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**THE CONQUEST OF ISRAELI INFLATION  
AND CURRENT POLICY DILEMMAS**

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# THE CONQUEST OF ISRAELI INFLATION AND CURRENT POLICY DILEMMAS<sup>†</sup>

## Abstract

During the five decades since the creation of the Bank of Israel in 1954 Israel experienced high and extremely variable inflation. Price stability (as defined by current international norms) was finally achieved at the beginning of the twenty first century. The paper divides the 1954-2015 sample into six sub-periods characterized by different inflation environments.

The first part of the paper documents the impact of those different inflation environments on the average speed of individual price adjustments, the related pass-through from the exchange rate to domestic prices, inflation uncertainty, the extent of dollarization, relative price variability and the cost and time to maturity of the public debt. There are major quantitative differences in the above mentioned variables between the five inflationary sub-periods and the more recent price stability period. Among those are dramatic changes in the anchoring of inflation expectations, in the pass-through coefficient, inflation uncertainty, the speed of price adjustments, relative price variability, the (rather late) disappearance of dollarization in the real estate market and the benefits induced by price stability for the financing of the public debt. The paper provides an explanation for the fact that high inflation was stabilized in “one shot” while the subsequent moderate inflation was stabilized gradually within an inflation targeting framework. It argues that the second stabilization fits into the mold of the opportunistic approach to disinflation.

The second part of the paper focuses solely on the period of price stability. It documents major, non-inflation related, structural changes since the turn of the century and discusses current policy dilemmas. Among the major structural changes are a persistent switch from current account deficits to surpluses, increased flexibility in the labor market, a reduction in the size of government, separation of pension and provident funds from the banking system and the emergence of a corporate bond market. Particularly remarkable is the macroeconomic resilience of the Israeli economy to the world financial crisis. As in many developed economies both the inflation gap and the output gap are recently in the negative range implying that, on both counts, monetary policy should be expansionary. The current policy rate is indeed almost at the zero bound. On one hand this policy, along with occasional interventions in the forex market, partially offsets overvaluation pressures on the exchange rate. On the other it reinforces a nine year long cycle of price increases in the real estate market.

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<sup>†</sup> We benefitted from the research assistance of Rachel Axelrod, Tzliil Kovetz and Gabi Gordon, and from the comments of Reuben Gronau, Akiva Offenbacher and other members of the Bank of Israel Research Department. The usual disclaimer applies.

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## The Conquest of Israeli Inflation and Current Policy Dilemmas

Alex Cukierman and Rafi Melnick<sup>1,2</sup>

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### Introduction

The Bank of Israel (BOI) was founded in 1954. The first four to five decades following the Bank's foundation were characterized by inflation rates above the current two percent international norm, at times very much so.<sup>3</sup> Following a successful heterodox stabilization program in July 1985, and after a prolonged stabilization that followed, Israel finally reached price stability on a permanent basis at the beginning of the twenty-first century.

During the first forty-five years of the Bank's existence, both the average level and the variability of inflation went through dramatic changes in both upward and downward directions. Recent statistical evidence presented in Melnick and Strohsal (2015) suggests the beginning of 1999 as a reasonable dividing line between the "inflationary period", during which Israeli inflation was above the 2 percent international standard, and the more recent "price stability period", when it fluctuated in a narrow range around this target. However, as this paper shows, full anchoring of inflation expectations was achieved only in 2003. Figure 1 provides a bird's eye view of inflation in Israel from the creation of the Bank until April 2015.

For the entire sample, the average twelve-month inflation rate (measured each month as the twelve-month rate of inflation since the same month in the previous year) was 31 percent and it fluctuated between a maximum of 486 percent and a minimum of almost minus 3 percent. However, those summary statistics hide very different inflation environments.

The paper divides the 61 years between the creation of the BOI and the present into six sub-periods, in line with the nature of the inflationary process. Three of those are prior to the July 1985 inflation stabilization and the remaining three are after it. The dividing lines between the three post-1985 periods are characterized as inflation steps.<sup>4</sup>

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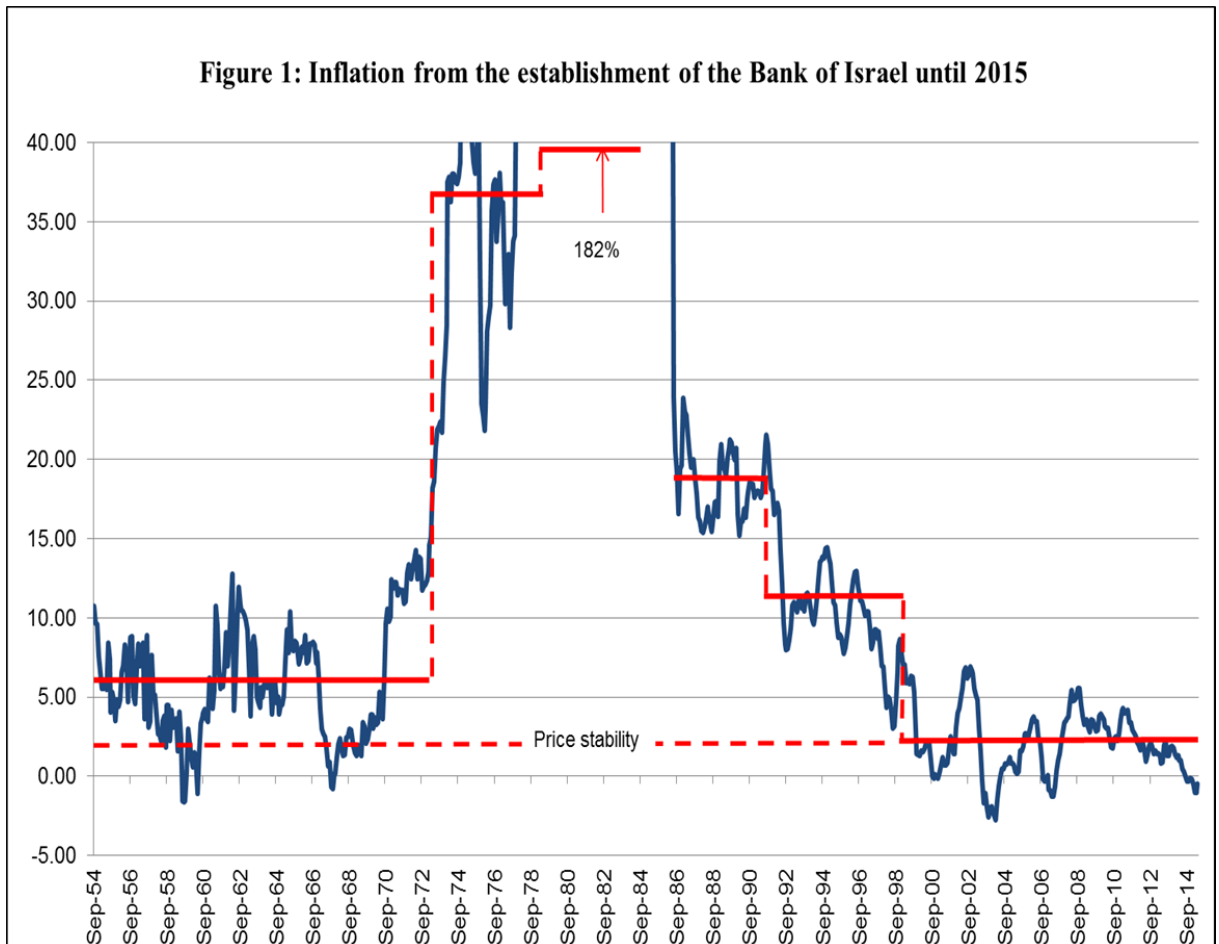
<sup>1</sup> Cukierman and Melnick are members of the Tiomkin School of Economics at the Interdisciplinary Center, Herzliya and were both members of the first monetary committee of the Bank of Israel. Cukierman is also professor emeritus at Tel-Aviv University and research fellow at CEPR.

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<sup>3</sup> Michael Bruno used to say that, as a rule of thumb, Israeli inflation is twice the world inflation. This rule was unequivocally violated between 1977 and 1985 when inflation accelerated to the triple-digit range.

<sup>4</sup> An inflation step is defined formally as a period in which the inflation rate is trendless and deviations from average inflation within the step are serially uncorrelated.

Liviatan and Melnick (2001) proposed this concept to characterize the sustained downward changes in the rate of inflation between the 1985 stabilization and the end of the 1990s.<sup>5</sup> Using a statistical methodology suggested by Bai (1997) and Bai and Perron (1998), Melnick and Strohsal (2015) identify the two break points between the three post-July 1985 periods. The classification into inflation sub-periods in this paper in the post-stabilization period corresponds roughly to the steps identified in their paper. A look at inflation rates in the pre-stabilization era suggests that it can also be divided into three sub-periods, the first of which corresponds to single-digit inflation, the second to double-digit and the third to triple-digit inflation. Figure 1 presents an overall summary of inflation by sub-periods over the entire sample from the creation of the BOI until the present.<sup>6</sup>



<sup>5</sup> See also Bruno and Fischer (1986), Liviatan and Piterman (1986) and Bruno and Melnick (1995).

<sup>6</sup> The rate of inflation in each month is measured as inflation over the twelve months ending in that month.

The figure suggests that the July 1985 "cold turkey" stabilization constitutes a watershed between the era in which the rate of inflation was on an upward trend and the post-stabilization era in which the rate of inflation exhibited a rather slow but sustained downward trend.

The variety of inflation experiences since the establishment of the BOI provides a natural laboratory for an investigation of the consequences of different inflation environments for various real and nominal effects of inflation. The first part of the paper documents the impact of those different inflation environments on the average speed of individual price adjustments, the related pass-through from the exchange rate to domestic prices, inflation uncertainty, the extent of dollarization, relative price variability and the cost and time to maturity of the public debt. As background and for completeness, the paper describes the combinations of shocks, and the shifting of monetary and fiscal institutions that caused the rise and fall of inflation.

The paper documents major quantitative differences in the above mentioned variables between the five inflationary sub-periods and the more recent price stability period. Among those are dramatic changes in the anchoring of inflation expectations, in the pass-through coefficient, inflation uncertainty, the speed of price adjustments, relative price variability, the (rather late) disappearance of dollarization in the real estate market and the benefits induced by price stability for the financing of the public debt.

The second part of the paper focuses solely on the period of price stability. It documents the major, non-inflation related, structural changes since the turn of the century, the impact of the global financial crisis (GFC) on monetary policy, and current policy dilemmas. After reading this introduction readers who are less interested in more distant history and the stabilization of inflation processes may skip sections 1 through 4 and go directly to section 5.

The organization of the paper follows: Section 1 provides a brief historical survey of the evolution of inflation prior to the 1985 stabilization along with a description of the underlying institutional structure and the combination of shocks and policy mistakes which led to successively higher inflation that culminated in triple-digit inflation during the end of the 1970s and the first half of the 1980s. Section 2 identifies three inflation steps in the post-stabilization era, the first two of which still belong to the inflationary period while the third belongs to the era of price stability. The section discusses worldwide developments and the partially related changes in Israeli monetary and fiscal institutions that transformed the pre-1985 upward trend across sub-periods into a post-1985 downward trend.

Section 3 provides an explanation for the fact that policymakers chose to stabilize the galloping inflation of the first half of the 1980s in "one shot" while the remaining lower double-digit inflation was stabilized gradually until the end of the century. Section 4 describes the main exogenous shocks that led to the birth of the inflation targeting (henceforth, IT) regime and to its gradual improvement over time. The section argues that the Bank of Israel's policy responses during the 1990s are consistent with the "opportunistic approach" to disinflation.<sup>7</sup>

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<sup>7</sup> See Boehne (1989), Blinder (1994) and Orphanides and Wilcox (2002).

The IT system's ability to deliver long-run price stability is closely associated with the extent to which inflation expectations are anchored to IT. Section 5 proposes a methodology for estimating the degree of anchoring of expectations and documents the evolution of the anchoring parameter between the mid-1990s and the present. Section 6 documents the impact of the inflation environment and of stabilizations on inflation uncertainty.

Section 7 presents evidence on the evolution of the pass-through coefficient across inflation steps. Section 8 documents and explains the closely related disappearance of dollarization in the real estate market during 2007–2009. Section 9 presents evidence on relative price variability across the last several inflation sub-periods and Section 10 reviews the main non-inflation related structural changes during the period of price stability. Section 11 documents the effects of price stability on interest rates as well as its impact on the cost of government debt and its maturity. Section 12 deals with the impact of the Global Financial Crisis (GFC) on monetary policy and institutions. Section 13 discusses current policy dilemmas and open issues. Section 14 presents a bird's eye view of the relation between Israeli inflation and US inflation as a proxy for world inflation. Concluding remarks follow in Section 15.

## **1. Inflation, monetary policymaking institutions and major shocks prior to the 1985 stabilization**

The Bank of Israel (BOI) was founded in August 1954 after a substantial inflationary bulge due to high monetary expansion cum initially suppressed inflation during the early statehood years had largely subsided. Although its legal independence was reasonable, by international standards of the time, its actual ability to confront the remaining inflationary pressures was severely limited mainly because it was directed by the government to function as a development bank allocating credit to various industries in the economy. Although the law instructed the Bank to aim for price stability (along with a multitude of other objectives) and endowed the Bank with some instrument independence, in practice monetary policy was dominated by fiscal and political considerations.<sup>8</sup> The fact that the inflation objective took a back seat induced further cementing of pre-existing indexation arrangements in the labor and financial markets. Although indexation made life, in the presence of inflation, bearable it reinforced the destabilizing effects of major shocks that occurred later on.

The pre-1985 era is divided into an initial single-digit inflation sub-period followed by double-digit and then triple-digit inflation sub-periods. During the first sub-period, which stretches from the creation of the BOI until a few months before the Yom Kippur war, inflation averaged about 6 percent and never exceeded 15 percent. During the second sub-period, which ends at the beginning of 1979, inflation averaged over 37 percent and never exceeded 60 percent. During the third sub-period, which ends with the 1985 stabilization, mean inflation accelerated to 182 percent and reached a maximum of 486 percent in November 1984.

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<sup>8</sup> Details appear in Cukierman (2007).



**Table 1: Summary statistics by inflation sub-periods between the creation of the BOI and the 1985 stabilization<sup>9</sup>**

<b>Period</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Maximum</b>	<b>Minimum</b>	<b>De Facto Independence of the BOI</b>
<b>1: 1954:M9–1973:M2</b>	6.1	7.8	14.6	-1.6	0.13
<b>2: 1973:M3–1979:M3</b>	37.2	46.2	56.1	15.1	0.13
<b>3: 1979:M4–1985:M6</b>	181.8	220.1	486.2	57.9	0.13

Table 1 presents the means, the standard deviations and the ranges of inflation within each of the three sub-periods. Along with a parallel table (in Section 2) for the post-1985 era, Table 1 implies that the mean and the standard deviation of inflation are positively related.<sup>10</sup>

The gradual acceleration of inflation from the first to the second sub-period and then to the third can be understood as a consequence of adverse shocks and policy mistakes against the background of fiscal laxity and current account deficits along with a central bank that did not have a clear mandate to prevent inflation, nor the instruments required to achieve such an objective. The buildup toward the inflationary acceleration from the first to the second sub-period started with a fiscal expansion in the aftermath of the Six Day War that was required, among other things, for beefing up the Bar-Lev line along the Suez Canal<sup>11</sup> along with social programs that responded to the "Black Panthers" protest.<sup>12</sup> The fiscal expansion was substantially magnified by defense challenges after the Yom Kippur war and the associated first oil shock. Those events led to further fiscal laxity, to increases in the debt-to-GDP ratio and to deterioration in the current account of the balance of payments. The acceleration of inflation from the second to the third step was fed by further fiscal cum monetary laxity and the second oil shock. It was further reinforced, in 1977, by an ill-prepared foreign exchange liberalization following the transition of government from Labor party dominance to the Likud party.<sup>13</sup> Against a background of increased dollarization and indexation of the economy, this liberalization led to a substantial reduction in the demand for domestic currency, adding further fuel to inflation.

