Macroeconomic and Labor Market Impact of Russian Immigration in Israel[*]

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Abstract

From the end of 1989 to 1997, over 710 thousand Russian Jews emigrated to Israel, increasing Israel's working-age population by 15 percent. This paper argues that a canonical one-sector neoclassical growth model explains both the short run and the medium run response of Israel's economy to this shock. Specifically, we show that *average* effective wages of native Israelis fell and the return to capital increased during the height of the influx in 1990 and 1991. By 1997 however, both average wages and the return to capital had returned to pre-immigration levels due to an investment boom induced by the initial increase in the return to capital. As predicted by an intertemporal model of the current account, the investment boom was largely financed by external borrowing. Furthermore, despite the high educational levels of the Russian immigrants, the Russian influx did not lower the skill-premia of native Israelis. We show that this result is not explained by Rybczynski-type output composition changes but because the Russian immigrants suffered from substantial occupational downgrading in Israel and thus did not change the relative supply of skilled workers in Israel.

I. Introduction

In the last few months of 1989, the former Soviet Union lifted emigration restrictions on its Jewish citizens. This policy change, along with changes in U.S. immigration policy that made it more difficult for Jews from the former Soviet Union to emigrate to the US, precipitated one of the largest immigration inflows in Israel's history. From 1990 to 1997, over 710 thousand Russians emigrated to Israel, increasing its working-age population by more than 15 percent (see Figure 1). At the peak of the immigration influx in 1990 and 1991, over 330 thousand Russian Jews emigrated to Israel, increasing Israel's working-age population by 8 percent in two years. This large and exogenous immigration inflow represented a shock to Israel's factor endowments in two dimensions. First, the inflow of Russian immigrants lowered Israel's aggregate capital-labor ratio. Second, in addition to its size and exogenous nature, another unique aspect of the Russian immigration was that many of the Russian immigrants were highly educated. About 60 percent of the Russian immigrants were college-educated, compared with only 30 to 40 percent of native Israelis (see Table 1). Therefore, in addition to lowering the capital-labor ratio, this immigration inflow also potentially increased the relative supply of skilled workers in Israel.

The impact of this factor endowment shock on Israel's economy can be broadly grouped into short run and medium run effects. First, a conventional neoclassical growth model predicts that an increase in the aggregate labor endowment will lower the capital-labor ratio, raising interest rates and lowering wages in the short run. In addition, if the influx of educated Russians also increased the relative supply of skilled workers in Israel, we would also expect the skill-premia of native Israeli workers to fall in the short run.

It is, however, less clear how an economy would adjust to a large factor endowment shock in the medium run. We can think of four adjustment mechanisms. First, many people have argued that migration of native workers from regions that receive large inflows of immigrants dissipate the effect of immigration on local labor markets.[1] This is not as important in the case of Israel since it is more difficult to emigrate between countries than between regions within the same country. Second, in

[1] See Borjas, Freeman, and Katz (1997).

a conventional neoclassical growth model, the initial increase in interest rates will stimulate an investment boom which, over time, can offset the impact of an increase in a country's labor endowment on real wages.[2] A third mechanism, based on the Rybczynski theorem from international trade, is that in a multi-sectoral model, a change in a country's relative factor endowments can be absorbed by a reallocation of resources between sectors which utilize the factors in different intensities without affecting relative factor prices.[3] A final possibility is that changes in relative factor endowments may stimulate technological change biased towards the more abundant factor, which would mitigate the impact of the relative factor endowment shock on relative factor prices.[4]

Our objective in this paper is to examine the mechanisms through which the Israeli economy adjusted to the Russian immigration shock. The main finding is that a conventional one-sector neoclassical model does a remarkable job in explaining both the short run and the medium run response of the Israeli economy to the Russian immigration.[5] We show that average effective wages of native Israelis fell by 20 percent and real interest rates increased sharply during the peak of the Russian immigration in 1990-1991. The initial rise in interest rates led to an investment boom from 1990 to 1994 that was largely financed by external borrowing. In turn, the investment boom triggered by the immigration influx led to a gradual recovery of real wages after 1991 and decline in real interest rates after 1994. By 1997, real wages

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[2] Brezis and Krugman (1996) made the same point about Israel.

[3] Hanson and Slaughter (1998) and Gandal, Hanson, and Slaughter (1999) have suggested that output composition changes can explain how relative wages can remain unchanged despite large changes in relative labor supplies.

[4] See Acemoglu (1998, 1999).

[5] In work contemporaneous to ours, Blanchard and Zeira (2000) also analyze the macroeconomic effect of Russian immigration in Israel. They reach a similar conclusion that a neoclassical model explains the response of Israel's economy to this influx. There are, however, a number of important differences between their work and ours. First, Blanchard and Zeira use VARs instead of simulations (as we do in this paper) to analyze the macroeconomic effects of Russian immigration in Israel. In addition, we analyze the effect of the Russian immigration on relative wages and other labor market outcomes of native workers as well as on average wages of native Israelis.

and interest rates had returned to their pre-immigration levels. To assess the plausibility of a story of induced capital accumulation, we calibrate the response of a one-sector neoclassical growth model with standard labor and capital adjustment costs to an exogenous increase in its labor endowment. We show that the model does a remarkable job in matching the actual patterns of real wages, the return to capital, investment spending, and the current account in Israel.

In contrast to the pattern of average wages, we find no evidence that the Russian immigration exerted downward pressure on the skill-premia of native Israelis. To examine whether Rybczynski-type output composition changes may have dissipated the impact of an increase in the relative supply of educated workers on the skill-premia of native workers, we use a standard decomposition of changes in the relative utilization of educated workers into relative utilization changes within industries and shifts due to the reallocation of labor between industries of different skill intensities. We find that the Russian immigrants were absorbed into the Israeli labor market by an increase in the relative utilization of educated Russian immigrants within all industries, with little due to shifts in output composition. Based on this evidence, we conclude that output composition changes do not explain why the Russian immigration did not lower the skill-premia of native Israelis.[6]

There are two explanations for this finding. First, an increase in the rate of skill-biased technical change (SBTC), perhaps induced by the immigration influx along the lines of Acemoglu's (1998, 1999) models, may have offsetted the effect of the Russian immigrants on relative wages on native Israelis. For example, Gandal, Hanson, and Slaughter (1999) argue that an increase in the rate of SBTC swamped the negative effect of the Russian immigration on the skill-premium in Israel.[7] A second explanation is that despite their high levels of education, the Russian immigrants were poor substitutes for skilled native Israelis and thus did not affect the relative supply of

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[6] In related contemporaneous work, Gandal, Hanson, and Slaughter (1999) reach a similar conclusion using a decomposition of changes in factor endowments into related decomposition of changes in factor employment into components due to changes in production techniques and changes in output composition.

[7] Gandal, Hanson, and Slaughter (1999), however, argue that the increase in the rate of SBTC was due to an increase in *worldwide* rates of SBTC rather than to an increase in the rate of SBTC specific to Israel.

skilled workers in Israel. To discriminate between these alternative explanations, we use the industry and occupational distribution of the Russian immigrants and of native Israelis to estimate the degree of labor market competition between these two groups. These measures indicate that the Russian immigrants suffered from substantial occupational downgrading in the Israeli labor market and thus did not represent an increase in the labor supply experienced by skilled native Israelis. We therefore conclude that the native skill-premia has remained unchanged simply because the relative supply of skilled workers in Israel was not affected by the influx of Russian immigrants.

This paper thus contributes to the large body of literature on the impact of immigration on labor market outcomes of native workers.[8] In previous work on the impact of the Russian immigration on Israel, Friedberg (1998) found that the relative growth rate of wages of native Israelis in occupations that received more Russian immigrants fell from 1989 to 1994. However, after using the occupational distribution of Russian Jews in the former Soviet Union as an instrument to control for the possible endogeneity of occupational selection by the immigrants, she finds little evidence of occupational wage pressures on native Israelis. This paper differs from Friedberg's work in that we analyze the impact of the Russian immigration on *educational* wage differentials rather than on *occupational* wage differentials since occupational choices are endogenous and difficult to instrument for.[9] In addition, we attempt to discriminate between several explanations for why the Russian immigrants did not affect the wage distribution among native Israelis.

We view the main value-added of this paper, however, as focusing on the impact of an exogenous increase in a country's labor endowment on *average* wages and the return to capital and on the response of aggregate investment and other macroeconomic variables to changes in factor prices. In addition, we examine how the response of these macroeconomic variables to the Russian influx over the medium

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[8] See Borjas (1994) and Friedberg and Hunt (1995) for comprehensive reviews of this literature.

[9] As we will show later in this paper, the Russian immigrants suffered from substantial occupational downgrading in the Israeli labor market. Therefore, the occupational distribution of the Russian immigrants in the former Soviet Union is a poor instrument for their occupations in Israel.

run feeds back into the labor market. More precisely, one of our central points is that the endogenous response of capital accumulation to a labor endowment shock can offset a significant part of the initial adverse effect of immigration on native wages. Our broader point is that a minimalist one-sector neoclassical growth model performs quite well in explaining the macroeconomic adjustment of the Israeli economy to an exogenous factor endowment shock.

The paper proceeds as follows. Section II provides descriptive statistics on the size of the Russian immigration inflow and on the educational and occupation distribution of the Russian immigrants. Section III analyzes the trends in wages, labor force participation rates, and unemployment rates of native (non-Russian) Israelis, Palestinians, and the Russian immigrants. Section IV assesses whether the Russian immigrants appeared to have no effect on native relative wages due to output composition changes or whether they simply increased the supply of all skill groups proportionately and thus did not affect the relative supply of skilled workers in Israel. Section V turns to explanations for the behavior of average wages by presenting data on the return to capital, the investment rate, and the current account in Israel and calibrates a standard neoclassical growth model with capital and labor adjustment costs to show how such model can account for response of Israel's macro-economy to the Russian immigration. Section VI concludes.

II. The Russian Immigration[10]

In last few months of 1989, due to the Soviet Union's elimination of emigration restrictions on its Jewish citizens, a large number of Jews from the former Soviet Union began to emigrate to Israel. By 1997, more than 710 thousand Russian Jews had settled in Israel, increasing the working-age population in Israel by more than 15 percent (see Figure 1). At the peak of the immigration wave in 1990 and 1991, over 330 thousand Russian Jews emigrated to Israel, increasing Israel's potential labor force by 8 percent in two years. In addition to its size and exogenous nature, another unique aspect of the Russian influx was that many of the immigrants

[10] Unless otherwise stated, the data in Sections II and III are based on the micro data from the Israeli *Income Surveys* and *Labor Force Surveys* from 1980 to 1997. See the appendix for additional details on these datasets.

were highly educated. About 60 percent of the Russian immigrants who arrived in Israel between 1989-1990 were college-educated and almost one-fourth were college graduates. In contrast, only about 30 percent of the native Israeli Jews in 1990 were college educated, and 12 percent were college graduates (see panel A in Table 1). Among the 258 thousand Russians with work experience in the former Soviet Union who had emigrated to Israel from 1990 to 1993, 57 thousand had worked as engineers and 12 thousand as medical doctors. In contrast, there were only 30 thousand engineers and 15 thousand medical doctors in Israel in 1989.[11]

Not surprisingly, the majority of the Russian immigrants were unemployed upon their arrival in Israel. In 1990, only 32 percent of the Russian men and 19 percent of the women participated in the labor market (see Table 2).[12] And among those who were in the labor force, 40 percent of the men and 53 percent of the women were unemployed (see Table 3). However, the Russian immigrants were quickly absorbed into the Israeli labor market over the next two years. By 1992, their labor force participation rate was virtually identical to that of native Israelis.[13] The unemployment rate of the Russian immigrants also dropped substantially after 1990, albeit more slowly than the increase in the labor force participation rate (see Table 3). The unemployment rate of male Russian immigrants fell from 41 percent in 1990 to 7 percent in 1995 and that of females fell from 53 percent to 12 percent over the same five years.

Despite their high levels of education, most of the Russian immigrants who managed to find work immediately upon their arrival in Israel were predominantly employed in low-skilled occupations. Panel B in Table 1 presents the occupational

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[11] Eckstein and Weiss (1999), p. 2.

[12] The unemployed Russian immigrants were supported by an "absorption package" consisting of monthly cash payments, rent subsidies and other non-monetary benefits provided by the Israeli government.

[13] Tables 2 and 3 presents the labor force participation and unemployment rates for *all* Russian immigrants, and does not distinguish between the Russians who arrived in the first wave (in 1990 and 1991) of immigrants and those who arrived in later years. The aggregate labor force participation and unemployment rate of all Russian immigrants thus understates the extent to which the labor force outcomes of the Russian immigrants have converged to that of native Israelis.

distribution of the Russian immigrants, as well as that of native Israeli Jews and native non-Jewish Israelis (mostly Israeli Arabs). In 1990, more than one-half of the Russian immigrants who were employed worked in manufacturing or construction jobs or as unskilled manual workers[14] In fact, the occupational distribution of the Russian immigrants in 1990 is similar to that of native non-Jewish Israelis who have much lower levels of education. In contrast, only about one-fourth of native Israeli Jewish workers were employed in these low-skilled occupations.

