# THE LACK OF DOLLAR FUNDING IN ISRAEL AND ABROAD—AN EXAMINATION OF DEVIATIONS FROM THE CIP CONDITION<sup>1</sup>

- The global economy presents multiple investment opportunities in different countries. As a result, investors worldwide are interested in investing their capital in international markets and hedging their currency exposure, for which they need dollar funding. However, a shortage of such funding has become evident in recent years worldwide and in Israel.<sup>2</sup> This article examines the reasons for the lack of dollar funding and how it is measured. Israel is included in the examination for the first time.
- One indicator in examining the lack of dollar funding is the size of the deviation from the CIP (Covered Interest Rate Parity) condition. According to this condition, the direct dollar interest rate (the rate in cash markets) and the indirect dollar rate (reflected in forward foreign-currency contracts) should be the same. Accordingly, the lower the direct dollar rate is relative to the indirect one, the more severe the lack of dollar funding. There have been deviations from the condition in most G10 countries<sup>3</sup> since the great financial crisis of 2008.
- In this article, we adopt the measuring methodology of deviations from the CIP condition in Du, Tepper, and Verdelhan (2018) but add two strata. First, we prolong the sampling period for the G10 countries by about five and a half years (from September 2016 to April 2022), covering the pandemic crisis period. Second, we add Israel to the sample.
- We show that deviations from the CIP condition exist in Israel as well as in the G10 countries and that their trend in Israel strongly resembles the global one—widening at around the time of the financial crisis and exhibiting a negative basis most of the time, indicating that Israel, too, has a lack of dollar funding.

# **General background**

The development of the global economy has given diverse sectors in various countries (e.g., high-tech industry, banks, and pension funds) multiple investment opportunities. The main transaction currency is the US dollar, and to conclude the transactions, the investors need to provide dollar funding. Such funding, however, has been lacking in recent years worldwide and in Israel. As the shortage worsens, companies incur costs beyond the ordinary ones (interest). In this article, we assess the reasons for the lack of dollar funding, examine how it is measured, and include Israel in the examination for the first time.

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<sup>&</sup>lt;sup>2</sup> The examination was performed up to April 2022.

<sup>&</sup>lt;sup>3</sup> The G10 countries are comprised of the following ten developed markets: Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the UK, and the U.S. These countries advise each other and cooperate in economic, monetary, and financial matters.

#### **Theoretical background**

#### The CIP condition

The CIP condition reflects the inability to profit from arbitrage spreads. For the condition to be present, the direct dollar interest rate must be equal to the indirect dollar rate. The direct rate is that obtained on the "direct track," on which the borrower borrows dollars from the bank directly and repays the principal plus dollar interest at maturity of the contract. The indirect rate is the rate obtained on the "indirect track," in which the borrower borrows on the foreign-currency market (in an FX swap contract) in the following manner. First, the domestic currency is deposited with the bank as a guarantee. Concurrently, the borrower signs a forward contract with the bank, in which the sides agree on a future exchange rate at which the borrower, on the date of maturity, will repay the dollars and receive the domestic currency previously deposited in return to guarantee the loan. At maturity, the borrower converts the dollars at the bank at the predetermined exchange rate and then repays its debt to the bank in domestic currency plus interest at the domestic rate. Thus, the borrower avoids exchange-rate risk due to the forward contract that hedges it.

The mathematical expression of the CIP condition is as follows<sup>4</sup>:

$$(1+i_d) = \frac{F}{S} * \left(1+i_f\right)$$

where  $i_d$  is the interest rate on the domestic currency,  $i_f$  is the interest rate in foreign currency (the dollar), S is the current exchange rate, and F is the exchange rate set in forward contracts.

