Is foreign farm labor a blessing or a curse? Evidence from Israel

By Ayal Kimhi

Department of Environmental Economics and Management, The Hebrew University

Shoresh Institution for Socioeconomic Research

The Center for Agricultural Economic Research

After Israel became self-sufficient in food in the 1960s, farmers started migrating out of agriculture while production continued to increase towards export markets. This process intensified considerably when foreign labor became available. Traditional production theory predicts that foreign workers replace local workers, but the number of Israeli hired farm workers has actually increased since the arrival of foreign labor. This paper develops a modified theoretical model in which farm labor is heterogeneous, so that changes in the number of foreign and local hired workers are not necessarily opposite in sign. The results of the model are consistent with the observation that the availability of foreign labor has led to an increase in the production and export of labor-intensive horticultural products. Farms became larger and more specialized, and this has led to labor specialization, with foreign workers doing manual tasks and Israeli hired employees doing mostly managerial and professional tasks.

IAAE

1. Introduction

Agricultural development has long been associated with the exit of labor from agriculture (Lucas 2004; Mundlak 2005). This is still very true for developing and transition economies. In developed economies however, the situation is different. While the number of self-employed farm operators continues to decline, the number of hired farm workers is not declining as fast, and in many cases, it is even on the rise. Thus, farms in developed economies are relying more and more on hired labor (Findeis 2002; Blanc et al. 2008).

The advantage of hired farm labor is often its low cost (Hertz and Zahniser 2012; Taylor et al. 2012). Hence, as economies develop and wages rise, farming will rely more and more on migrant labor. Farm labor use is linked to the globalization process in several ways. First, international migration as a whole, both legal and illegal, is becoming more prevalent, and agricultural employment is an obvious option for the immigrants. As the supply of migrant farm labor increases, local unskilled laborers are pushed out of the sector, total farm employment increases, farms become larger and fewer, and the supply of labor-intensive agricultural products increases. Some of this supply increase can be exported. Second, globalization leads to increased international trade in agricultural products and as a result, the local production mix changes in the direction of products with comparative advantages. If demand for labor-intensive agricultural products increases, the demand for farm labor increases as well, and can be satisfied by migrants. It is not surprising, then, that migrant labor is becoming more and more important for structural changes in agriculture that are driven in part by globalization. Malchow-Møller et al. (2013) showed, for example, that Danish farms employing immigrants are larger and no less productive than other farms.[1]

The supply of migrant labor is affected by policies and regulations, including, of course, migration policy (Martin 2012; Taylor et al. 2012), but also others, such as minimum-wage policies (Buccola, Li and Reimer 2012). Various schemes are used to increase the availability of farm labor, including, for example, guest worker programs in the US (Rickard 2014), the Seasonal Agricultural Workers Scheme in Canada (Hennebry and Preibisch 2012) and in the UK

---

[1] It should be noted that there are claims that the availability of cheap migrant labor hinders farm mechanization and slows down technological progress. See, for example, Napasintuwong and Emerson (2006).

(Migration Advisory Committee 2013), the Seasonal Foreign Farm Labour Policy in Germany (Hess et al. 2012), the Fledging Seasonal Worker Scheme in Australia, and the Recognized Seasonal Employer Program in New Zealand (Gibson and McKenzie 2014). In recent years, food supply has become an issue of greater concern in more than a few countries. Understanding the links between farm labor migration and supply of agricultural products, in specific countries as well as internationally, is thus relevant for policy-makers worldwide.

This article claims, and supports this claim with empirical evidence, that the inflow of migrant farm labor was pivotal to the expansion of agricultural production in Israel into export markets that required more precise and timely cultivation and processing techniques. In doing so, migrant workers drove some unskilled farm workers from their jobs, but at the same time, increased the demand for local skilled farm workers, as well as workers in other industries that provide agricultural inputs and services. In addition, the use of relatively cheap migrant farm labor helped keep the local prices of fresh produce relatively low, thereby increasing the welfare of consumers, especially low-income ones.

The article is organized as follows. It starts with a historical background on the development of agriculture in Israel, continues with more details on farm labor regulation, then expands on the issue of foreign labor in Israel in general, and discusses the recommendations of government committees aimed at reducing the number of migrant workers. After that, the article uses descriptive data to detail the structural changes that have occurred in Israeli agriculture over the years. Based on the implications of the descriptive findings, it then offers a theoretical framework to analyze the impact of cheap migrant farm labor on agriculture. The theoretical predictions are subsequently tested with the data. The article concludes with a discussion of the findings and their policy implications.

2. Historical background

Jewish agricultural settlement in Israel started in the late 19th century, when pioneers came from Europe and established farm businesses. Based mostly on horticulture (citrus,

grapes), the new farms relied on Palestinian hired labor which was abundant and cheap.[2] In the early 20th century, young socialist immigrants tried to compete with the Palestinians for the agricultural work, with little success. Consequently, these immigrants later established their own agricultural settlements: first the *Kibbutz*, a collective commune with joint production and consumption, and later the *Moshav*, a cooperative village of individual family farms (Kislev 1992). Both *Kibbutzim* and *Moshavim* were based on Zionist and socialist ideology, and one of the main principles was self-employment. As a result, farms were planned to rely on family labor alone.

After the establishment of the State of Israel in 1948, and the subsequent mass migration of holocaust refugees and those from MENA countries, the self-employment principle was relaxed because of the need to increase food production on the one hand, and provide employment for the new immigrants on the other. Following the War of 1967 and the occupation of the West Bank and Gaza Strip, Palestinian workers from those territories became available for employment at low wages, and they gradually replaced some of the unskilled Israeli hired laborers, commuting daily from their residences. During the first Palestinian intifada (uprising) and the First Gulf War, Palestinian laborers became a security burden, and many of them could not come to work on a regular basis due to frequent blockades (Angrist 1996). Beginning in 1993, the government allowed farmers to bring a small number of guest workers from Thailand to replace the Palestinians, and the number of permits was increased in subsequent years as the security situation deteriorated (Miaari and Sauer 2011). Between 1996 and 2000, the number of permits for guest workers in agriculture was roughly 17,000, and since 2002 it has been at around 27,000.

3. Regulation

Initially, Palestinians could work in Israel almost freely, after registering with the Israeli Employment Service. The only constraint was that they had to return to their homes every day. Following the First Intifada, and especially since the Second Intifada, Palestinians need a

---

[2] French Baron Edmond James de Rothschild supported the new settlers (although perhaps not from the beginning) who could not stand (economically) on their own two feet, by investing in infrastructure, farm equipment and agricultural research.

personal permit to work in Israel. These permits are issued by the Ministry of Defense and their number is determined according to the security situation, although an increase in the number of permits is, in most cases, a political decision. A permit-holding Palestinian can commute to Israel daily in order to work without further regulation on the sector, location or terms of work.

Agricultural guest workers are brought from Thailand for a period of 5 years according to permits given to employers. Hence, each worker is assigned to a specific employer.[3] The number of permits is determined by the government, and they are issued by the Ministry of the Interior, according to the recommendations of the Ministry of Agriculture. These recommendations are based on specific criteria that are updated from time to time. Specifically, farmers have to apply for permits and report the type and size of their operations. The Ministry of Agriculture decides how many workers are needed per unit of operation in each enterprise, and then adjusts the numbers downward to fit the number of permits, which is always lower than demand. Once the farmer obtains the permits, he approaches one of a number of certified employment agencies to find the workers and bring them to Israel. The agency is supposed to make sure that the workers are paid the official wage rate and obtain decent living and working conditions. The government charges a fee for each permit issued, which must be paid by the farmer. While farmers claim that the total cost of a guest worker is not lower than that of a comparable Israeli worker, it is reasonable to assume that it is considerably lower in terms of efficiency units.