However, over the next few years, the Russian immigrants have been able to upgrade their occupations and find jobs that are a better match for their skills. The fraction of Russian Jews working in manufacturing or construction jobs or as unskilled manual workers fell from 54 percent in 1990 to 41 percent in 1997 (see Panel B in Table 1). The proportion of the Russian immigrants working in the manufacturing sector fell from 47 percent in 1990 to 35 percent in 1997 (see Panel C in Table 1). Consequently, their real wage grew rapidly after their arrival in Israel (see Panel A in Table 4). Real hourly wages of male Russian immigrants grew at an average annual rate of 4.2 percent from 1992 to 1997. Real wage growth for female Russian immigrants was even higher, averaging 5.9 percent per year over the same time period. In addition, educated Russians experienced faster wage growth than their less-educated counterparts (see Panel B in Table 4), which provides additional evidence that the Russian immigrants were able to upgrade their occupations over time.[15]

Nonetheless, even after a few years in Israel, the Russian immigrants were still largely employed in low-skilled industries and occupations, at least relative to their occupations in the former Soviet Union and their level of education. One way to measure the extent of this occupational downgrading is to compare the occupational distribution of the Russian immigrants in the Israeli labor market with their occupational distribution in the former Soviet Union. Figure 2, which replicates figure 6 in Friedberg's (1998) paper, presents a scatterplot of the number of Russian

[14] Our sample of immigrants in 1990 is relatively small.

[15] Eckstein and Weiss (1998, 1999) show that the returns to education and experience of the Russian immigrants increase with time in the Israeli labor market, and that this increase accounts for roughly one-half of the average real wage growth among the Russian immigrants.

immigrants in a given occupation in Israel in 1994 (relative to the number of native Israelis in the occupation) with their prior occupation in the former Soviet Union. If all the Russian immigrants worked in the same occupation in Israel in which they were employed when they lived in the former Soviet Union, all the observations would lie on the 45 degree line. As can be seen, there is virtually no correlation between these two variables: a regression of the occupational distribution of the Russian immigrants in Israel in 1994 on their occupational distribution in the former Soviet Union yields a marginally significant coefficient of 0.2 with an adjusted R-squared of only 0.03.[16] In Section IV of the paper, we will directly measure the extent by which the Russians have able to upgrade their occupations and thus increase the relative supply of skilled workers in Israel.

III. Impact on Labor Market Outcomes of Native Israelis

It is natural to expect that this large exogenous increase in the aggregate labor supply in Israel would have an adverse effect on employment rates and wages of native Israeli workers in the short run. In addition, since the Russian immigrants were highly educated, their absorption into the Israeli labor market may have also affected the skill-premia of native Israeli workers. This section assesses the evidence for these labor market effects among native Israeli workers.

We first analyze the trends in the labor force participation rates of native Israelis. As can be seen in Table 2, there is some evidence that the large initial influx of Russian immigrants in 1990 and 1991 had a small effect on the labor force participation rate of native Jewish Israeli men, which fell from 63 percent in 1989 to 62 percent in 1992.[17] There is, however, no evidence of this effect among native Israeli women (Jew), whose labor force participation rate remained constant from 1989 to 1992 at 47-48 percent, before increasing to roughly 53 percent in 1995-1997.

[16] We used the same data as that used by Friedberg (1998) (the 1989 and 1994 Income and Labor Force Surveys and the 1994 Immigrant Employment Survey) to obtain these estimates. Although our estimates are not identical to those reported by Friedberg (1998, Table 4), they are very close. Specifically, we obtained a coefficient of 0.207 (s.e.: 0.1), compared to Friedberg's reported coefficient of 0.204 (s.e.: 0.102).

[17] Using quarterly data, Hercowitz and Yashiv (2000) found a similar lagged response of labor force participation rates of native Israelis to the Russian immigration influx.

These figures, however, mask sharp differences between native Jews with different levels of educational attainment. There was a sharp decline in the labor force participation rates of less-educated natives in the 1990s, from 57 percent in 1989 to 42 percent in 1997 for native men with less than eight years of schooling, although it is difficult to disentangle how much of this decline was due to the Russian immigrants, and how much was due to pre-existing trends.[18] Similarly, the labor force participation rate of less-educated native Jewish women fell in the 1990s, from 26 percent in 1989 to 18 percent in 1997 for native Jewish women with less than 8 years of schooling.

Turning to unemployment rates, Table 3 shows that the unemployment rate of native Israelis in the early 1990s are higher than that in the late 1980s. However, since the upturn in the unemployment rate began in 1989 (before the arrival of most of the Russian immigrants), the higher unemployment rate can not be attributed solely to the arrival of the Russian immigrants. In contrast to the labor force participation rate, there is little difference in the change in the unemployment rates between natives with different levels of schooling.

While there is little evidence of a significant adverse effect on unemployment rates and labor force participation rates, there is stronger evidence that the Russian influx exerted a larger downward pressure on wages of native Israelis. After a decade in which real wages grew by over 7 percent annually, real wages of Israeli natives declined during the peak of the immigration inflow from 1989 to 1991 (see Panel A in Table 4). This decline was particularly concentrated among native Jewish Israeli men, whose real wages fell by 5.3 percent from 1989 to 1991. Although their wages recovered over the next 6 years, growing at an average rate of 1.9 percent a year for native Jewish Israeli men and 2.3 percent a year for women, this growth rate was substantially lower than the 7 percent growth rate in the 1980s. We see a similar pattern of average wages among the Israeli Arabs, whose wages grew by only 2.3 to 3 percent a year from 1992 to 1997 after growing at an annual rate of 6.5 to 7.8 percent a year in the 1980s.

However, these simple comparisons of growth rates of real wages do not provide a complete picture of the impact of the Russian immigration influx on native

[18] For evidence of this trend, see Weisberg and Meltz (1999).

wages since they do not control for other economic forces that may also have affected wages in Israeli. In particular, there may have been changes in the underlying rate of technological progress that would have also affected wages in Israel. As evidence of this, Figure 3 shows that aggregate labor-augmenting technological progress increased by roughly 13 percent from 1981 to 1987, remained unchanged from 1987 to 1989, increased by roughly 14 percent from 1989 to 1991, and then fell by 11 percent from 1992 to 1997. In the absence of other forces, the productivity boom from 1989 to 1992 should have resulted in an equivalent rise in wages. Similarly, the productivity downturn after 1992 should have led to a fall in average wages.

The standard way to adjust wages for technological progress is to measure wages per unit of *effective* worker. Figure 4 presents estimates of average wages per effective native Israeli worker calculated by combining the index of labor-augmenting technology (shown in Figure 3) with income data from the Israeli *Income Survey*.[19] Due to a moderate decline in average wages and a sharp increase in labor augmenting technology over the same time period from 1989 to 1991, real wages per *effective* worker fell sharply (by roughly 20 percent) over these 2 years. Using alternative estimates of average wages from Israel's National Insurance Institute's administrative records, Figure 5 presents alternative estimates of average effective wages in Israel. Since these figures are averages of effective wages of *all* workers in Israel (including Russian immigrants), they are therefore a biased estimate of wages of native Israeli workers. [20] Nonetheless, they indicate that effective wages fell by 17 percent from 1989 to 1991, which is about the same magnitude as that obtained from the Israeli Income Surveys. Both figures also indicate that after the sharp drop in 1990 and 1991, real wages per effective worker staged a sharp recovery after 1991. According

[19] More precisely, these estimates of average wages are computed from the merged *Israeli Income Survey* and *Labor Force Survey*. The estimates of average wages used in Figure 4 are the coefficients of the year dummies of a pooled regression of log hourly real wages of native Israelis on years of education, a quadratic in experience, country of origin, location of workplace, and dummies for survey quarter. See the appendix for additional details on the construction of this merged dataset.

[20] In addition to being an average of all workers in Israel rather than of natives, the estimates in Figure 5 are also simple averages of wages per worker and do not control for changes in demographic characteristics (in contrast to the estimates in Figure 4).

to these estimates, average effective wages increased by roughly 20 percent between 1992 and 1997, completely recovering all the ground lost from 1989 to 1991.

In addition to having an effect on average wages, it is also natural to expect that the absorption of Russian immigrants in the Israeli labor market would have an effect on relative wages of native Israelis. Since the Russian immigrants are highly educated, the Russian influx should have lowered the skill-premia of native Israelis if the Russians represented an increase in the relative supply of skilled workers in Israel. On the other hand, since the Russian immigrants were employed in low-skilled occupations, the initial effect of the Russian influx may have been to *increase* rather than to lower the skill-premia of native Israelis. Over time, however, as the immigrants acquire local human capital and language skills, they may have been able to upgrade their occupation and thus adversely affect the relative wages of skilled Israeli natives.

To examine these hypotheses, Table 4 (Panel B) presents the growth rates of wages of native Israelis for four educational groups: less than 8 years of schooling, 9-12 years of schooling, 13-15 years of schooling, and more than 16 years of schooling. As can be seen, the immediate effect of the Russian immigration was a small *increase* in the skill-premia of native Israelis. Real wages of native males with an elementary school education (0-8 years of schooling) and with a high school education (9-12 years of schooling) fell by roughly 10 percent from 1989 to 1991. In contrast, real wages *increased* by 4.5 percent for native men with some college education (13-15 years of schooling) and only fell by 3 percent for native men with college degrees (more than 16 years of education). The wage patterns for native Israeli women is similar, although the fall in wages for the two lower educational groups (less than 8 years and 9-12 years of education) is more moderate and the wage decline for the college-educated group is somewhat larger. This evidence suggests that the Russian immigrants affected both ends of the native wage distribution in the short-run. On the one hand, many immigrants downgrade their occupations upon their arrival in Israel and thus lower wages of less-skilled native Israelis. On the other hand, some highly educated immigrants also manage to obtain jobs in high-skilled occupations and thus lower native wages on the upper end of the skill distribution.

Turning to the medium-run effect of the Russian influx on relative wages of native Israelis, there is little evidence that movement of Russian immigrants into

higher skilled occupations adversely affected relative wages of skilled native Israelis. Real wages of native Israelis with college degrees grew at a faster rate from 1992 to 1997 than those of workers from the other three educational groups. However, public sector workers in Israel, the majority of which are college educated, benefited from substantial raises from 1993 to 1996.[21] To control for this, Table 4 presents the growth rate of real wages of workers in the private sector. As can be seen, when we just consider workers in the private sector, there is no evidence of an increase in the skill-premia of native Israelis. Instead, relative wages of educated male native Israelis in the private sector fell from 1992 to 1997, since real wages of (private sector) native male Israelis grew at 1 percent a year while those of college-educated male native Israelis remained constant or fell over this time period.

The main limitation of these simple comparisons of average growth rates is that they do not control for changes in the demographic characteristics of the different educational groups that may also have affected educational wage differentials of native Israelis. To address this possibility, we present estimates of the returns to schooling for native Israelis obtained from a standard wage regression that control for other factors that may have also affected relative wages of native Israelis.[22] These point estimates, along with their 95 percent confidence intervals, are plotted in Figure 6. As can be seen, there is little evidence that the mass migration had a significant adverse affect on the skill premia of native Israeli Jews. The return to education for native Israeli males averaged roughly 9.3 percent in the 1980s and increased slightly to an average of 10 percent in the 1990s, but this increase is not statistically significant. For native females, the returns to schooling in the 1990s (9.3 percent) is virtually identical to that in the 1980s (9.4 percent).[23]

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[21] Real wages for public sector workers increased by 20 percent in real terms from 1993 to 1996, after remaining constant from 1988 to 1993. Bank of Israel's *Annual Report* (1999).

[22] These wage regressions control for a quadratic in experience, country of origin, locality of workplace, and quarterly time-effects.

[23] The estimates in Table 4 and Figure 6 exclude ultra-orthodox Jews (Haredim). Since the number of ultra-orthodox Jews has been increasing over time in Israel (see Berman and Klinov, 2000), the small increase in the skill-premia would be even smaller if the ultra-orthodox Jews were not excluded from our sample.

We have so far focused on the impact of the Russian immigrants on native Israelis. However, there are also a large number of Palestinian workers who commute from the West Bank and the Gaza Strip to Israel on a daily basis to work in low-skilled occupations, mainly in the construction industry. The Russian immigrants may have substituted for these workers and thus adversely affected their wages. In fact, after 1992, the number of Palestinian workers in Israel fell from roughly 10 percent of the labor force in Israel to 3 percent by 1998 (Figure 7). However, this was not due to an adverse shift in the demand for these workers caused by the Russian influx, but rather due to border closures and other restrictions imposed by the Israeli authorities after 1992 due to numerous bus bombings and other security incidents. In addition, these workers were not replaced by Russian immigrants, but by temporary foreign workers from other countries (primarily from Romania, Thailand, and the Philippines) who were permitted to work in Israel after 1993. By 1998, these temporary foreign workers accounted for almost 10 percent of the Israeli labor force.

