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Implications of labor supply specifications in CGE models: a demonstration for employment of Palestinian labor in Israel and its impact on the West Bank economy

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Abstract

Results of general equilibrium models are sensitive to model parameterization and specification. The role of macroeconomic closures and the effect of trade elasticities are documented in the literature, but there is no systematic analysis of the implications of different labor supply specifications for the effect of shocks to labor markets. This study analyzes these implications, using data for the West Bank economy and a general equilibrium model with four different labor market specifications. The findings indicate that increased Palestinian employment in Israel leads to changes in real GDP in the range of -1.8% to +3.4%, depending on the model specification. This wide range of effects on macroeconomic aggregates stems from the definition of the production boundary, the implicit assumptions on the opportunity cost of labor in activities outside the production boundary, and the conditions for a transfer of labor across the boundary. Economic theory indicates that the labor-leisure trade-off is the most consistent framework for modeling labor supply decisions. However, in the absence of data for activities outside the SNA boundary, the full-employment assumption may be the second-best alternative, although it risks overstating the changes in real wage rates. The surplus labor and upward-sloping labor supply curve specifications both tend to understate the increases in wage rates and overstate the welfare gains.

Key words: Labor-leisure, labor mobility, production boundary, unemployment, general equilibrium models, Palestine

JEL Codes: D13, D58, E24, J21, J22, J60

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Acronyms	Definition
CBS	Israeli Central Bureau of Statistics
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
CPI	Consumer Price Index
EV	Equivalent Variation
GAMS	General Algebraic Modelling System
GDP	Gross Domestic Product
GE	General Equilibrium
ISWGNA	Intersecretariat Working Group on National Accounts
PCBS	Palestinian Central Bureau of Statistics
RGHs	Representative Household Groups
SAM	Social Accounting Matrix
SNA	System of National Accounts
STAGE	Static Applied General Equilibrium model
VAT	Value Added Tax

1 Introduction

Labor markets are critical to the functioning of economic systems and the generation of welfare; but they are complex and involve interactions in and between multiple agents in many markets. Hence, it is arguable that many aspects of labor market analyses have general equilibrium (GE) implications; indeed, labor markets are key components of GE models. Computable General Equilibrium (CGE) models therefore provide a laboratory for analyzing the implications of different characterizations of labor markets. However, while the implications of different macroeconomic closure settings have been extensively explored (see Rattsø, 1982; Robinson, 1991), different specifications of labor market behavior have been less well examined, although different labor market specifications have been developed (for an overview see Boeters and Savard, 2011).

Analyses of labor markets are complicated by the fact that labor is used in activities that are components of measured economic activity, e.g., GDP, absorption, etc., in the national accounts and in activities not included in the national accounts, e.g., social reproduction and leisure. In the System of National Accounts (SNA) (see ISWGNA, 2009) measured economic activity and the size of the labor force (ISWGNA, 2009, paragraphs 19.16 – 19.19, pp 406-8) is defined by reference to the SNA production boundary (ISWGNA, 2009, paragraphs 6.23 - 6.49, pp 97-100). However, the SNA recognizes that a substantial part of economic activity takes places outside the SNA production boundary but within a wider *general* production boundary. Households supply labor to activities within and outside the production boundary and changes in incentives induce households to adjust their allocations of labor services across the SNA boundary (see McDonald, 2018 for a review).

A standard CGE specification for the labor force, employed and unemployed, within the SNA production boundary assumes the total labor supply is fixed. Other approaches allow for flexible labor supplies, by moving labor across the SNA production boundary by changing the quantity of labor "not in the labor force" (ISWGNA, 2009, paragraph 19.17). The production boundary in a CGE model defines the demarcation between the economic transactions that are endogenous and those that are exogenous; this boundary may be the SNA boundary or some other model specific boundary. If the model departs from the SNA boundary there are implications for the definition of macroeconomic aggregates and for welfare analysis. Conventionally, macroeconomic aggregates, e.g., absorption and GDP, are defined with reference to goods and services produced and consumed within the SNA boundary. However, households also derive utility from services produced outside the SNA boundary, e.g., social reproduction and leisure. Arguably, therefore a full accounting of welfare effects needs to include effects within and outside the SNA boundary, especially when there are transfers of labor across the production boundary. When a policy shock leads to increases in wage rates within the production boundary, households may allocate more labor within the SNA boundary, generating an increase in measured activity (GDP), and less outside, generating a reduction in welfare generated outside the boundary. Therefore, positive and negative welfare effects occur. Limiting the analysis to what happens within the SNA production boundary may miss important components of the net welfare effects.

This paper reports an investigation of the implications of four different labor supply specifications and the consequences resulting from limiting the analysis to what happens within the production boundary. The specifications of the labor supply are: i) fixed supply, ii) surplus labor, iii) upward-sloping labor supply curve, and iv) labor-leisure trade-off. These specifications could be used in most CGE models given an adequate database. The demonstration of the implications of labor supply specifications for simulation results uses data for the West Bank. The magnitude of the results depends on the specific case, but the conclusions have relevance for the specification of labor supply in CGE models in general.

