lagged) Tobin's q affects positively investment in fixed assets, but not investment in inventories. This is perfectly sensible since investment in fixed assets is a better proxy for the expansion of productive capacity than investment in inventories.[39] The magnitude of the coefficient on q is interpreted as follows. Consider the first column of Table 2a. If q increases by 1 (from the sample mean of 1.1 to 2.1, that is, if q roughly doubles), the ratio of investment to fixed assets increases by 12 percentage points (from the sample mean of 30.7 percent to 42.7 percent). Consider, for example, a more realistic rise of, say, 20 percent in market. Because financial leverage is on average about 50 percent, this is translated to a rise of 10 percent in q which entails a rise of 1.2 percentage points in the ratio of investment to fixed assets.

We repeated the analysis using current (rather than lagged) variables as regressors. The coefficients were very similar except the coefficient on the current interest rate that was not significantly different from zero. This probably reflects the lagged response of investment to changes in factor prices, e.g., due to the fact that the investment taking place in a given year is largely the consequence of irrevocable decisions made previously.

Dually listed firms

We ran the same regressions including an additional regressor - R(-1) interacted with a dummy variable that indicates whether a firm is dually traded (in Tel Aviv and New York). We included this regressor both in addition and instead of R(-1) interacted with "Export share," and found that the effect of monetary policy on the investment of dually listed firms is significantly lower. As mentioned, these firms exhibit higher than average export intensity so this result is not surprising. Since dually listed firms are special in many respects, we removed them from the sample and repeated the regressions in Table 2a obtaining virtually identical results. We do not pursue this issue further.

[39] It is worth recalling that q theory is based on the notion that *all* relevant information is captured in market valuation and, therefore, other variables such as liquidity and profits should have *no* explanatory power for investment. Our results do not go as far this.

Robustness

Table 2b displays similar regressions with the dependent variable (investment) normalized by lagged sales income rather than by fixed assets. In columns numbered (1) we use a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses as a measure of the short-term interest rate. In columns numbered (2) we use instead the rate on monetary loans to commercial banks announced monthly by the Bank of Israel. In all the regressions we use the log-transformed "Export share" (the log of one plus the ratio of export income to sales income). We display specifications where the variables liquidity, leverage, and "Govshare" are included as stand-alone regressors and where they are interacted with R(-1).

The results are similar to those in Table 2a. In particular, the coefficient on R(-1) is negative in all the columns, and significant in most, while the coefficient on "R(-1) *Export share(-1)" is positive and significant in all the columns. The impact of an increase of one percentage point in the interest rate on investment, for a firm that has an average "Export share," varies across the columns. For example, in the first column, the reduction is about 80 percent, for the fifth column it is 16 percent, but for the second column it exceeds 90 percent. It is evident from these additional regressions that the real investment of export-intensive firms is affected much less by domestic monetary policy, but pinning down the exact magnitude is difficult.

In Table 2c we perform similar regressions using the nominal interest rate and inflation expectations as separate regressors. The results are overall similar and in columns headed by (1), the coefficients on the nominal interest rate and on inflation expectations are virtually equal, suggesting that merging these variables into a single variable (the real interest rate) is roughly equivalent.

In Table 2d we perform similar regressions using GLS where the data are weighted by log-assets. (We do not further correct the residuals for heteroskedasticity.)

The results are almost identical to those displayed in Table 2a.

In Table 3, we report regressions for two sub-samples - export-intensive and non-exporting firms.[40] This specification is more transparent since the results do not depend on the coefficient on the non-linear variable "R(-1)*Export share(-1)." Its main disadvantage is the smaller sample size. The results are consistent with previous tables, and are quite sharp: tight monetary policy negatively affects the investment of non-exporting firms, but has no effect on the investment of export-intensive firms.[41]

In Table 4, we allow for firm-fixed effects. For each variable and every firm-year, we subtract the mean of the variable over time for the corresponding firm. We do this for leverage, liquidity, size, profitability, and Tobin's q. We include firm age, the interest rate, and (in the second column of the table) its interaction with "Export share" as regressors. The estimated coefficients on the interest rate and its interaction with "Export share" are very similar to those in previous tables, and the other coefficients are qualitatively similar as well.[42]

Other measures of liquidity

Until now, we measured liquidity as the ratio of the change in cash holdings to sales income. Bernanke, Gertler, and Gilchrist (1996) use the coverage ratio - current assets to current liabilities - as an alternative measure of liquidity. We estimated several specifications using this measure, obtaining virtually identical results (not shown).

[40] Non-exporting firms are defined as firms with export income share less than 10 percent.
[41] Notice that in this specification "Export share" is included as a stand-alone regressor.
[42] We also performed the regressions in Table 4 with industry dummies. The coefficients of these dummy variables control for potential industry-specific linear trend growth in the left-hand variable (investment). The inclusion of these dummy variables has no effect on the estimated coefficients, and the coefficients on these variables are not significant. We also ran a specification with a constant (capturing a common linear trend growth in the left-hand-side variable) with virtually identical results.

Risk

Profitability may proxy for risk, a potential determinant of investment. To address this, we included as additional regressors (in separate regressions) the following firm-level variables: the standard deviation of profitability and the standard deviation of sales (both computed over the sample period), and the "beta" of the firm's stock (computed "out of sample.") These variables were never significant in any regression and did not affect the other coefficients. We also computed the ratio of profitability to the standard deviation of profitability (a "Sharpe ratio") and included it as a regressor instead of profitability. The coefficient on this risk adjusted measure of profitability was sometimes positive and significant and sometimes insignificant but its inclusion never affected the other coefficients and their significance levels.