Another way to examine whether wages of the Palestinian workers fell due to the arrival of the Russian immigrants is to measure the premium Palestinian workers received from working in Israel relative to working in the West Bank and the Gaza Strip. If the Russian immigrants substituted for Palestinian workers, this should have put downward pressure on the premium received by Palestinian workers who work in Israel.[24] Table 5 presents estimates of this premium and the returns to different levels of schooling for Palestinians living in the West Bank and the Gaza Strip.[25] As can be

[24] Angrist (1996) interpreted changes in the wage premium received by Palestinian workers working in Israel since the late 1980s as movements along the demand curve for Palestinian workers in Israel due to border closures imposed by the Israeli authorities. However, as long as the supply curve of Palestinian workers in Israel has remained unchanged since the early 1990s, this premium can also measure movements along the supply curve due to shifts in the demand for Palestinian workers.

[25] These estimates are based on the microdata from the *Territories Labor Force Survey* (TLFS), a representative household survey conducted by the Israeli Central Bureau of Statistics in the West Bank and the Gaza Strip until 1995. The dependent variable is log daily wages. In addition to an indicator variable for work in Israel and for the three educational groups, the independent variables include a quadratic in potential experience, quarterly dummies, and an indicator variable for work in the Gaza Strip.

seen, there is no evidence of a fall in the wage premium Palestinian workers received from working in Israel. If anything, this premium increased from an average of 38 percent in 1988 and 1989 to an average of 52 percent in 1994 and 1995. Finally, as with the native Israelis, there is no evidence of any significant change in the returns to schooling of the Palestinians in the 1990s.[26]

In summary, we find that the Russian immigration had little effect on relative wages of native Israelis, but a large effect on their average wages in 1990 and 1991. However, after 1991, average effective wages of native Israelis grew rapidly and had returned to their pre-immigration levels by 1997. The next two sections turn to alternative explanations for the pattern of relative and average wages of native Israelis after the Russian influx.

IV. Why Have Relative Wages of Native Israelis Remained Unchanged?

There are three explanations for the finding that the Russian immigration had little effect on relative wages in Israel. The first explanation is that changes in output composition, specifically an increase in the relative output (and exports) of sectors that utilize skilled workers more intensively, dissipated the impact of the Russian immigrants on relative wages of native Israelis. A second explanation is that an increase in the rate of skilled biased technical change in Israel in the 1990s masked the impact of the Russian immigrants on the wage distribution of native Israelis. Finally, a third and perhaps the simplest explanation is that educated Russian workers were simply not good substitutes for skilled native Israelis. Clearly, if the Russian immigrants did not change the relative supply of skilled workers in Israel, there is little reason to expect there to be a change in the relative wage among native Israelis. This section assesses the evidence for these three explanations.

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[26] The estimates of returns to education and work in Israel for 1992 are substantially out of line with those from the other years and thus appear to be unreliable. In addition, the estimates of the returns to schooling presented in Table 5 differ slightly from those in Angrist (1995) since our educational groups are constructed to match the classifications in the Israeli *Labor Force Surveys* and are not the same as those used by Angrist (1995). In addition, we ran the wage regression for each year separately (for 1980-1995), while Angrist (1995) reports the results from a pooled regression for 1981-1991.

The simplest way to assess whether output composition changes are important in explaining why relative wages of native Israelis have remained unchanged in the presence of the Russian influx is to decompose the change in the skilled-worker share of the wage bill and employment into changes within industries and shifts due to the reallocation of labor between industries of different skill intensities.[27] This standard "between-within" decomposition is as follows:

$$\Delta P_{jt} = \sum_k \left(\Delta E_{kt} \gamma_{jk}\right) + \sum_k \left(\Delta \gamma_{jkt} E_k\right) = \Delta P_{jt}^b + \Delta P_{jt}^w , \quad (1)$$

where *k* indexes industries, E_{jkt} is the employment of group j in industry *k* in year t as a share of aggregate employment in year t, E_{kt} is total employment in industry *k* in year t, $\gamma_{jkt} \equiv E_{jkt}/E_{kt}$ is group *j*'s share of employment in industry *k* in year t, E_{kt} is the average total employment in industry *k*, and γ_{jk} is group *j*'s average share of employment in industry *k*. The first term (ΔP_{jt}^b) reflects the change in the aggregate proportion of skilled workers due to changes in employment shares between industries that utilize skilled workers in different intensities. The second term (ΔP_{jt}^w) reflects within-industry skill upgrading. If the Russian immigrants were absorbed by an increase in the relative output of sectors that utilize educated workers more intensively, then most of the aggregate increase in the relative employment of educated workers after 1989 should be due to a reallocation of labor across industries.

Table 6 presents the results of this decomposition for the relative employment share of college-educated workers (Panel A) and college graduates (Panel B) for 191 industries (83 in the manufacturing sector). As can be seen, the large increase in the relative employment of educated workers after 1989, both in the aggregate economy and in the manufacturing sector, were primarily due to increases in the relative utilization of skilled workers within individual industries, and not due to the reallocation of labor between industries that utilize skilled workers less intensively to those that are more intensive in skilled workers. This decomposition exercise

[27] In related work done contemporaneously with this paper, Gandal, Hanson, and Slaughter (1999) also measured the extent of changes in sectoral composition in Israel but instead of the decomposition of relative employment into shifts between and within industries that we use in this paper, they decompose changes in factor endowments into components due to changes in production techniques and changes in output composition.

therefore provides no evidence that Rybczynski-type output composition changes explain why the Israeli labor market was able to absorb the Russian immigrants with little effect on relative wages.

Gandal, Hanson, and Slaughter (1999) reach a similar conclusion using a related decomposition of changes in factor employment into components due to changes in production techniques and changes in output composition. They interpret this finding as evidence for an acceleration of skill biased technical change in Israel in the 1990s. In addition, since the sectoral pattern in the rate of skill-biased technical change in Israel is highly correlated with that in the US, they argue that the acceleration of SBTC in Israel is due to increase worldwide rates of SBTC in the 1990s.

However, an alternative explanation for dominant role of changes in the relative utilization of educated workers within specific industries is that the Russian immigrants simply did not represent an increase in the relative supply of skilled workers in Israel. As previously discussed, the Russian immigrants were initially employed in low-skilled occupations and industries. In addition, despite the fact that the Russian immigrants were able to slowly upgrade their occupations, they were still predominantly employed in low-skilled jobs even after several years of working in the Israeli labor market (see Table 1). Eckstein and Weiss (1998, 1999), Weiss, Sauer, and Gotlibovsky (1999), and Friedberg (2000), for example, also provide evidence that immigrants in Israel suffered from substantial occupational downgrading upon their arrival in Israel. Angrist (1995) showed that the large increase in the relative supply of educated Palestinian workers in Israel in the 1980s had no effect on relative wages of native Israelis, presumably because educated Palestinians were not good substitutes for skilled Israelis. If this were also the case for the Russian immigrants, then it would explain both the absence of any sectoral reallocation effect and the constant skill-premia of native Israelis.

The simplest way to assess these competing explanations is to measure the increase in the relative supply of skilled workers in Israel represented by the Russian immigrants. Following Altonji and Card (1991), a more precise way to evaluate the effect of the Russian immigrants on particular native groups is to calculate the overlap in the industry and occupational distribution of the group with that of the immigrants. If the costs of interindustry and occupational mobility are large, the effect of Russian

immigration on native wages will be directly proportional to the average increase in labor supply to the industries and occupations in which Israeli natives are employed. To formalize this measure, let S_{Nj} represent the share of a native group in the j_{th} industry (occupation), let E_j represent the initial level of total employment in industry (occupation) *j*, and let ΔE_j represent the increase in labor supply to the j_{th} industry (occupation) due to the arrival of a total number of immigrants ΔE. The average proportional increase in labor supply experienced by the native group is:

(2) $$\sum_j S_{Nj} \cdot \frac{\Delta E_j}{E_j}.$$

If we define S_{Ij} as the share of immigrants in industry (occupation) *j* and S_j as the share of all workers in industry (occupation) *j*, then the average proportional increase in labor supply experienced by native group N is $\beta\Delta E/E$, where β is an index of the degree of similarity between the industry (occupational) distribution of the Russian immigrants and the particular native group, or:

(3) $$\beta = \sum_j \frac{S_{Nj} \cdot S_{Ij}}{S_j}.$$

More precisely, β measures whether the Russian immigrants increased the labor supply experienced by the native group by more or by less than the aggregate increase in the labor supply represented by the Russian immigrants (roughly 15 percent by 1997).

Based on the occupational and industry distribution of native Israelis and Russian immigrants in 1990-91 and 1996-97, the estimates of β presented in Table 7 confirm the impression that skilled native Israelis are the most isolated from immigrant competition, while less-educated native Israelis are in most direct competition with the Russian immigrants. In columns 3 and 6, we also present estimates of β in 1996-97 for the large cohort of Russian immigrants who arrived in 1990 and 1991. These estimates indicate that while the Russian immigrants were able to upgrade their occupations after a few years of working in Israel, they still did not represent an increase in the labor supply experienced by skilled native Israelis. The estimates of β based on the occupational distribution of natives and Russian immigrants indicate that the Russian immigrants increased the relative supply of *less*-skilled workers, while the values of the index based on the employment distribution

across industries are not far from one, suggesting that the Russian immigrants had roughly proportional effects on the labor market of skilled native Israelis.

V. Induced Capital Accumulation and Average Wages

We now turn to an analysis of the impact of the Russian immigration on average wages in Israel. The sharp downturn in average effective wages of native Israelis in 1990 and 1991 is exactly what one expects out of an outward shift in the labor supply curve in a basic static model of labor supply and demand. Since unions are relatively important in Israel, one may be surprised that the Israeli labor market was flexible enough to allow real wages to fall by as much as it did. There are however, a number of explanations for this. First, there is evidence that the Israeli labor market has become more flexible over the last ten years due to the diminished role of industry and countrywide wage setting in the private sector. The fraction of workers covered under these industry and countrywide wage agreements fell by 70 percent of the Israeli labor market in 1985-1989 to only 30 percent in 1997.[28] The minimum wage, which is relatively high in Israel (roughly one half of the average wage), is also not effectively enforced.[29] Finally, since the inflation rate is relatively high in Israel (e.g., the inflation rate was 17 percent per year during 1989-91), real wages can fall without a decline in nominal wages.

The recovery of average effective wages after 1991 may be due to an outflow of native Israelis, but a plot of the annual growth rate of the native Israeli population provides little evidence of this (Figure 11). The endogenous response of capital accumulation within a basic neoclassical growth model can also provide an alternative explanation for the upturn in average wages after 1991. Specifically, due to labor adjustment costs, the short run effect of an exogenous increase in the labor endowment of a country is a fall in real wages and an increase in the return to capital. This increase in the return to capital does not trigger an infinite investment rate, since there clearly are costs to adjusting the capital stock as well as to changing the number of employed workers. Instead, the investment rate increases and gradually increases the capital-labor ratio. For a small open economy that faces constant exogenous real

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[28] Bank of Israel's *Annual Report*, 1998, p. 119-120.

[29] Bank of Israel's *Annual Report*, 1998, p. 123.

interest rates, this induced capital accumulation continues until the return to capital and real wages return to their original levels. In addition, if households in this small open economy have standard preferences over their lifetime consumption, the capital accumulation should be financed through external borrowing rather than by an increase in domestic savings.

The patterns of the main macroeconomic variables in Israel are in fact remarkably consistent with this story of induced capital accumulation. Figure 8, which presents the return to capital imputed from the Israeli national accounts and the return to equity of firms in the Tel-Aviv Stock Exchange, shows that the return to capital in Israel sharply increased from 1989 to 1992 and slowly fell over the next 5 years. By 1997, the return to capital had returned to its 1989 level. The investment rate in machinery and equipment (as a fraction of the stock of machinery and equipment) increased from 11 percent in 1989 to 19 percent in 1994 and slowly fell to roughly 15 percent in 1998 (Figure 9).[30] As widely noted in Israel, the Russian immigrants also stimulated a temporary housing boom in 1991 and 1992, which returned to normal levels by 1993. Lastly, in support of the consumption smoothing model of the current account, the current account deficit as a fraction of GDP increased by 8 percentage points (800 basis points) from 1989 to 1996, before declining after 1996 (Figure 10).[31]

To examine whether this story of induced capital accumulation can explain the magnitude of the change in effective average wages in Israel, as well as that of the return to c, the investment rate, and the current account, we calibrate a standard

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[30] It's worth noting that in a multisectoral model with no sectoral adjustment costs, an increase in a country's aggregate labor endowment will be absorbed by an increase in the relative output of the labor-intensive sector and a contraction of the capital intensive sector, without any effect on the aggregate investment rate. The large response of investment in Israel to the Russian immigration influx suggests that such a model is inadequate in explaining the effect of a labor endowment shock.