4. Foreign workers in the Israeli labor market

Palestinian workers were not only employed in agriculture. Their role in the construction sector was even larger (Bartram 1998). Hence, while the government was allowing Thai workers into the country for agriculture, it was also allowing foreign construction workers to be brought over, initially from Romania and Portugal, and later, from China. These workers were brought on terms similar to those of the Thai workers, but while the agricultural workers tended to comply with the regulations, many of the construction workers left their designated employers and went to work illegally (Amir 2002; Ida 2012). Foreign workers were also allowed into Israel for geriatric care work, mostly from the Philippines and more recently also from Nepal, India and

---

[3] Seasonal mobilization of workers between employers has been allowed in recent years under certain conditions.

Sri Lanka. Altogether, it is estimated that at the end of 2009, there were about 130 thousand legal foreign workers in Israel and a similar number of illegal workers, comprising more than 10 percent of the workers in the private sector. In addition, in recent years, especially during 2007–2011, there has been an influx of asylum and employment seekers from Africa, crossing the border from Egypt. Their number was estimated at 20 thousand at the end of 2009, 33 thousand at the end of 2010, and 50 thousand at the end of 2011. During the second half of 2012, the number of new illegal immigrants declined sharply as a result of more intense border control activity and physical entry barriers. As of July 2013, the number of asylum and employment seekers was believed to be 54 thousand, and their influx had stopped almost completely.

Theoretically, immigration is considered a growth engine. On the other hand, immigrants compete for jobs held by local workers. In the case of Israel, foreign workers replaced low-skilled workers who had little alternative employment opportunities. Such workers join the pool of unemployed and are less likely to escape poverty. This is the main motivation for the government's attempts to reduce the number of foreign workers. A number of governmental committees set targets for reducing the number of permits for foreign workers and deporting illegal workers, but most of these efforts failed, either because of pressure exercised by employer organizations and human rights activists, or due to a lack of determination on the part of the enforcement authorities.

5. The Eckstein Committees

A committee in 2007 headed by Professor Zvi Eckstein, at the time serving as Deputy Director of the Bank of Israel, recommended reducing the number of foreign workers in agriculture to 5,000 by 2014, all of them to be employed in the far south. Another committee headed by Eckstein negotiated a deal with farmers' representatives in 2009 to gradually reduce the number of foreign workers in agriculture by about a third, to 18,900 by 2015. The reduction in the number of employment permits was conditional upon the implementation and success of accompanying policies to subsidize farmers' investments in labor-saving technologies, and invest in developing new labor-saving technologies, to subsidize the employment of Israeli workers, and to create a system of bringing seasonal foreign workers. However to date, little success has been recorded. Adoption of labor-saving technologies is slow due to farmers'

reluctance to give up their "right" to employ foreign workers in exchange for machines that only partially replace them. Employment of Israeli workers has not increased, in part because farmers have had negative experiences with similar attempts in the past, and in part because the wage subsidy is not attractive enough. A plan for bringing seasonal foreign workers from Sri Lanka was designed; it passed the pilot stage with some success, and is awaiting full implementation. The bottom line is that the number of foreign workers in agriculture has remained roughly stable over the last decade.

6. Structural changes in agriculture

After Israel declared its independence and masses of immigrants started pouring in, food security became one of the government's top priorities. Many agricultural communities (especially *Moshavim*) were established in the early 1950s and populated by immigrants. The new settlers were provided with infrastructure and professional guidance that enabled them to rely on agriculture for a living. Agricultural research was also promoted and financed by the government, and the resulting technological progress was remarkable. In the 1970s, terms of trade in agriculture began to worsen, but the prosperity of agriculture continued thanks to the opening of export markets for fruits, vegetables and flowers. This led to increased capital investments that were heavily subsidized by the government. However, the reliance on exports made farmers more vulnerable to world price fluctuations and macroeconomic conditions. The unstable economic environment brought about by high inflation in the late 1970s and early 1980s made farm incomes even more uncertain. The massive debt due to capital investments could not be serviced adequately (Kislev 1993). The development of non-agricultural manufacturing and service industries provided an alternative source of income, especially for the high-ability farmers. Out-migration from agriculture accelerated through two complementary channels: some farmers left the farm sector altogether, whereas others supplemented their income by engaging in non-agricultural activities (Kimhi 2000; Sofer 2001). The farm debt crisis that followed the 1985 economy-wide stabilization plan was a major accelerator for this process. Many farms became practically delinquent due to the high real interest rates and could no longer fulfill their role as a source of livelihood. Many cooperatives collapsed, leaving their members without the safety nets and support systems that had served them for decades (Kislev, Lerman and Zusman 1991;

Schwartz 1999). Farmers increasingly shifted to alternative income-generating activities, while some of the more productive farms were able to acquire more farm resources and expand production. Today, in most rural communities, only a handful of families are living off agriculture (Sofer and Applebaum 2006; Kimhi 2009).

Figure 1 shows the changes in the number of farm workers over the years. The number of Israeli workers, both self-employed and employees, declined sharply during the 1960s and the early 1970s.[4] This was mostly due to the fact that the immigrants of the early 1950s, who had no choice at the time but to work in agriculture, gradually found jobs in other sectors of the fast-growing economy. From the mid-1970s to mid-1980s, the numbers of both self-employed and Israeli employees remained relatively stable, in part due to the stabilization of output prices during that period as a result of the shift to export crops. This was accompanied by the employment of roughly 10,000 Palestinian workers. The number of self-employed resumed its downward trend in the late 1980s, and the number of Palestinian workers also declined during the late 1980s and early 1990s due to the First Intifada and the First Gulf War. The decline in the number of Palestinian workers was initially offset by an increase in the number of Israeli employees. The arrival of foreign workers in the mid-1990s halted the trend of the self-employed exiting agriculture, but this trend resumed in the mid-2000s, despite stabilization of output prices due to the global surge in commodity prices. At the same time, the number of Israeli hired employees increased further, and in recent years the number of Palestinian employees has started increasing as well. Altogether, the employee fraction of the agricultural labor force, which was roughly stable at just under 40% until 1990, has increased almost monotonically since then and has reached almost 80%. This is perhaps the best indicator of the structural change in agriculture that has accompanied the foreign workers' arrival.

Despite the sharp reduction in the number of farmers in general, and full-time farmers in particular, over the years, agricultural output has not shown any sign of contraction. Output growth did decelerate somewhat, from an annual rate of 3.5% between 1970 and 1991 to 2.8% between 1991 and 2012. However, the fact that output continued to grow is even more

---

[4] The number of self-employed includes unpaid family members and *Kibbutz* members. The number of unpaid family members was 14,500 in 1970 but declined steadily thereafter, until the Central Bureau of Statistics stopped reporting their numbers after 1998.

impressive given that agricultural growth in the earlier period was facilitated by an annual increase of 2.2% in farm capital stock, while this rate went down to 0.9% in the later period. Whereas growth was mostly facilitated by technical changes, another factor that allowed output to grow was the change in the crop mix. Figure 2 shows that the fraction of farmland used to grow fruits increased from 22% to 25% during the 1980s and has remained stable since then. The fraction of farmland used to grow vegetables increased throughout that period, with modest increases up to the 1980s and an accelerated growth rate during the 1990s and especially in the last decade. Figure 3 shows that the changes in cropland allocation are reflected in the output mix. Specifically, while the output of all types of crops increased during the 1960s and 1970s, only output of vegetables and non-citrus fruits has continued to grow since the 1980s. Since the production of both vegetables and fruits is labor-intensive compared to field crops, the availability of cheap hired labor may have an important role in these changes. Whereas the decline of citrus is mostly due to the relative decline in their price because of competition in the European market, it is still consistent with the labor-availability hypothesis, because the cultivation of citrus is less labor-intensive than that of many other types of fruits.[5]

Much of the increase in agricultural output was exported (Figure 4). This was particularly true for vegetables (except for the 1980s) and fruits other than citrus (except for the 1980s and 1990s). As already noted, both types of crops are perhaps most affected by the availability of foreign labor, and this may be the reason for the increase in exports. Figure 5 shows that the time profile of growth in agricultural exports was very similar to the time profile of the increased dependence on hired labor in agriculture. This does not imply causality, of course, but it does reflect the structural change that has occurred in Israeli agriculture since foreign labor was allowed to enter the country.