According to the CIP condition, as stated, the dollar interest rates on the direct track and the indirect track are in parity. If the condition is not present, arbitragers can borrow dollars at a lower rate and lend them at a higher rate, thus reaping a risk-free arbitrage profit.<sup>5</sup>

# The "basis" as an indicator of deviation from the CIP condition

One way to determine whether the CIP condition obtains is by calculating the "basis," defined as the difference between the direct and indirect dollar rates. When the condition is present, the basis must be equal to zero. By and large, as is found in the literature and as shown below, the basis has been negative for most G10 countries (apart from Australia and New Zealand ) since the 2008 financial crisis. A negative basis attests that the indirect dollar rate is higher than the direct one, signifying a lack of dollar funding.<sup>6</sup>

# The market—the 2008 great financial crisis

Although most international transactions take place in dollars, many players in international markets cannot borrow dollars directly. This gives financial intermediaries (large global banks) a critical role in supplying

<sup>&</sup>lt;sup>4</sup> The mathematical presentation is simplified here. Its exact form appears in Appendix 1.

<sup>&</sup>lt;sup>5</sup> Notice that both rates build in exactly the same risk, such that their spread does not build in risk differentials.

<sup>&</sup>lt;sup>6</sup> Here we relate to developed countries in which the supply of dollars was totally elastic before 2008. In this situation, the indirect and direct interest rates were in parity due to arbitrage conditions. In some developed countries, the spread may be indicative not of a dollar shortage but of a lack of competition in the market.

dollars internationally. The great financial crisis of 2008 affected this supply considerably, inducing many regulatory reforms in the banking sector that resulted mainly in crimping the banks' supply of liquid dollars. This contraction of dollar supply breaches the CIP condition considerably. The literature refers to various factors that explain the deviation from the CIP condition. The explanations of focal concern to us are based on restrictions that have applied to the banks' balance sheets since the 2008 crisis.

**Restrictions on dollar supply:** One of the major regulatory reforms that banks faced in the aftermath of the 2008 crisis was the need to maintain a supplementary leverage ratio to minimize their risk exposure. This requirement, which obliged banks to hold capital against all assets at a rate irrespective of the characteristics of asset risk, adversely impacted the supply of dollar funding and led to the development of a negative basis.

Before the 2008 crisis, the supply of dollar funding and hedging in the swap market was totally elastic, due to the lack of restrictions on cash. The flat supply curve at zero basis before the crisis (i.e., when the CIP condition was present) reflects that the financial intermediaries incurred no cost when they offered their dollars on the swap market, irrespective of the quantity in demand. Had the deviations from the CIP condition been other than zero at the time, players in the swap market, free of balance-sheet regulatory restrictions, would have borrowed dollars at the lower rate and lent them out at the higher rate.

After the 2008 crisis, and due to new regulations intended to stop banks from taking excessive risks that might adversely impact their financial stability, large banks had to deal with steadily escalating balance-sheet restrictions. The new rules made it more expensive for banks to supply the large amounts of dollar funding needed to hedge their services on the swap market. Consequently, the supply curve for dollar funding sloped upward. The high balance-sheet cost of supplying dollar liquidity on the swap market became a major determinant of the persistence of deviations from the CIP condition in the post-crisis period. In other words, after the crisis, the banks had to be compensated for larger deviations from the CIP condition to agree to increase their supply of dollar funding on the swap market. When the supply curve rises, changes in demand for dollar funding (and hedging) may induce volatility in the equilibrium of the deviation from the CIP (in contrast to a situation where the supply curve is totally elastic). The supplementary leverage ratio requirement was perceived as a grave regulatory restriction of arbitrage in the short term because it limited the size of global banks' positions.

Before the Basel III rules were adopted, most capital-market regulations that coped with large global banks found expression in the "risk-weighted capital" requirement, which required banks to hold capital at a level that would suffice to cover risk assets. The Basel III rules added the compulsory limitation of the leverage ratio. According to these regulations, global banks had to hold an adequate scale of capital against all assets irrespective of their risk characteristics. Before the Basel III rules were adopted, banks outside the United States did not have to contend with any compulsory limit on their leveraging rate. For American banks, the compulsory level rose from 3 percent to 5–6 percent.

**Surplus dollar demand:** Given the condition of the dollar reserves and the low interest rates in Japan and Europe after the 2008 crisis, demand for dollar funding for hedging dollar assets remained strong, particularly among market players outside the United States. Such players are often willing to pay fees to financial intermediaries.