[31] One may be surprised that international capital markets worked well enough so that Israel was able to entirely finance its investment boom through external borrowing. However, one should keep in mind that Israel has historically been able to borrow large amounts of funds from abroad. For example, Israel's current account deficit (as a fraction of GNP) averaged 6.3 percent a year from 1964 to 1980 (*Bank of Israel Annual Report 1998*, Table 2.A.16).

neoclassical model with an aggregate production function, competitive markets, adjustment costs of labor and capital, and standard preferences over consumption and labor supply. We first sketch the model and discuss the parameter values used for the calibration exercise and then present the simulated response of the economy to a labor supply shock.

We start by assuming that output is given by the following aggregate Cobb-Douglas production function:

(4) $$Y_t = BK_t^{\alpha}(A_t L_t)^{1-\alpha}.$$

where

Y_t= output in period t

K_t=capital stock in period t

L_t=number of workers in period t

A_t=index of labor-augmenting technology

A, B, and α are positive parameters, $0<\alpha<1$.

We will assume that each firm faces costs of adjusting the amount of labor, given by $\frac{c}{2}\frac{dL_t^{\,2}}{L_t}$, where *c* is an exogenous parameter and dL_t is the change in the number of workers in period *t*. This assumption implies that the initial effect of an increase in the labor supply is higher unemployment, since firms do not immediately adjust the number of workers they employ. In addition, we will assume that the adjustment cost of capital is given by a standard convex function $\frac{\chi}{2}\frac{I_t^2}{K_t}$ where I_t is the quantity of gross investment in period *t*. Finally, we assume that each firm faces real interest rates *r* and real wages *w*, which are taken as given by the firm.

Under these assumptions, the value of the representative firm is given by the present discounted value of its profit:

(5) $$V_0 \equiv \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t \cdot \left[Y_t - w_t L_t - \frac{c}{2}\frac{dL_t^{\,2}}{L_t} - \frac{\chi}{2}\frac{I_t^2}{K_t} - I_t\right]$$

Lastly, the capital stock depreciates at a constant rate of δ, which implies that the evolution of the capital stock is given by:

(6) $$K_t = (1-\delta)K_{t-1} + I_{t-1}$$

Similarly, the evolution of the aggregate number of workers is given by:

(7) $$L_t = L_{t-1} + dL_{t-1}.$$

The aggregate supply of labor and aggregate consumption (and by extension, the current account) are determined by the preferences of the representative household, which is given by:

(8) $$U_0 = \sum_{t=0}^{\infty}\left(\frac{1}{1+\rho}\right)^t \cdot \left(\log(C_t) + \phi \log(T - \ell_t)\right) \cdot dt$$

where

C_t=consumption in period t

T=total labor (or leisure) endowment per household

ℓ_t =labor supply of the representative household in period *t*

ρ and ϕ are positive parameters, 0<ρ<1.

These preferences are completely standard. The budget constraint for the representative household in every time period *t* is given by:

(9) $$C_t + I_t + S_t^f = w_t \ell_t + r_t K_t$$

where S_t^f is the net increase in foreign assets (or equivalently, the current account). To capture the response of the current account to the Russian immigration, we assume that households are able to borrow and save in international capital markets at a fixed interest rate *r*. We also assume that Russian immigrant do not own any capital or foreign assets when they emigrate to Israel, but otherwise have the same preferences and labor endowment as native Israelis.

The competitive equilibrium in this economy is given by the path of C_t, S_t^f, L_t, I_t, K_t such that: (1) firms maximize the present discounted value of its profits (equation 5) subject to the capital accumulation constraint (equation 6) and the change in number of workers constraint (equation 7); (2) households maximize the present

discounted value of their lifetime utility (equation 8) subject to their budget constraint (equation 9) and; (3) the following set of market clearing conditions hold:

(10) $$N_t \ell_t = L_t$$

(11) $$Y_t = C_t + I_t + S_t^f - \frac{c}{2}\frac{dL_t^{\,2}}{L_t} - \frac{\chi}{2}\frac{I_t^2}{K_t}$$

where N_t is number of households in the economy. N_t is the key exogenous variable in this model, since we model the influx of Russian immigrants as an increase in N_t.

To calibrate the model, we choose parameter values so that the model captures key aspects of the Israeli economy prior to the immigration wave. The weight on the log of leisure ϕ is set to 2, which implies that the labor supply is roughly one-third of total labor endowment in steady state. We set the discount rate (ρ) to 0.05, since each period corresponds to one year. The real interest rate r is also set to 0.05, so the optimal consumption path is constant over time. The annual depreciation rate δ is assumed to be 0.10. For the Cobb-Douglas production function, we set α=0.3, B=0.5 and A_t=1 for all *t* in our baseline simulation. We assume that the initial number of households is 1, and increase N_t from 1990 to 1997 by the actual increase of the labor force in Israel due to the Russian immigrants.[32]

Turning to the adjustment cost parameters, we set the adjustment cost parameter of labor, *c*, equal to 4 which implies that firms close roughly 17% of the gap between desired and actual employment each year, or roughly a mean adjustment lag of 4.8 years to a shock. This is approximately the amount of time it took for the labor force participation and unemployment rates of the Russian immigrants to converge to that of native Israelis. The adjustment cost parameter for capital (χ) is assumed to be 5. Along with the other parameters of this model, this implies a steady-state shadow price of capital (widely known in this literature as Q) of 1.5. The estimates from the literature on the responsiveness of investment to Q indicate a higher value of χ. For example, the IV estimates in Cummins, Hassett, and Hubbard (1994) based on tax policy changes indicate an investment elasticity to Q of 0.7,

[32] Specifically, we assume that N_t increases by 4.67 percent in 1990, 3.56 percent in 1991, 1.48 percent in 1992, 1.45 percent in 1993, 1.47 percent in 1994, 1.36 percent in 1995, 1.21 percent in 1996, 1.1 percent in 1997, and remains constant for all subsequent years.

which implies that χ is roughly 17. However, such a high adjustment cost is inconsistent with estimates of Q which typically do not exceed 1.5.[33]

Our baseline simulation of the response of the Israeli economy to the Russian immigration in this model is shown in Figure 12.[34] These figures shows the deviation of log wages, profit rate, investment/capital stock, and the current account deficit/GDP from a steady-state baseline in which the number of households is constant. According to the simulation, wages fall by almost 8 percent and the profit rate increases by 3 percentage points in the first year of the immigration wave. In turn, this stimulates an investment boom; the investment rate (relative to the capital stock) increases by 1.6 percentage and only gradually falls after 1996. The investment boom increases real wages at an average rate of 1 percent a year from 1990 to 1998 so that the real wage is only 1 percent lower than its pre-immigration level by 1998. These simulations match the time pattern of the response of wages, profit rate, and the investment rate in Israel after 1989 relatively closely, but the magnitude of the initial fall in real wages is much larger than that indicated by our model. In addition, the increase in the profit rate is larger (but more gradual) and the investment boom is larger than in our simulations. Turning to the current account, the simulation shows that the current account deficit as a fraction of GDP increases by 6 percentage points from 1989 to 1996, and gradually falls afterwards, which is broadly consistent with the actual response of the current account in Israel.

Figure 13 present simulations that assess the sensitivity of these calibrations to different assumptions about the capital adjustment cost parameter. As can be seen, a smaller capital adjustment cost parameter results in a larger investment boom, but the results are otherwise relatively insensitive to different values of this parameter.

We have so far assumed that the Russian immigration influx was the only shock affecting the Israeli economy in the 1990s. However, Israel also experienced sharp swings in productivity growth over this period; as previously discussed, there was a productivity boom in Israel from 1989 to 1992, followed by a productivity downturn after 1992 (see Figure 3). We therefore examine whether the simulated response of the Israeli economy to the combination of these productivity shocks and

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[33] See, for example, the estimates in Blanchard, Rhee, and Summers (1993).

[34] We used the GAMS program for the calibration exercise.

the labor endowment shock matches the pattern of real wages, profit rate, investment rate, and the current account more closely than a simulation based solely on the Russian immigration shock. Figure 14 presents these simulations under the assumption that the productivity shocks in the 1990s were perfectly anticipated.[35] As can be seen, the initial fall in real wages is now much larger than in the baseline case, and roughly matches the actual fall in effective wages in Israel. The increase in the return to capital is also much larger and approximates the actual increase in the return to capital. Due to the anticipated productivity downturn after 1992, the current account deficit initially falls, which does not match its actual behavior.

Figure 14 presents the simulated response to the immigration influx and the productivity changes, but without assuming that the productivity changes were anticipated.[36] The response of real wages and the return to capital are broadly similar to the case of perfectly anticipated productivity shocks, but the simulated response of the current account now matches the data more closely. In sum, the pattern of wages, real interest rates, investment rate, and the current account in Israel can be explained as the response of a neoclassical growth model to the Russian immigration shock, but to explain the magnitude of the initial fall in wages and increase in real interest rates, we have to combine the effect of the productivity boom along with that of the labor endowment shock.

Lastly, one could object to our conclusions on the basis that in addition to the Russian immigration and the productivity shocks, there were other major macroeconomic events in Israel during this time period. However, the timing of the two major events -- Persian Gulf War in 1991 and the Peace Agreement with the Palestinian Authority in 1993/1994 -- are inconsistent with the time-series behavior of investment spending. The instability generated by the Persian Gulf War in 1991 should have led to a decline in investment. Instead, there was an investment boom during this time. Similarly, the Peace Accord should have resulted in an investment

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[35] Specifically, we assume A_t=1 in the baseline simulation and adjust it by the difference between the actual productivity growth rate (plotted in Figure 3) and the trend productivity growth. After 1997, we assume productivity growth returns to its trend.

[36] We assume the productivity shocks are the same as described in footnote 35, but the shock is entirely unanticipated.

boom in 1994 (the Oslo peace accords were signed in 1993). Instead, the investment boom that began in 1990 began to taper off in 1994.

VI. Conclusion

This paper analyzes the impact of the Russian immigration on Israel's labor market and macroeconomy. We argue that a minimalist one-sector neoclassical growth model is sufficient to explain the response of Israel's economy to this factor endowment shock in both the short and in the medium run. Specifically, we show that the Russian immigration resulted in a sharp fall in average wages of native Israelis and an increase in the return to capital in Israel in the short run. However, over the medium run, induced capital accumulation offsetted most of the initial impact of the Russian immigration on average native wages. Our results therefore suggest that immigration may have important effects on the wage/rental ratio as well as on relative wages. In addition, these initial changes in factor prices can trigger inflows (and outflows) of other factors such as capital that can mitigate the initial change in relative factor prices. More broadly, the paper suggests that despite its simplicity, the canonical one-sector neoclassical growth model performs remarkably well in explaining the response of an economy to exogenous factor endowment changes.

In contrast, while the high educational levels of the Russian immigrants may seem to provide an ideal laboratory to examine the importance of output composition effects, we show that the Russian immigrants suffered from substantial occupational downgrading in Israel and thus did not increase the relative supply of skilled workers in Israel. This also implies that the Russian immigration does not provide a good test for the existence of human capital externalities. In sum, the Russian immigration episode appears to have been a straightforward labor endowment shock and thus had a large short run effect on wages of *all* native Israelis, but did not exert a downward pressure on the skill-premia of native Israelis despite the high educational levels of the Russian immigrants.

Appendix: Data Sources

To study the effect of immigration on labor market outcomes of native Israelis, we use the microdata from the Israeli *Labor Force Survey* (LFS) and the Israeli *Income Survey* from 1980 to 1997. The LFS is an annual household survey conducted by the Israeli Central Bureau of Statistics (CBS) which collects data from roughly 25,000 household over four interviews conducted over a period of eighteen months. Each household is interviewed for two consecutive quarters, followed by a break for two quarters, and is interviewed again for two consecutive quarters. The LFS provides information on labor market participation, occupation, education, country of origin, year of immigration and other demographic variables as well as details on workplace, but does not provide any information on income. We use the LFS from 1980 to 1997 for our estimates on labor force participation, unemployment rates, and the occupational and industry distribution of workers in Israel.

The CBS also administers a supplemental income survey (IS) to outgoing LFS households (during the fourth interview) that live in Jewish or mixed-ethnicity regions with at least 2,000 inhabitants or in non-Jewish communities with at least 10,000 inhabitants. This covers roughly 95 percent of the Jewish population, but less than half of the non-Jewish population in Israel. The IS provides income data for about 6,500 households each year, but the publicly available microdata provides relatively little demographic data. For this project, we match the households in the fourth panel of the LFS to those in the IS using common variables that appear in both datasets. This allows us to use the covariates (such as quarter of survey and region of residence) that appear in the LFS along with the income data from the IS. Our estimates of changes in relative wages are based on this merged IS-LFS dataset. There are approximately 7,000 observations for each year of this merged IS-LFS dataset.