Long-term rates

Often, the relevant cost of capital is the long-term interest rate. This rate is clearly determined in market equilibrium (and hence is endogenous). Nevertheless, we ran our main specifications with the yield on 10-year government tradable bonds, and the medium-term indexed bank debt, as additional regressors. Their coefficients are not significant, and their inclusion does not meaningfully affect the coefficients and significance levels of the other regressors. When the short-term rate is omitted from the regression, the coefficients on the long- (or medium-) term rate become negative and significant. This indicates that the long- and the short- term rates are correlated (through the yield curve) and that most of the variability in long-term rates is due to variability in short-term rates.

6. An Empirical Evaluation of Alternative Interpretations

In this section, we study alternative interpretations of the empirical findings that account for the differential response of exporting and non-exporting firms to monetary policy. One interpretation is based on the effect of monetary policy on the demand for firms' products and the ensuing effect on investment. Another interpretation stresses the indirect impact of monetary policy on investment through its effect on the exchange rate. A third interpretation stresses productivity differences across firms. We provide evidence

that strongly suggests that these mechanisms are not the driving forces behind the observed patterns of firm-level investment in our sample, and conclude that supply-side credit market effects are the most probable explanation for the empirical findings.

Demand-side effects

Tight money may reduce domestic demand. Exporting firms can better compensate for the decline in domestic demand by shifting marketing and sales activities to export markets and, as a result, they should be less sensitive to domestic monetary policy. To address this possibility, we check whether the export intensity of export-intensive firms varies with aggregate variables that proxy for changes in domestic demand. The first column of Table 5a displays a regression of firm-by-firm and year-by-year "Export share" on firm characteristics, GDP growth, the nominal exchange rate, and the lagged interest rate. We find that "Export share" does not vary with GDP growth nor with the lagged interest rate, which is not consistent with the interpretation that exporting firms shift sales activity to markets overseas in response to a lower domestic demand induced by tight money.

It may be that export-intensive firms do not *shift* sales activities to foreign markets during periods of tight money, yet they are less affected by fluctuations in domestic demand because part of their income relies on demand overseas. In that case, their *domestic* sales should respond to the domestic interest rate whereas their *export* sales should not. To check this, we regress the domestic and export sales of the export-intensive firms in our sample on the lagged interest rate, controlling for firm characteristics; see the third and fourth columns of Table 5a. We find that neither domestic nor and export sales respond to tight money, which is not consistent with this interpretation.

Moreover, the sales of the non-exporting firms exhibit a negative and significant response to the lagged interest rate; see the second column of Table 5a. This is consistent with the supply-side interpretation that a balance sheet effect of tight money operates

more strongly on the investment of firms that have less access to foreign currency denominated credit.

As an additional check, we performed the regressions of Table 2a controlling for GDP growth (see Table 5b) obtaining virtually identical results and an insignificant coefficient on GDP growth. We also used aggregate consumption growth as an alternative control for demand obtaining the same results (not shown). This constitutes further evidence that monetary policy is not transmitted through domestic demand.

Exchange rates

Tight monetary policy is associated with high a domestic interest rate that induces capital inflows. This entails an appreciation of the domestic currency, which depresses exports and may reduce the real investment of export-oriented firms. In contrast, the sales and real investment of non-exporting firms should not be directly affected by a currency appreciation. But in the data, the real investment of non-exporting firms declines *more* strongly in response to a rise in the domestic interest rate, which rules out this channel as an explanation for the observed patterns in the data.

An appreciated currency also renders imports less expensive, in particular imports of investment goods. This should induce firms to *increase* investment in response to tight money, whereas our results strongly suggest the opposite. Thus, also this channel is ruled out as an explanation for the observed patterns in the data.[43]

Nevertheless, for the sake of robustness, we included the (year-by-year) nominal exchange rate (the price of a US dollar in terms of the domestic currency) and the real exchange rate, measured as the ratio of the export price index to the GDP deflator. The results are displayed in Table 6. The coefficients on the nominal and real exchange rate

[43] Campa and Goldberg (1995, 1999) study the effect of exchange rate fluctuations on investment at the industry level for the US, controlling for industry-specific imported input shares. The data necessary for computing imported input shares for our sample, at the firm level or at the manufacturing sub-industry level, are not available.

are not significantly different from zero, and the other coefficients are virtually unaffected. We also included the rate of change of the nominal and real exchange rates, with identical results (not shown). It seems, therefore, that our results are not driven by the effect of monetary policy on nominal or real exchange rates.

As a further check, we calculated the spread between the domestic short-term interest rate and two proxies of the "foreign short-term rate" - the US Federal Funds rate and the 3-months Eurobond rate - adjusted for the change de facto in the relevant nominal exchange rate. We included this variable as an additional regressor and found it not significant without materially affecting any of the other coefficients.[44]

Productivity

It is sometimes argued that exporting firms are more productive than firms selling only in domestic markets.[45] To ensure that such differences are not driving the differential response to monetary policy of exporting and non-exporting firms, we constructed the variable wage expenditure as a fraction of sales for every firm-year in the sample.[46] We included this variable as an additional regressor obtaining a negative and significant coefficient (i.e., other things equal, less efficient firms invest less). The coefficients on all the other variables and their significance levels remained unchanged.[47]

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[44] It is well documented that interest parity does not hold in the short run, so we are reluctant to interpret the spread between the domestic short-term interest rate and the "foreign short-term rate" as a measure of the expectations for a depreciation of the domestic currency. The reason that this spread does not affect the invesment of export intensive firms (in regressions that control for fluctuations in the domestic rate) may be that fluctuations of the US Federal Funds rate and the 3-months Eurobond rate during the sample period were too small to have a detectable effect. Alternatively, it may be that since the export destinations of the firms in our sample vary (a large fraction of exports is directed to the far east, for example), different firms respond to different "foreign" rates that are hard to control for empirically.

[45] See Clerides, Lach, and Tybout (1998) and the references therein. They provide a discussion of potential reasons for this phenomenon.