The substantial acceleration of inflation toward the end of the triple-digit sub-period provides a dramatic illustration of the fact that the speed of price adjustment depends on the inflation environment. The acceleration was largely due to an attempt by the finance minister of the time (Yigal Cohen-Orgad) to improve the position of the current account by means of nominal devaluations. This policy started at the end of 1983,

<sup>9</sup> Except for its standard deviation (which is based on monthly inflation at yearly rates over each sub-period) the inflation rate in each month is measured over the immediately preceding twelve months. The range of the De Facto independence of the Bank of Israel is normalized to the [0–1] range. 0 is the minimal possible level and 1 is the maximal possible level. The independence figures are calculated over the relevant sub-periods from Table 1.2 in Cukierman (2007).

<sup>10</sup> We further elaborate on this widely documented regularity later on.

<sup>11</sup> The Bar-Lev line was a static line of military fortifications designed to stem a potential surprise attack by Egypt.

<sup>12</sup> The "Black Panthers" was a group of young second-generation Jewish immigrants from the Arab countries, mainly in Jerusalem, that demonstrated against discrimination.

<sup>13</sup> From the creation of the state until 1977 the Labor party was always the main party in government.

after the collapse of the 5-5 policy implemented by the previous finance minister (Yoram Aridor) and the collapse of the banking system as a result of the end of the bank shares manipulation scheme. Cohen-Orgad adopted an aggressive devaluation of the currency designed to improve the current account. Due to the fact that the pass-through from the exchange rate to domestic wages and prices was large and swift, this policy raised the real exchange rate for only a short while at the cost of a very substantial further acceleration of inflation.<sup>14</sup>

## 2. The long way to price stability in the post-1985 era

As in the case of the pre-1985 period it is instructive to divide the post-1985 period into three broad sub-periods or inflation steps. The break points between sub-periods have recently been estimated by Melnick and Strohsal (2015). They apply various multiple break tests based on Bai (1997) and Bai and Perron (1998) to endogenously find the break points between inflation steps. There are several important differences between the pre- and the post-1985 sub-periods. First, after 1985 inflation and its variability decreased over time, finally reaching price stability, as currently defined, from 1999 onward. We refer therefore to the post-1985 era as the disinflationary period. Second, the post-1985 period is characterized by a gradual but sustained process of increased focus on price stability and a closely associated increase in the actual and (with a substantial lag) the legal independence of the BOI (Cukierman, (2007).

The 1985 stabilization reduced inflation from the triple-digit to the low double-digit range but did not eliminate it for about 15 years. Table 2 shows summary statistics for the disinflationary period. During the first disinflationary step between July 1986 and September 1991 average inflation was over 18 percent.<sup>15</sup> It decreased to a bit over 10 percent during the second disinflationary step which ended at the end of 1998. Israel entered the era of price stability, as defined in terms of actual inflation only, at the beginning of 1999. From then until April 2015 inflation averaged 2.14 percent—very close to the midpoint of the current inflation target range (1–3 percent).<sup>16</sup>

As was the case in the pre-1985 era, there is a strong positive association between the variability of inflation and its average over the disinflationary steps. Eyeball econometrics based on Table 2 suggests that the relation is very strong. Figure 2 shows the relation between the standard deviation of inflation and its mean over the entirety of all six inflation sub-periods since the creation of the Bank to the present. This is supported by conventional econometrics. The coefficient of correlation between the standard deviation of inflation and its mean level is 0.99 and the regression coefficient of the standard deviation on mean inflation is 0.82 and is highly significant.

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<sup>14</sup> Section 7 below documents the substantial differences between the pass-through coefficient during the early 1980s and during the current period of price stability.

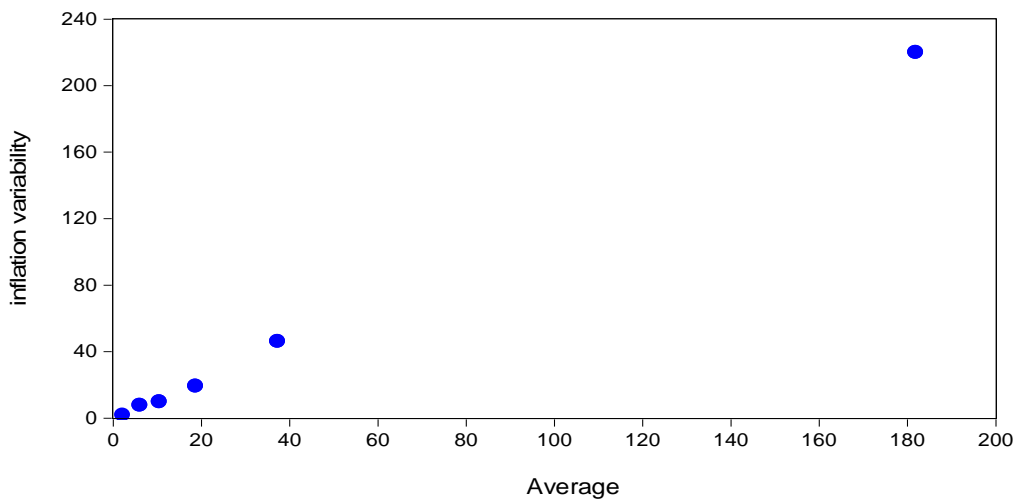
<sup>15</sup> By comparison the maximal rate of inflation during the Great Inflation in the US during the 1970s and the beginning of the 1980s was 15%. This peak was reached at the beginning of 1980 during the second oil shock (Cukierman, 2010).

<sup>16</sup> However, it is shown in Section 5 that tight anchoring of inflation expectations to the inflation target was achieved only in 2003.

**Table 2: Summary statistics by sub-periods between July 1986 and April 2015<sup>17</sup>**

Period	Mean	Standard Deviation	Maximum	Minimum	De Facto Independence of the BOI
<b>4: 1986:M7–1991:M9</b>	18.7	19.4	23.9	15.2	0.41
<b>5: 1991:M10–1998:M12</b>	10.5	9.9	19.4	3.0	0.52
<b>6: 1999:M1–2015:M4</b>	2.1	1.9	7.8	-2.7	0.66*

\*calculated only over the first 5 years.

**Figure 2. The relation between inflation variability and its average level across subperiods**

The difference between the pre- and post-1985 nature of the inflationary process cannot be over-emphasized. The first era was dominated by the needs of the new state of Israel to absorb large waves of immigration, to maintain effective defenses against hostile neighbors and to provide the funds necessary to finance capital formation against the background of an underdeveloped private capital market.<sup>18</sup> As a consequence, the price stability objective took a back seat and fiscal policy dominated aggregate demand policies. A modest degree of inflation anchoring was achieved by pegging the domestic currency to the US dollar backed by controls over capital flows. Since domestic

<sup>17</sup> Except for its standard deviation (which is based on monthly inflation at yearly rates over each step) the inflation rate in each month is measured over the immediately preceding twelve months. The 12-month period after the July 1985 stabilization is excluded in order not to contaminate our twelve-month inflation measures with very high monthly inflation rates prior to the stabilization. Due to that and to the fact that our time unit is monthly while that of Melnick and Strohsal (2015) is quarterly the three post-1985 sub-periods correspond to their inflation steps only approximately. The range of the de facto independence of the Bank of Israel is normalized to the [0–1] range. 0 is the minimal possible level and 1 is the maximal possible level. The independence figures are calculated over the relevant sub-periods from Table 1.2 in Cukierman (2007).

<sup>18</sup> Detailed accounts of the real and financial aspects appear respectively in Patinkin (1967) and Ben-Shahar, Bronfeld and Cukierman (1971).

aggregate demand policies were relatively expansionary, this regime gradually led to current account problems which were periodically addressed by devaluing the currency.

By contrast, during the disinflation period the price stability objective rose into prominence. After the correction of the fundamental fiscal imbalances as a key component of the 1985 stabilization program, fiscal dominance was substantially curtailed, controls over international capital flows were gradually dismantled and the exchange rate was gradually made more flexible culminating in a fully floating exchange rate in 2005, but effectively already since 1998.<sup>19</sup> In parallel a gradual increase in the independence of the BOI took place. The first step in this process was the “No printing” 1985 amendment to the original 1954 BOI law that prohibits the Bank from lending to government.<sup>20</sup> The latest legal step in this process is the March 2010 Bank of Israel Law. It states that the Bank's main objective is to maintain price stability, and endows the Bank with full instrument independence.<sup>21</sup> But between the mid-1990s and 2010, due to the processes described above, legal independence lagged behind actual independence (Cukierman, 2007).<sup>22</sup>

There is little doubt that the economic distortions and traumas caused by the extremely high inflation during the triple-digit sub-period were major factors behind the increased emphasis on price stability cum CBI after 1985.<sup>23</sup> This was further reinforced by international developments in both policymaking institutions and the theory of monetary policy.<sup>24</sup> Following the global inflation of the 1970s, an increased worldwide quest for the creation of institutions that would assure price stability emerged. Contrary to the 1960s and the 1970s, the accepted view during the 1980s and the 1990s became that inflation and the associated uncertainties retard growth.<sup>25</sup>

The gradual dismantling of controls on capital flows and the associated widening of international capital markets also reinforced the quest for price stability and raised the importance of CBI as a signal of macroeconomic nominal responsibility to domestic and international investors.<sup>26</sup> Relatedly, the IMF embraced the view that a high level of independence is a desirable institutional feature and actively promoted CB reform in many developing economies through conditionality and other means.

Finally, the intellectual revolution triggered by the Kydland-Prescott (1977), Barro-Gordon (1983) inflation bias story helped cement a consensus that trying to use monetary policy to raise output, beyond its full employment under a flexible price level, is ineffective and only leads to socially harmful inflation. By offering a relatively simple theory of the prisoner's dilemma aspects of the interaction between monetary policymakers and individuals in the economy, the inflation bias model provided academic

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<sup>19</sup> The exchange rate band was formally eliminated only in 2005. But the exchange rate was floating in practical terms within a widening band since 1998.

<sup>20</sup> This amendment was an integral part of the 1985 stabilization program.

<sup>21</sup> Other objectives the BOI is supposed to attain without prejudice to its main objective are high levels of economic activity and employment, reduction of inequality and financial stability.

<sup>22</sup> In particular, removal of controls over capital flows and increased flexibility of the exchange rate raise the actual independence of the CB.

<sup>23</sup> This is consistent with the main thesis of Drazen and Grilli (1993) that inflation stabilizations are delayed until inflation becomes sufficiently unbearable.

<sup>24</sup> This paragraph and the next two draw on Cukierman (2008a).

<sup>25</sup> The relatively good real performance of some low-inflation countries like Germany and Japan until the 1980s supported this view.

<sup>26</sup> Maxfield (1998) argues that this is particularly important in developing countries.

credence to the claim that monetary policy should be delegated to a sufficiently independent CB and helped spread this notion internationally.

### **3. Why was the triple-digit inflation of the third sub-period stabilized in one shot, and the subsequent double-digit inflation only gradually?**

Between the third, triple-digit inflation sub-period, and the first post-1985 disinflation step average inflation was reduced from a bit over 400 percent to around 18 percent. This was achieved after several failed package deals, which tried to dis-inflate without correcting the fundamental macroeconomic imbalances (mainly the fiscal deficit and the current account deficit). This dramatic decrease was achieved by means of a quick, one-shot, cold turkey, stabilization in July 1985. By contrast the reduction of average inflation from the first post-1985 disinflation step to the price stability norm of 2 percent was very gradual, and turned out to be spread over 15 years. Another major difference between the 1985 stabilization and the subsequent slow convergence to price stability is that the government (including the prime minister and the finance minister) was heavily involved in the earlier cold turkey stabilization, while the subsequent gradual stabilization was largely implemented by the CB. The main thesis of this section is that those differences are not accidental.

One important factor that affects the relative desirability of shock versus gradual stabilization under high versus moderate inflation is related to the existence of nominal wage contracts and other temporary nominal rigidities. In particular, when initial inflation is sufficiently high, the structure of overlapping sticky wages and prices is very compressed, implying that prices and wages adjust quickly. As a consequence the relative price distortions associated with a shock treatment are relatively small. By contrast, when initial inflation is moderate the structure of overlapping wage contracts and prices is spread out, making the relative price distortions associated with a shock treatment larger and more persistent.<sup>27</sup> Hence gradual stabilizations are more attractive in reducing moderate inflation.

In addition, the choice of stabilization type is likely to depend on the reputation of policymakers prior to stabilization. The strategic literature on the reputation of policymakers implies that the lower the reputation is prior to stabilization the more likely it is that cold turkey stabilization will be chosen. Imperfect reputation is modelled by assuming that the policymaker in office can be one of two exogenously given types: a dependable one who takes the inflation target as a commitment to set the policy instrument in a way that will bring inflation as near to the target as possible, and a weak type who mimics the announcement of his dependable counterpart, but is not really

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<sup>27</sup> Using detailed microeconomic data underlying the Israeli CPI during the 1970s and the 1980s, Hanoch and Galyam (1985) and Lach and Tsiddon (1992) show that sustained increases in the general level of inflation are accompanied by non-negligible increases in the frequency of price adjustments. A voluminous theoretical literature that developed during the 1980s (spurred by Sheshinski and Weiss (1983)) is consistent with those findings. The work of Woodford (2003) and Gali (2008) implies that the welfare costs of unanticipated shocks are lower as prices are more flexible. An application of this notion to monetary policy in the US during the Great Inflation of the 1970s appears in Cukierman (2008b).

committed. Both types share an identical objective function that is positively related to unexpected inflation and negatively related to actual inflation.<sup>28</sup> This framework is adapted in Section 5 to estimate the degree of anchoring of expectations to the target. Cukierman (2000) extends these frameworks to allow for imperfect control of inflation by policymakers. An important consequence of imperfect control is that the opportunistic policymaker can engage in short-term discretionary policies without being revealed as weak. In such an environment the public adjusts its evaluation of the reputation of policymakers gradually using Bayes rule. Stabilization of inflation brings with it long-term benefits at the cost of abandoning short-term advantages associated with the creation of unanticipated inflation under discretion. One can therefore think of the onset of a drive for stabilization as an increase in the concern of policymakers for the longer run, relative to current objectives, and model it as an increase in the (common to both types) discount factor.