7. Theoretical framework

Kislev (2003) proposed a theoretical model to evaluate the impact of inflow of cheap foreign labor on the agricultural sector. It is based on a constant-returns-to-scale Cobb-Douglas production function in which an intermediate agricultural product (value added) is produced

---

[5] While citrus cultivation requires labor mostly for harvesting, cultivation of other fruits requires considerable labor input in trimming and pruning in addition to harvesting.

using operator's labor, hired labor, capital and land, and a fixed-proportions technology that transforms this intermediate product into a final agricultural product, using purchased inputs such as water, fertilizers and pesticides. The agricultural sector is in equilibrium, and the equilibrium is perturbed when migrant workers offer their services as hired labor for lower wages. This leads to an increase in the use of hired labor and an increase in capital investments on each farm, both leading to higher farm production and larger farms. In the long-run industry equilibrium, production, capital and use of hired labor will be higher, but due to the inflow of migrant workers, the use of local hired labor will decline. Farms will grow in size, and this will lead to a decline in the number of farms, except for a case in which the local demand for agricultural products is sufficiently elastic, or when a sufficiently large fraction of output is exported. Prices of locally consumed agricultural products will be lower, and exports of exportable products will be higher. Provided that the alternative income of farm operators remains the same, their profits will not change in the long run. In the short run, however, profits may go down until the number of farms adjusts.

Kislev (2003) relies on the presumption that the arrival of migrant workers who are paid lower wages (at least in terms of efficiency units) will drive down the wage of local hired labor. However, given that the number of migrant agricultural workers is subject to a quota and that the quota is binding in the sense that the demand for these workers is higher than the supply, the marginal hired worker is still a local worker that is paid the on-going local wage. If the local wage does not change, each migrant worker simply replaces a local worker, and there will be no change in agricultural production. This could happen if the supply of local farm workers is perfectly elastic, which is the case depicted in panel (a) of Figure 6. The local labor supply curve AB is perfectly elastic, the aggregate demand curve for agricultural labor is CD, and the initial equilibrium wage and number of workers are A and h_0, respectively. An inflow of EF migrant workers, who are willing to work for a lower wage, changes the supply curve to EFGB. As long as EF is smaller than h_0, the equilibrium wage and number of workers do not change, and the migrant workers simply replace local workers. Production does not change, but farmers enjoy a rent, equal to the area AEFG, for having access to the quota of migrant workers. In the long run, existing and potential farmers will compete for the quota, and the way it is allocated may affect the structure of the industry. This is, however, beyond the scope of the current analysis, and

hence it is assumed, for simplicity, that there exists a market mechanism that divides the quota equally among all farmers and farmers pay the entire rent resulting from the quota, so that it does not affect their profits.

Of course, the fact that migrant workers drive local workers out of employment in agriculture could dampen the local wage, if the local labor supply is not perfectly elastic. This case is exposited in panel (b) of Figure 6. Here, the initial supply of hired labor is EH, and a similar inflow of migrant workers changes it to EFI. As a result, the local wage declines to w_1 and the number of workers increases to h_1, so that fewer local workers lose their jobs compared to the case in which the supply of workers is perfectly elastic. Farm size (in terms of value added) increases because of the lower cost of labor, the supply of agricultural products increases as well, and unless the demand for agricultural products is perfectly elastic, the price of output will go down. With lower output prices, the demand for hired labor declines to C'D', and the new equilibrium will be at (h_2, w_2).

The question is, which of these two scenarios more closely reflects reality? According to the most recent published data (State of Israel 2014), Israeli employees in agriculture are paid on average 46% above the official minimum monthly wage. Moreover, 54% of those employees define their occupation as skilled workers in agriculture, and an additional 11% define their occupation as unskilled workers. These are the two types of occupations that are potentially subject to competition from migrant workers in agriculture. As of 2013, there are 33,000 foreign workers in agriculture, a third of whom are Palestinians. Recall that Palestinians used to work in Israeli agriculture prior to the arrival of the migrant workers, and that the migrants were initially brought to replace them. Nevertheless, suppose that all 22,000 migrant workers are taking the jobs of local workers. Those 22,000 local workers, who supposedly lost their jobs, are now competing with 425,000 skilled workers and 208,000 unskilled workers in other industries. Even if the unskilled workers are the most affected by this competition, their gross monthly wage in 2012 was 4,675 NIS on average, not much higher than the official minimum wage of 4,300 NIS, so this competition could not lead to considerably lower wages paid to local agricultural workers.[6]

---

[6] Buccola, Li and Reimer (2012) found agricultural labor supply to be highly elastic in Oregon.

To summarize this simple model, the availability of a limited number of cheap migrant workers will not change agricultural production if the supply of local workers is perfectly elastic as in panel (a) of Figure 6. Let us continue with the less straightforward case depicted in panel (b), where the supply of local workers is upward-sloping. Recall that the migrant workers compete with at most 65% of hired employees in agriculture, while the other 35% include mostly drivers and equipment operators (15%), office workers (9%), and sales workers (3%). It might be useful, then, to consider hired workers in agriculture as composed of two types, only one of them substitutable by migrant labor. Let us denote this type as unskilled workers, as opposed to skilled workers, and consider the two types of workers as two separate inputs in agricultural production. For simplicity, let us focus on unskilled workers and bundle all other inputs, including skilled workers, as a composite input.

Following Kislev (2003), this is illustrated using a Cobb-Douglas example. Each farm produces value added (Q), whose "price" is z, with unskilled labor (H), earning a wage w, and a composite input K, whose price is r, according to the function $Q = AH^{\alpha}K^{\beta}$, where $\alpha+\beta<1$ due to the existence of fixed inputs such as operator's labor.[7] The first-order conditions for profit maximization are:

(1) $z\alpha AH^{\alpha-1}K^{\beta} = w$

(2) $z\beta AH^{\alpha}K^{\beta-1} = r$

These can be rearranged to give:

(1)' $H = [(z/w)\alpha AK^{\beta}]^{1/(1-\alpha)}$

(2)' $H = [(r/z\beta A)K^{1-\beta}]^{1/\alpha}$

In Figure 7, the intersection of (1)' and (2)' determines the optimal input quantities H_0 and K_0 and value added $Q_0 = Q = AH_0^{\alpha}K_0^{\beta}$, for a given output price z. According to (1)', a decrease in w increases the optimal value of H for every given level of K. Hence, the curve (1)' rotates upward

---

[7] Some consider land and water as fixed inputs at the farm level, because farmland and freshwater quotas have been historically allocated among farms. Sales and rentals of farmland are not allowed, and the water quota has no formal market either. However, in practice, it is quite common to informally rent land and water quotas. Kislev (2003) claims that not all farmland is cultivated at the aggregate level, but this is difficult to quantify because of multiple cropping patterns that may change over time. Water quota has become less relevant in recent years because of the availability of desalinated and recycled water.

to (1)'', raising optimal input quantities to H_1 and K_1 and value added to $Q_1 = Q = AH_1^{\alpha}K_1^{\beta}$. The rest of the scenario depends on the elasticity of demand for agricultural products. If demand is perfectly elastic, as in the case of exportable products, farm profitability, perhaps in the form of returns on the fixed inputs (including operator's labor), increases, and new producers will enter the market in the long run. If demand is perfectly inelastic, output price will decline to a point at which the quantity produced does not change. Since farm profits at this point are smaller than in the original situation (see appendix), farms will exit the market, so that in the new equilibrium, the same output will be produced by a smaller number of larger farms.

This analysis, which deals with the case of imperfectly elastic supply of unskilled labor, can be summarized by the following conclusions:

(C1) The inflow of migrant workers always leads to an increase in farm size.

(C2) It also leads to higher aggregate agricultural production, as long as the demand for agricultural products is not perfectly inelastic.

(C3) It leads to lower prices of agricultural products, as long as the demand for them is not perfectly elastic.