We define native Israelis are those who were born in Israel or who had emigrated to Israel prior to 1989. Russian immigrants are defined as people who came from the former Soviet Union after 1989. We restrict the sample to men between the ages of 21 and 65 and females between the ages of 20 to 60. We further restrict the sample to people who worked more than two weeks during the last month and more than 25 hours per week. We exclude all individuals with no information on age, on education and with more than 30 years of schooling. After 1985, the IS

provides data on the average monthly income during the three months prior to the IS interview. Prior to 1985, the IS provides information on annual earnings, which we convert to average monthly wages by dividing by 12. We then convert average monthly wages to average hourly wages by dividing by usual hours worked per month. Finally, we convert all wages to 1998 prices.

Wages of Palestinians who live in the West Bank and the Gaza Strip are computed from the microdata from the *Territories Labor Force Survey* (TLFS), a quarterly labor force survey conducted by Israel's CBS from 1968 to 1995. Each year, roughly 7,500 households are chosen for the survey and are randomly divided into four rotation groups, each of which is interviewed for two consecutive quarters, excluded for the next two quarters, and then interviewed again for two consecutive quarters. We focus on men over the age of 18 and under the age of 65, and exclude all men with no information on age, education, or with more than 25 years of schooling. We estimate average daily wages by dividing the average monthly wage by the number of days worked.

The data on the number of Russian immigrants and native Israelis, the investment rate, current account, return to capital imputed from the national accounts, inflation rate, average wages from the National Insurance Institute are from the *Statistical Abstract of Israel*. The number of foreign workers and workers from the West Bank and the Gaza Strip are from the Bank of Israel's 1998 *Annual Report* (Table 4.A.3). The return to equity for firms in the Tel-Aviv Stock Exchange is from the Bank of Israel's 1999 *Annual Report*. Total factor productivity is computed as the growth rate of real GDP minus the weighted average of the growth rate of the labor force and the capital stock, where the weights are the respective factor shares. Real GDP, total employment, and the factor shares are also from the *Statistical Abstract of Israel*. To calculate the capital stock, we apply a perpetual inventory approach to annual data on real investment spending starting in 1951. The initial capital stock (in 1951) is computed as 10 times the amount of investment in 1951.

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Table 1. Educational, Occupational and Industry Distributions of Native Israelis and Russian Immigrants.

	Native Israelis (Jews)		Russian Immigrants (Jews)		Native Israelis (Non-Jews)	
	1990	1997	1990	1997	1990	1997
Panel A. Years of Schooling (%)						
< 8	13.15	9.29	6.21	4.66	52.00	45.38
9-12	57.00	49.75	32.59	32.06	40.33	42.74
13-15	17.78	23.08	38.58	39.66	5.48	6.79
> 16	12.06	17.88	22.62	23.61	2.19	5.09
No. of observations	33,692	28,428	902	4,675	6,254	5,143
Panel B. Occupational Distribution (%)						
Academic Professionals	8.31	9.66	7.43	10.06	2.02	3.96
Associate professionals and technicians	17.25	17.12	12.16	12.33	7.58	10.13
Managers	5.65	6.97	0.68	0.82	1.37	1.43
Clerical workers	20.38	21.80	4.73	9.13	5.84	7.00
Agents, sales workers, and service workers	8.78	9.59	1.35	4.84	7.68	8.22
Skilled agricultural workers	12.69	13.19	19.59	21.20	12.26	11.96
Industry, construction and other skilled workers	24.60	20.19	44.59	34.93	52.73	54.17
Unskilled workers	2.34	1.49	9.46	6.71	10.52	3.13
No. of observations	21,987	20,901	148	3,430	2,928	2,300
Panel C. Industrial Distribution (%)						
Agriculture and mining	4.11	0.23	1.37	0.24	7.50	0.59
Food, textile and light manufacturing	6.49	4.62	21.23	10.90	13.08	8.60
Machinery and heavy manufacturing	16.25	12.89	25.34	24.55	9.26	8.51
Government (includes utilities)	20.35	19.78	4.11	6.85	11.73	14.32
Services and personal care	33.62	37.31	32.19	34.57	51.96	57.67
Finance, business sector and banking	11.27	15.88	4.11	10.93	3.30	6.27
Universities and medical care	7.90	9.30	11.64	11.96	3.17	4.03
No. of observations	21,786	20,106	146	3,312	2,906	2,185

Source: Authors' tabulations from Israeli *Labor Force Survey*.

Table 2. Labor Force Participation Rates of Israeli Natives and Immigrants, 1980-1997

	1980	1981	1982	1983	1984	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Men																	
Native Israelis (Jews)	62.8	62.6	62.0	62.1	62.0	62.1	62.8	63.4	63.2	62.6	62.7	62.2	63.2	63.1	64.2	63.3	62.6
By schooling groups																	
0-8	65.1	63.2	61.5	60.3	60.4	58.6	59.4	58.1	57.3	55.0	55.1	52.9	50.9	50.5	46.4	43.3	42.1
9-12	59.5	59.8	59.9	60.2	60.1	60.3	61.5	62.3	61.7	61.4	61.4	60.8	62.4	61.5	62.5	61.9	60.3
13-15	68.8	70.6	67.4	68.3	68.3	68.1	69.5	69.8	70.4	71.0	70.2	70.6	72.8	71.9	72.6	70.9	70.4
16+	76.5	74.5	75.0	76.5	76.5	77.2	75.1	74.8	75.6	74.9	75.3	75.2	74.5	76.2	76.9	76.0	76.4
Native Israelis (Non-Jews)	65.1	67.1	67.2	66.6	65.8	66.6	66.1	67.0	67.8	68.6	67.9	67.3	67.3	66.0	65.5	66.4	66.4
Russian Immigrants										32.0	57.3	63.9	66.0	65.4	63.8	62.8	62.2
Women																	
Native Israelis (Jews)	39.2	39.7	40.2	41.0	41.9	42.4	44.5	45.9	47.6	47.9	48.2	48.8	49.7	51.2	52.7	52.9	53.0
By schooling groups																	
0-8	23.7	23.6	23.2	24.1	24.2	22.6	24.1	24.2	26.1	26.4	23.8	24.6	25.0	24.4	20.3	18.7	18.0
9-12	41.5	41.5	42.1	42.3	43.4	43.1	44.4	45.9	46.8	47.1	47.4	48.0	48.9	49.8	49.6	49.2	49.7
13-15	61.4	63.0	62.9	63.0	63.8	65.3	64.8	65.7	68.3	66.7	67.7	67.2	68.5	66.4	69.3	68.9	65.9
16+	77.8	76.2	74.8	75.2	78.0	75.9	78.0	78.0	78.5	79.9	81.3	80.8	79.1	81.4	80.9	81.9	81.5
Native Israelis (Non-Jews)	11.7	10.7	9.8	9.5	10.9	11.8	10.6	11.2	11.8	11.4	10.5	11.5	12.9	12.9	13.6	13.4	13.9
Russian Immigrants										19.3	36.7	45.1	47.4	48.7	46.3	46.9	47.8

Source: Authors' tabulations from Israeli *Labor Force Survey.*

Table 3. Unemployment Rates of Israeli Natives and Immigrants, 1980-1997

	1980	1981	1982	1983	1984	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Men																	
Native Israelis (Jews)	4.1	4.1	4.1	4.0	5.0	5.6	4.8	5.3	7.3	7.5	7.1	7.7	6.7	5.2	4.8	5.2	5.8
By schooling groups																	
0-8	4.6	6.0	4.7	4.0	6.3	7.0	5.7	6.0	8.6	10.4	9.2	10.8	10.2	8.0	6.9	6.8	7.8
9-12	4.7	4.8	4.9	4.7	5.5	6.9	5.6	6.4	9.1	9.1	8.5	9.3	8.5	6.5	5.9	6.4	7.3
13-15	3.5	2.5	2.6	3.2	3.6	3.6	3.7	3.9	5.3	5.4	5.3	5.4	3.6	3.3	3.3	3.8	4.3
16+	2.0	1.9	1.9	2.2	2.9	1.7	2.2	3.1	3.0	2.3	3.2	2.9	2.0	2.1	2.2	2.9	3.1
Native Israelis (Non-Jews)	4.8	5.6	6.3	5.8	6.9	11.1	8.9	8.4	11.2	11.0	10.3	12.6	12.2	8.9	5.0	5.7	7.2
Russian Immigrants										40.7	28.5	19.9	15.0	9.0	7.1	7.7	7.0
Women																	
Native Israelis (Jews)	6.0	6.6	6.0	5.3	7.0	7.4	7.2	7.9	10.2	11.0	11.0	11.5	10.0	9.1	7.4	6.8	7.0
By schooling groups																	
0-8	5.8	6.4	4.7	4.6	6.8	8.0	7.8	8.5	11.3	12.2	11.6	12.0	12.2	11.3	6.9	6.2	7.9
9-12	7.9	8.7	8.1	7.2	9.6	10.1	9.5	10.8	13.4	15.3	15.8	16.2	14.1	13.2	11.1	9.8	10.1
13-15	4.3	4.8	4.9	3.8	4.4	4.8	5.0	5.2	7.3	7.0	6.6	7.5	6.0	5.0	4.9	5.0	5.3
16+	3.4	3.8	2.4	2.9	3.6	3.0	4.0	3.0	4.3	3.6	3.1	3.4	2.8	2.9	2.2	3.0	2.7
Native Israelis (Non-Jews)	1.2	3.6	5.8	6.6	4.4	4.7	6.5	8.1	6.9	8.4	8.5	9.7	14.6	9.4	8.8	4.1	9.3
Russian Immigrants										52.9	50.3	38.4	21.5	17.6	11.8	10.4	10.0

Source: Authors' tabulations from Israeli *Labor Force Survey.*

Table 4. Average Annual Growth Rate of Real Wages of Natives and Immigrants

	1980-1989		1989-1991		1991-1997	
	All Sectors	Private Sector	All Sectors	Private Sector	All Sectors	Private Sector
Panel A. All Israelis						
Males						
Russian Immigrants					5.06	
Native Israelis (Jews)	7.05		-2.65		1.94	
Native Israelis (Non-Jews)	7.72		1.98		2.33	
Females						
Russian Immigrants					7.06	
Native Israelis (Jews)	10.98		-0.25		2.26	
Native Israelis (Non-Jews)	6.52		-5.78		3.04	
Panel B. By Educational Attainment						
Males						
<8 Years of schooling						
Russian Immigrants					4.60	2.77
Native Israelis (Jews)	6.90	6.85	-4.50	-5.33	0.86	0.95
9-12 Years of schooling						
Russian Immigrants					3.82	3.84
Native Israelis (Jews)	5.94	5.93	-5.25	-5.23	1.34	1.02
13-15 Years of schooling						
Russian Immigrants					5.32	6.18
Native Israelis (Jews)	6.04	6.08	2.25	3.14	0.98	0.06
>16 Years of schooling						
Russian Immigrants					5.90	5.81
Native Israelis (Jews)	7.85	7.28	-1.55	-3.17	1.98	-0.24
Females						
<8 Years of schooling						
Russian Immigrants					6.54	2.58
Native Israelis (Jews)	8.22	9.08	-1.85	-3.03	1.04	1.23
9-12 Years of schooling						
Russian Immigrants					5.62	3.65
Native Israelis (Jews)	6.21	6.32	-1.15	-1.08	1.88	1.69
13-15 Years of schooling						
Russian Immigrants					7.48	6.18
Native Israelis (Jews)	5.79	7.15	2.50	0.46	0.56	-1.33
>16 Years of schooling						
Russian Immigrants					6.12	6.73
Native Israelis (Jews)	6.42	6.42	-2.90	-5.29	4.10	3.83

Note: The numbers are the log change in mean hourly wages x 100.
Source: Authors' tabulations from merged Israeli *Income Survey* and *Labor Force Survey*.

Table 5. Returns to Education and Work in Israel, Male Palestinian Workers.

	Educational Groups (years of schooling)			Work in Israel	Number of Observations
	8-12	13-15	16+		
1981	0.173	0.509	0.695	0.250	14,588
	(0.009)	(0.020)	(0.023)	(0.009)	
1982	0.118	0.339	0.513	0.207	15,222
	(0.009)	(0.020)	(0.022)	(0.010)	
1983	0.126	0.348	0.548	0.246	15,340
	(0.008)	(0.016)	(0.018)	(0.008)	
1984	0.168	0.429	0.630	0.057	16,219
	(0.009)	(0.0166)	(0.019)	(0.087)	
1985	0.152	0.384	0.553	0.052	16,873
	(0.009)	(0.016)	(0.018)	(0.009)	
1986	0.122	0.266	0.417	0.182	18,178
	(0.006)	(0.011)	(0.014)	(0.006)	
1987	0.099	0.193	0.360	0.260	20,871
	(0.005)	(0.010)	(0.011)	(0.005)	
1988	0.072	0.075	0.218	0.311	15,621
	(0.006)	(0.011)	(0.013)	(0.006)	
1989	0.043	0.022	0.128	0.450	16,639
	(0.006)	(0.009)	(0.012)	(0.006)	
1990	0.068	.084	0.185	0.427	17,025
	(0.005)	(0.009)	(0.011)	(0.005)	
1991	0.066	.106	0.226	0.482	15,008
	(0.006)	(0.011)	(0.012)	(0.006)	
1992	0.386	0.255	-0.123	0.799	14,325
	(0.007)	(0.015)	(0.012)	(0.009)	
1993	0.061	0.083	0.199	0.541	18,586
	(0.007)	(0.010)	(0.012)	(0.007)	
1994	0.048	0.006	0.166	0.560	15,815
	(0.008)	(0.011)	(0.014)	(0.007)	
1995	0.067	-0.034	0.164	0.488	11,849[1]
	(0.009)	(0.013)	(0.014)	(0.008)	

[1] no fourth quarter interview in 1995.