Proposition 6 in Cukierman (2000) establishes that when the future becomes more important, the choice of stabilization type by a dependable policymaker depends on the initial level of reputation: A shock treatment is more likely when initial reputation is sufficiently low and gradual stabilization is more likely when it is sufficiently high. To the extent that the initial level of reputation is lower in times of high inflation than in times of moderate inflation, a dependable policymaker will choose to stabilize high inflation via a shock treatment and low inflation gradually.

Why was the Israeli government heavily involved in the 1985 stabilization whereas the subsequent moderate inflation was stabilized gradually by the BOI with the Ministry of Finance operating only in the background? There are several reasons. First, the high inflation during the third inflation sub-period was due to the government's fiscal needs. Since the root cause of the problem resided in government its involvement was essential. Second, even when the root cause resides elsewhere, once high inflation has been allowed to develop, it is unlikely that the CB alone will be able to stabilize it for several reasons. Without a clear-cut demonstration of fiscal responsibility by government, the low reputation of policymakers makes it extremely hard for the CB to convince the public that a change in regime is around the corner. This is reinforced by the fact that during high inflation the independence of the CB is low.<sup>29</sup> In addition, the 1985 stabilization would have run into serious difficulties without temporary suspension of the widespread indexation arrangements that prevailed prior to stabilization. Clearly, actions of this type require the involvement of government and other economic entities such as labor unions.

#### **4. From exchange rate anchoring to inflation targeting and the gradual stabilization of the 1990s in light of the opportunistic approach to disinflation**

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<sup>28</sup> This two-type framework was first suggested by Barro (1986) and extended to include preannounced targets by Cukierman and Liviatan (1991).

<sup>29</sup> International evidence presented in Chapter 20 of Cukierman (1992) supports the existence of such a relation.

During the 1985 stabilization and for several years thereafter the exchange rate was used as the main nominal anchor. A major component of the stabilization was a deep cut in government expenditure (mainly defense and subsidies) that temporarily transformed the deficit into a surplus (with the \$1.5 billion stabilization aid from the US government also contributing). However, starting in 1987 the surplus was gradually eroded and turned again into a deficit. From mid-1988 until the end of the first post-stabilization step deficits averaged about 4 percent of GDP leading to deterioration in the current account of the balance of payments. This occurred in spite of the fundamental correction in the fiscal position due to the termination of the US aid package.

Against this background and the appreciation of the real exchange rate due to the continuation of a positive inflation differential under a fixed exchange rate regime, policymakers periodically devalued the shekel in order to maintain competitiveness vis-à-vis foreign producers. But, since, the pass-through coefficient at the time was substantially larger than today, as demonstrated in Section 7, this combination of policies maintained inflation around the 18 percent level.

These developments weakened the effectiveness of the fixed exchange rate peg as a nominal anchor and induced policymakers, in September 1991, to replace it with an upwardly crawling diagonal band. As succinctly recounted by Klein (2001) this necessitated a decision about the slope of the band. An obvious first pass solution would have been to specify it as the difference between actual domestic inflation and world inflation. However, that would have transformed the exchange rate into an endogenous variable jeopardizing its function as a nominal anchor. The resolution to this problem was to decide on an inflation target and to specify the slope of the crawling exchange rate as the difference between the inflation target (IT) and world inflation.

Thus, the inception of the Israeli IT system occurred through the back door as an attempt to improve the functionality of the exchange rate anchor. The initial IT range was set between 14 and 15 percent for one year. Given inflation expectations at the time, it constituted a compromise between economic growth and a desire to anchor inflation and inflation expectations with minimal harm to the balance of payments. In parallel the BOI substantially raised the short-term rate, initially, as an immediate reaction to an attack on the domestic currency. Against the background of high unemployment triggered by massive immigration from Russia, these policy steps reduced both actual and expected inflation to the 10 percent range in 1992. This trend was helped by the passing of a law that mandated a gradual reduction of the fiscal deficit within a five-year horizon. Sokoler (2001) provides a detailed account of this episode and the evolution of monetary policy during the subsequent five years. Encouraged by this success the government reduced the IT for 1993 to 10 percent. Several months of low inflation in mid-1993 along with a concern for high unemployment at the time led to a reduction of the policy rate and to the announcement of an 8 percent IT for 1994. The inconsistency between the announcement of a more ambitious IT, and the reduction in the policy rate induced a loss of credibility. As a consequence, during 1994 both inflation and inflation expectations rebounded leading to an inconsistency between the pre-announced slope of the band and actual inflation.

Following this development the BOI faced the following dilemma: It could give in to the demands of industrialists and increase the slope of the band, or it could attempt to resolve the inconsistency by reducing inflation. Helped by strong backing from

government, the Bank took the latter course, aggressively increasing the policy rate to a peak of 18 percent at the end of 1994. This was preceded by three historically uncharacteristic government meetings, at the conclusion of which the government “noted to itself” an IT range of 8 to 11 percent. Sokoler (2001, pp. 305–308) reports that those policy steps led to an increase of the ex-ante short-term real rate from 1.8 percent between 1992 and 1994 to 4.8 percent between 1995 and 1997. Except for an inflationary bulge in 1996 those determined steps led to what appeared to be a sustained decrease in inflation.

Following the LTCM crisis of 1998 and the related Russian and Southeast Asia crises, Israel experienced a large capital outflow and a related depreciation of the currency that led to a re-acceleration of inflation. The BOI quickly reacted by raising the policy rate in the last quarter of 1998 and by maintaining it at a high level for almost a year. (Details appear in Figure 3 of Melnick and Strohsal (2015).) This determined reaction raised the ex-ante real rate, stemming the foreign inflationary shock.

The monetary policy steps of the 1990s appear to fit well into the mold of the “opportunistic approach to disinflation”. This approach was first suggested, without labeling it as such, by President Boehne of the Philadelphia Fed in 1989, and succinctly restated by Blinder (1994) at his confirmation hearings in front of the US Senate Committee on Banking as follows: *“Proponents of this approach hold that when inflation is moderate but still above the long-run objective, the Fed should not take deliberate anti-inflation action, but rather should wait for external circumstances such as favorable supply shocks and unforeseen recessions to deliver the desired reduction in inflation. While waiting for such circumstances to arise, the Fed should aggressively resist incipient increases in inflation”*.<sup>30</sup>

The gradual stabilization policy measures of the 1990s along with a sharp policy reversal by Governor Klein in 2002 fit remarkably well into the mold of the opportunistic approach to disinflation. The initial hesitant use of IT as a disinflation device was implemented at the beginning of the 1990s when, due to a large immigration from Russia, unemployment was high and inflationary pressures were consequently low (a negative shock to inflation).<sup>31</sup> Subsequently, when positive shocks to inflation originating abroad or due to domestic policy mistakes threatened the gains made on the inflation front, the BOI aggressively raised the short-term interest rate. This was the case in 1994 when inflation re-accelerated due to inconsistencies between the announced IT and the lowering of the policy rate in 1993, and again in the face of its acceleration due to an external exchange rate shock in 1998. Finally, following a substantial reduction of the policy rate in 2001 that quickly pushed both inflation and inflation expectations back up, Governor Klein reversed course and aggressively raised the policy rate in 2002.<sup>32</sup>

Thus, during the decade from 1991, the BOI followed the prescriptions of the opportunistic approach rather closely. It reduced the IT when labor market conditions

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<sup>30</sup> An early formal treatment of this strategy appears in Orphanides and Wilcox (2002).

<sup>31</sup> The downward pressure on inflation was reinforced by the reluctance of the Russian immigrants to join the Histadrut (the general labor union). This reduced nominal wage increases leading to a decline in real wages.

<sup>32</sup> The 2001 rate reduction was due to a deal with government. Further details on this episode appear in the next section.



generated a negative shock to inflation and strongly reacted to foreign shocks or policy mistakes that generated positive shocks to inflation.<sup>33</sup>

## 5. The impact of stabilizations on the anchoring of inflation expectations

Both the shock stabilization of 1985 and the gradual stabilization of the 1990s were followed after a while by a decline in inflation expectations. In the first case this was achieved mainly by demonstrating that policymakers were serious about reducing inflation.<sup>34</sup> In the second case such demonstration was accompanied by a pre-announcement of an IT making it possible to examine possible changes in the extent to which inflation expectations became anchored to the target over time. The first part of this section investigates the second, timelier, question, and the latter part examines the speed with which inflation expectations came down after the 1985 stabilization.

During the decade from the mid-1990s to 2004/5 inflation declined from the 13 percent range to the 2 percent range. As we have seen, this process was partly achieved through the establishment and strengthening of the IT regime. At the outset the target was relatively high reflecting the view that, within this range of inflation rates, gradual stabilization of inflation is preferable to cold turkey.<sup>35</sup> But once the CB managed to maintain inflation sufficiently close to the target for some time the target was gradually adjusted downward. Between 1994 and 1998 the target was at least 8 percent. It was reduced to 4 percent at the beginning of 1999. From the beginning of 2000, the target was reduced further in small steps of half a percent, finally converging to the current long-term target of 2 percent at the beginning of 2003.

An important function of a pre-announced inflation target is to affect inflation expectations up front in order to reduce the real costs of stabilization. Once the long-term inflation target is reached, the main function of the pre-announced inflation target is to anchor inflation expectations tightly to the target. The extent to which expectations are well-anchored depends on the credibility of the pre-announced target. The credibility of the target depends, in turn, on how well the CB has done in keeping actual inflation near the target in the past.

We start by taking a broad look at the evolution of expectations and of the inflation target. Figure 3 presents the evolution of one- and ten-year inflation expectations along with the pre-announced targets between 1994 and 2014.<sup>36</sup> The figure shows that between 1994 and the beginning of the 21st century, one- and ten-year ahead inflation expectations went down from a double-digit range to around 2 percent and stayed in this range for about two years. But, following a dramatic one-shot 2 percentage point decrease in the BOI interest rate (from 5.8 percent to 3.8 percent) in December 2001, expectations quickly adjusted back upward reaching over 4 percent in mid-2002.

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<sup>33</sup> According to Roni Frisch, this strategy had already been proposed by Nissan Liviatan in the early 1990s, who referred to it as “positive opportunism”.

<sup>34</sup> The 1985 stabilization took place at least five years before the introduction of IT anywhere in the world.

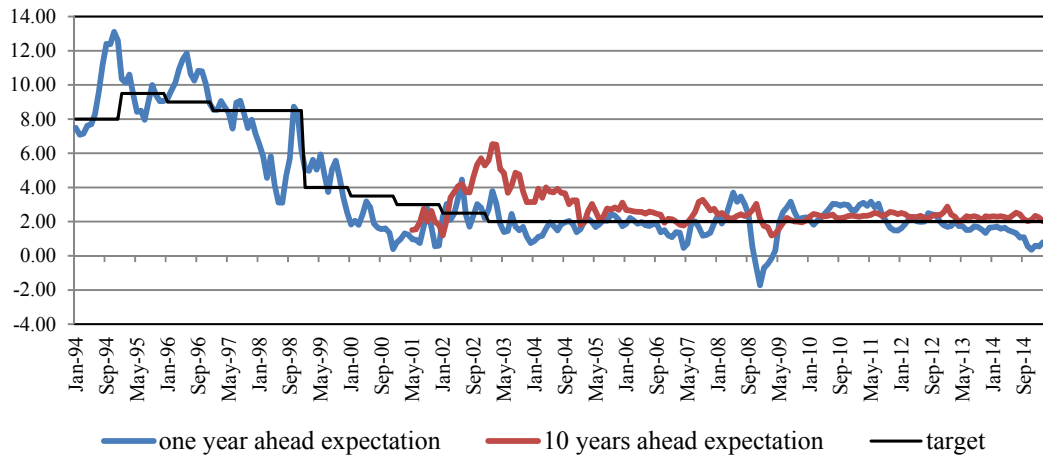
<sup>35</sup> Further details appear in Cukierman and Liviatan (1992).

<sup>36</sup> For periods with target ranges the pre-announced target is taken to be the midpoint of the target range.

The decrease was due to a deal struck between Governor Klein and government. The Bank agreed to reduce the interest rate in return for full issuing authority over *Makam*

Very much in line with the opportunistic approach (discussed in the previous section), Governor Klein reversed this interest rate reduction rather quickly and increased it substantially above the pre-deal 5.8 percent policy rate. As a consequence the BOI rate reached a local maximum of 9.1 percent during the third quarter of 2002. Following this determined policy reversal, and after peaking above 4 percent in June 2002, one-year ahead expectations began to decline gradually, reaching the 2 percent range at the end of the first quarter of 2003. Figure 3 shows that, excluding the last quarter of 2008, from that point on inflation expectations fluctuated in a comparatively narrow range around the 2 percent inflation target. Long-term 10-year ahead expectations show a similar pattern but with less volatility around the 2 percent level.

**Figure 3: One-year and 10-year ahead inflation expectations**



In what follows we propose and implement a methodology for estimating the changing degree to which expectations are anchored to the target. The methodology is a variant of a formulation in Cukierman and Liviatan (1991). Let  $\pi_t$ ,  $\pi_t^e$  and  $\pi_t^T$  respectively be actual inflation, one-year ahead expected inflation and the inflation target in month  $t$ . When the pre-announced target is fully credible expectations are equal to the target. When it has no credibility at all expectations are based only on actual past inflation developments. Between those two extremes there is a whole range of partial credibility cases in which the public forms its expectation based on both the pre-announced target and actual past inflation developments. This leads to the following expectation formation process:

$$\pi_t^e = \beta \pi_t^T + (1 - \beta) \bar{\pi}_{t-1}, \quad 0 \leq \beta \leq 1 \quad (1)$$

where  $\bar{\pi}_{t-1}$  is the twelve-month rate of inflation up to and including period  $t-1$ .  $\beta$  is a parameter that characterizes the credibility of the announced inflation target. When it is 1, credibility is perfect (full anchoring) and when it is 0, credibility is nonexistent (no

anchoring at all). More generally, the higher  $\beta$  is, the higher the target's credibility. Since the anchoring of expectations to the target is stronger when credibility is higher,  $\beta$  is also a measure of anchoring of expectations to the target. In order to estimate  $\beta$ , equation (1) can be rewritten as

$$\pi_t^e - \bar{\pi}_{t-1} = \beta(\pi_t^T - \bar{\pi}_{t-1}) \quad (2)$$

Thus, the anchoring parameter,  $\beta$ , can be estimated by running a regression of the difference between the inflation expectation and past inflation on the difference between the target and past inflation<sup>37</sup>. In order to examine whether the target's credibility, and with it the anchoring of inflation expectations, have changed over time we divide the 1994–2014 period into three segments. The first includes dates which belong to the post-1985 stabilization step 2 and the last two to the price stability era. The first segment lumps together the period of gradual stabilization between 1994 and 1999, the period of low, seemingly well-anchored, expectations during 2000/2001, and the inflationary bulge triggered by "Klein's deal" in December 2001.<sup>38</sup>

The last two segments, starting in April 2003, are characterized by values of inflation and of inflation expectations that are mainly confined to the range between 2 and 4 percent. Although both segments 2 and 3 belong to the price stability era, they differ in that segment 2 (April 2003 to October 2007) precedes the global financial crisis and segment 3 (November 2007 to July 2014) includes the crisis and its aftermath as well as the creation of a monetary policy committee. Equation (2) is estimated for each of the sub-periods by ordinary least squares.