The choice of the West Bank for this study reflects two considerations. First, the West Bank's labor market and employment is intrinsically interesting. The volatility of Israel's employment policies has consequences for labor markets in the West Bank that are intensively debated in policymaking and in civil society. This study contributes insights into the implications of Israeli labor market policies, using a new and comprehensive database for the West Bank. The model for the West Bank closes a research gap as previous studies either did not account for the multiplier effects of the additional labor income earned in Israel (Bulmer, 2003; Etkes, 2012; Mansour, 2010) or addressed the effects of Palestinian employment in Israel only from the perspective of the Israeli economy (Flaig *et al.*, 2013). And second, the West Bank's labor markets provide a case study for other labor markets operating as dual markets where employment opportunities in the domestic market must be traded off against employment in a foreign market, e.g., South Asian economies with migrant labor employed in the Gulf states. Access to the Israeli labor market for non-domestic labor is administered, which reflects situations where temporary migration is permitted under license. This provides insights into the economic implications for poorer economies when richer economies can temporarily attract skilled labor into lower skilled employment. More generally, in the context of models with different labor market specifications, it is advantageous that the determinants of the policy shock – increases in administered employment in the foreign economy – are exogenous. This makes the analyses of the implications of different labor market specifications more transparent. Consequently, it is easier to derive implications that are relevant for CGE models.

The following section of the paper presents the theoretical foundations and implications of the four stylized labor supply specifications as well as background information on the West Bank's labor market. Section three describes the model and the data as well as the simulations implemented. Section four analyses the main results, while section five draws conclusions and derives policy implications for the case study.

2 Literature review

2.1 Stylized specifications of the labor market conditions

The specification of the labor markets used in CGE models can be stylized by four alternate formulations. First, the supply of labor is assumed perfectly inelastic (fixed supply), such that all adjustments take place through wage rates. Second, the supply of labor is perfectly elastic (surplus labor), with all adjustments taking place through employment. Third, it is assumed that there is an upward-sloping labor supply curve; as wage rates increase/decrease so employment increases/decreases. And, fourth a labor-leisure trade-off is assumed such that changes in labor supply within the production boundary reflect changes in labor supply outside the boundary.

The fixed labor supply specification implies a strong separability between the uses of labor within and outside the SNA production boundary. This assumption allows no transfer of labor across the boundary, and hence welfare generated outside the boundary is unchanged. This assumption means that changes in measured welfare, where measured welfare is that generated inside the boundary, are not achieved through reductions in welfare generated outside the boundary. The assumption of strong separability is not consistent with theory whereby representative household groups (RHGs) maximize utility by optimizing the allocation of labor within and outside the production boundary, i.e., RHGs respond to changes in real wages, which is supported by empirical analyses (Aguiar and Hurst, 2007; Gronau, 1977; Juster and Stafford, 1991).

The surplus labor specification assumes that surplus labor can be drawn into employment within the SNA production boundary at current real wage rates and at zero opportunity cost, i.e., its marginal product outside the production boundary is zero. This assumption allows for involuntary unemployment, and ensures that changes in measured welfare, generated inside the boundary, are not achieved through reductions in welfare generated outside the boundary. But it achieves this by assuming more labor can be drawn into the market at fixed real wages, which is contrary to the empirical evidence, and ignores the fact that labor used outside the production boundary does generate welfare. The opportunity cost of withdrawing labor from activities outside the production boundary is avoided by assumption (Aragie et al., 2017).

The upward-sloping curve formulation reflects the assumption that changes in wage rates influence the supply of labor within the SNA production boundary (Blanchflower and Oswald, 1995). This formulation requires the transfer of labor across the production boundary; but this requirement is typically ignored. Changes in measured welfare, generated inside the boundary, are derived from changes in employment and real wage rates, which seems to relax the either/or specifications of full-employment and surplus labor. Typically, this specification is silent on the opportunity cost of labor outside the production boundary. When a transfer across the boundary takes place, the change in the utility generated outside the boundary is ignored, but this is inconsistent with the requirement that changes in real wage rates are required to induce the transfers. Consequently, this formulation is inconsistent in that while it requires positive marginal products of labor outside the boundary, the implications of changes in labor used

outside boundary are ignored. It is evident that if the supply of labor to activities within the boundary increases/decreases then measured welfare changes are overstated/understated because the impact on welfare generated outside the boundary is ignored (McDonald, 2018).