Notes: Standard error in parenthesis. Estimates are taken from wage regressions on the microdata from the *Territories Labor Force Survey*. Dependent variable is the log of real daily wages. In addition to indicator variables for the three educational groups and work in Israel, the other covariates in the regression are a quadratic in experience, quarterly dummies, and an indicator variable for work in the Gaza Strip.

Table 6. Between- And Within-Industry Decomposition of Change in Share of Skilled Workers in Employment, 1981-1997

Panel A. Dependent Variable:
100 x (Annual Change in Employment Share of College-Educated Workers)

	Aggregate Economy			Manufacturing		
Period	Between	Within	Total	Between	Within	Total
1980-1989	0.23	0.61	0.84	0.11	0.81	0.92
1989-1997	0.07	1.39	1.46	0.17	2.20	2.37
1989-1991	-0.19	1.85	1.66	-0.26	2.26	2.00
1991-1997	0.18	1.22	1.40	0.31	2.18	2.49

Panel B. Dependent Variable:
100 x (Annual Change in Employment Share of College Graduates)

	Aggregate Economy			Manufacturing		
Period	Between	Within	Total	Between	Within	Total
1980-1989	0.14	0.29	0.43	0.02	0.37	0.39
1989-1997	0.07	0.82	0.89	-0.02	1.06	1.04
1989-1991	-0.12	0.78	0.66	-0.24	0.94	0.70
1991-1997	0.14	0.82	0.96	0.00	1.15	1.15

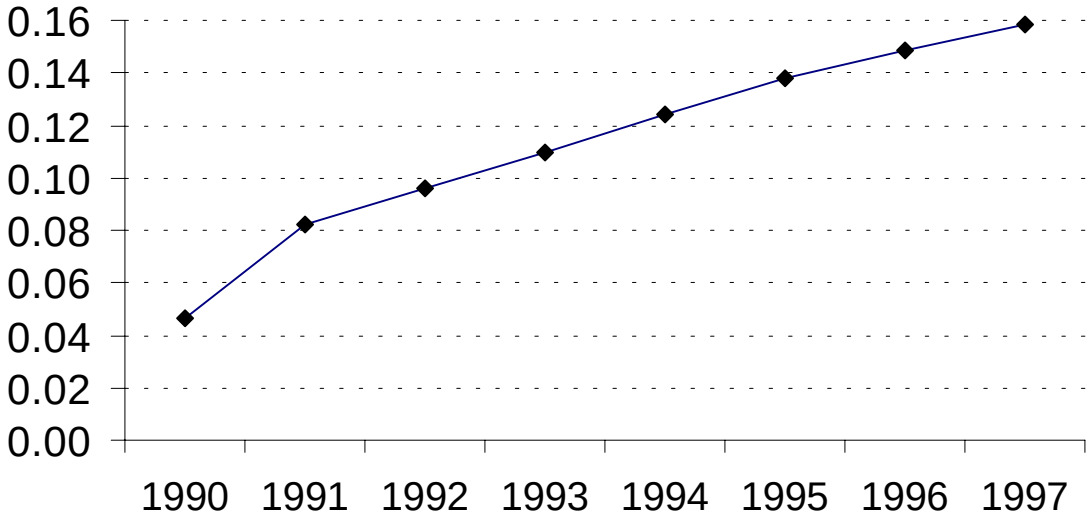
Source: Authors' calculations from Israeli *Labor Force Survey*.
Note: There are 83 industries in the manufacturing sector and 191 industries in the aggregate economy.

Table 7. Index of Labor Market Competition between Russian Immigrants and Native Israeli Jews

	Based on Industry Distribution			Based on Occupational Distribution		
	1990-91	1996-97		1990-91	1996-97	
		all cohorts	1990-91 cohort		all cohorts	1990-91 cohort
Males						
<8 years of schooling	1.421	1.374	1.280	1.915	1.826	1.551
9-12 years of schooling	1.196	1.142	1.073	1.173	1.223	1.108
13-15 years of schooling	1.017	1.026	1.003	0.748	0.893	0.927
>16 years of schooling	0.846	0.930	0.991	0.929	0.824	1.063
Females						
<8 years of schooling	1.089	1.339	1.256	2.233	2.579	2.038
9-12 years of schooling	0.911	0.974	0.973	0.879	0.985	0.938
13-15 years of schooling	0.717	0.843	0.897	0.470	0.663	0.758
>16 years of schooling	0.647	0.730	0.851	0.497	0.566	0.763

Source: Authors' calculations from microdata from Israeli *Labor Force Survey* based on 191 industries and 3-digit occupational classifications.

Figure 1. Russian Immigrants Aged 15+/ Native Israelis Aged 15+



Source: Israeli Central Bureau of Statistics, Statistical Abstracts, various issues.

Figure 2: Occupational Distribution of Russian Immigrants in the former Soviet Union and in Israel

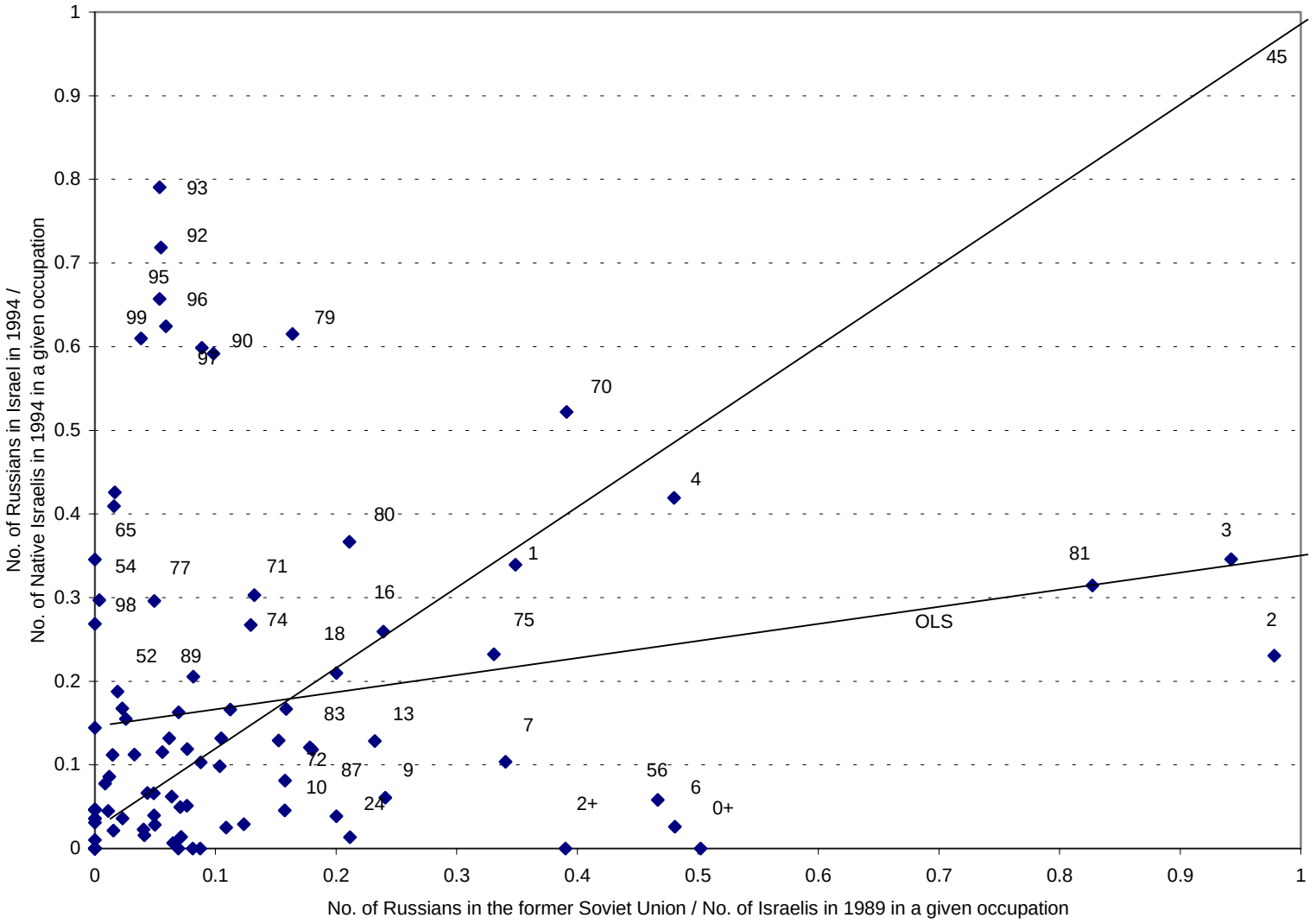


Figure 3. Index of Total Factor Productivity

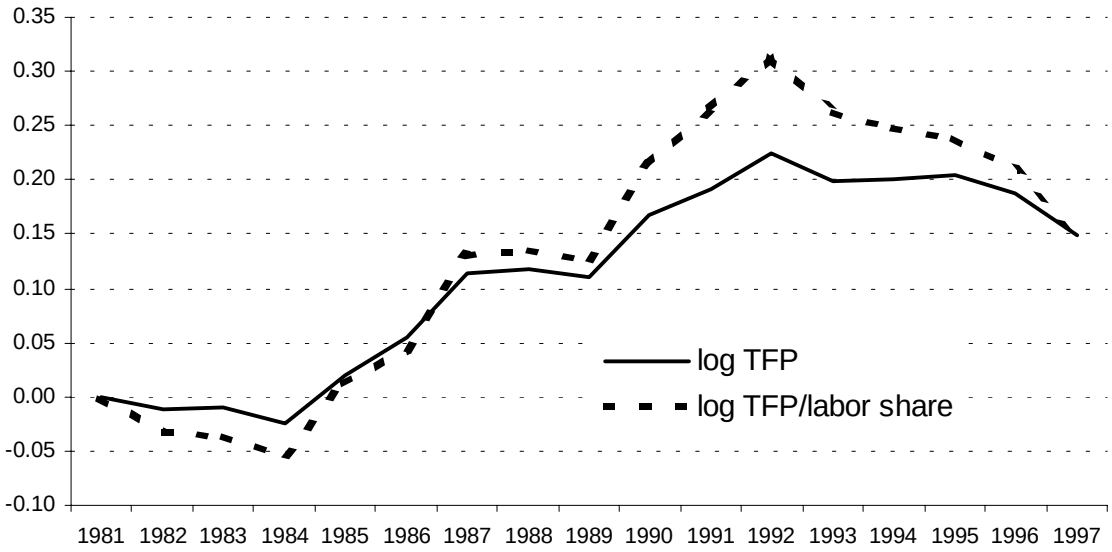


Figure 4. Real Effective Wages of Native (non-Russian) Jews
(from Israeli Income Surveys)

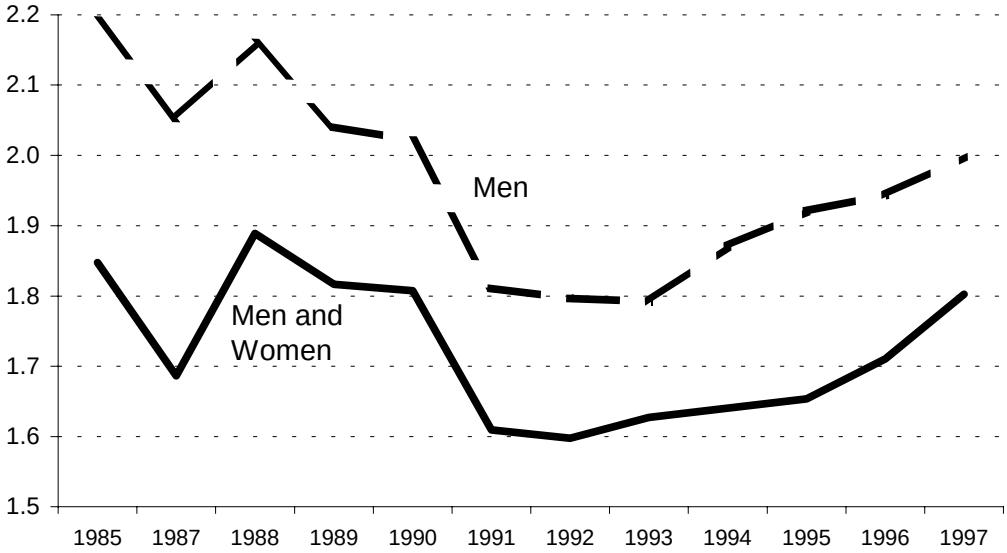


Figure 5. Real Effective Wages of all Israelis
(from National Insurance and other Administrative Sources)