(C4) There is some threshold of output demand elasticity above which the inflow of migrant workers leads to an increase in the number of farms.

The implication of (C4) is that if the farm sector includes farms that specialize in export-oriented crops and other farms that specialize in locally consumed crops, the former group is likely to expand in number relative to the latter. At the same time, existing farms can switch from locally consumed crops to export-oriented ones, if local conditions permit.

Recall that according to Figure 7, the quantity of the composite input K increases in the case of perfectly elastic demand. In the case of perfectly inelastic demand, it can be shown (see appendix) that this quantity does not change in the long run, so that the increase in output is solely due to the increase in hired unskilled labor. This leads to the following conclusion:

(C5) As long as demand is not perfectly inelastic, the quantity of the composite input increases in the long run.

Recall that the composite input is an aggregate of capital, land, skilled labor, etc. Within these specific inputs, some could be complements to unskilled labor while others could be substitutes. Those that are complements to unskilled labor are more likely to increase with the decrease in

wage, whereas those that are substitutes are more likely to decrease. Therefore, the direction of change in the quantity of each input depends on (a) the elasticity of the demand for output and (b) the degree of substitutability or complementarity with unskilled labor.

8. Is the theory supported by the data?

A simple confrontation of the theory with data can be performed by comparing changes in the relevant observable quantities before and after the arrival of foreign workers. Table 1 reports average annual rates of change by decade. An increase in the number of migrant workers is evident in the 1970s (Palestinian), 1990s (Thai) and to a lesser extent in the 2000s (both Thai and Palestinian). In addition, during the 1970s, the wage of Israeli workers in agriculture (normalized by the wage of workers in manufacturing) did not change, while their number declined. This is consistent with the scenario in which the supply of local labor is perfectly elastic. During the 1990s, however, the wage of hired Israelis declined but their number went up. Here the assumption of perfectly elastic labor supply does not hold, but the increase in the number of workers is consistent with the assumption that skilled agricultural workers are complementary in production to unskilled workers. During the 2000s, both the number of hired Israeli workers and their wage increased. The wage increase could be due to increased reliance on skilled workers whose wage is higher, as a result of an increase in farm size and mechanization.[8] Altogether, there is weak support for the claim that migrant workers are replacing hired Israelis. Perhaps it was true in the 1970s, but in recent years, the evidence shows the opposite.

Farm size itself increased throughout the period of investigation, at a rate that is, not surprisingly, negatively correlated with the rate of decrease in the number of farms. The number of self-employed in agriculture, which serves as a proxy for the number of farms, has an overall downward trend. The decline was very modest in the 1970s, when output prices went up. It went down more sharply in the 1980s, when output prices declined, and even more so in the 1990s, when output prices continued to decline and the number of migrant hired workers increased

---

[8] The increase in the number of hired Israelis in agriculture could be, at least in part, a statistical artifact due to the privatization of some of the *Kibbutz* collectives. It could be that *Kibbutz* members who worked in agriculture were considered self-employed before privatization and as hired employees afterwards.

sharply. The rate of decrease in the number of farms was still high in the 2000s, despite the increase in output prices, perhaps due to the continued increase in the number of hired workers, both local and migrant, and the increase in farm size. The comparison of the 1990s, with a sharp increase in the number of migrant workers, with the 1980s, having no such increase, is consistent with the theoretical conclusion that the inflow of migrant labor increases farm size. The fact that there is also a higher rate of farm exits in the 1990s is consistent with the demand for agricultural products being relatively inelastic, which indicates production mostly for the local market.

Farm capital stock increased in the 1960s and 1970s for reasons that are perhaps not related to the availability of foreign labor. It declined in the 1990s despite the inflow of foreign workers, perhaps as a result of the financial crisis of the late 1980s, and resumed its increase in the 2000s. Overall, farm capital shows signs of substitutability with labor in some periods and complementarity with labor in others. Combining this with the earlier conclusion that in the 2000s, skilled labor became more important than unskilled labor, it makes sense that farm capital is a substitute for unskilled labor and a complement for skilled labor.[9]

The rate of growth of farm output was highest during the 1960s due to the heavy capital investments, and declined monotonically throughout the period without showing any relation to the changes in size and composition of the labor force. However, agricultural exports, which declined somewhat in the 1980s, increased more than 5% annually during the 1990s and the 2000s, despite a more modest increase in farm output as a whole. Note that the increase in exports in the 1990s occurred despite a decrease in the price of exports, compared to both the consumer price index and the prices of agricultural products in the domestic market. The increase in exports could be related to the inflow of migrant workers, which was accompanied by an increase in the number of hired skilled local workers. However, with more of the agricultural output directed to export markets, the overall demand elasticity is expected to increase, and this should lead, according to the model's predictions, to a slowdown in the rate of farm exits, but this did not happen.

---

[9] Recall that farmers have not responded overwhelmingly to the subsidy offered for capital investments in recent years in return for giving up part of the quota for migrant workers, but this could be because in general, farmers do not trust the policies of the Ministry of Agriculture.

9. Discussion

The growth in Israeli exports of fresh produce in the last two decades and especially in the last decade is reasonably linked to the inflow of migrant workers. The workers from Thailand turned out to be much more than a source of cheap labor that competes with local low-skilled workers. They allowed farms to expand their marketing efforts overseas and specialize in crops that are in demand there. They also allowed farms to expand within-farm labor specialization, with farm operators and hired Israelis performing mostly managerial tasks and supervision, and Thai workers doing the manual tasks. The question is why all of this did not happen when it was only Palestinians working in agriculture. The reason might be related to the reliability of the workers. Palestinians were not allowed to stay overnight, and their long commute did not allow their employers to use them flexibly. In addition, Palestinians worked on a daily basis, relied on contractors to drive them to the farm, and farmers could never know for sure how many workers would show up each day, especially on rainy days. Thai workers, in contrast, reside on the farm, are always willing to work longer hours if needed, and perhaps more importantly, are not allowed to switch employers easily. They turned out to be very reliable and farmers knew with much better certainty how long it would take to accomplish a certain task and what the quality of the work would be. All of this allowed farmers to adopt precision cultivation methods that helped them satisfy the strict requirements of overseas wholesalers, enter overseas markets with larger quantities, and offer a more diversified produce portfolio. This, in turn, contributed to export growth.

Although it was not possible to establish the association between the availability of migrant workers and the increase in exports empirically, much of the evidence points in that direction. Vegetable exports increased more than that of fruits, perhaps because precision agriculture is more important for vegetables. A large proportion of the vegetables are grown in greenhouses, and they tend to have a shorter shelf life compared to most fruits. Among fruits, citrus export did not increase, perhaps because citrus cultivation does not depend as much on labor as other fruits, requiring mass labor input only for harvesting. A more disaggregated analysis of exported crops could potentially strengthen the precision agriculture hypothesis.

The analysis also pulls the rug out from under the argument that foreign workers in agriculture drive the local farm workers out of the market. First, higher labor specialization

actually creates jobs for hired Israelis who are able to assume managerial and supervision positions. Second, Thai and Israeli workers are not perfect substitutes even in manual unskilled tasks, because of the Thai worker's willingness to work long and irregular hours. Finally, all government attempts to support the employment of Israeli farm workers have largely failed, although the jury is still out on the latest programs.

In addition, the farm labor specialization enhanced by the availability of migrant workers contributed to productivity enhancements that allowed Israeli produce to compete successfully in export markets on the one hand, and kept local prices of farm produce relatively low on the other. These low prices clearly benefit all, but especially low-income consumers, and at least partially compensate for the job losses of local unskilled farm workers. Moreover, the development of agriculture creates more jobs for skilled agricultural workers, as well as jobs in other industries that provide inputs or services to agriculture. Finally, farm-labor specialization allowed ageing farm operators to concentrate on managerial tasks, thereby allowing them to continue running the farm even in the absence of successors. Note that this last point is not necessarily beneficial in the long run, because the fact that operators keep running the farms may depress the availability of successors even further (Kimhi 1995).