[46] Publicly traded compaies in Israel are required to report wage expenditure in their financial statements.

[47] Curiously, in a regression of the export share on various variables and this "productivity" measure, we obtained a negative and significant coefficient. Taken literally, this means that export intensive firms are *less* efficient, contrary to the commonplace view and to several empirical studies in various countries as reported in Clerides, Lach, and Tybout (1998). Maybe

It should also be remembered that the inclusion in previous tables of the year-by-year real exchange rate - a proxy for the relative productivity of the export sector - did not affect the results. Thus, overall, we believe that productivity differences are not driving the empirical regularities we have found.

7. Alternative Methodologies Addressing the Potential Endogeneity of the Short-Term Interest Rate

In this section, we repeat the analysis using two alternative methodologies that are commonly used in the literature, and it is useful to verify that our empirical findings hold up. Furthermore, these methodologies alleviate to some extent the bias that arises if the nominal interest rate set by the central bank responds to real economic activity. We argued that for the time period under consideration, the Bank of Israel's monetary policy was mainly exogenous to real economic activity, but it is worth verifying the robustness of this claim by using methodologies that are less sensitive to endogeneity bias.

Two points are worth mentioning in this context. First, if there is a bias in the coefficient on the interest rate in the investment regression, it is likely to be *upward*. To see this, suppose that the Bank of Israel's policy is to reduce the interest rate in response to negative shocks to investment. This creates a positive correlation between investment and the real interest rate. Therefore, the negative effect of the interest rate on investment that we obtained in all the empirical specifications may be *understated*. Second, we have been mainly concerned with the differential response to monetary policy of export-intensive versus other firms. The *difference* in the response is not in and of itself sensitive to the presence of bias; it is sensitive only to different degrees of bias for export-intensive versus other firms, which is harder to justify.[48, 49]

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the wages to sales ratio also reflects the quality of human capital, and is not a good measure of productivity.

[48] Differential bias in the coefficient on the interest rate can arise through differential bias in the coefficients on other variables in the regression. This is unlikely in light of the robustness of the results across specifications and using different measures of the interest rate and of investment.

[49] Djivre and Ribon (2000) estimate an autoregressive system using quarterly macro-level data for the Israeli economy. They find a negative relation between the Bank of Israel's nominal

Investment of exporting and non-exporting firms before and after the tightening of monetary policy in 1994

Our sample is too short for identifying a series of "monetary shocks" through analysis of historical records, as in Romer and Romer (1989, 1990). Nevertheless, we identify one conspicuous "tight money event" and analyze the investment of the firms in the sample before and after this event.

The following excerpt from the Bank of Israel Annual Report 1994 (p.15) is worth citing: "Monetary policy in 1994 represents a departure from that of the past. From 1990 to the end of 1993 the main object of monetary policy was to advance the process of immigrant absorption. … Economic conditions in 1992 and 1993 made it possible to attain the inflation target without having to resort to rigorous monetary policy. The gradual rise in the effective interest on the Bank of Israel's monetary loan, *from 9.5 percent in November 1993 to 18.5 percent at the end of 1994* [emphasis added], reflects the central bank's commitment to attaining the inflation target, in view of the departure from it during the year. As the unemployment rate declined, monetary policy was given a more active role in combating inflation, and greater attention was paid to the expansion of the money supply. The *policy switch* [emphasis added] appears to have made a positive contribution to preventing the further acceleration of inflation in 1994, as it was instrumental in stopping monetary adjustment to price increases, as has occurred in the past. It also appears to have helped to dampen inflationary expectations at the end of the year. This trend persisted in 1995." In fact, this trend persisted at least until 1998. The policy switch is clearly visible in the top panel of Figure 1.

Figure 2 displays firm-level investment in fixed assets for exporting and non-exporting firms before and after 1994. For exporting firms, the decline in investment is

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monetary interest rate and gross domestic product, which is consistent with our results (monetary policy negatively affects real activity). However, they also report a negative relation between the Bank of Israel's nominal monetary interest rate and the estimated "output gap." If, indeed, the Bank of Israel responds to the "output gap," our discussion of potential bias is highly relevant.

extremely small, whereas for non-exporting firms it is very large, from an average (across firms and years, nonweighted) of 50 percent to an average of 30 percent.

Using nominal interest rate "surprises" to measure monetary policy

In this subsection, we identify "monetary shocks" by estimating a "Taylor-type rule" for the central bank's nominal interest rate policy, and then use the residuals from the estimation as a proxy for monetary surprises; see, e.g., Rudebusch and Svensson (1998). We estimate two types of rules where we regress the rate on monetary loans to commercial banks announced monthly by the Bank of Israel on: (1) inflation expectations, unemployment, and the lagged left-hand variable; and (2) the same three variables and the nominal exchange rate. As Israel is extremely open to trade, a nominal devaluation of the local currency exerts upward pressure on prices as a result of the higher price of imports. As a consequence, the Bank of Israel has always taken into account the nominal exchange rate in forming monetary policy. We believe that the second variant of the "Taylor-type rule" is more appropriate.

In the estimation of the "Taylor-type rules," we use quarterly data for the period 1991-1998. We calculate the residuals from these regressions and translate them into yearly terms. These year-by-year residuals are then used as a measure of monetary policy in the investment regressions. The results, displayed in Table 7, are very similar to those reported in previous tables. In all the columns, the coefficients are of the same sign as in previous tables. They are also statistically significant except for the first column, where the first variant of the "Taylor-type rule" is used. Therefore, the basic empirical findings of this paper survive when "monetary surprises" are used as a proxy for the central bank's monetary policy.