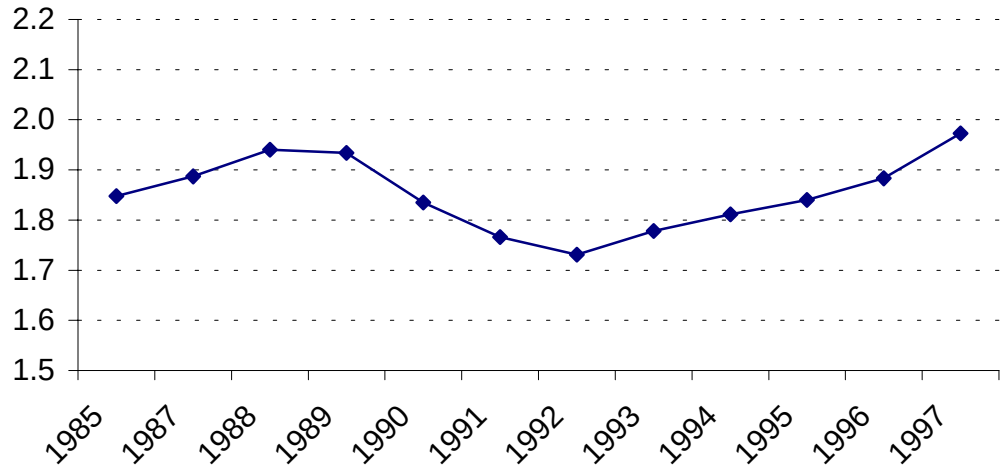


Figure 6. Returns to Education of Native Israeli Jews in Private Sector

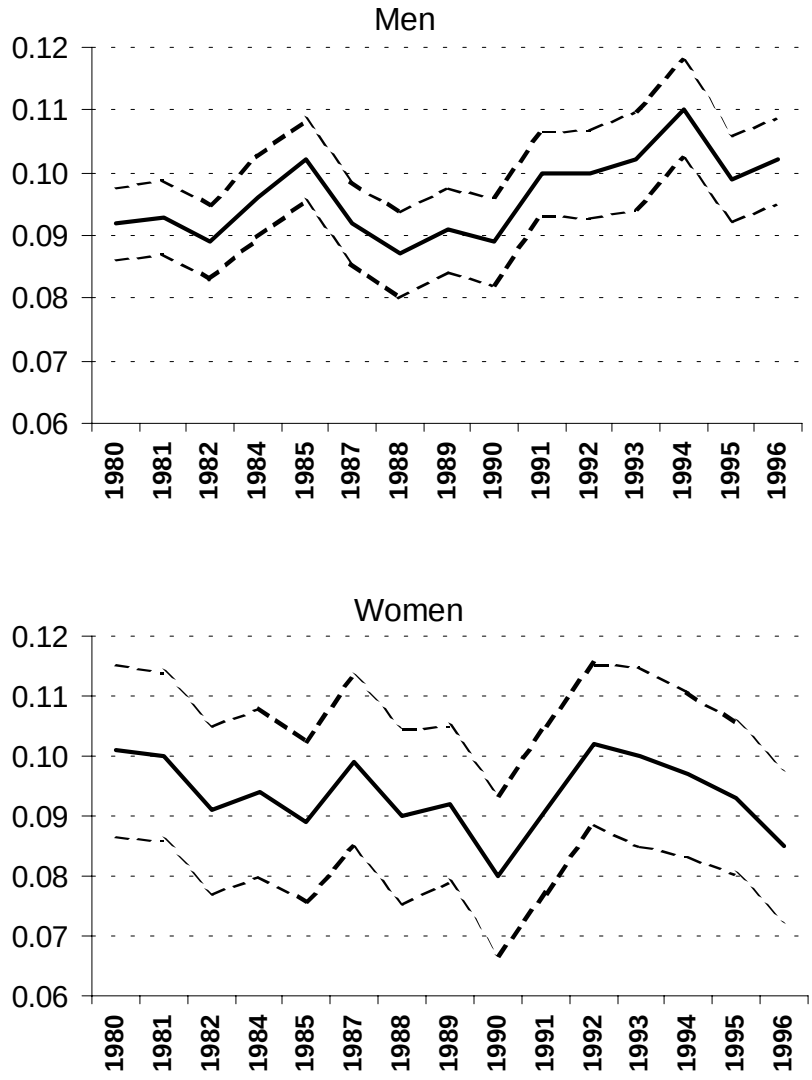


Figure 7. Number of Palestinian and Foreign Workers in Israel

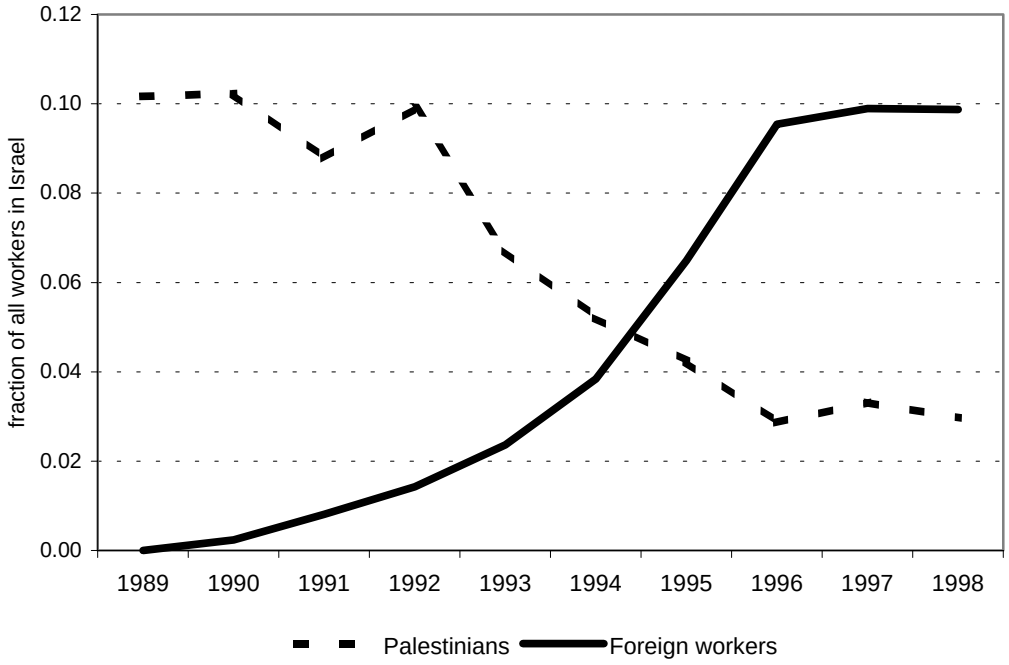


Figure 8. Return to Capital

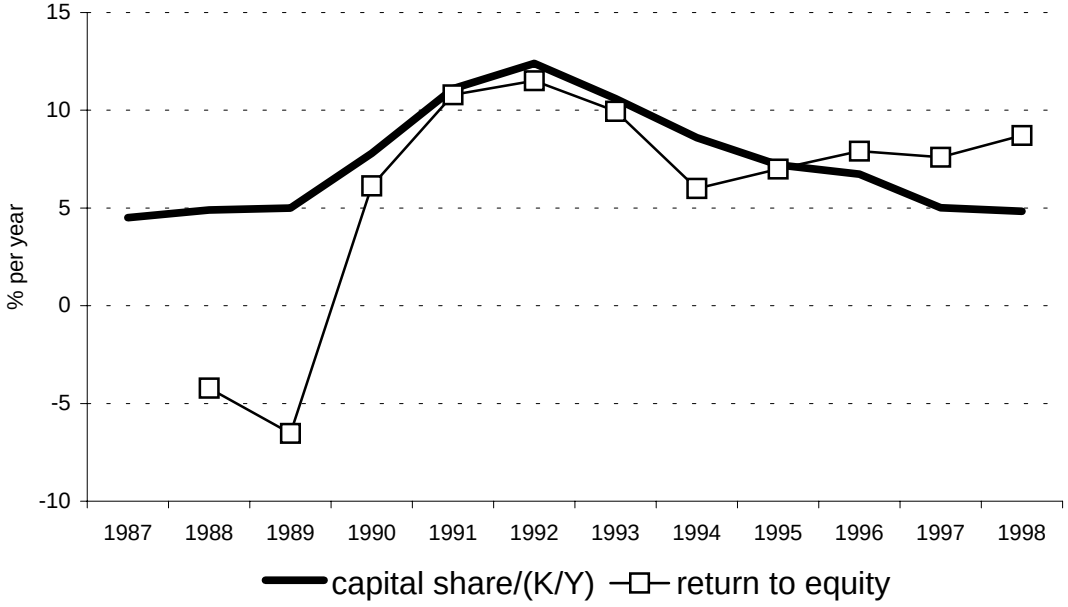


Figure 9. Gross Investment/Capital Stock

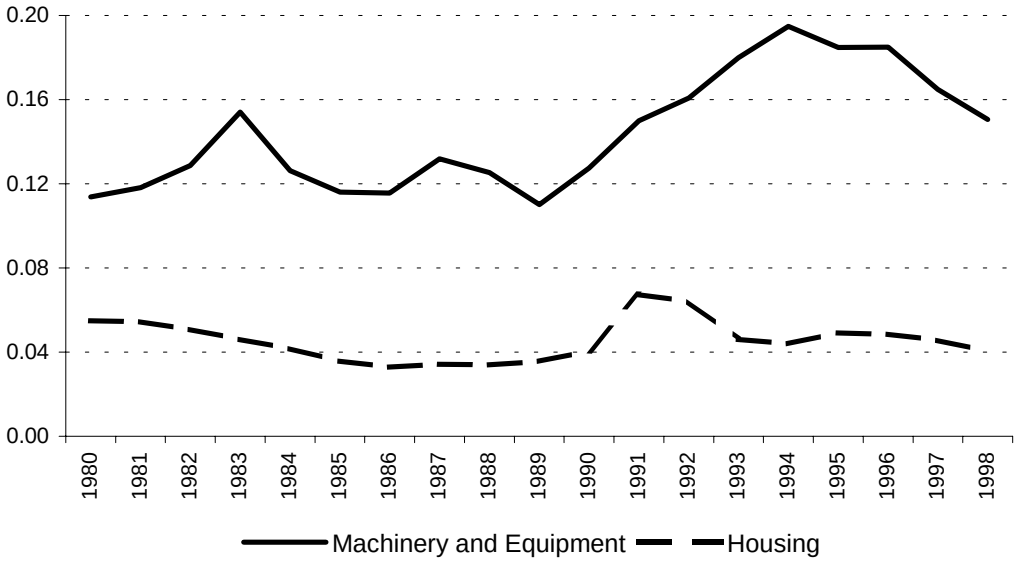


Figure 10. CA Deficit/GNP

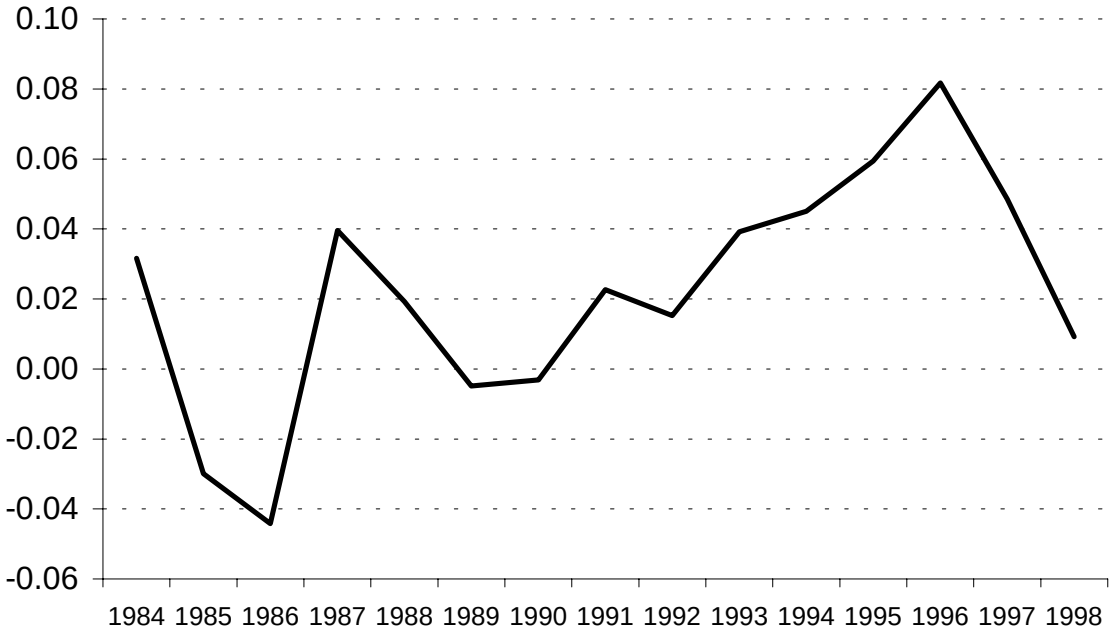


Figure 11. Growth Rate of
Native Israeli Population

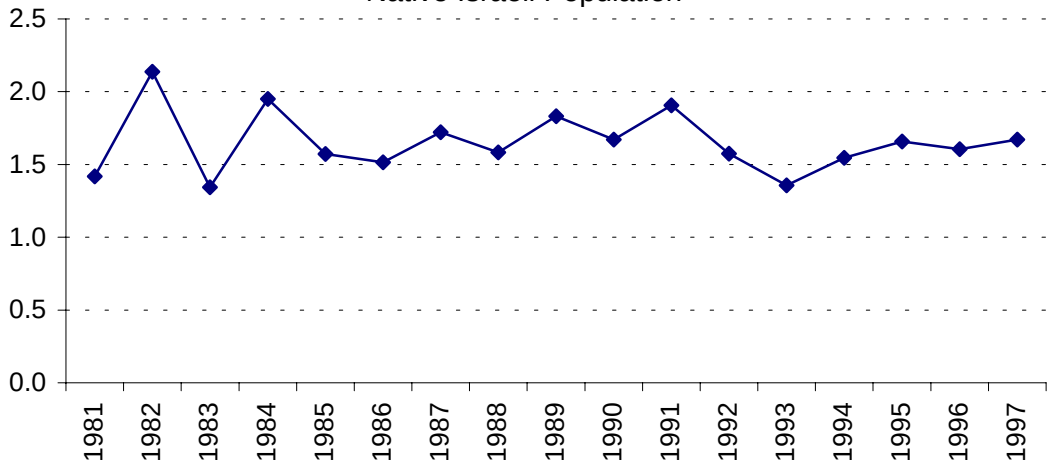
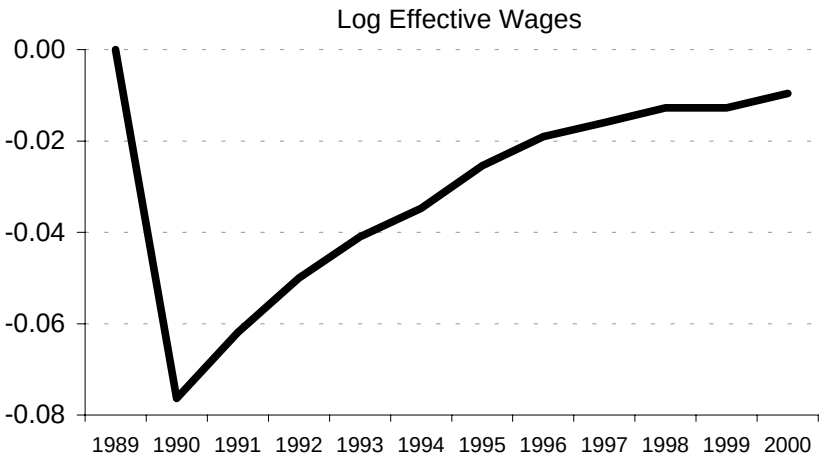