The bottom line is that using the services of Thai workers in agriculture is largely irreversible. Farms have gone through structural changes and have adopted crop portfolios and cultivation methods that are specifically suited to the availability of migrant workers, and if these workers are no longer available, many of the farms will simply go out of business. As opposed to most other industries in Israel, labor productivity in agriculture is comparable to that of other developed countries (Ben-David 2013), and this is evidence of the competitiveness of Israeli agriculture. The success of agriculture in penetrating export markets should be imitated by other industries, and allowing migrant labor to come in legally for a specified period is a price that might be worth paying.

Appendix: Implications of the decrease in unskilled labor wage when output demand is perfectly inelastic

Solving (1) and (2), one obtains the optimal input demanded and output supplied for given input and output prices:

(A1) $H = [zA(\alpha/w)^{1-\beta}(\beta/r)^{\beta}]^{1/(1-\alpha-\beta)}$

(A2) $K = [zA(\alpha/w)^{\alpha}(\beta/r)^{1-\alpha}]^{1/(1-\alpha-\beta)}$

(A3) $Q = [z^{\alpha+\beta}A(\alpha/w)^{\alpha}(\beta/r)^{\beta}]^{1/(1-\alpha-\beta)}$

Q_0 is obtained for prices (w_0,r,z_0), while Q_1 is obtained for prices (w_1,r,z_1). When the demand for Q is perfectly inelastic, and the number of farms is fixed, $Q_1=Q_0$. Using (A3), it can be shown that prices adjust so that:

(A4) $z_1 = (w_1/w_0)^{\alpha/(\alpha+\beta)}z_0$

Farm profit is $\pi=zQ-wH-rK$. Using (A1)–(A3), and defining $\delta=1/(1-\alpha-\beta)$, one obtains:

(A5) $\pi = (zAw^{-\alpha}r^{-\beta})^{\delta}[(\alpha^{\alpha}\beta^{\beta})^{\delta} - (\alpha^{1-\beta}\beta^{\beta})^{\delta} - (\alpha^{\alpha}\beta^{1-\alpha})^{\delta}]$

π_0 is obtained for prices (w_0,r,z_0), while π_1 is obtained for prices (w_1,r,z_1). Using (A5) and (A4), it can be shown that farm profits change at the same rate as output prices:

(A6) $\pi_1 = (w_1/w_0)^{\alpha/(\alpha+\beta)}\pi_0$

since $w_1<w_0$, $\pi_1<\pi_0$. In the long run, farms will exit until profits return to their original level. Using (A5), it can be shown that for π_1 to be equal to π_0, output price will have to increase so that:

(A7) $z_1 = (w_1/w_0)^{\alpha}z_0$

This is clearly below the original price z_0 and above the short-run price in (A4). Using (A1) and (A2), it can be shown that in the long run,

(A8) $H_1 = (w_0/w_1)H_0$

(A9) $K_1 = K_0$.

References

Amir, Shmuel (2002). "Overseas Foreign Workers in Israel: Policy Aims and Labor Market Outcomes." *International Migration Review*, 36(1): 41-57.

Angrist, Joshua D. (1996). "Short-Run Demand for Palestinian Labor." *Journal of Labor Economics*, 14(3), pp. 425-453.

Bartram, David V. (1998). "Foreign Workers in Israel: History and Theory." *International Migration Review*, 32(2), 303-325.

Ben-David, Dan (2013). "Labor Productivity in Israel." in Dan Ben-David (ed.), *State of the Nation Report: Society, Economy and Policy in Israel 2013*, Taub Center for Social Policy Studies in Israel, pp. 95-113.

Blanc, M., Cahuzac, E., Elyakime, B. and Tahar, G. (2008). "Demand for on-farm permanent hired labour in family holdings." *European Review of Agricultural Economics* 35(4), 493-518.

Buccola, Steven, Cheng Li and Jeffrey Reimer (2012). "Minimum Wages, Immigration Control, and Agricultural Labor Supply." American Journal of Agricultural Economics 94 (2), 464-470.

Findeis, J. L. (2002). Hired farm labour adjustements and constraints. In J. L. Findeis, A. M. Vandeman, J. M. Larson and J. L. Runyan (eds), *The Dynamics of Hired Farm Labour Constraints and Community Responses*. Cambridge, MA: CABI Publishing, pp. 3–15.

Gibson, John, and David McKenzie (2014). **"**The Development Impact of a Best Practice Seasonal Worker Policy." *Review of Economics and Statistics* 96(2), 229-243.

Hennebry, Jenna L. and Kerry Preibisch (2012). "A Model for Managed Migration? Re-Examining Best Practices in Canada's Seasonal Agricultural Worker Program." *International Migration* 50(s1), e19-e40.

Hertz, Tom and Steven Zahniser (2012). "Is There A Farm Labor Shortage?" *American Journal of Agricultural Economics*, 95(2), 476–481.

Hess, Sebastian, Stephan von Cramon-Taubadel, Ulrike Zschache, Ludwig Theuvsen and Daniela Kleinschmit (2012). "Explaining the puzzling persistence of restrictions on seasonal farm labour in Germany." *European Review of Agricultural Economics* 39(4), 707-728.

Ida, Yoram (2012). *Reforming Foreign Worker Employment in Israel: Transitioning from the Restrictive Employment Arrangement to the Corporations Arrangement*, Policy Paper No. 2012.03, Jerusalem: Taub Center for Social Policy Studies in Israel.

Kimhi, Ayal (1995). "Differential Human Capital Investments and the Choice of Successor in Family Farms." *American Journal of Agricultural Economics* 77(3), 719-724.

Kimhi, Ayal (2000). "Is Part-Time Farming Really a Step in the Way Out of Agriculture?" *American Journal of Agricultural Economics*, 82, 38-48.

Kimhi, Ayal (2009). "Heterogeneity, Specialization and Social Cohesion in Israeli Moshav Cooperatives." *Journal of Rural Cooperation*, 37, 124-136.

Kislev, Yoav (1992). "Family Farms, Cooperatives and Collectives." In *Sustainable Agricultural Development: The Role of International Cooperation*, Eds. G.H. Peters and B.F. Stanton, Aldershot, England: Dartmouth, p. 520-530.

Kislev, Yoav (1993). "Experience with Collective Action and Cooperation in Agriculture in Israel." In *Agricultural Cooperatives in Transition*, Eds. Csaba Csaki and Yoav Kislev, Boulder, Colorado: Westview Press, p. 269-290.

Kislev, Yoav (2003). *Foreign Labor and Farm Structure*. Unpublished Manuscript, available at http://departments.agri.huji.ac.il/economics/teachers/kislev_yoav/yoav-f-labor.pdf (accessed October 17th, 2014).

Kislev, Yoav, Zvi Lerman, and Pinhas Zusman (1991). "Recent Experience with Cooperative Farm Credit in Israel." *Economic Development and Cultural Change*, 39, 773-789.

Kislev, Yoav, and Shaul Zaban (2013). Statistical Abstract of Israeli Agriculture 2013 (Hebrew). Unpublished Manuscript, available at http://departments.agri.huji.ac.il/economics/teachers/kislev_yoav/atlas2013.pdf (accessed October 17th, 2014).

Lucas, Robert E., Jr. (2004). "Life Earnings and Rural- Urban Migration." *Journal of Political Economy* 112(1), S29-59.

Malchow-Møller, Nikolaj, Jakob Roland Munch, Claus Aastrup Seidelin and Jan Rose Skaksen (2013). "Immigrant Workers and Farm Performance: Evidence from Matched Employer-Employee Data." *American Journal of Agricultural Economics* 95(4), 819-841.

Martin, Philip (2012). "Immigration and Farm Labor: Policy Options and Consequences." *American Journal of Agricultural Economics* 95(2), 470–475.

Miaari, Sami H. and Robert M. Sauer (2011). "The Labor Market Costs of Conflict: Closures, Foreign Workers, and Palestinian Employment and Earnings." *Review of Economics of the Household*, 9(1), 129–148.