Table 3 shows the evolution of the credibility/anchoring parameter and related statistics over the three segments. Two main results stand out: First, the anchoring parameter  $\beta$  increases dramatically from 0.50 to 0.84 between the last inflationary period and the price stability era. This can be rightly considered as the main payoff for the relatively difficult stabilization period. It is consistent with the view that credibility cannot be earned by simply announcing a target. It is established only after demonstration of the fact that actual inflation is held close to the target for a sufficient length of time.<sup>39</sup> Second,  $\beta$  goes even further up after the outbreak of the global financial crisis.

**Table 3: Evolution of the credibility/anchoring parameter**

Period	Credibility/Anchoring parameter- $\beta$	t-statistic	S. E, Regression	DW
<b>1994:M2–2003:M3</b>	0.50	12.28	1.24	0.56
<b>2003:M4–2007:M10</b>	0.84	34.65	0.41	0.90
<b>2007:M11–2014:M7</b>	0.90	14.14	0.82	0.23

<sup>37</sup> Strohsal, Melnick and Nautz (2015) expand the framework to accommodate a time-dependent random anchoring parameter as well as additional effects.

<sup>38</sup> The issue of the degree to which expectations were anchored during the 2000/2001 low expectations time period is tested later in this section.

<sup>39</sup> A conceptualization of the learning process through which credibility is built up appears, *inter alia*, in Cukierman and Liviatan (1991).

We turn next to the question of whether expectations were already well-anchored in 2000/2001. A look at Figure 3 shows that over 2000 and 2001 inflation expectations fluctuated within a narrow range around 2 percent. This observation raises the possibility that inflation expectations were already well-anchored at the very beginning of the 21st century, or, in other words, that this sub-segment is actually more similar in terms of anchoring to segment 2 in Table 3 than to the preceding segment 1. To test this hypothesis we re-estimate equation (2) from the beginning of segment 1 in Table 3, 1994:M2, until the end of the second segment in Table 3, 2007:M10, with a slope dummy on the regressor for the 2000–2001 interval. More precisely, we estimate

$$\pi_t^e - \bar{\pi}_{t-1} = \beta(\pi_t^T - \bar{\pi}_{t-1}) + \delta D(\pi_t^T - \bar{\pi}_{t-1}) \quad (3)$$

where

$$D = 1 \text{ over } 2000\text{--}2001 \quad (4)$$

$$D = 0 \text{ otherwise.}$$

Since the combined period is a mixture of the first and second segments, its estimated anchoring parameter should be somewhere between the anchoring parameters of those two segments, as indeed is confirmed by the estimation results below. If the degree of anchoring of the 2000–2001 interval is closer to that of the second segment,  $\delta$  should be positive. If it is closer to that of the first segment,  $\delta$  should be negative. An OLS regression of equation (3) reveals that the estimate of  $\beta$  is 0.62 with a t-statistic of 19.20 and the estimate of  $\delta$  is -0.38 with a t-statistic of -3.71.<sup>40</sup> Those estimates support the conclusion that, in spite of the fact that during 2000–2001 expectations were rather low, they were not yet anchored to the same extent as in the second segment of Table 3. This supports the decision to classify it as done in Table 3.

Furthermore, the negative estimated value of  $\delta$  supports the view that the swift and large upward reversal in the BOI interest rate policy following the December 2001 "Klein deal" contributed to the increase in the subsequent anchoring of expectations by demonstrating that, following a substantial deviation of the inflation environment from its target range, the Bank will react with vigor. An important conclusion of this section is that, although the period of actual inflation stability starts at the beginning of 1999, tight anchoring of inflation expectations to the target was achieved only three-and-a-half years later.

## 6. The impact of the inflation environment and of stabilizations on inflation uncertainty

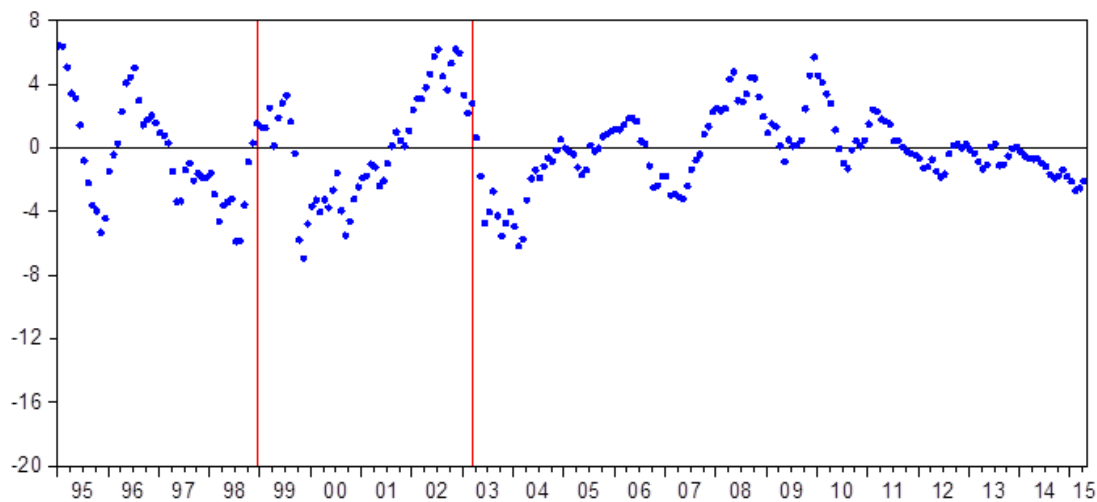
An important cost of inflation is the uncertainty that is associated with it.<sup>41</sup> A natural measure of inflation uncertainty is the inflation forecast error (FE). Figure 4

<sup>40</sup> The standard error of the regression is 1.07, and that of the DW statistic is 0.57.

<sup>41</sup> Extended discussions of the costs of inflation appear in Leijonhufvud (1977) and in Fischer and Modigliani (1978).

shows a measure of FE over the period from 1995:M1–2015:M4 period which covers part of the second post-1985 step as well as the last price stability step. This measure is defined as the difference between past actual twelve-month inflation in each month and the capital market breakeven inflation between returns on indexed and unindexed government bonds twelve months prior to the current month. The first vertical red line shows the end of the post-1985 step 2 and the second marks the end of the “Klein deal” episode discussed in the previous section. Over the entire sample the range of the forecast error is bounded by 8 percent in absolute value. The figure broadly supports the view that inflation uncertainty during the “Klein deal” episode was similar to its level during the post-1985 step 2. But inflation uncertainty during the remainder of the post-1985 step 3 (from April 2003 and on) is lower. This is corroborated by Table 4 which shows that during the second part of step 2 as well as during the “Klein deal” episode the standard deviation of FE was over 3 percent, in contrast to the remainder of step 3 over which this standard deviation is only 2.2 percent.<sup>42</sup> Interestingly, Figure 4 suggests that there is a further decrease in the absolute value of the inflation FE from about 2010 onward.<sup>43</sup>

**Figure 4: Unexpected inflation at yearly rates  
between 1995M1-2015M4**



<sup>42</sup> The difference between the mean square deviations over these two subperiods is highly significant.

<sup>43</sup> This could be attributed to the legislation of the new Bank of Israel law and to the formation of the Monetary Committee.

**Table 4: Standard deviations of forecast errors over sub-periods since 1995:M1**

<b>Periods</b>	<b>Standard Deviation of Forecast Error</b>
1995:M1–1998:M12	3.2
1999:M1–2015:M4	2.6
1999:M1–2003:M3 <sup>1</sup>	3.5
2003:M4–2015:M4 <sup>2</sup>	2.2
<sup>1</sup> Including the “Klein deal” episode.	
<sup>2</sup> After the “Klein deal” episode.	

Next we take a look at the behavior of FE just before and after the July 1985 stabilization. Figure 11 shows three months ahead FE at yearly rates between January 1984 and October 1986.<sup>44</sup> Not surprisingly, prior to stabilization, FE fluctuates widely. More interestingly the magnitude of unexpected inflation in the immediate post-stabilization period remains high and persistently negative until the beginning of 1986. The initial negative difference of about 40 percent between actual and expected inflation reflects the initially low credibility of the stabilization program. But, as financial markets observed that the sharp decrease in inflation persisted, expectations gradually came down and reached the new lower range of inflation within half a year after the stabilization. Thus, although the IT regime did not exist at the time, the widespread public awareness of the dramatic measures taken by policymakers along with the persistence of actual disinflation convinced the public within about six months that a new lower inflationary step had been permanently reached. In parallel, from that point onward, inflation uncertainty comes down very substantially (Table 5).

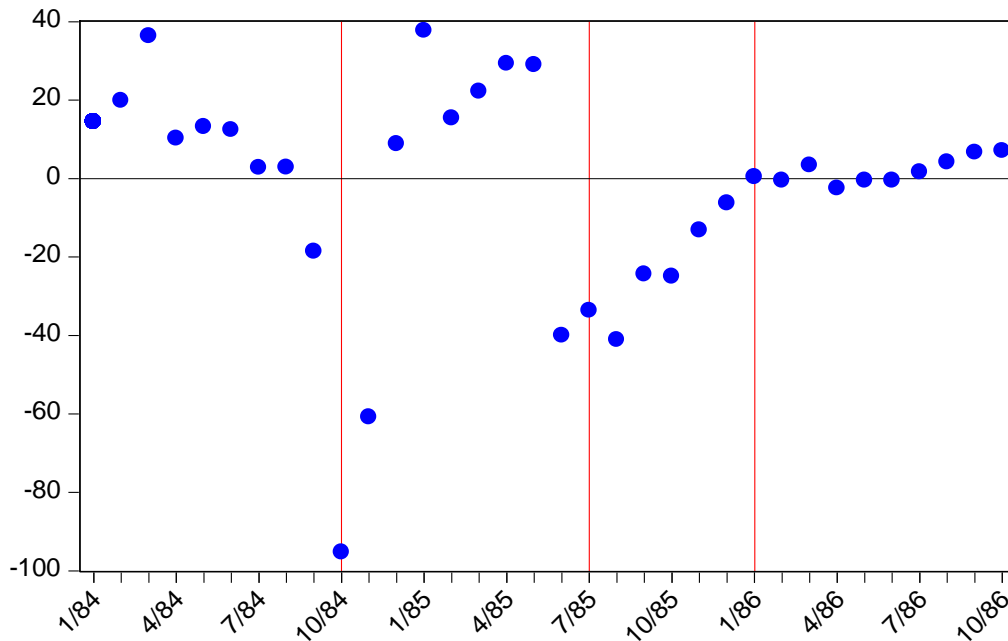
**Table 5: Standard deviations of forecast errors just before and after the 1985 stabilization**

<b>Period</b>	<b>Standard Deviation of Forecast Error</b>
1984:M1–1986:M10	27.3
1984:M1–1985:M6	29.0
1985:M7–1986:M10	16.6
1985:M7–1985:M12	26.6
1986:M1–1986:M10	3.7

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<sup>44</sup> The huge negative difference between actual and expected inflation in October 1984 is due to a largely non-credible very temporary decrease in actual inflation as a consequence of a package deal that was not supported by restrictive fiscal and monetary measures.

**Figure 5: Forecast Errors at yearly rates just before and after the 1985 stabilization**



Source : Adapted from Cukierman (1988) table 2.3

Comparison of the vertical scales of Figures 4 and 5 and of the standard deviations of the forecast errors across Tables 4 and 5 confirms that the levels of inflation uncertainty both before and after stabilization differed by orders of magnitude between the 1985 stabilization and the gradual stabilization of the 1990s. As can be seen from Table 4 the standard deviation of FE during the second part of step 2 and during the “Klein deal” episode were bounded between 3 and three-and-a-half percent. By contrast this standard deviation during the 18 months preceding the 1985 stabilization amounted to a whopping 29 percent (Table 5). Although it went down a bit, this high level of uncertainty persisted at over 26 percent during the first six months after the July 1985 stabilization. But from January 1986 onward, it dropped dramatically to only 3.7 percent.

## 7. Price stickiness and the evolution of the pass-through coefficient across sub-periods

Conceptually the pass-through coefficient is related to the degree of price stickiness and to the Calvo coefficient in the New-Keynesian model.<sup>45</sup> Under the influence of the Great Moderation, current economic literature assumes that the frequency of price adjustments, and therefore the Calvo coefficient, are constant. Although this assumption provides a useful approximation for a given inflation

<sup>45</sup> The Calvo coefficient is the probability that a representative firm will change its price in any given period. The larger this coefficient the less sticky are individual prices.

environment, it clearly does not hold when the inflation environment changes as it did in the Israeli case.

Using detailed microeconomic data underlying the Israeli CPI during the 1970s and the 1980s, Hanoach and Galyam (1985) and Lach and Tsiddon (1992) show that sustained increases in the general level of inflation are accompanied by non-negligible increases in the frequency of price adjustments.<sup>46</sup> The magnitude of the pass-through coefficient (PTC) from changes in the nominal exchange rate to domestic prices is one manifestation of the speed of price adjustments. One mechanism through which the speed of price adjustment increases when inflation changes is the tendency of indexation arrangements to gradually emerge when inflation accelerates and to die out, even more gradually, following credible sustained stabilizations.

This section presents estimates of the PTC over the Israeli inflation steps between August 1980 and April 2015. The PTC is calculated in the following manner: Within each sub-period the monthly rate of inflation in the CPI is regressed on the contemporaneous rate of change in the exchange rate, on six monthly lags of the latter variable and on two lags of quarterly rates of change in import prices. The PTC (denoted  $a$ ) is then calculated as the sum of the coefficients of the seven monthly rates of change in the exchange rate regressors.

**Table 6: Evolution of the Pass-through Coefficient (PTC) over Sub-periods**

Periods	$a$	Wald test Probability $H_0:a=0$	Wald test Probability $H_0:a=1$	Average Inflation	Inflation Variability
1980:M8–1985:M6	1.01	0.00	0.87	199.85	240.72
1986:M7–1991:M9	0.97	0.00	0.81	18.65	19.36
1991:M10–1998:M12	1.01	0.00	0.87	10.47	9.93
1999:M1–2015:M1	0.17	0.00	0.00	2.19	1.95
1991:M1–2003:M3	0.50	0.00	0.00	8.55	9.10
2003:M4–2015:M4	0.09	0.12	0.00	1.70	5.44

The PTC is shown in Table 6 along with Wald tests of the (alternative) null hypotheses that it is 0 and 1, as well as memo items showing average inflation and its variability within each sub-period. The table supports the conclusion that until 1998:M12 the PTC was not significantly different from one. It did go down substantially later on, and reached the current low level of about 0.09 since 2003.<sup>47</sup> An important consequence

<sup>46</sup> A voluminous theoretical literature that developed over the 1980s (spurred by Sheshinski and Weiss (1983)) is consistent with these findings. An application of this notion to the monetary policy in the US during the Great Inflation of the 1970s appears in Cukierman (2008b).