We distinguish among three types of customers who are willing to pay fees to financial intermediaries:

- 1. Banks outside United States that are not leading banks at the global level: These banks find it hard to break into the direct-dollar-loan market (both as borrowers and as lenders) and, insofar as they succeed, they do so at a high cost. At the same time, they have access to safe deposits in domestic currency; therefore, they choose to raise dollar funding in the foreign-currency market to finance their assets in which the dollar is dominant.
- 2. Institutional investors outside the United States (pension, insurance, and other funds): Even though these entities have liabilities in domestic currency, they choose (or are required by law in certain countries) to invest much of their portfolio in dollar-dominated assets.
- 3. Nonfinancial corporations that borrow in a wide range of currencies: These entities may incur asymmetric funding costs relative to the risk-free domestic benchmark because the equity markets trade in different currencies. Therefore, they may choose to invest in the inter-currency swap market in order to minimize their funding costs.

Given the points above, large deviations from the CIP condition may reflect a lack of dollar funding supply among financial intermediaries and growing demand for dollar funding among final borrowers.

# Analysis—deviation from the CIP condition

Inspired by Du et al. (2018), we calculated the basis for the G10 countries and added Israel. The basis was calculated using an interest rate reflected in three-month forward contracts. In their study, Du et al. (2018) examined the basis for 2000–16 and found that deviations from the zero basis began during the 2008 financial crisis and widened afterward. Our study examines the 2006–16 period and adds 2017–22 (up to April 1, 2022) for all G10 countries.<sup>7</sup>

As Du et al. show, major deviations from the CIP condition first occurred in 2008 and continued vigorously for five years after the crisis. Afterward, they slackened until the beginning of 2020, when a major deviation from the condition occurred due to the COVID-19 pandemic.

# The COVID-19 pandemic

The pandemic induced major deviations from the CIP condition due to demand- and supply-side factors in the dollar funding market. According to Avdjiev, Eren, and McGuire (2020), institutional investors are the key players on the demand side. As stated, these investors have domestic-currency liabilities, but their investment portfolios are diversified at the global level and contain a considerable share of dollar assets. To finance the dollar assets, these investors sign swap contracts to convert domestic currency into dollars and gain access to dollar funding. These investors' asset portfolios grew from the 2008 crisis onward, and so, in tandem, did the need to hedge the assets. The same happened in Israel (Nathan and Ben Zeev, 2022).

On the supply side, banks and other financial intermediaries get their supply of dollars from the global financial markets. In the decade following the 2008 crisis, however, banks that provide hedging services

<sup>&</sup>lt;sup>7</sup> As stated, we began in 2006 and not in 2000 because Du et al. found in their earlier study that the basis from 2000 to 2008 was zero.

played a declining role in the overall financial system, as reflected in the narrowing of lending margins because of low interest rates and tougher regulation. The financial crunch that began with the COVID-19 pandemic induced a steep decrease in the supply of bank hedging services. Concurrently, US and European



Note: The data were obtained from quotes by international banks. The basis presented is the difference between the direct dollar interest rate and the indirect rate in annual terms. The direct rate is the USD OIS rate; the indirect rate is our calculation.



Note: The data were obtained from quotes by international banks. The basis presented is the difference between the direct and indirect dollar interest rates. The direct rate is the USD OIS rate; The indirect rate is our own calculation using the following data: the spot rate of the domestic currency against the dollar, the forward rate as determined in three-month contracts, and the interbank rate in the country in question.

prime money-market funds, traditional providers of dollar funding, dwindled as investors redeemed their holdings to raise liquidity because of the pandemic, resulting in a smaller supply of dollars.

It is easy to see in Figure 2 how the deviation from basis worsened in March 2020. It crested around March 15, the day on which the Federal Reserve announced an increase in its swap lines with five central banks. It may also be seen that the shortage of dollar funding negatively impacted the Israeli foreign exchange market. As a result, the Bank of Israel announced on March 16, 2020, that it would begin providing the market with dollar liquidity in swap transactions.<sup>8</sup> The figure demonstrates how the lack of dollar funding (in March 2020, when the pandemic erupted) manifested in a steep deviation from the CIP condition.