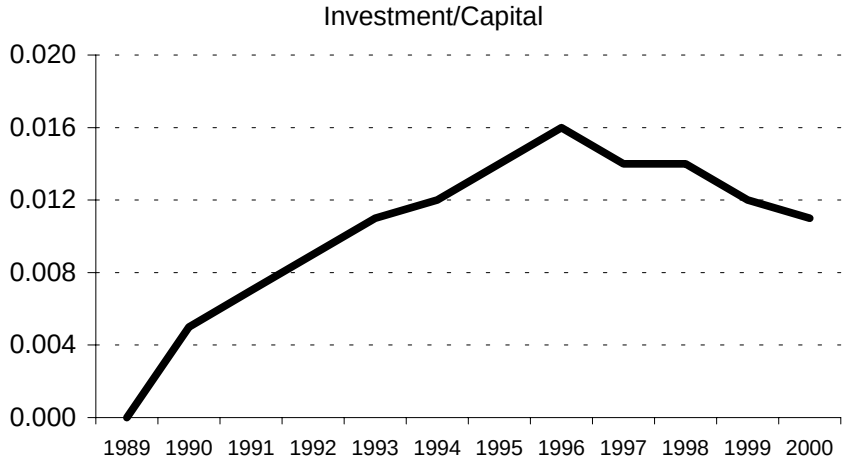
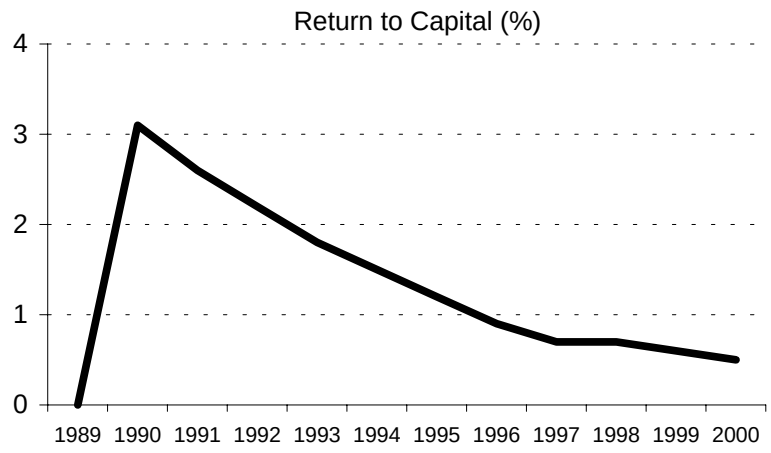


Figure 12. Simulated Response to Labor Endowment Shock (deviation from steady state)







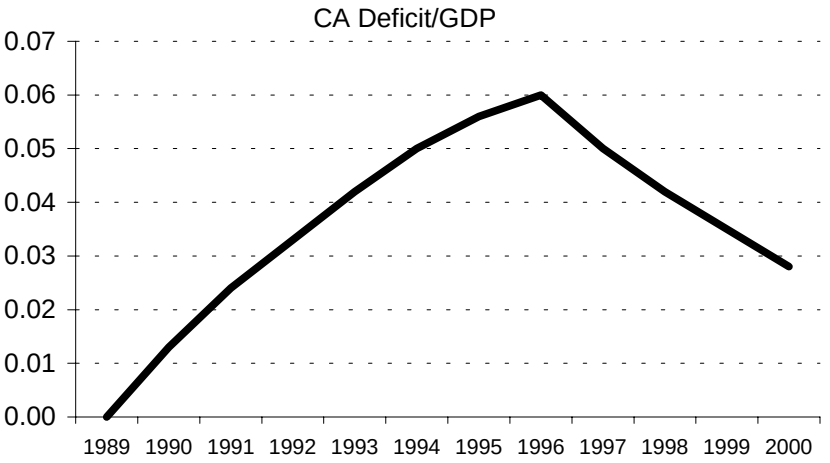
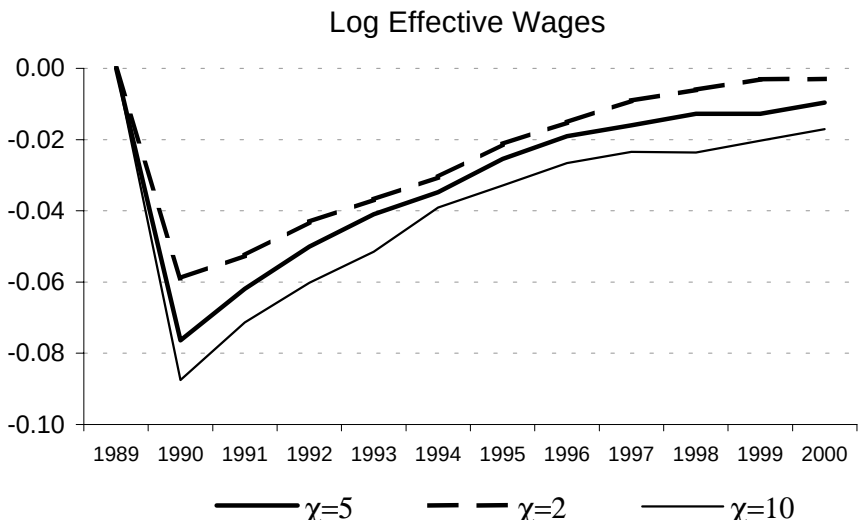
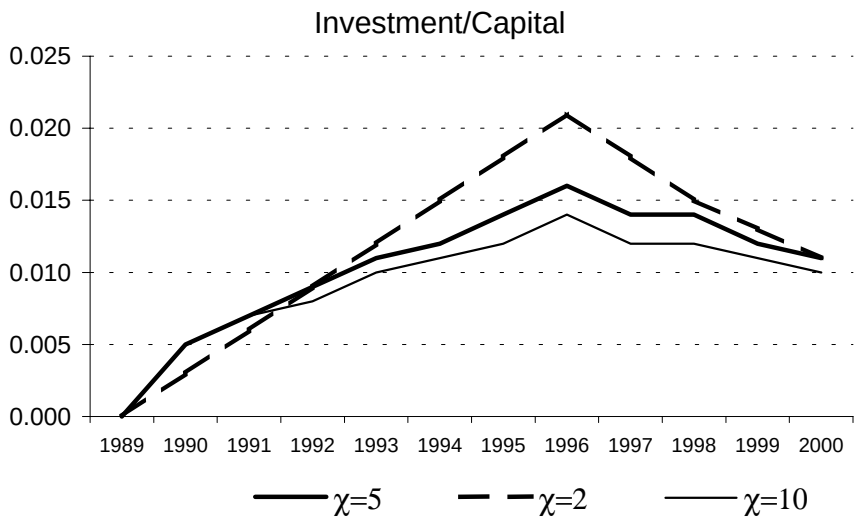
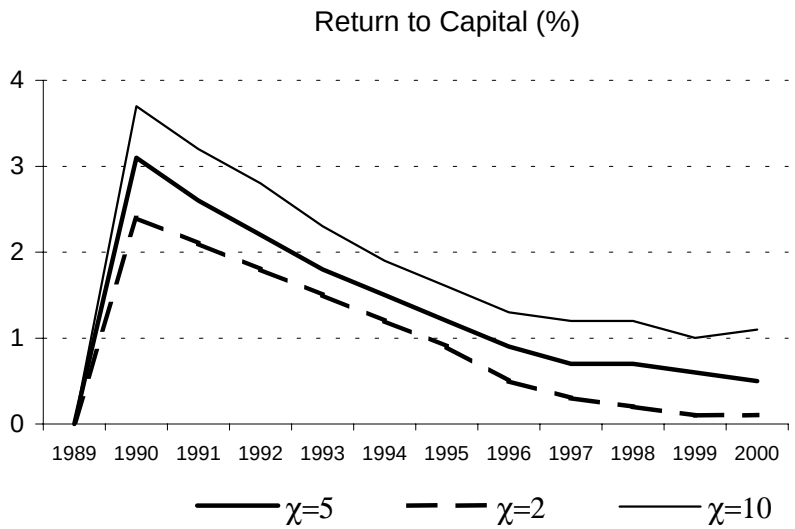


Figure 13. Simulated Response to Labor Endowment Shock with Different Capital Adjustment Costs (deviation from steady state)







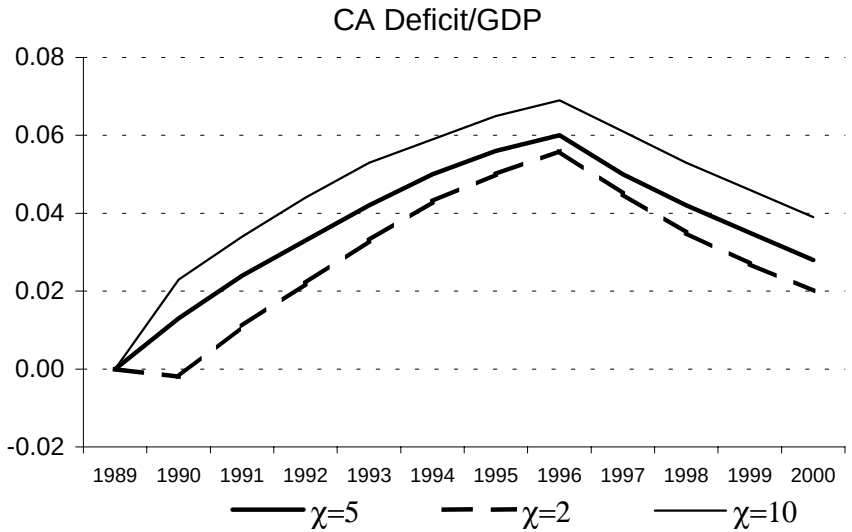


Figure 14. Simulated Response to Labor Endowment and *Anticipated* Productivity Shock (deviation from steady state).