<sup>47</sup> Implicitly we assume that the correlation between changes in the exchange rate and domestic inflation is due mainly to causality running from changes in the exchange rate to domestic inflation. Yoav Friedman, at a BOI research seminar, suggested that this correlation may also be due to causality in the opposite direction. It is beyond the scope of this paper to further expand on this. Our gut feeling is that during the current price stability period causality from the exchange rate to domestic prices is relatively more important for the following reason: In the monthly data we use, movements in the exchange rate are dominated by short-run financial flows rather than by inflation differentials. The latter is presumably more important in the longer run or when inflation differentials are substantial, as was the case in the 1977–1985 sub-period.



of this dramatic decrease in the PTC is that, contrary to the past, policy induced, nominal depreciations translate into gains in foreign trade competitiveness for quite a while.

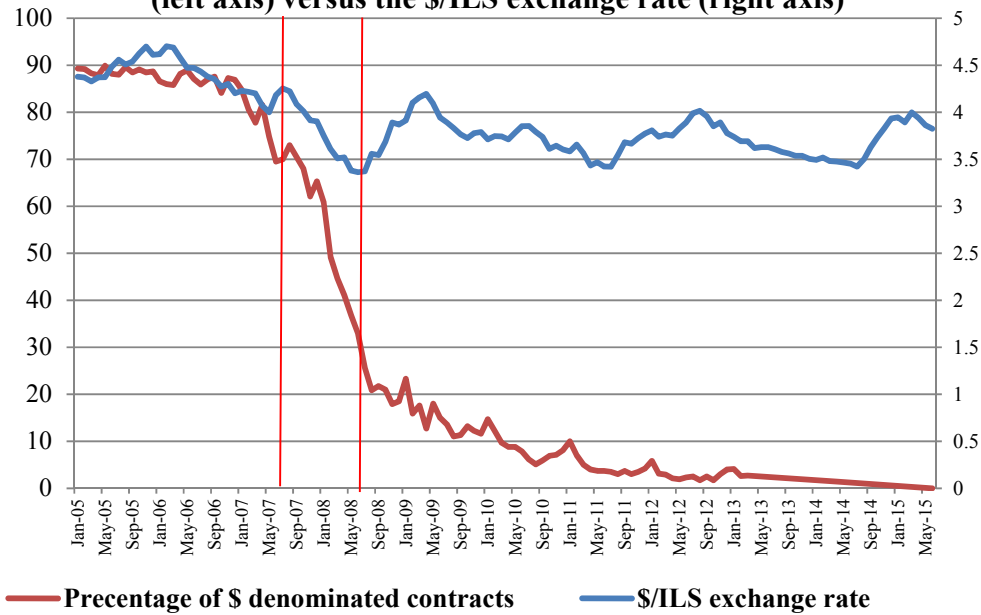
As argued at the beginning of this section the pass-through coefficient is related to the degree of price stickiness and to the Calvo coefficient in the New-Keynesian framework. In particular, as the rate of inflation abates the speed of price adjustments goes down. But, due to widespread dollarization of real estate prices during the five inflationary decades, changes in the pass-through coefficient are also affected by the percentage of real estate prices that are denominated in US dollars. The following section explores this channel.

## **8. The disappearance of dollarization and its impact on the pass-through coefficient**

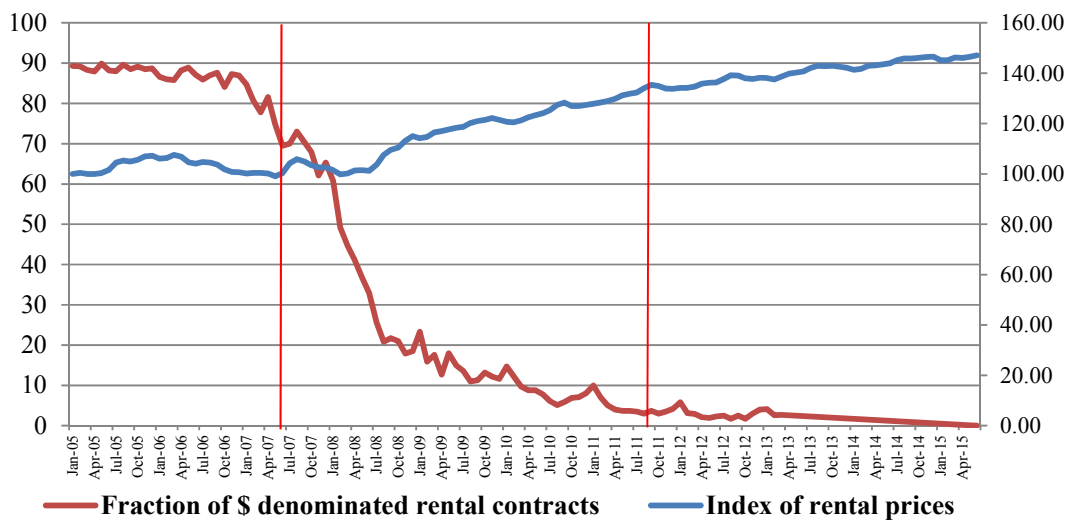
The persistence and magnitude of Israeli inflation during the first fifty years of statehood induced the creation of elaborate indexation arrangements. Given high and uncertain inflation, the quest for a stable real anchor in long-term contracts was achieved by indexation to either the CPI or to the rate of exchange of the US dollar. In particular, most prices in the real estate market, including owned homes and rentals, were denominated in US dollars although transactions were usually settled in Israeli shekels. To a theoretically minded international economist this is a bit surprising since real estate is fundamentally a non-tradable good. What is even more surprising is that dollarization in the real estate market persisted for a good number of years after inflation was stabilized and the inflation environment shifted to price stability. A high level of dollarization in the real estate market persisted until 2007 and then quickly became negligible by 2009. Using data provided by the Central Bureau of Statistics on the denomination of rental contracts, this section documents this phenomenon and then provides an explanation for both the persistence of dollarization during the first part of the price stability period and its swift disappearance by 2009.

Figure 6 shows the percentage of dollar-denominated new rental contracts along with the dollar exchange rate between 2005 and 2015. The main message of the figure is that dollarization started to decline at fast rates only when the shekel appreciated substantially with respect to the dollar. Figure 7 shows the percentage of dollar-denominated new rental contracts along with the index of rental prices in the CPI. It appears that the latter part of the erosion in dollarization occurred concurrently with an acceleration in rental prices, although at less dramatic rates.

**Figure 6: Percentage of new dollar-denominated rental contracts (left axis) versus the \$/ILS exchange rate (right axis)**



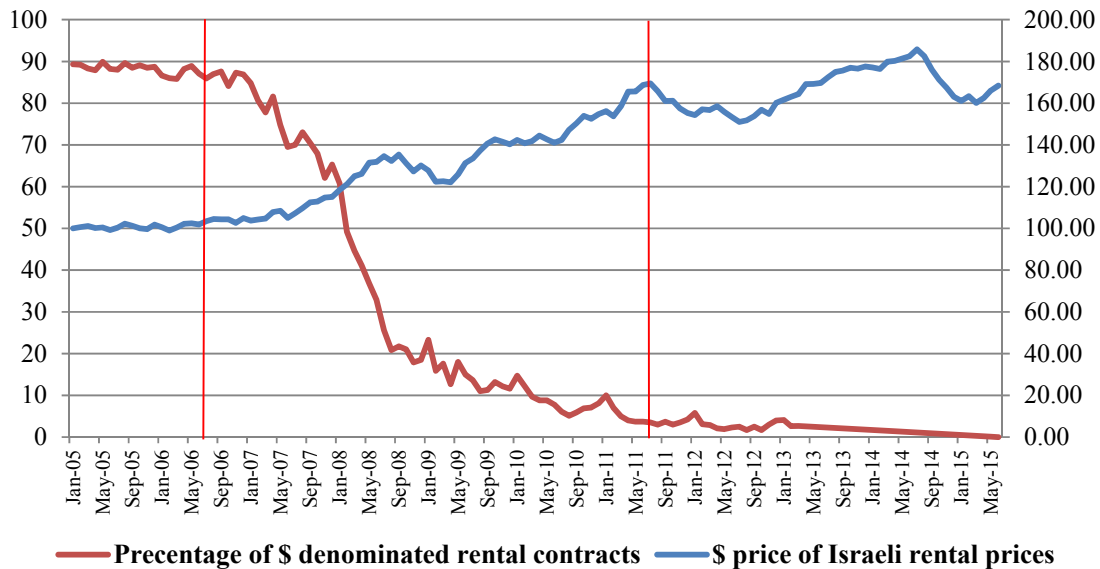
**Figure 7: Percentage of new dollar-denominated rental contracts (left axis) versus the index of rental prices (right axis)**



It appears that both the appreciation of the dollar and the rise in rental prices are related to the decline in dollarization, albeit with somewhat different timing. To capture the combined impact of both on the percentage of dollarized rental contracts we note that the incentive to specify new rental contracts in dollars is inversely related to the dollar price of rentals. Figure 8 shows the percentage of dollar denominated rental contracts (Ps) along with (on the right axis) an index of the dollar price of rentals (Rs).<sup>48</sup> A regression of Ps on Rs yields a highly significant regression coefficient of -1.2 with an adjusted R-square of 0.84. This coefficient implies that the increase in Rs in the five-years period bounded by the two vertical red lines in Figure 8 is associated with a decrease of almost 40 percentage points in the percentage of new dollar-denominated rental contracts.

Institutional arrangements designed to safeguard the real value of a unit of account are highly persistent. The introduction of the dollar as the unit of account was introduced in the first place to safeguard the real value of real estate contracts. However, once established, dollarization in the real estate market tended to persist long after price stability made it no longer necessary. The evidence presented above supports the view that, once established, dollarization disappears only when there is a strong disincentive to continue using it. Such a disincentive was provided by the acceleration in the dollar price of rental contracts since 2007.<sup>49</sup>

**Figure 8: Percentage of new dollar-denominated rental contracts (left axis) versus an index of the dollar price of Israeli rental prices (right axis)**



<sup>48</sup> The index is normalized to 100 in January 2005.

<sup>49</sup> Shiffer (2001) notes a similar phenomenon in the context of indexation to the CPI. Eichengreen (2009) and others note that the US dollar has an incumbency advantage as an international currency vis-a-vis newer contenders like the Euro and the Yuan.

We turn next to the impact of changes in the degree of dollarization on the PTC. In principle this coefficient may change either because the extent of dollarization changes or because, at a given level of dollarization, the reaction of domestic prices to changes in the exchange rate changes. The estimate of parameter  $a$  in Table 6 reflects both the extent of dollarization and the response of domestic prices to changes in the exchange rate at a given level of dollarization. To evaluate the relative contribution of each of these to the PTC over the period of price stability we decompose the PTC into a part that operates independently of the degree of dollarization and a part that operates through the outstanding degree of dollarization in each period. More precisely we run the regression:

$$\pi_t = \text{Constant} + \sum_{i=0}^6 \beta_i^{ND} e_{t-i} + \sum_{i=0}^6 \beta_i^D f_{t-i} e_{t-i} \quad (5)$$

+two lagged quarterly rates of change in import prices  
+ one year ahead inflation expectations

where  $\pi_t$  is the general rate of inflation,  $e_t$  is the rate of change in the \$/NIS rate and  $f_t$  is the percentage of dollar-denominated rental contracts in period  $t$ . This regression is identical in all respects to the regressions used to estimate the PTC in Table 6 except that for any given degree of dollarization, the rate of change in the exchange rate is allowed to affect domestic prices directly through the coefficients,  $\beta_i^{ND}$  and  $i=0,1,..6$ , and via the degree of dollarization prevailing in each period. The latter is captured by the coefficients,  $\beta_i^D$  and  $i=0,1,..,6$ . The sum

$$a^{ND} = \sum_{i=0}^6 \beta_i^{ND}$$

reflects the total impact of changes in the exchange rate that operate independently of the prevailing degree of indexation. The sum

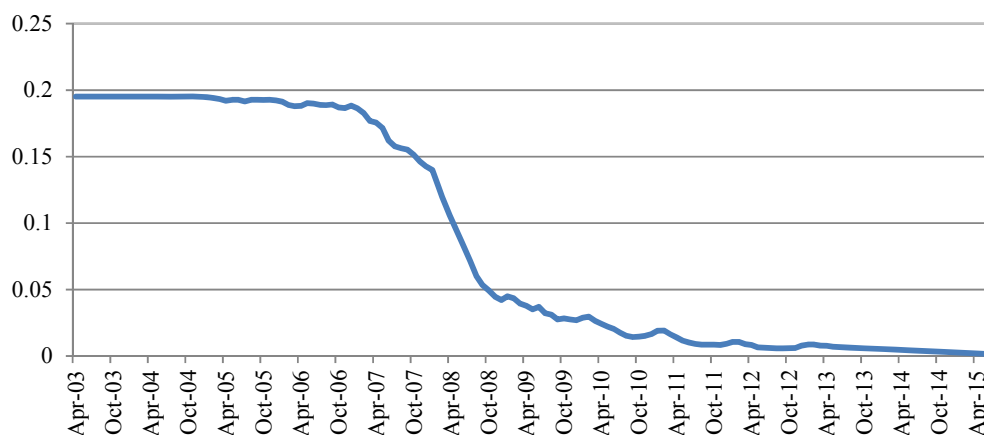
$$a^D = \sum_{i=0}^6 \beta_i^D$$

represents the total impact of changes in the exchange rate that affect the rate of inflation when the degree of indexation is one. The ratio  $\frac{a^D}{a^{ND}}$  is a measure of the extent to which the total PTC in Table 6 depends on the degree of dollarization relative to other more direct impacts of exchange rate changes on domestic inflation. Since the degree of dollarization is changing over time, the PTC is time-dependent as well. This time-dependent total PTC, which is the counterpart of parameter  $a$  in Table 6, is given by

$$a_t = \sum_{i=0}^6 \beta_i^{ND} + \sum_{i=0}^6 \beta_i^D f_{t-i} \quad (6)$$

The regression in equation (5) has been estimated with data between April 2003 and April 2015 which corresponds to the last period in Table 6. The estimate of  $a^D$  is equal to 0.22 and is significant at the 0.08 level while the estimate of  $a^{ND}$  is not significantly different from zero. Those results support the conclusion that the low value of the PTC during the period of price stability is due entirely to remnants of dollarization during the first half of this period. Figure 9 shows the evolution of  $a_t$  over the period of price stability. It graphically confirms the previous conclusion.