As mentioned, the methodologies used in this section are more immune to endogeneity bias, but a caveat is in order. The methodology based on "monetary events" (or policy switches) suffers from the potential criticism that these events themselves respond endogenously to real economic activity. The methodolgy based on identifying

"monetary shocks" by estimating "Taylor-type rules" for the central bank's nominal interest rate policy is also subject to a similar criticism because, often, the right-hand variables in the "Taylor-type rules" regressions are potentially endogenous (inflation expectations, inflation, unemployment, and - in our case - the nominal exchange rate).

At the end of the day, we believe that the strongest argument presented here in support of the validity of the findings is that our empirical startegy exploits the *cross-sectional heterogeneity* of the firms in the sample. It is hard to argue that the differential response of exporting and non-exporting firms is driven by endogeneity bias. We, therefore, believe that our analysis constitutes genuine evidence of a negative and economically meaningful effect of monetray tightening on firm-level investment in fixed assets.

8. Conclusion

We provided evidence that monetary policy affects firm-level real investment differentially. In particular, we found that the greater its export intensity the less a firm is affected by tight money. The result is extremely robust and, after carefully considering several explanations, we concluded that the results are best interpreted as indicating that monetary policy is transmitted through the credit market: tight money affects more the investment of firms that have less access to foreign currency denominated financing.

The increased globalization of markets should render such a finding of interest to researchers and policy makers since it implies that although monetary policy has real effects even in a liberalized and open economy, these effects should be smaller the more open and liberalized the economy.

Table 1

Descriptive Statistics

Export share (%)	Percent of observations	Age	Profitability	Size	Tobin's q	Leverage
<10	56	31	7.4	38.9	1.12	0.86
of which:						
reporting	20	41	8.3	73.0	1.13	0.97
not reporting	36	24	7.1	32.7	1.10	0.81
>10 and <50	20	24	6.7	48.5	1.03	0.73
>50 and <80	12	31	6.7	39.8	1.09	0.76
>80	12	26	8.8	77.2	1.15	0.78
All firms	100	28	7.4	44.2	1.10	0.80

Publicly traded firms are required to disclose their export sales income if it exceeds 10 percent of their sales income. Otherwise, publishing this information is optional. The variable "Export share" is the ratio of export income to sales income. In this table, the numbers are averages across firms over the sample period. "Age" is the number of years since incorporation. "Profitability" is the ratio of operating profits to sales (in percent). "Size" is the firm assets (in million 1997 NIS). "Tobin's q" is the market value of assets divided by their replacement value. "Leverage" is total debt divided by liabilities.

Table2a

The Effect of Monetary Policy on Investment
Scaled by Fixed Assets (I_t / K_{t-1})

	Investment in fixed assets		Investment in inventories	
	(1)	(2)	(1)	(2)
Mean of the dependent variable (%)	30.7		6.4	
Intercept	YES	YES	YES	YES
Sales income change (%)	0.13 2.5*	0.13 2.4*	0.22 3.9*	0.21 3.8*
Tobin's q (-1)	12.0 4.6*	11.9 4.6*	2.7 1.4	2.6 1.3
R(-1)	-1.4 -2.7*	-1.4 -2.7*	-1.9 -3.1*	-1.8 -3.0*
R(-1)* Export share(-1)	3.3 2.4*	1.13 2.4*	4.0 2.5*	1.14 2.3*
R(-1)* Leverage(-1)	-0.8 -0.2	-0.7 -0.2	-1.7 -1.0	-1.6 -0.9
R(-1)* Liquidity(-1)	4.2 2.6*	4.0 2.4*	2.0 0.9	.8 0.9
R(-1)* Govshare(-1)	-0.7 -1.0	-0.7 -1.0	-0.3 -1.1	-0.3 -1.1
Age	-0.15 -2.25*	-0.16 -2.3*	0.12 1.5	0.12 1.5
Size(-1)	-2.2 -2.2*	-2.3 -2.3*	-2.3 -2.0*	-2.2 -1.9*
Profitability(-1)	0.24 1.8**	0.25 1.9**	0.5 3.7*	0.5 3.7*
Industry dummies	YES	YES	YES	YES
Adjusted R-squared	0.197	0.197	0.100	0.097
Firm-year observations	772	772	774	774

In columns numbered (1), "Export share" is the log of one plus the share of export sales income out of sales income, and in columns numbered (2), "Export share" is the level of the share of export sales income out of sales income. "R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total sources. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table2b

The Effect of Monetary Policy on Investment: Robustness

	Investment normalized by fixed assets				Investment normalized by sales			
	Investment in fixed assets		Investment in inventories		Investment in fixed assets		Investment in inventories	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Mean of the dependent variable (%)	30.7		6.4		8.9		0.5	
Intercept	YES	YES	YES	YES	YES	YES	YES	YES
Sales income change (%)	0.1 2.5*	0.14 2.5*	0.22 3.9*	0.2 4.2*	0.03 1.2	0.03 1.3	0.04 4.5*	0.04 4.4*
Tobin's q (-1)	11.9 4.5*	12.4 4.6*	2.7 1.4	2.8 1.5	1.2 1.74**	1.3 1.9*	0.3 0.9	0.4 1.4
R(-1)	-1.4 -2.8*	-1.2 -2.4*	-1.9 -3.1*	-2.4 -4.2*	-0.56 -3.0*	-0.3 -1.6	-0.36 -4.2*	-0.3 -3.1*
R(-1)* Export share(-1)	3.3 2.3*	10.7 2.8*	4.0 2.5*	6.9 1.9**	0.96 2.1*	3.0 2.3*	0.53 2.2*	1.5 2.2*
R(-1)* Leverage(-1)		0.2 0.04	-1.7 -1.0	-3.3 -0.9		0.14 0.12		-0.2 -0.3
R(-1)* Liquidity(-1)		7.1 1.3	2.0 0.9	0.4 0.1		0.5 0.2		-0.6 -1.0
R(-1)* Govshare(-1)		-2.7 -1.4	-0.3 -1.1	-1.1 -1.3		-0.5 -1.0		0.01 0.07
Leverage(-1)	-12.8 -0.4				-4.8 -0.5		-4.8 -0.8	
Liquidity(-1)	43.4 2.6*				5.9 0.7		-1.5 -0.7	
Govshare(-1)	-6.7 -1.0				-0.8 -0.5		0.1 0.2	
Age	-0.15 -2.4*	-0.16 -2.1*	0.12 1.5	0.08 0.9	-0.07 -3.9*	-0.08 -3.8*	-0.02 -1.0	0.009 0.8
Size(-1)	-2.2 -2.2*	-2.1 -1.9*	-2.3 -2.0*	-1.9 -1.6	-0.2 -0.5	-0.15 -0.4	-0.2 -1.4	-0.3 -1.8**
Profitability(-1)	0.23 1.7**	0.3 2.0*	0.5 3.7*	0.5 3.5*	0.13 2.8*	0.13 3.1*	0.1 4.0*	0.1 3.8*
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.202	0.189	0.100	0.099	0.099	0.089	0.104	0.095
Firm-year observations	772	772	774	774	772	772	774	774