Migration Advisory Committee (2013). "Migrant Seasonal Workers: The impact on the horticulture and food processing sectors of closing the Seasonal Agricultural Workers Scheme and the Sectors Based Scheme." https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/257242/migrant-seasonal-workers.pdf (accessed October 17th, 2014).

Mundlak, Yair (2005). "Economic Growth: Lessons from Two Centuries of American Agriculture." *Journal of Economic Literature* 43(4), 989-1024.

Napasintuwong, Orachos, and Robert D. Emerson (2006). *Immigrant Workers and Technological Change in U.S. Agriculture: A Profit Maximization Approach of Induced Innovation*. Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia.

Rickard, Bradley J. (2014). *On the Political Economy of Guest Worker Programs in Agriculture*. WP 2014-10, Charles H. Dyson School of Applied Economics and Management, Cornell University.

Schwartz, Moshe (1999). "The Rise and Decline of the Israeli Moshav Cooperative: A Historical Overview." *Journal of Rural Cooperation*, 27, 129-166.

Sofer, Michael (2001). "Pluriactivity in the Moshav: Family Farming in Israel." *Journal of Rural Studies*, 17, 363-375.

Sofer, Michael, and Levia Applebaum (2006). "The Rural Space in Israel in Search of Renewed Identity: The Case of the 'Moshav'." *Journal of Rural Studies*, 22, 323-336.

State of Israel, Central Bureau of Statistics (2014). *Statistical Abstract of Israel 2014*, No. 65. Jerusalem: State of Israel.

Taylor, J. Edward, Stephen R. Boucher, Aaron Smith, Peri L. Fletcher, and Antonio Yúnez-
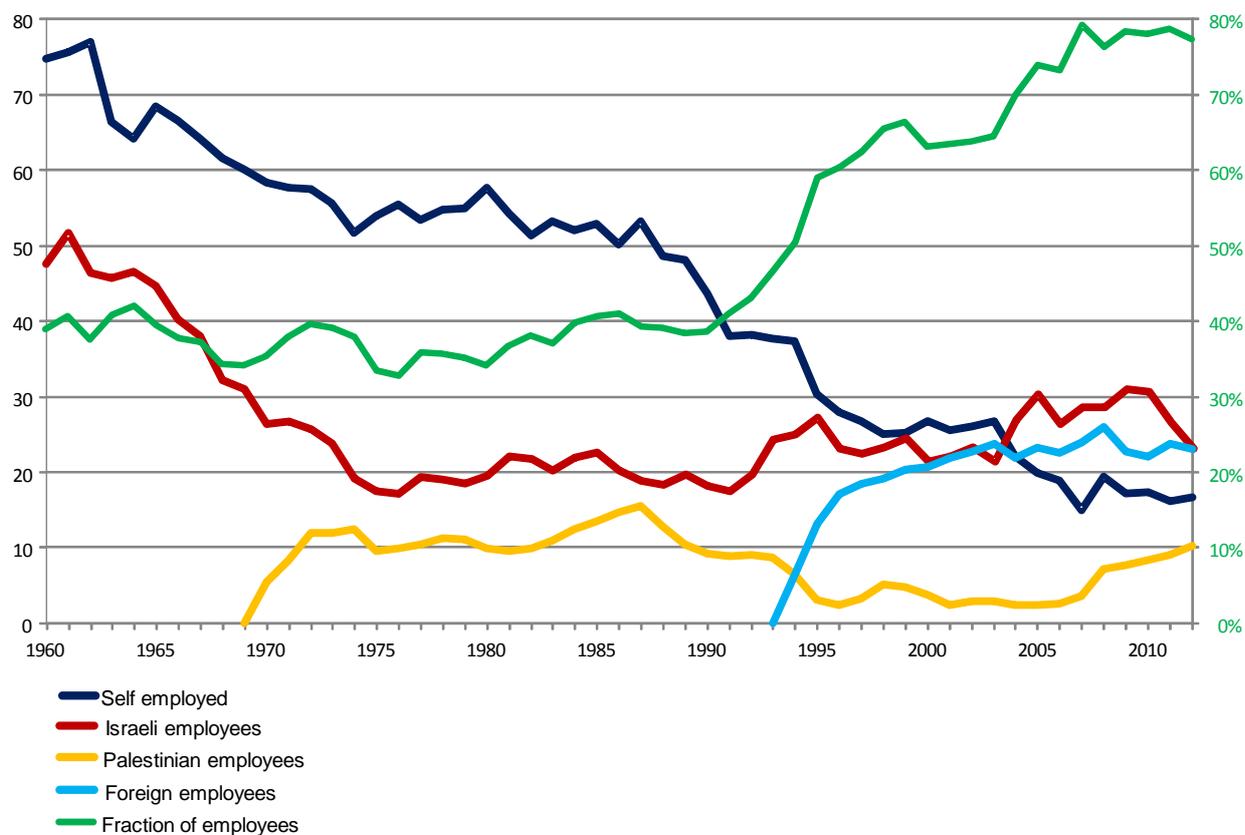Naude (2012). "Immigration and the US Farm Labour Supply." Migration Letters 9(1),
87-99.

Figure 1. Workers in agriculture by work status and nationality (thousands)

Source: Israeli Central Bureau of Statistics, Statistical Abstract of Israel (various years)
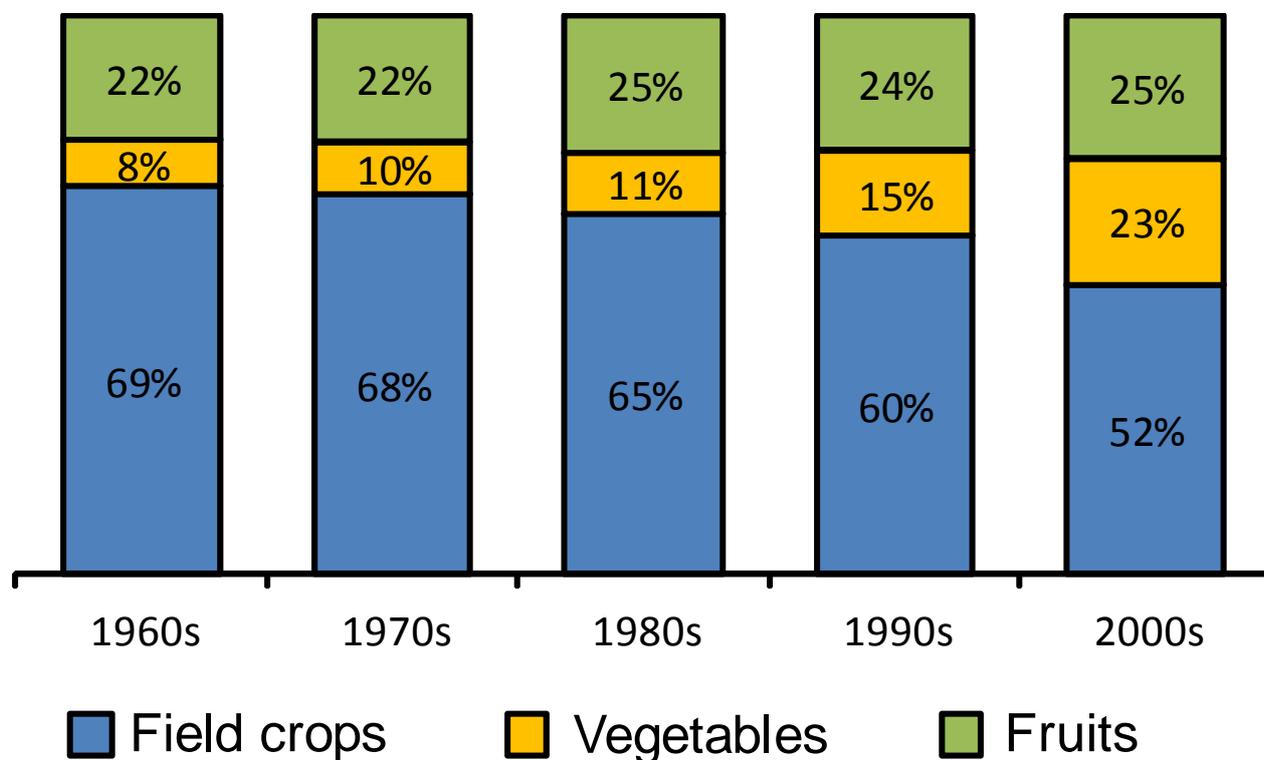
Figure 2. Cropland allocation by major crop categories