**Figure 9: The impact of shifts in the percentage of dollar denominated contracts on the pass-through coefficient**



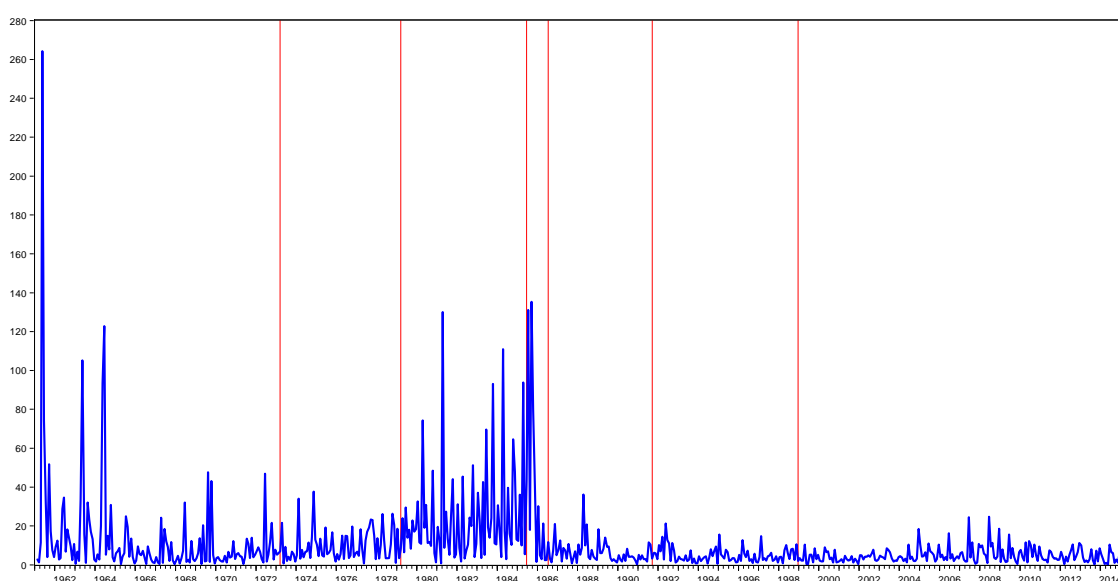
## 9. Evolution of relative price variability over sub-periods

The work of Patinkin (1965) lays out the well-known classic benchmark of monetary neutrality: When the supply of money goes up all prices go up by the same factor without any change in relative prices—and therefore in real magnitudes. The worldwide inflation of the 1970s taught the economic profession that this theoretical paradigm is of negligible practical relevance. In particular, the variability of relative prices is positively related to the magnitude of inflation and to its variability (Chapter 6 of Cukierman (1984)). The variety of inflationary experiences in Israel provides a natural laboratory for testing the hypotheses that the higher average inflation and its variance are the higher relative price variability is, implying that the real economy is not neutral to the level and the associated variability of inflation.

This section provides evidence on the evolution of relative price variability over Israel's inflation sub-periods. Relative price variability is measured by the sum of the mean square deviation of the monthly rates of inflation in each of the ten major subdivisions of the CPI from the monthly inflation of the CPI general index.

Figure 10 shows the evolution of monthly relative price variability between 1961 and 2015. The vertical red line on top of the July 1985 date highlights the timing of the stabilization and the vertical red line on top of July 1986 marks the beginning of the fourth subperiod. The other vertical red lines denote the last month of each sub-period. Thus the utmost left line designates the last month of sub-period 1 and the utmost right vertical line marks the end of the fifth sub-period. Table 7 shows the average value of monthly cross-sectional relative price variability over each sub-period. Both the figure and the table confirm that there is a positive association between relative price variability on one hand and average inflation and its variability on the other.

**Figure 10: Relative Price Variability (RPV) 1961:M2–2015:M4**



**Table 7: Evolution of Relative Price Variability over Sub-periods (percent)**

Period	Relative Price Variability	Average Inflation	Standard Deviation of Inflation
Sub-period 1: 1961:M2–1973:M2	13.1		
Sub-period 2: 1973:M3–1979:M3	9.9	37.2	46.2
Sub-period 3: 1979:M4–1985:M6	24.9	181.8	220.1
Sub-period 4: 1986:M7–1991:M9	6.4	18.7	19.4
Sub-period 5: 1991:M10–1998:M12	4.9	10.5	9.9
Sub-period 6: 1999:M1–2015:M4	4.8	2.1	1.9

Chapter 6 in Cukierman (1984) provides theoretical underpinnings for the positive relation between relative price variability and the variability of inflation within the framework of Lucas' (1973) "islands" model. The main idea is that when inflation variability goes down, individuals correctly interpret a larger fraction of any nominal price change as a change in a relative price as opposed to a change in the general level of

prices. As a consequence shocks to aggregate demand or supply have a relatively stronger impact on real variables and a relatively weaker impact on the general level of prices. Both theory and Figure 10 support the conclusion that the era of price stability brought with it reduced fluctuations in relative prices.

## 10. Major structural changes since the start of the 21<sup>st</sup> century

After fifty years of inflation at various levels, the Israeli economy finally reached price stability and tight anchoring of inflation expectations at the beginning of the 21<sup>st</sup> century. As recounted in Section 4, this was achieved by initially announcing relatively modest short-term interim targets that were attainable without excessive recessions and successively reducing those targets once they were achieved. This process finally converged when government decided (in August 2000) that, starting in 2003, the inflation target (IT) range will be permanently fixed between 1 and 3 percent.<sup>50</sup> At the end of 2001 (Section 5), the BOI was authorized by the government to freely issue “*makam*” (“treasury” bills with a maturity of up to one year that cannot be used to finance the government budget) as an important tool of monetary policy. Following the final transfer of this instrument to the Bank, the balance of *makam* increased from NIS 34 billion in 2001 to NIS 124 billion in 2013. In parallel, the trend toward a fully floating exchange rate was completed in 2005. Due to a widening exchange rate band prior to 2005, in practice the exchange rate was already largely floating since 1998.

But the last 15 years also witnessed additional real structural changes beyond changes in monetary policy and institutions, some of which have important consequences for current monetary policy. The most important of these are a persistent shift from current account deficits to surpluses, a substantially increased flexibility of the labor market, the creation of a long-term fiscal discipline cum debt reduction plan and the privatization of pension and provident funds. This section briefly describes the main features of these changes.

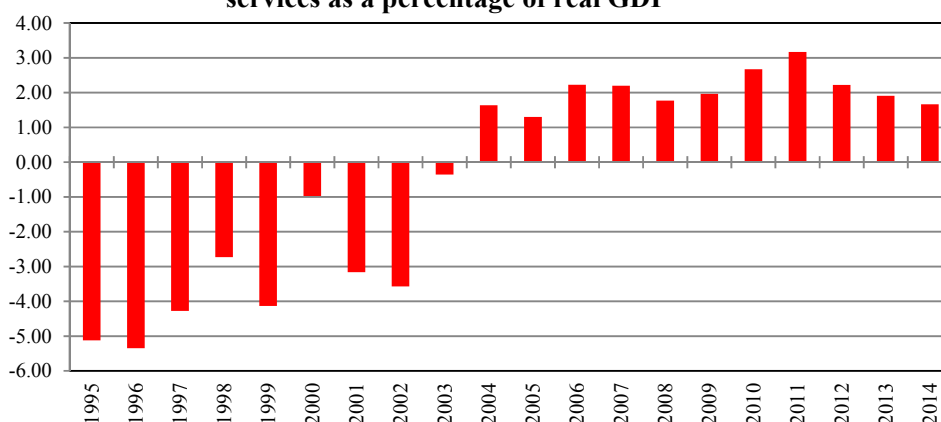
Between the establishment of the state in 1948 and 2003 the Israeli current account balance was typically in deficit.<sup>51</sup> From 2003 onward this balance moved into a consistent surplus. Figure 11 shows the evolution of the balance of trade as a percentage of GDP. Factors that contributed to this shift were fiscal restraint and the growth of the high tech industry through a combination of domestic and foreign investment such as that made by Intel, as well as the discovery of gas in 2009.

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<sup>50</sup> Bank of Israel, Inflation Report (2000), second half.

<sup>51</sup> Although the CA deficits after the 1985 stabilization were substantially lower than before.

**Figure 11: Difference between exports and imports of goods and services as a percentage of real GDP**



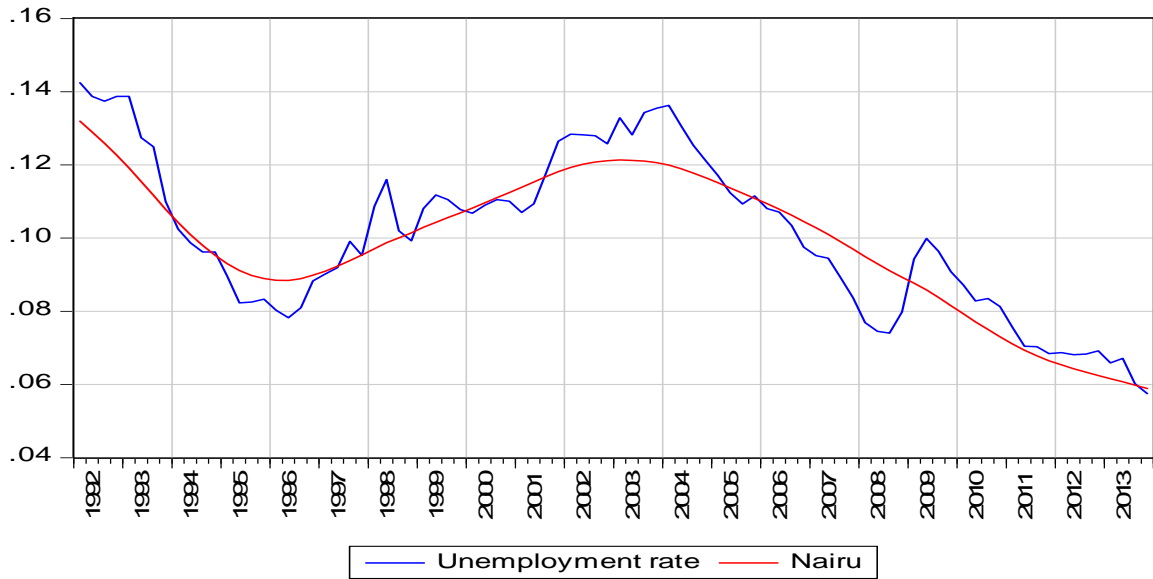
Since 2004 the rate of unemployment has been decreasing, labor force participation has been increasing, and the labor market has displayed a substantial degree of flexibility in the sense that these changes occurred with very little increase in gross real wages. One explanation for this development is that, due to reductions in direct taxes on labor, the average after-tax wage rose faster than the average gross real wage. Between 2003 and 2013 the net real wage increased at a yearly rate of 1.7 percent while the gross wage increased at only 0.7 percent per annum.<sup>52</sup> Elkayam and Ilek (2013) convincingly show that most of the decrease in the rate of unemployment is due to a decrease in the natural rate of unemployment (Figure 12). They also report a leftward shift in the Beveridge curve since about 2008, suggesting that the matching process in the labor market has become more efficient (Figure 13).

Several other factors contributed to the flexibility of the labor market. First, the percentage of unionized workers decreased substantially during the last two decades. This process started with the large wave of Aliyah (immigration) from the former Soviet Union and the reluctance of the Olim (immigrants) to join a labor union. An important element was also the passing of universal health care legislation in 1995. This separated health insurance from union membership and weakened the power of the Histadrut (General Federation of Labor). Second, at the beginning of the 21<sup>st</sup> century, various governmental activities were outsourced to private contractors, which raised the percentage of non-unionized labor. Third, a non-negligible inflow of foreign workers kept the supply of unskilled low-paid workers relatively flexible. Fourth, the last few years witnessed a modest but persistent increase in the rate of participation of ultra-orthodox Jews and Arabs (women in particular). Finally, the general reduction in the size of government freed resources for the private sector.

<sup>52</sup> Bank of Israel, Recent Economic Developments, No. 138, p.8.

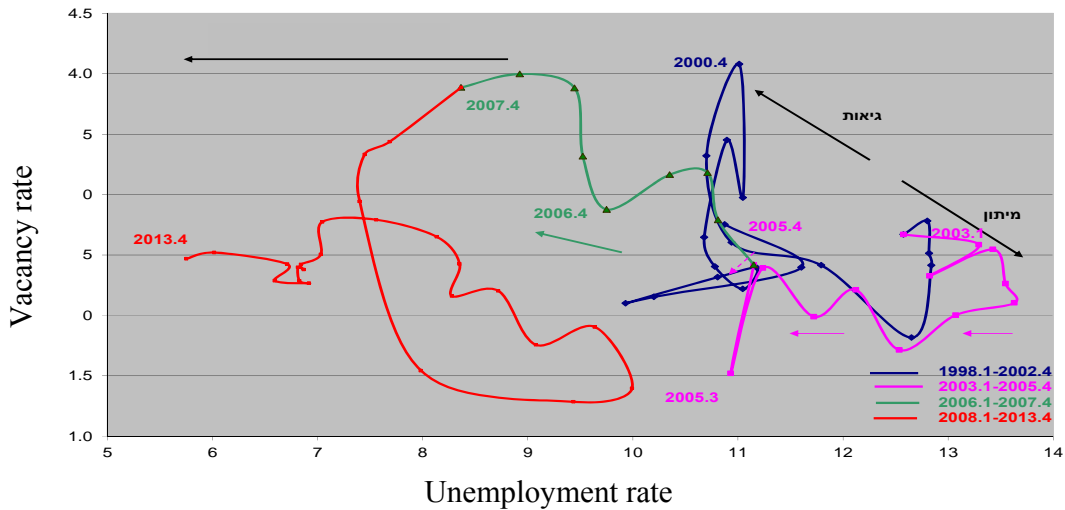


**Figure 12: Actual and Natural Rates of Unemployment**



Source: Elkayam and Ilek (2013), Figure 3

**Figure 13: Beveridge curve**

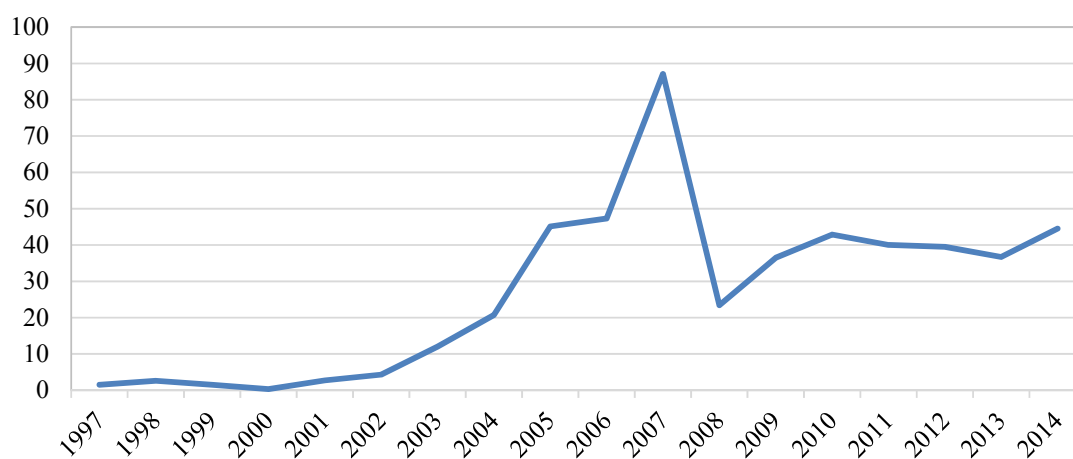


Source: Elkayam and Ilek (2013), Figure 2

In 2005 banks were directed to divest their holdings in pension and provident funds. Prior to that, in 2003, there began a (still ongoing) long-term shift from a pay-as-you-go defined benefit pension system to fully funded, defined contribution, pensions. This created a huge supply of funds to non-banking financial institutions and partially

reduced the government's implicit liability as a pension provider of last resort. The channeling of public savings via private non-banking financial institutions rather than government and banks created a huge supply of funds to the local long-term capital market and spurred the emergence of a domestic corporate bond market which was virtually nonexistent at the turn of the century. Figure 14 shows that corporate bond issues became quantitatively important following the two institutional reforms described above.