In columns numbered (1), "R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. In columns numbered (2), "R" is the rate on monetary loans to commercial banks announced monthly by the Bank of Israel. "Export share" is the log of one plus the share of export sales income out of sales income. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total sources. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table 2c

The Effect of the Nominal Interest Rate on Investment

	Investment in fixed assets		Investment in inventories	
	(1)	(2)	(1)	(2)
Mean of the dependent variable (%)	30.7		6.4	
Intercept	YES	YES	YES	YES
Sales income change (%)	0.13 2.5*	0.13 2.6*	0.2 3.8*	0.2 3.9*
Tobin's q (-1)	12.2 4.5*	11.7 3.7*	3.4 1.6	1.0 0.4
Inflation expectations(-1)	1.2 2.0*	0.46 1.1	1.97 2.9*	1.4 2.9*
i(-1)	-1.15 -2.4*	-1.0 -1.3	-1.4 -2.6*	-2.7 -3.1*
i(-1)* Export share(-1)	1.2 2.0*	2.0 2.2*	1.7 2.5*	2.8 2.6*
i(-1)* Leverage(-1)	-0.5 -0.4	-0.7 -0.4	-0.9 -1.1	-1.4 -1.3
i(-1)* Liquidity(-1)	2.0 2.7*	3.0 2.6*	1.0 1.0	1.5 1.0
i(-1)* Govshare(-1)	-0.3 -0.9	-0.5 -1.0	-0.14 -1.1	-0.2 -1.2
Age	-0.15 -2.3*	-0.15 -2.3*	0.13 1.6	0.13 1.6
Size(-1)	-2.1 -2.1*	-2.3 -2.3*	-2.3 -2.0*	-2.6 -2.3*
Profitability(-1)	0.2 1.7**	0.2 1.5	0.5 3.7*	0.5 3.7*
Industry dummies	YES	YES	YES	YES
Adjusted R-squared	0.197	0.194	0.100	0.104
Firm-year observations	772	772	774	774

In columns numbered (1), "i" is a weighted average (across banks) of the *nominal* interest rate on non-indexed overdraft credit to businesses. In columns numbered (2), "i" is is the *nominal* rate on monetary loans to commercial banks announced monthly by the Bank of Israel. "Inflation expectations" denotes inflation expectations calculated from the yield differential on tradable non-indexed and indexed government bonds of the same maturity. "Export share" is the log of one plus the share of export sales income out of sales income. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total sources. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table2d

The Effect of Monetary Policy on Investment:
Regressions Weighted by Log-Assets

	Investment in fixed assets		Investment in inventories	
	(1)	(2)	(1)	(2)
Intercept	YES	YES	YES	YES
Sales income change (%)	0.14 3.0*	0.13 2.9*	0.21 4.6*	0.21 4.6*
Tobin's q (-1)	12.4 7.6*	12.3 7.5*	2.7 1.5	2.5 1.4
R(-1)	-1.16 -2.3*	-1.15 -2.3*	-1.8 -3.5*	-1.8 -3.3*
R(-1)* Export share(-1)	3.6 2.9*	1.2 3.2*	4.1 3.2*	1.1 2.9*
R(-1)* Leverage(-1)	-1.0 -0.3	-0.9 -0.3	-1.4 -0.5	-1.3 -0.5
R(-1)* Liquidity(-1)	3.8 3.4*	3.5 3.2*	2.2 1.8*	2.0 1.7**
R(-1)* Govshare(-1)	-0.8 -2.6*	-0.8 -2.6*	-0.4 -1.0	-0.3 -1.0
Age	-0.15 -2.4*	-0.16 -2.5*	0.1 1.5	0.1 1.4
Size(-1)	-2.0 -2.0*	-2.0 -2.1*	-2.0 -1.9*	-1.9 -1.8**
Profitability(-1)	0.2 1.4	0.2 1.5	0.5 3.6*	0.5 3.6*
Industry dummies	YES	YES	YES	YES
Adjusted R-squared	0.187	0.186	0.100	0.097
Firm-year observations	772	772	774	774

In columns numbered (1,) "Export share" is the log of one plus the share of export sales income out of sales income, and in columns numbered (2), "Export share" is the level of the share of export sales income out of sales income. "R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total sources. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Year-by-year data, 1991-1998.