Source: Israeli Central Bureau of Statistics, Statistical Abstract of Israel (various years)

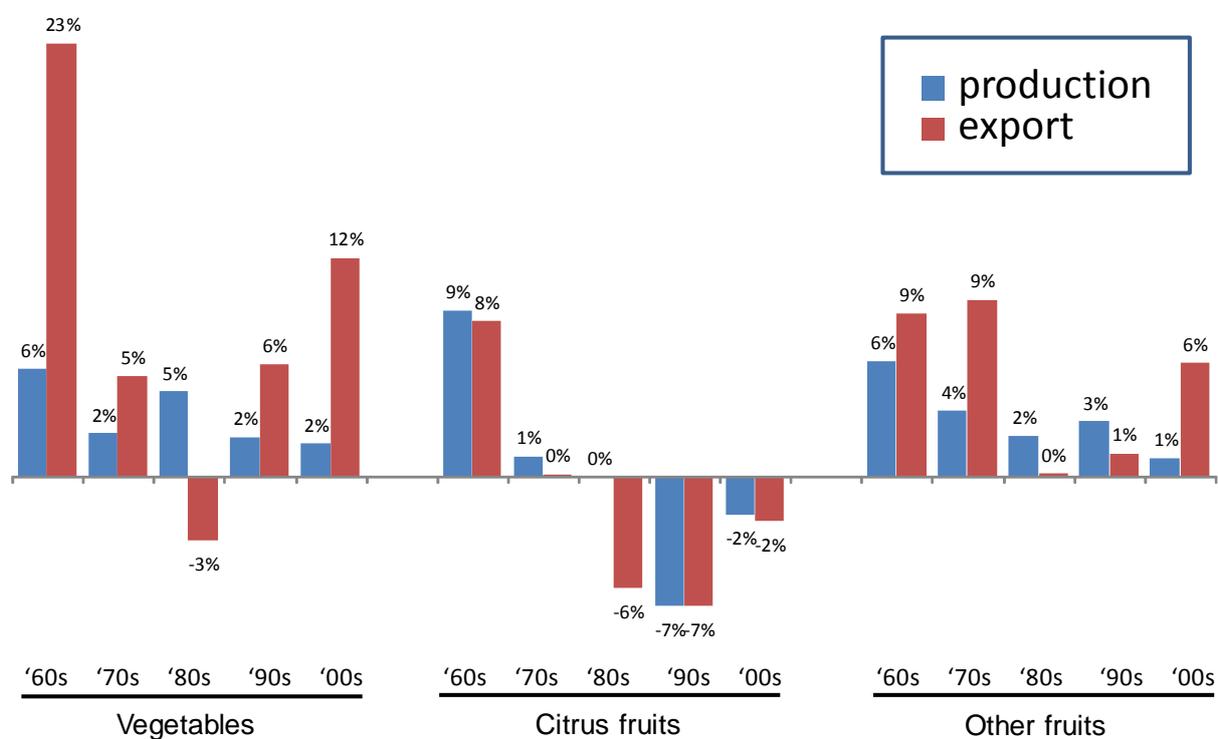Note: Cropland allocated to flowers and nurseries is excluded because of the lack of recent data. In 1999, the last year for which data are available, the excluded category was 1.5% of cropland.
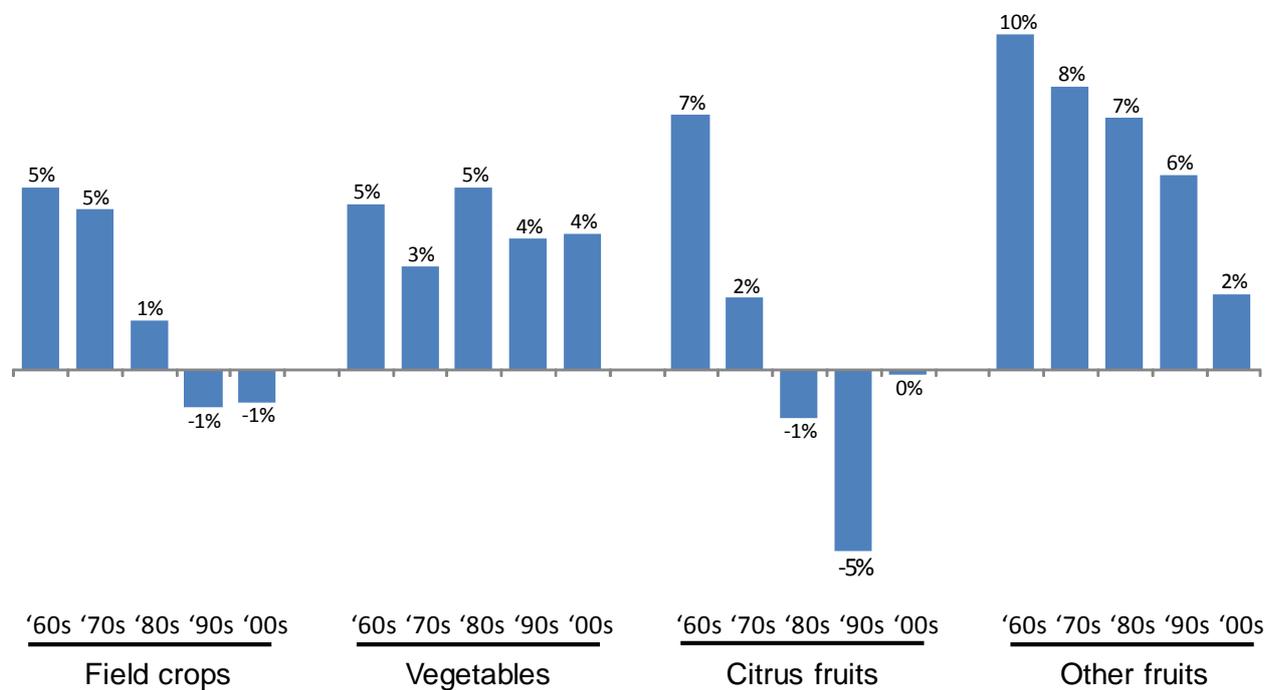
Figure 3. Average annual increase in quantity produced by major crop categories

Source: Israeli Central Bureau of Statistics, Statistical Abstract of Israel (various years)

Figure 4. Average annual increase in the value of production and export by major crop categories (excluding field crops)