**Figure 14: Gross corporate bond issues in billions of shekels**



Source: Tel Aviv Stock Exchange

Following the end of the 2001–2003 recession, fiscal authorities continue to insist on a long-term path of public debt reduction and a moving ceiling on real public expenditures.<sup>53</sup> Except for a brief bulge during the 2009 recession the debt/GDP ratio has been on a downward trend since 2004. Between 2003 and 2014 it decreased from 93.8 percent to 67 percent. At the eve of the 2001 recession the debt/GDP ratio was around 90 percent. By contrast at the eve of the 2009 recession it had shrunk to around 73 percent. As stressed by Braude and Flug (2012), this facilitated the anticyclical response of fiscal and monetary policies to the 2009 recession, relative to their responses to the 2001–2003 recession. An additional benefit of the reduction in the debt/GDP ratio is that, along with price stability, this trend contributed to a reduction in the average interest rate on the public debt. Further details on this process appear in the next section.

In May 2010, Israel was admitted to the OECD in recognition of the economic progress Israel achieved during the previous twenty years, but also reinforcing current policy dilemmas in the foreign exchange market. This is discussed at some length in Section 12.

<sup>53</sup> The process of reduction in the debt to GDP ratio started with the 1985 stabilization.

## 11. The impact of price stability and of the global financial crisis on government finances and on real rates

Until the mid-1990s most long-term debt instruments were indexed to the CPI. The sustained effort to bring inflation down to international standards, which started at that time, led to the gradual emergence of unindexed instruments with steadily increasing terms to maturity. Government finances were the first to benefit from this trend. An early unindexed nominal government bond with a maturity of two years (Shahar) was issued in August 1995, soon to be followed by the issuance of a three-year Shahar bond in October 1996. As the drive toward price stability gathered momentum and credibility, the maturity of new issues gradually became longer and the yields to maturity on new issues gradually went down.

**Figure 15: Nominal government bond yield curves on dates of issuance of successively longer maturities**

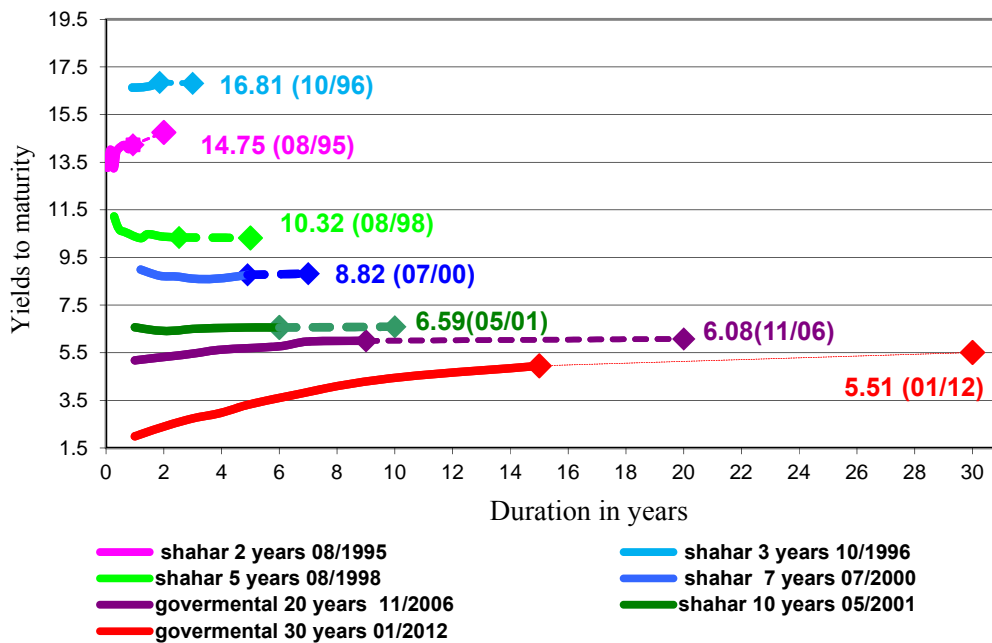
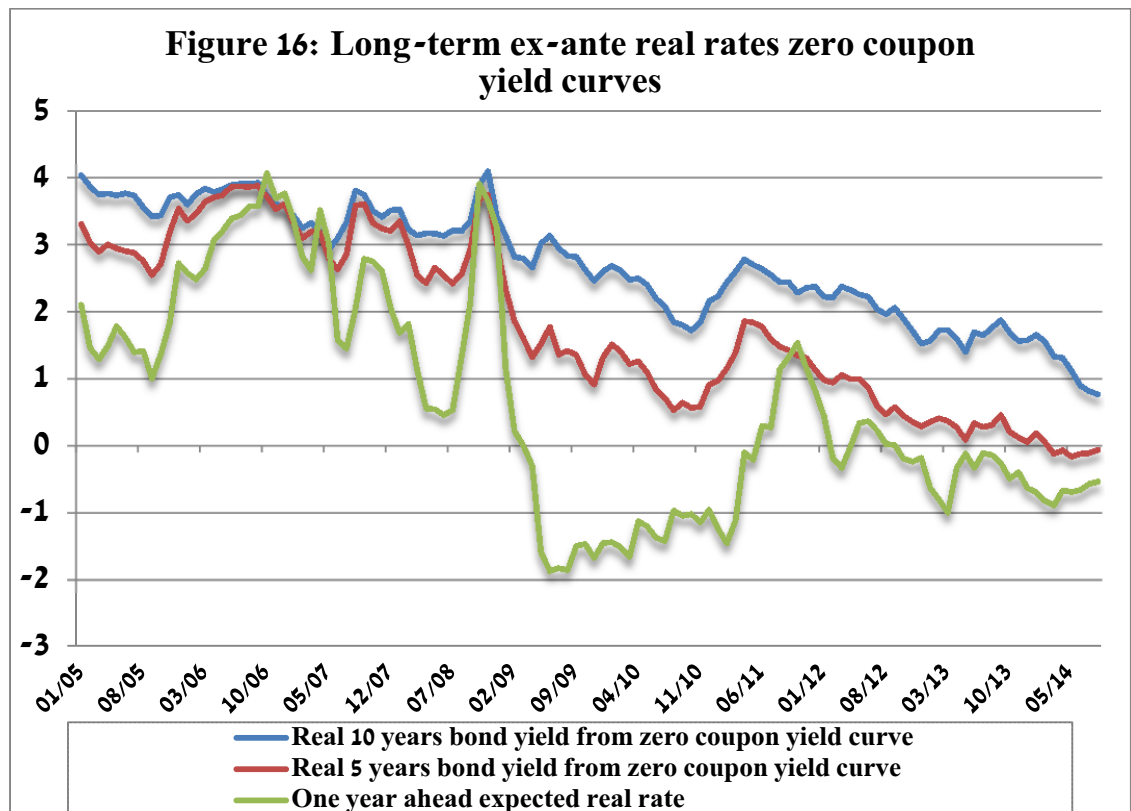


Figure 15 documents this process. The first five-year Shahar bond was issued in October 1998, followed by a seven-year bond in July 2000. The first ten-year nominal bond was issued in May 2001 and the first twenty-year bond in November 2006. After ten years of price stability the Israeli treasury even issued a thirty-year bond in January 2012. Figure 15 shows the yield curves on the dates of first issues of successively longer term nominal government bonds and their yields to maturity on the day of issue.

The figure highlights the fact that as inflation abated and Israel achieved price stability, nominal yield curves went down dramatically. There is little doubt that the bulk of the decline during the ten years starting in the mid-1990s was due to the achievement

of price stability, particularly the tight anchoring of inflation expectations after 2003. The long-term commitment to gradually reduce the debt/GDP ratio reinforced this tendency. The lowest yield curve in Figure 15 that occurs in January 2012, also reflects the impact of very low world interest rates since the onset of the financial crisis.

Since the sustained reduction in yield curves was accompanied by a decline in inflation expectations, the information above is mute about what happened to long-term real rates. Figure 16 provides information on the evolution of the ex-ante real rates on 10-year and 5-year Shahar bonds and on the one-year *makam* since the beginning of 2005. It is apparent that, excluding two upward bulges (one following Lehman's downfall and the other during the buildup period to the first Greek rescue package) both long- and short-term real rates are on a downward trend. This trend brought the five- and ten-year ex-ante real rates to zero and one percent respectively in the summer of 2014. Those are the lowest real rates the Israeli treasury ever faced since statehood. They reflect mainly the achievement of price stability. A degree of fiscal conservatism along with the impact of extremely low world rates since the GFC also contributed to this trend.



One measure of the Israeli government's risk premium is the spread between the 10-year Shahar bond and the 10-year US Treasury Bond. Figure 17 shows the evolution of this spread between 2001 and 2015. The spread reached a peak of about 8 percent during the 2001–2003 recession and Intifada, and two lower peaks after Lehman's downfall and during the first Greek default in 2012. The spread has been on a downward trend since then and is currently in the vicinity of zero. In interpreting the spread, it should be kept in mind that it may also reflect expectations of appreciation of the shekel. A measure that purges those expectations would involve a comparison of dollar-denominated Israeli government bonds with their US counterparts.

**Figure 17: Spread between 10-year Shahar bond yields and 10-year US Treasury Bill yields**



## 12. The impact of the Global Financial Crisis (GFC) on monetary policy and institutions

The position of the Israeli economy at the outbreak of the GFC was strong: The economy was growing at a rate of over 5 percent per year, the unemployment rate was slightly above 7 percent and declining rapidly, the 2007 government budget was balanced, there was a surplus in the current account and the rate of inflation was near the midpoint of the IT range. Lehman's collapse had a strong impact on local financial markets, particularly the stock market, which experienced a sharp decline. The Bank of Israel reacted rapidly with a sharp reduction in the policy rate.<sup>54</sup> Against the backdrop of a strong trend of shekel strengthening, the Bank intervened in the foreign exchange market and bought some 40 billion US dollars between 2008 and 2011. This roughly

<sup>54</sup> The Bank of Israel was one of the first Central Banks to act.

doubled Israel's foreign exchange reserves, which were initially low by current international standards. Given the severity of the threat posed by the GFC to the real economy, the government prepared a number of policy measures to aid the business sector. Implementation turned out to be limited as the measures were not needed, but the clear signal by the government contributed significantly to maintaining confidence in the economy. The initial strong position of the economy and the rapid intervention of the BOI and the government made the Israeli recession in 2009 milder and shorter than that of other Western economies, and by mid-2009 growth was restored.

In spite of the fact that financial stability is last among the BOI's goals in the new 2010 law, the GFC elevated the actual importance of this goal in comparison to the goal of price stability, with particular emphasis on issues of systemic risk. Cooperation between regulatory agencies was identified as an important issue in policy-making. But no major structural changes have been adopted to date in this area.

The relative strength of the Israeli economy resulted in continuous appreciation pressures on the shekel. These pressures were addressed by continuous reductions in the policy rate, which partially mitigated them. But, in parallel, this policy reinforced the rise in housing prices that started to develop in 2007. This dilemma has been a central issue in monetary policy in recent years and is discussed further in the next section. The Bank was driven, by world developments, to the vicinity of the zero lower bound on its key policy rate, and has been relying on macro-prudential instruments to deal with increased risk in the home mortgage market.

Additional measures like quantitative easing, which were adopted in the US and Europe, were considered by the BOI but have not been used to this point.

### **13. Current policy dilemmas and some open issues**

The persistent shift from deficits to surpluses in the balance of goods and services, the decrease in Israel's risk premium, the fact that the growth rate during the last decades has consistently surpassed the growth rate of Israel's major trading partners, a substantial flow of exits by start-up companies in the high technology sectors, and the natural gas discovery created pressures for appreciation of the shekel in the foreign exchange (forex) market. By historical standards this phenomenon, which started in 2007, was new for Israel. Until then pressures on the exchange rate (ER), if any, were usually toward depreciation. The sustained pressure toward appreciation since 2007 was reinforced in the following years by the US subprime crisis, the sovereign debt crisis in Europe, and the stamp of economic maturity and financial respectability bestowed on Israel by its admission to the OECD in 2010.

Israel is a highly open small economy with strong dependence on foreign trade. Its forex market is small in comparison to world forex markets. As a consequence, short- and medium-term capital flows motivated by developments abroad, interest rate differentials and geopolitical events, even if small by world standards, have substantial effects on the effective ER. This, along with the fact that inflation differentials between Israel and its major trading partners are negligible implies that capital flow-induced changes in the ER may translate into substantial fluctuations in the real ER. This is rather

disruptive for foreign trade in general and for the competitiveness and viability of Israeli exports and employment.

Since 2008, the BOI has been using various combinations of interest rate policy and direct interventions in the forex market to iron out excessive fluctuations in the ER and to lean against overvaluation of the shekel relative to an equilibrium exchange rate determined by long-run fundamental factors. Although the principle underlying such policies is sound, its practical implementation is complicated by substantial uncertainty about the current as well as the future equilibrium exchange rate.

Making a strong public commitment to maintain the nominal exchange rate within a certain range is likely to have a substantial impact on financial markets and, through them, on the actual exchange rate. On the other hand, the credibility loss of renegeing on a strong commitment, when either domestic or foreign circumstances change sufficiently, is normally larger than abandoning a more moderate commitment. The January 2015 abandonment of the floor on the ER between the Swiss franc and the euro by the Swiss National Bank after the announcement of a second large quantitative easing program by the ECB is a case in point. It is therefore likely that the optimal degree of commitment to limit ER fluctuations is internal in the sense that it is maintained for sufficiently mild unexpected developments but abandoned in the face of sufficiently large unexpected events.

Cukierman, Kiguel and Liviatan (1994) discuss some of the factors that determine the optimal degree of commitment. Experience shows that the relative importance of those factors changes over time, supporting the view that the central bank should be endowed with sufficient discretion to tighten or loosen the strength of ER commitment when circumstances change. Since the last quarter of 2008, the Fed policy rate has been in the vicinity of the zero lower bound and the refinancing rate of the ECB reached this territory during the last quarter of 2014. By persistently widening the interest rate differential between the BOI policy rate and those of its major trading partners, those low rates generated excess demand for the shekel and eventually forced the BOI to, reluctantly, reduce its policy rate and to occasionally intervene in the forex market.

Between mid-2008 and the end of 2009 the BOI intervened massively in the forex market. Details on this episode appear in Flug and Shpitzer (2013). Sorezcky (2010, reprinted in this volume) shows that, relative to a no intervention state, the intervention managed to maintain the ER at about a ten percent more depreciated level for about a year on average. Besides prevention of over-appreciation, the intervention achieved the additional objective of raising Israel's forex reserves, which were too low at the time in light of Israel's import needs, foreign obligations and geopolitical situation.