Table 3

The Effect of Monetary Policy on Investment:
Export-Intensive versus Other Firms

	Investment in fixed Assets	
	Export-intensive firms	Other firms
Intercept	YES	YES
Sales income change (%)	0.18 2.0*	0.08 1.1
Tobin's q (-1)	1.9 2.7*	10.7 3.7*
R(-1)	0.23 0.3	-2.1 -2.9*
Exportshare	0.20 3.2*	-0.005 -0.01
R(-1)*Leverage(-1)	-10.6 -2.1*	0.4 0.2
R(-1)*Liquidity(-1)	4.6 2.1*	4.1 1.8**
R(-1)*Govshare(-1)	-2.0 -1.6	0.3 0.9
Age	-0.39 -3.3*	-0.03 -0.4
Size(-1)	0.8 0.5	-4.7 -2.9*
Profitability(-1)	0.13 0.5	0.3 1.6
Industry dummies	YES	YES
Adjusted R-squared	0.25	0.182
Firm-year observations	326	446

"R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to sales income. "Govshare" is the share of government provided sources in total sources. "Export-intensive" refers to firms with "Export share" larger than 10 percent of sales income. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table 4

The Effect of Monetary Policy on Investment:
Allowing for Firm-Fixed Effects

	Investment in fixed assets	Investment in fixed assets	
	All firms	Export-intensive firms	Other firms
Sales income change (%)	0.07 1.4	0.14 2.0*	0.03 0.3
Tobin's q (-1)	5.7 2.5*	6.4 2.1*	4.7 1.4
R(-1)	-0.56 -4.3*	-0.27 -1.9*	-0.4 -3.1*
R(-1)* Export share(-1)	0.88 2.4*	–	–
Leverage(-1)	4.5 0.4	-17.8 -1.1	12.8 0.8
Liquidity(-1)	24.7 1.8**	19.3 0.8	29.9 1.7**
Govshare(-1)	-10.1 -1.7	-16.7 -1.6	-4.2 -0.9
Size(-1)	-24.0 -4.5*	-10.4 -1.3	-34.7 -5.0*
Profitability(-1)	0.7 4.2*	0.7 2.6*	0.7 3.2*
Adjusted R-squared	0.125	0.131	0.119
Firm-year observations	772	326	446

We remove, for each firm and every variable, the mean over time of this variable. "R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. "Export share" is the log of one plus the share of export sales income out of sales income. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total source. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table 5a
The Effect of Monetary Policy and Aggregate Activity on Export Share and Sales

	Export share	Sales income change (%)		
	Export-intensive firms	Other firms	Export-intensive firms	
			Local sales	Export sales
Intercept	YES	YES	YES	YES
Sales income change (%)	0.005 0.2	-	-	-
Age	-0.1 -1.1	-0.18 -2.7*	-0.2 -1.4	-0.07 -0.2
Size	3.5 2.7*	0.6 0.5	0.3 0.2	2.0 0.4
R(-1)	0.7 0.6	-1.4 -2.0*	-0.2 -0.2	-1.4 -0.4
GDP growth	0.8 0.5	1.2 1.3	2.8 1.4	1.7 0.3
Nominal exchange rate	-1.8 -0.4	-2.3 -0.8	4.1 0.6	11.7 0.7
Industry dummies	YES	YES	YES	YES
Adjusted R-squared	0.09	0.05	0.005	0.00
Firm-year observations	323	446	323	323

"Export share" is the log of one plus the share of export income out of sales income. "R" is a weighted average (across banks) of the interest rate on non-indexed short-term credit to businesses. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to sales income. "Govshare" is the share of government provided sources in total sources. "GDP growth" is the annual growth rate of same year gross domestic product. "Nominal exchange rate" is the average (over each year) domestic currency price of the US dollar. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table 5b
The Effect of Monetary Policy on Investment:
Controlling for Changes in Aggregate Activity

	Investment in fixed assets		Investment in inventories	
	(1)	(2)	(1)	(2)
Intercept	YES	YES	YES	YES
Sales income change (%)	0.13 2.5*	0.1 2.4*	0.2 3.9*	0.2 3.8*
Tobin's q (-1)	12.1 4.3*	11.9 4.3*	2.9 1.4	2.8 1.4
R(-1)	-1.5 -2.4*	-1.4 -2.4*	-2.1 -2.8*	-2.1 -2.8*
R(-1)* Export share(-1)	3.3 2.4*	1.1 2.4*	4.0 2.5*	1.1 2.3*
GDP growth	-0.13 -0.2	-0.11 -0.1	-0.5 -0.5	-0.5 -0.5
R(-1)* Leverage(-1)	-0.8 2.8*	-0.7 -0.2	-1.6 -0.9	-1.5 -0.8
R(-1)* Liquidity(-1)	4.3 2.6*	4.0 2.4*	2.0 0.9	1.8 0.9
R(-1)* Govshare(-1)	-0.7 -1.0	-0.7 -1.0	-0.3 -1.1	-0.3 -1.0
Age	-0.1 -2.2*	-0.1 -2.3*	0.1 1.5	0.1 1.4
Size(-1)	-2.2 -2.2*	-2.2 -2.3*	-2.2 -1.9*	-2.2 -1.9*
Profitability(-1)	0.2 1.8**	0.2 1.9**	0.5 3.7*	0.5 3.6*
Industry dummies	YES	YES	YES	YES
Adjusted R-squared	0.196	0.196	0.099	0.096
Firm-year observations	772	772	774	774

In columns numbered (1), "Export share" is the log of one plus the share of export sales income out of sales income, and in columns numbered (2), "Export share" is the level of the share of export sales income out of total sales income. "R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total sources. "GDP growth" is the annual growth rate of same year gross domestic product. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table 6

The Effect of Monetary Policy on Investment:
Controlling for Changes in the Nominal and the Real Exchange Rate