Before we discuss the Israeli case, we should note that the deviation from the CIP condition, reflected in a nonzero dollar basis, is a global phenomenon. Table 1, presenting the matrix of coefficients between the various currency bases and the dollar, shows that the correlations are positive en bloc, and their mean is positive and high at 0.74. These findings indicate the presence of a rather strong covariance among the bases of the various currencies and the dollar, attesting that when a lack of dollar liquidity occurs, it crosses borders and currencies.

Table 1											
Coefficient matrix among currency bases											
	AUD	DKK	CAD	CHF	EUR	GBP	ILS	JPY	NOK	NZD	SEK
AUD	1										
DKK	0.791719	1									
CAD	0.480682	0.43523	1								
CHF	0.730842	0.836691	0.804667	1							
EUR	0.865994	0.946798	0.561733	0.87011	1						
GBP	0.73921	0.796622	0.302921	0.609718	0.882554	1					
ILS	0.834841	0.69298	0.536448	0.716955	0.780833	0.581822	1				
JPY	0.369095	0.525675	0.829188	0.845004	0.527297	0.153489	0.466786	1			
NOK	0.821052	0.923257	0.647833	0.900194	0.926969	0.738963	0.705361	0.636906	1		
NZD	0.813397	0.669474	0.237465	0.489395	0.764697	0.879177	0.538865	0.029335	0.61805	1	
SEK	0.811955	0.880079	0.703613	0.903327	0.935111	0.746471	0.816613	0.636292	0.944008	0.593296	1

Note: The coefficients take into account the data on various currency bases throughout the sample period (January 1, 2006 through April 1, 2022). Data are daily.

We now focus on Israel. As Figure 3 shows, the trend in deviations from the CIP condition in Israel strongly resembles the global one. Israel, too, was affected by the 2008 great financial crisis and the pandemic.

Table 2 provides descriptive statistics of the USD basis in Israeli contracts to various maturities—one week, one month, and three months. The average basis for these maturities is negative, and the standard deviation is rather large. In addition, all maturities have extreme values, mainly in the negative direction (minimum values).

<sup>&</sup>lt;sup>8</sup> On March 18, 2020, the program was expanded to USD 15 billion and to terms of more than one week.



Note: The data were obtained from quotes by Israeli banks. The basis presented is the difference between the direct dollar interest rate and the indirect rate. The direct rate is actually the USD OIS rate; the indirect rate was calculated by ourselves using the following data: the NIS–USD spot rate, the forward rate as determined in three-month contracts, and the Israel interbank (Telbor) rate.

Descriptive statistics - the dollar base in Israel over various ranges							
Forward contract	mean	sd	min	max			
1-week basis	-32.82	47.26	-640.70	710.81			
1-month basis	-38.15	44.97	-520.20	193.30			
3-months basis	-36.88	46.12	-246.10	172.10			

Table 2	
Descriptive statistics - the dollar base in Israel over various rang	ges

One way of explaining the trend in Israel comes from the demand side—the diversion of much institutional investment to abroad—and from the supply side, reflected in foreign investors' involvement in the Israeli economy. As Figure 4 shows, the key players for dollar funding in Israel on the demand side are institutional investors, whose demand is consistently growing due to diverting much of their investment abroad and hedging their currency exposure through swap contracts. On the supply side, the domestic banks were the main suppliers of dollar funding in Israel until 2012. In 2013, however, foreign financial players entered the picture due to opportunities for arbitrage profits. When they came in, the supply of dollar funding grew in a way that caused the deviation from the CIP condition to narrow (Figure 4).



SOURCE: Bank of Israel processing.

#### Further analysis—deviations from the CIP condition increase at end-of-quarters; in Israel, too?

According to Du et al. (2018), deviations from the CIP condition widen toward end-of-quarters due to the toughening of restrictions on the banks' balance sheets and investors' renewed attention to quarterly regulatory measures. Du et al. find that the deviation from the CIP condition for one-month contracts widens exactly a month before the end of the quarter, in which the contract is expected to appear on the quarterly balance sheet. Similarly, the deviation from the CIP condition in one-week contracts widens exactly one week before the end of the quarter. In contrast, three-month contracts that appear in the end-of-quarter statement (irrespective of their payback date) exhibit no particular dynamic.