Since then the BOI intervened on a systematic basis only to offset the impact of gas discoveries on the forex market, and occasionally to offset wide short-term fluctuations in the forex market. The cumulative impact of all the interventions since 2008 was to roughly double Israel's forex reserves as a percentage of GDP between 2008 and March 2015 (from 15 percent to 29 percent). Although the current figure is still below the BOI's current upper bound for the optimal range of reserves, the difference between this upper bound and the actual level of reserves is smaller than it was in 2008. It therefore appears that there is currently less leeway for direct interventions. On the other hand, a current smaller level of intervention is likely to have a stronger impact on the ER

since, the spreads between the BOI policy rate and those of the Fed and the ECB are substantially smaller than they were in 2008/2009.

Since roughly the beginning of 2014 inflation has been lower than the lower bound of the inflation target range. During the last year it even was mostly in negative territory, though due primarily to supply shocks that are expected to have a temporary effect on inflation. As a consequence the traditional tradeoff between using monetary policy to curb inflation and to stimulate economic activity virtually disappeared. The Bank was therefore freer to use interest rate policy to maintain reasonable levels of economic activity and of foreign trade competitiveness.

However, since 2007 the prices of real estate have been climbing rapidly. Although the 2010 Bank of Israel Law does not charge it with the maintenance of stable real estate prices, the Bank is concerned with rapid increases in those prices for two reasons. First the associated substantial increases in mortgage borrowing will present a potential risk to financial stability when world and domestic interest rates eventually start to rise. Second, although it is not directly in charge of equity in the distribution of wealth, the Bank cannot turn a complete blind eye to the adverse distributional consequences of sustained increases in housing prices for distributional equity reasons.<sup>55</sup> As a consequence, although there is currently no policy tradeoff between attaining the IT range and economic activity, there is a current tradeoff between the prevention of overvaluation in the forex market and prevention of overheating in the real estate market. The severity of this tradeoff has been partially alleviated by the Supervisor of Banks' issuance of various macro-prudential restrictions on mortgage borrowing, but some policy tradeoff remains.

The recent emergence of negative inflation rates raised an issue that has been dormant during the entire existence of the BOI: Given the state of the real economy, should the Bank lean against inflation rates below the lower bound of the IT range with the same determination and speed that it applies to lean against inflation when the latter is above the upper bound of the target range?

To provide a tentative answer to this question we note that most micro-based distributions of nominal wage changes show that those distributions possess a positive asymmetry around zero supporting the view that there is downward wage stickiness. One of many examples appears in Figure 18. Given the fact that wages (and therefore prices if firms maintain their markups) are more likely to increase than to decrease it would appear that the Bank should respond more vigorously, and possibly more quickly, to upward than to downward deviations from the target range. Since, under the current law, the Bank is endowed with some discretion to choose both the speed and the intensity of leaning against inflation those response differences can obviously be accommodated within the framework of the existing IT system.

An important current practical question concerns the conceptualization of potential output. In view of the sustained decrease in world demand for imports following the GFC, this issue is currently particularly relevant. There are at least two possible answers to this question. One is that potential output should reflect the output that can be produced given efficient use of available technology and factors of production independent of the state of aggregate demand. The other is that, in view of the persistent

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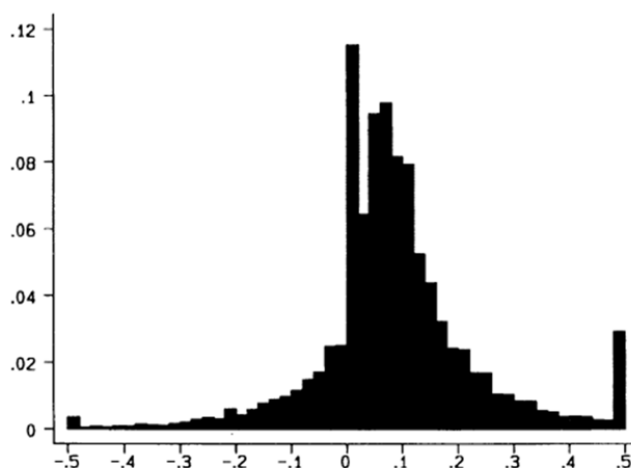
<sup>55</sup> Support for equity in the distribution of income, but not wealth, appears as a subsidiary objective in the 2010 BOI charter.



decline in world trade and the high openness of the economy, the definition of potential output should be adjusted for the state of world demand.

Although we do not have a clear unified position on this issue, we think that, for purposes of short- and medium-run monetary policies, the second concept is more relevant. This consideration is particularly relevant in view of the fact that the current interest rate is so close to the zero bound. However, for the purpose of longer-term structural policies including new markets penetration the first concept should also be considered.

**Figure 18:**  
**Distribution of annual percentage change in pay**  
**from micro data: US 1970–1988**



Source: Kahn (1997), Figure 1

#### **14. Israeli and world inflation: A bird's eye view**

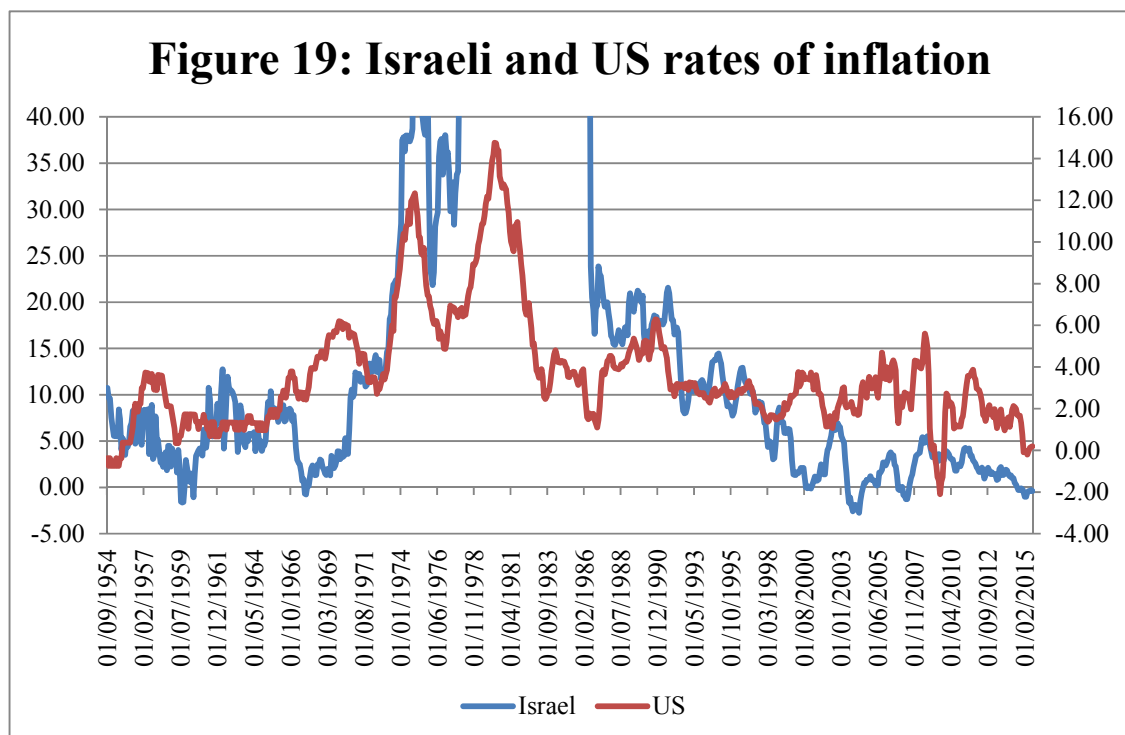
Israel is a small and very open economy. Consequently domestic prices are strongly affected by world prices. The relation is both direct, through the link of prices of imported finished products to the consumer price index, and indirect, through the impact of prices of imported raw materials and other production inputs on domestic costs.<sup>56</sup> Figure 19 shows the relation between Israeli inflation and world inflation, proxied here by US inflation over the sixty-one years since the creation of the Bank of Israel (1954–2015).<sup>57</sup> The correlation between Israeli and US inflation is 0.31 and is statistically different from zero with a t-statistic of 8.86.

<sup>56</sup> The indirect link is particularly important since domestic production is highly dependent on imported raw materials.

<sup>57</sup> In order to highlight the correlation between the Israeli and the US rates of inflation the former is measured on the left vertical axis and the latter on the right vertical axis. This scale adjustment can

Figure 19 highlights several episodes during which the positive correlation between world inflation and Israeli inflation is visible to the naked eye. Among those are the first and the second oil price shocks (in 1973 and 1979 respectively), and the decline in US inflation in the early 1990s. This decline probably facilitated the transition to the second post-1985 inflation step in Israel. By contrast the transition to the third post-stabilization step that started the price stability era in the late 1990s, occurred against the background of rising world inflation. The very low, close to zero, and even negative inflation over 2014–2015 appears to be directly related to the very low and even negative world inflation rate.

But Figure 19 also shows time periods over which Israeli inflation is due mainly to idiosyncratic factors unrelated to world inflation. An early instance is the decline of inflation during 1966–67 that was largely due to a domestically generated recession. The figure clearly shows that this deceleration of domestic inflation is negatively correlated with the acceleration of world inflation over that period. It is also evident that the triple-digit inflation sub-period is a purely Israeli phenomenon since the rate of inflation in the US was declining at the time. Finally, the sharp decline in US inflation in the aftermath of Lehman's collapse is another example of a negative correlation between domestic and world inflation: US inflation experienced a sharp downward idiosyncratic shock that was not transmitted to domestic inflation.



highlight a potential correlation between those two rates in spite of substantial differences in levels during the first five inflationary periods.

## 15. Concluding remarks

High and persistent inflation inflicts various costs on the economy, the best known of which is Friedman's "shoe leather cost"—a euphemism for the amount of time and other resources used up by individual attempts to economize on the use of money when inflation is high. But, as the Israeli experience shows this is only the tip of the iceberg. High inflation is associated with high levels of inflation uncertainty, of inflation variability and of relative price variability (Sections 6, 2 and 9 respectively) making it difficult to distinguish changes in relative prices from changes in the general level of prices.

Higher inflation uncertainty raises the difference between actual and full-information output, and induces larger errors in the optimal allocation of resources across different goods and activities.<sup>58</sup> Stated differently, an important benefit of price stability is that those social costs are avoided. In addition, price stability is associated with a lower pass-through coefficient from the nominal exchange rate to domestic prices (Section 7). This provides a lever for affecting the real exchange rate and employment by means of monetary policy. By contrast, under high inflation and the associated high pass-through coefficient, nominal depreciations have minor impacts on real variables and undesirable swift impacts on domestic inflation. Persistent inflation leads to the evolution of dollarization even in non-tradable sectors of the economy. As shown in Section 8, dollarization raises the pass-through coefficient and, once established, is quite persistent.

A stable price level environment also contributes to the establishment of more powerful policy instruments in both the fiscal and monetary policy areas. Reducing the cost of borrowing to government (Section 11) reduces the cost of providing public goods and raises social welfare. Inducing tight anchoring of inflation expectations to the target (Section 5) enables the central bank to maintain inflation within the target range at lower costs in terms of the output gap. In summary, price stability is a public good with numerous advantages.

Although the statistical test used to determine the beginning of the of price stability period places it in January 1999, we find that full anchoring of inflation expectations to the target is established only from April 2003 onward (Section 5). This result is consistent with the view that reputation for delivering the target is not achieved instantaneously. The CB needs to demonstrate its willingness and ability to deliver the target for some time before expectations become tightly anchored to the target.

How transparent should the central bank be about its *modus operandi*, its objectives, its model(s) of the economy and its forecasts? There are different views about the desirable level of transparency.<sup>59</sup> Those views differ across issues as well as across individuals. A practical impediment to full transparency is that in countries like Israel, in which monetary policy is decided by a committee, a consensus need not exist between decision makers about those issues. Most academics and policymakers would probably agree that transparency is desirable up to a point. One conclusion from this paper (Section 5) is that clear formulation of inflation targets along with reasonable adherence to them contributes a lot to the anchoring of inflation expectations. Since tight anchoring

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<sup>58</sup> Barro (1976) and Cukierman (1983).

<sup>59</sup> A survey appears *inter alia* in Cukierman (2009).

of expectations reduces the cost of maintaining inflation within the target range, this is a desirable feature.

However, immediate publication of detailed central bank (CB) minutes may be counterproductive. The main problem is that the CB operates within an uncertain environment and its forecasts and pronouncements are conditioned on the information and analysis available to its policymakers at a particular point in time. Forecasts and views obviously change with the arrival of new information. Since the arrival of information is generally continuous, this begs the question of how often the CB should communicate a change in its views on the economy to the public. An overly high frequency of communications is likely to reduce the public's attention span and to even confuse large segments of the population. The US Federal Reserve's recent bumpy experience with forward guidance provides an illustration of the misunderstandings that may arise between the CB and the financial community when the latter insists on communicating its vision of the future at a particular point in time.

Along with other structural changes described in Section 10, price stability bestowed several important benefits on the Israeli economy. Israel managed to maintain a growth rate somewhat above those of its main trading partners both before and after the GFC. Its credit rating gradually increased, the risk premium on Israeli government bonds is currently at an historic low, and inflation expectations are well-anchored.

But new challenges have emerged in the monetary policy arena. Due to its relatively stable performance, the discovery of natural gas, and the zero lower bound cum QE policies of its main trading partners, Israel has been attracting non-negligible capital inflows that maintain the exchange rate at a relatively appreciated level. This is reducing the competitiveness of exports and, with it, employment and the rate of growth of the economy.

In 2007/2008 the BOI reacted to those developments by means of massive interventions in the forex market. At the time this policy was desirable not only because it helped maintain the competitiveness of exports, but also because it increased forex reserves which were low relative to Israel's precautionary needs. More recently, with the growth of forex reserves, direct interventions were sized down and became less frequent. In parallel, the bank relied more on interest rate policy to stem the appreciation tide. As a consequence, between October 2011 and September 2015 the policy rate went down from 3.25% to 0.10%. To a large extent the extremely expansionary monetary policies of the Fed, and more recently of the ECB, induced the BOI to reduce its policy rate to the (current) vicinity of the zero lower bound.

Since inflation has been very low for some time, and recently even negative, this policy is not subject to the traditional tradeoff between the output and the inflation gaps. The reason is that, under current conditions, expansionary monetary policy reduces the absolute values of both gaps. But the low interest rate policy of the Bank reinforces the boom and the associated price increases in the housing market and in the capital market.<sup>60</sup> Since these developments are undesirable for both financial stability and equity reasons the Supervisor of Banks imposed, in parallel, various restrictions on mortgage borrowing.

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<sup>60</sup> Most likely, those booms were triggered in the first place by the decrease in long-term interest rates that responded to the world's very low rates. Our gut feeling is that, although it contributed to those price increases, the BOI's low short-term interest rate policy was a secondary factor. But a better informed answer to this question must await detailed empirical work.

In summary, although monetary policy does not currently face a tradeoff between economic activity and inflation, the Bank's low interest rate policy operates along a (nontraditional) tradeoff between high employment and financial stability in the real estate and capital markets.

Israel's path to price stability was long and arduous. We hope that, if nothing else, the multidimensional contrast between the five inflationary decades and the last ten to fifteen years recounted in this paper will convince the reader that price stability is a precious public good well worth preserving

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