Source: Israeli Central Bureau of Statistics, Statistical Abstract of Israel (various years)
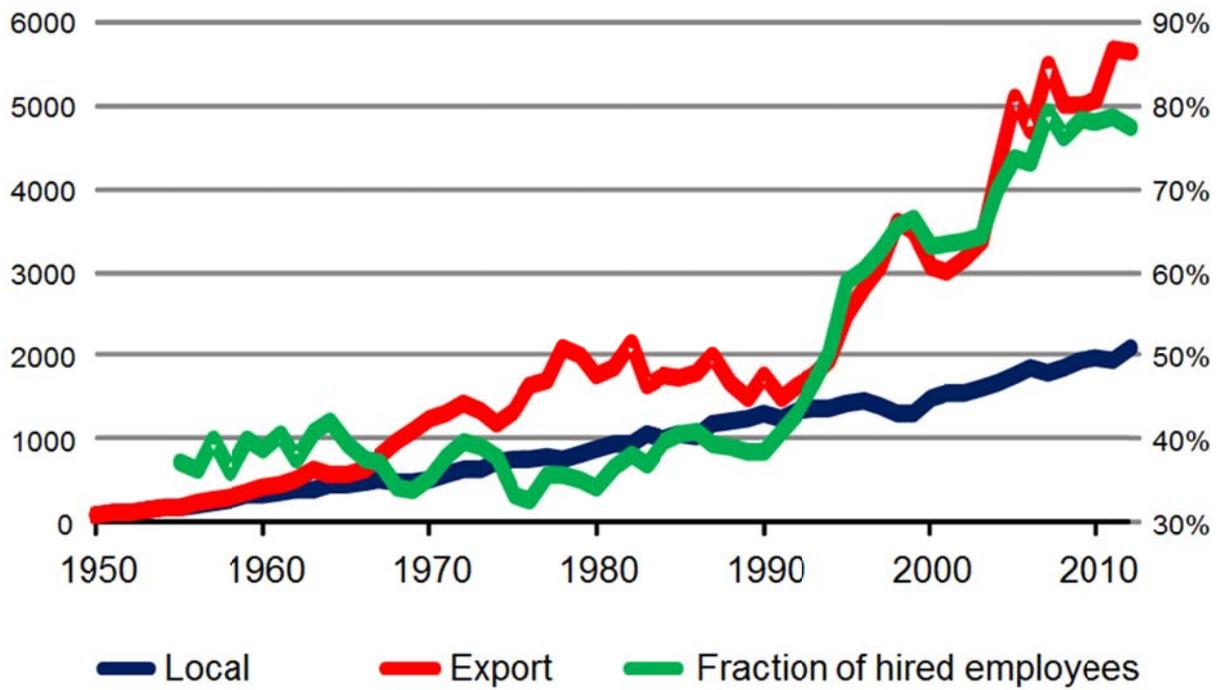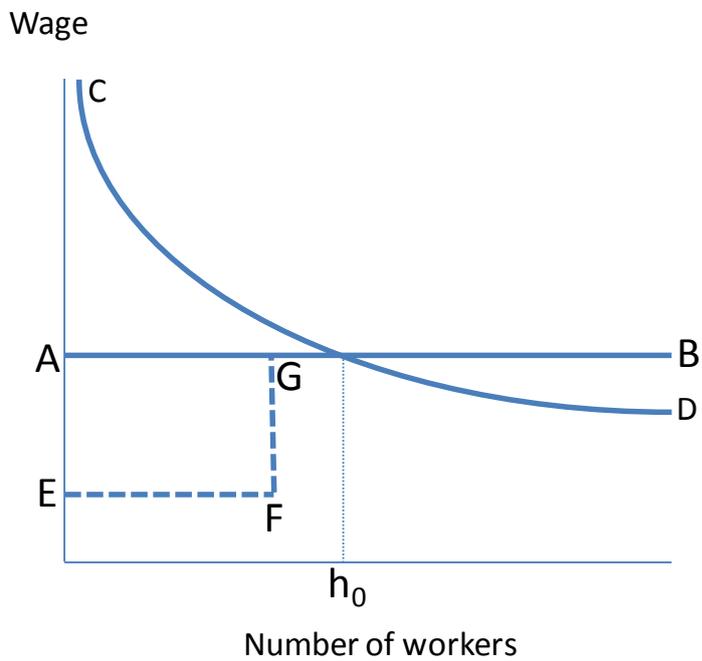
Figure 5. Index of output value (domestic and exports) and the fraction of hired employees

(a) Local labor supply is perfectly elastic

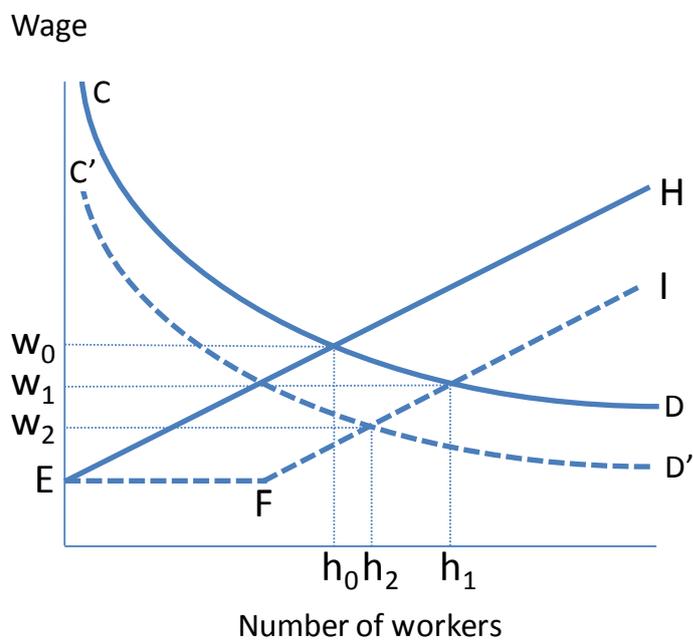

(b) Local labor supply is not perfectly elastic

Figure 6. The effect of introducing a quota of cheap migrant farm workers
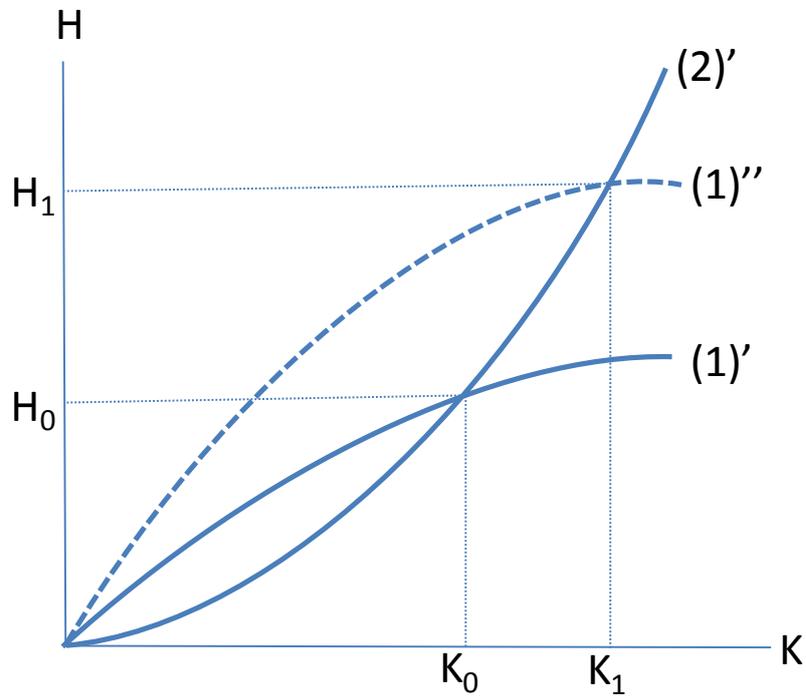
Figure 7. The effect of a decrease in the wage of hired farm workers

Table 1. Average Annual Changes in Selected Variables by Decade

Variable	1960s	1970s	1980s	1990s	2000s
Migrant labor	---	6.1%	-0.7%	10.2%	2.2%
Hired Israeli wage	1.0%	0.0%	-0.9%	-1.2%	0.7%
Hired Israelis	-5.7%	-3.0%	-0.8%	1.7%	3.6%
Farm size	8.9%	6.7%	9.6%	11.3%	8.5%
Self-employed	-2.5%	-0.1%	-2.7%	-4.8%	-4.3%
Real output price	-1.8%	0.6%	-4.2%	-4.2%	1.1%
Capital stock	4.4%	2.8%	0.6%	-1.1%	1.8%
Farm output	6.4%	4.8%	3.0%	2.5%	2.2%
Agricultural exports	11.1%	3.5%	-0.1%	5.8%	5.2%
Export price index	-1.1%	0.0%	-3.1%	-5.1%	4.3%
Domestic price index	-2.3%	0.9%	-4.8%	-3.9%	-0.4%

Sources: Kislev and Zaban (2013); Statistical Abstracts of Israel (various years).