Du et al. (2018) claim that the end-of-quarter deviation became more salient after January 2015, corresponding to the change in the method of calculating the leverage ratio and with the onset of exposure of the European banks' leverage ratio to the public. These findings are consistent with the belief that tough restrictions on the end-of-quarter balance sheet given banking regulation are translated, in the period following the great financial crisis of 2008, into wider deviations from the CIP.

Du et al. tested this hypothesis and confirmed it for the G10 countries. In this article, we examine the matter for Israel. Importantly, Israel, like other European countries, adopted the regulatory restrictions on the leverage ratio as presented in the Basel III directives (Bank of Israel, *Israel's Banking System—Annual Survey, 2015,* Chapter 2, "Activities of the Banking Supervision Department"). In our examination, as Du et al. hypothesized, we find that in Israel, too, the deviations from basis widen (become more negative)

Deviation from basis at end-of-quarter to each term—Israel						
Variables	1 Week	1 Month	3 Months			
End of quarter dummy	1.84	-8.93***	-2.15**			
	-2.9	-1.61	-1.07			
Constant	-27.8***	-30.2***	-29.1***			
	-0.887	-0.623	-0.561			
Observations	2,026	2,153	2,153			
R-squared	0	0.019	0.002			

Note: The data were obtained from quotes by international banks. The basis presented is the difference between the direct dollar interest rate and the indirect rate in annual terms. The direct rate is actually the USD OIS rate; we calculated the indirect rate by using the following data: the spot rate of the domestic currency against the dollar, the forward rate as determined in three-month contracts, and the interbank rate in the country in question. The regression was carried out on a selected part of the sample: from 2014 onward, given that regulation in Israel began in 2015. The dummy variable for each of the terms distinguishes between the last week of the quarter and the other weeks and between the last month of the quarter and the first two months. For three-month contracts, the last month in the quarter is marked. The outcomes are expressed in basis points.

toward the end-of-quarter in one-month contracts. Unlike their findings, however, we observed that in Israel, the deviations toward end-of-quarter are not significant in one-week contracts and are substantial in three-month contracts even though, according to the hypothesis of Du et al., we should not see any dynamic whatsoever toward the end of the quarter for a three-month contract (Table 3). Further research is needed to understand why the banks in Israel make three-month contracts more expensive toward end-ofquarters and do not do the same with one-week contracts.

#### **Summary and conclusion**

Table 3

Since the great financial crisis of 2008, the CIP condition has not been maintained in the global markets, leaving the theoretical possibility of creating arbitrage profits. The literature shows that arbitrage profits are explained by the toughening of regulatory restrictions imposed on the banks due to the 2008 crisis. However, the deviation from the CIP did not cease when the financial crisis waned; instead, it persisted.

In most G10 countries, deviation from the CIP condition is reflected in a negative basis; such is the case in Israel as well. We see that the deviation widened again at the time of the pandemic crisis, which caused the crisis in dollar funding to worsen on both the demand and the supply sides. It is also found that the deviation from basis in one-week and one-month contracts widens at end-of-quarters in most G10

countries. In Israel, we find—as the literature shows—that the deviation from basis widens in one-month contracts but also, unlike the findings in the literature, in three-month contracts as well. We do not find this in one-week contracts in Israel, even though such a phenomenon is found abroad.

### Appendix

The mathematical expression of the CIP condition follows:

where \_\_\_\_\_ is the USD interest rate and  $y_{t,t+n}$  is the domestic rate. Both rates are in annual *n* terms/ (When n=1, this is an annual rate, when n=0.25, it is a three-month rate, and so on.)  $X_{t,t+n}$  is the basis (which

$$e^{ny_{t,t+n}^{\$}} = e^{ny_{t,t+n} + nx_{t,t+n}} \frac{S_t}{F_{t,t+n}}$$

should be equal to 0),  $S_t$  is the effective exchange rate for time t, and  $F_{t,t+n}$  is the forward exchange rate set in forward contracts at times t and t+1.

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