	Investment in fixed assets		Investment in inventories	
	Nominal exchange rate	Real exchange rate	Nominal exchange rate	Real exchange rate
Intercept	YES	YES	YES	YES
Sales income change (%)	0.13 2.5*	0.13 2.5*	0.2 3.9*	0.03 1.3
Tobin's q (-1)	12.0 4.4*	12.2 4.4*	2.3 1.1	1.4 1.9*
R(-1)	-1.4 -2.7*	-1.4 -2.7*	-1.9 -3.1*	-0.5 -2.9*
R(-1)* Export share(-1)	3.3 2.4*	3.3 2.3*	4.0 2.5*	0.9 2.2*
Exchange rate	-0.2 -0.09	-0.03 -0.2	-1.9 -0.7	-0.05 -1.1
R(-1)* Leverage(-1)	-0.8 -0.3	-0.8 -0.3	-1.8 -1.0	-0.3 -0.3
R(-1)* Liquidity(-1)	4.2 2.6*	4.3 2.6*	2.0 0.9	-0.7 0.7
R(-1)* Govshare(-1)	-0.7 -1.0	-0.7 -1.0	-0.3 -1.1	-0.1 -0.5
Age	-0.1 -2.2*	-0.15 -2.3*	0.13 1.5	-0.08 -3.9*
Size(-1)	-2.2 -2.2*	-2.2 -2.1*	-2.4 -2.0*	-0.16 -0.4
Profitability(-1)	0.2 1.8**	0.2 1.8*	0.5 3.7*	0.13 2.8*
Industry dummies	YES	YES	YES	YES
Adjusted R-squared	0.196	0.196	0.099	0.099
Firm-year observations	772	772	772	772

"R" is a weighted average (across banks) of the interest rate on non-indexed overdraft credit to businesses. "Export share" is the log of one plus the share of export sales income out of sales income. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to total sales income. "Govshare" is the share of government provided sources in total source. "Nominal exchange rate" is the average (over each year) domestic currency price of the US dollar. "Real exchange rate" is the ratio of the export price index to the GDP deflator. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

Table 7
The Effect of Interest Rate Surprises on Investment

	Investment in fixed assets "Taylor-type rule 1"			Investment in fixed assets "Taylor-type rule 2"		
	All firms	Export-intensive firms	Other firms	All firms	Export-intensive firms	Other firms
Intercept	YES	YES	YES	YES	YES	YES
Sales income change (%)	0.13 2.5*	0.15 1.8**	0.11 1.8**	0.14 2.6*	0.18 2.0*	0.11 1.7**
Tobin's q (-1)	12.4 4.5*	13.6 3.1*	10.6 3.3*	12.7 4.7*	13.5 3.0*	11.5 3.8*
RSURPRISE(-1)	-1.3 -1.4	1.0 0.8	-1.9 -2.0*	-1.4 -1.9*	1.9 1.3	-1.4 -1.7**
RSURPRISE(-1) *Exportshare	8.2 1.2	-	-	15.3 2.3*	-	-
RSURPRISE(-1) *Leverage(-1)	24.4 2.4*	40.3 1.4	24.7 2.2*	-4.2 -0.2	-27.7 -0.6	3.4 0.2
RSURPRISE(-1) *Liquidity(-1)	-13.1 -1.1	-20.1 -1.3	-3.6 -0.2	-5.2 -0.5	-14.5 -1.0	8.9 0.6
RSURPRISE(-1) *Govshare(-1)	-2.8 -1.2	-3.8 -0.7	-2.0 -1.4	-3.8 -1.4	-7.7 -1.2	-1.1 -0.8
Age	-0.16 -2.4*	-0.3 -2.7*	-0.04 -0.4	0.16 -2.3*	-0.3 -2.8*	-0.03 -0.3
Size(-1)	-1.5 -1.5	0.5 0.4	-4.8 -2.9*	-1.7 -1.6	0.9 0.5	-5.0 -3.0*
Profitability(-1)	0.3 1.9*	0.3 1.0	0.3 1.7**	0.3 2.3*	0.4 1.5	0.3 1.6
Industry dummies	YES	YES	YES	YES	YES	YES
Adjusted R-squared	0.17	0.29	0.16	0.18	0.20	0.15
Firm-year observations	770	326	444	770	326	444

Interest surprises ("RSURPRISE") are calculated as the residuals from the regression of the rate on monetary loans to commercial banks announced monthly by the Bank of Israel on (1) inflation expectations, unemployment, and the lagged left-hand variable; and (2) the same three variables and the nominal exchange rate, for "Taylor-type rule 1" and "Taylor-type rule 2," respectively. "Export share" is the log of one plus the share of export income out of sales income. "Sales income change" is the yearly percentage change in sales income. "Size" is the log of total assets. "Profitability" is the ratio of operating profits to sales income. "Leverage" is debt to total liabilities. "Liquidity" is the ratio of cash holdings to sales income. "Govshare" is the share of government provided sources in total sources. Top number is the estimated coefficient; bottom number is the t-statistic; "*" denotes significant at the 5% level; "**" denotes significant at the 10% level. Standard errors are calculated using White's correction for hetroskedasticity. Year-by-year data, 1991-1998.

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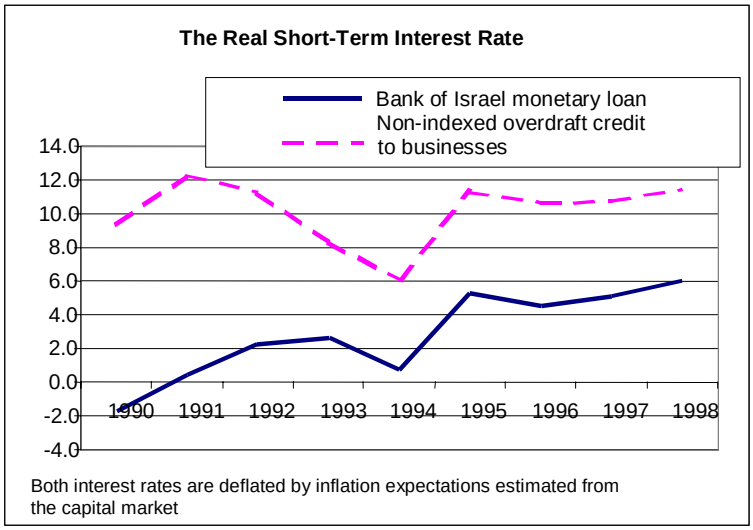
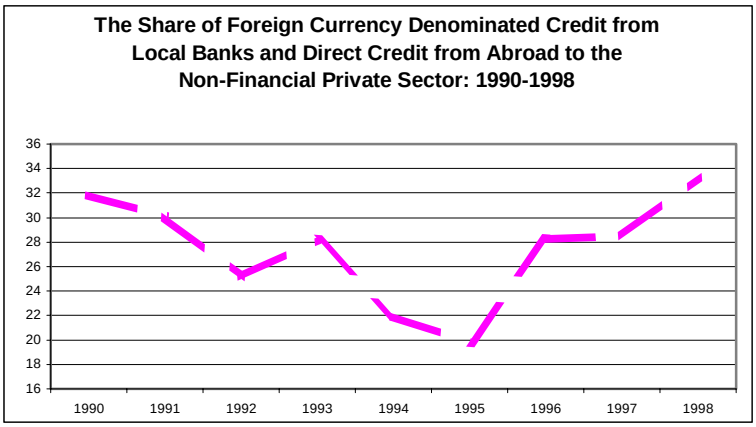
Figure 1


The Real Short-Term Interest Rate
Bank of Israel monetary loan
Non-indexed overdraft credit
to businesses
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
1990
1991
1992
1993
1994
1995
1996
1997
1998
Both interest rates are deflated by inflation expectations estimated from the capital market


The Share of Foreign Currency Denominated Credit from Local Banks and Direct Credit from Abroad to the Non-Financial Private Sector: 1990-1998
36
34
32
30
28
26
24
22
20
18
16
1990
1991
1992
1993
1994
1995
1996
1997
1998

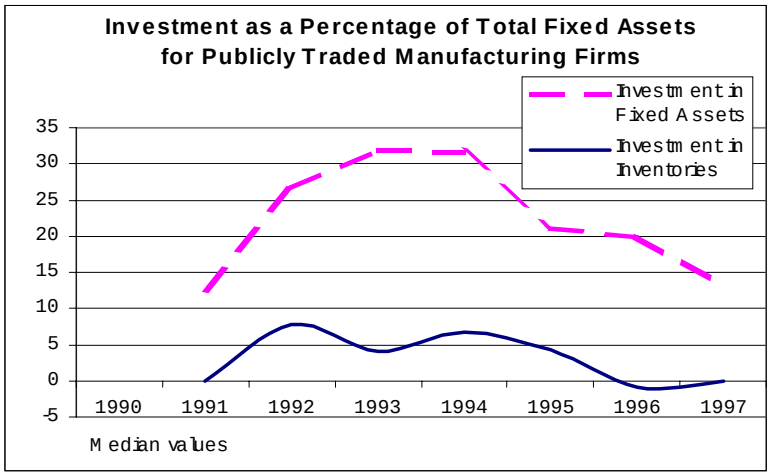
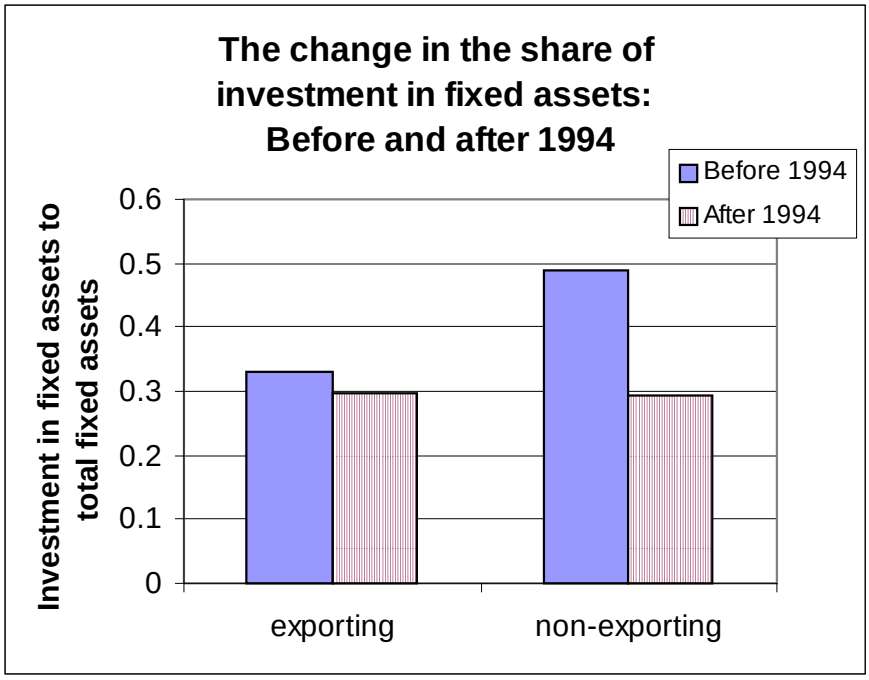

Investment as a Percentage of Total Fixed Assets for Publicly Traded Manufacturing Firms
Investment in Fixed Assets
Investment in Inventories
35
30
25
20
15
10
5
0
-5
1990
1991
1992
1993
1994
1995
1996
1997
Median values

Figure 2


The change in the share of investment in fixed assets: Before and after 1994
Investment in fixed assets to total fixed assets
0.6
0.5
0.4
0.3
0.2
0.1
0
Before 1994
After 1994
exporting
non-exporting