The labor-leisure trade-off formulation accounts for all the labor time available to RHGs by recording its use within and outside the SNA production boundary. Each RHG can sell some of its labor services within the production boundary and use the rest outside the boundary for social reproduction and leisure, referred to by the generic term "leisure". Leisure services can only be consumed by the RHG that produces the services and can only be produced by labor owned by the RHG, which ensures that leisure for each RHG has a unique price as required by the SNA. The opportunity cost of labor used to produce leisure is usually set equal to the wage rate of the respective labor type within the production boundary[1]. Household utility is then defined over goods and services from within the boundary and services outside the boundary, while absorption by RHGs is defined over goods and services from within the boundary. This model formulation captures the trade-off facing RHGs while allocating time within and outside the production boundary and links their consumption outcomes to the decisions made in the labor markets. When transfers of labor occur, the positive and negative welfare effects on both sides of the boundary are recorded.

The first three formulations typically make the RHGs passive agents in labor supply decisions; the decisions about the amount of labor services to supply are typically determined by each type of labor. The fourth formulation ensures that the labor supply decisions are taken by the RHGs. Moreover, the fourth formulation requires that the functional distribution of income in the model is controlled by variables that explicitly account for the supplies of factors by each RHG[2].

2.2 The West Bank labor markets and Palestinian employment in Israel

Labor markets in the West Bank are characterized by employment opportunities in both the internal market and in Israel. Employment in Israel for Palestinians is essentially demand-driven. The average wage for Palestinians employed in Israel is 3 times the average wage in the West Bank and 5 times the average wage in Gaza (PCBS, 2019). This large wage premium offered in Israel provides incentives to Palestinian workers to seek employment in Israel. As of 2018, some 18% of the employed persons in the West Bank were employed in Israel (PCBS, 2019).

[1] The model solution will depend on changes in relative wage rates.

[2] Most models that use the first three formulations assume that the functional distribution of labor is controlled by a matrix of parameters which do not change during the simulations.

The employment of Palestinians in Israel is an administered market, the operation of which is subject to political decisions taken in Israel over which the Palestinian National Authority (PNA) has little or no control. Palestinian workers in Israel are largely confined to low-skill and manual sectors such as construction and agriculture (Miaari and Sauer, 2011), where the domestic Israeli labor supply falls short of demand (Rosenhek, 2006). In 2017, Palestinians accounted respectively for 21.8% and 16.9% of all employee jobs in the construction and agricultural sectors in Israel (CBS, 2018). However, they "only" represented 2.4% of the total employee jobs in Israel in that year, showing their over-representation in the construction and agricultural sectors. Despite making up a substantial share of employee jobs in certain sectors in Israel, neither the Palestinian workers nor the Palestinian National Authority can influence Israeli policies and labor markets. First, Israeli employers can switch relatively easily between Palestinian labor and other foreign labor. Other foreigners in Israel are also present in the same sectors as Palestinians, making respectively 27.5% and 5.8% of employee jobs in the agricultural and construction sectors in 2017 (CBS, 2018). Moreover, due to its relative size – the Israeli economy was about 24 times the size of the Palestinian economy in 2017 (World Bank, 2019) – the Israeli economy would barely be affected by changes in labor markets and policy in Palestine.

Israel initiated a process of economic integration with Palestine in the aftermath of the 1967 war, which reached a culminating point in 1994 with the formalization of the customs and currency union between the two parties as part of the Oslo Agreements. This economic integration and currency union have, however, never been bilaterally coordinated and all decisions were made by Israel and primarily served Israeli interests (Dessus, 2004). Hence, the West Bank labor market and economy experience substantial fluctuations when access for Palestinians to the Israeli labor market is changed by legislative fiat. Israel introduced restrictions on the movement of people, goods and services between the Israeli and Palestinian territories during the Gulf war in 1991 (Aranki, 2006). The Palestinian access to the Israeli labor market is controlled by individual work permits that are issued in response to requests from Israeli employers and are conditional upon the personal status of Palestinians. The work permit and quota policy as well as the frequent closures of the entry points into Israel effectively limit the number of Palestinians in the Israeli economy.

The supply of work permits by the Israeli administration does not reflect the demand for Palestinian labor in Israel. Palestinian workers are a relatively cheap source of labor to the Israeli economy and competition between the Palestinian and native Israeli labor is limited. Because the demand of Palestinian labor in Israel exceeds the supply of work permits, a parallel market developed with Palestinians working in Israel without permits. Between 2005 and 2015, it is estimated that about 38% of Palestinian workers in Israel and its settlements did not have permits (PCBS, 2016).

3 Method and simulation

3.1 Model description

The model used in this study is the static applied general equilibrium model STAGE-2[3]. STAGE-2 is a single country CGE model programmed in the General Algebraic Modelling System (GAMS) software. The STAGE family of models is a member of the class of computable general equilibrium models that are neoclassical in origin. The agents in the model optimize their utility and profit subject to technology and factor supply constraints. They operate in economies subject to a variety of macroeconomic closures, e.g., fixed exchange rates and government budget constraints, factor market clearing conditions and structural rigidities that impose additional constraints on the range of responses available to them (De Melo, 2015, is a collection of papers from the early years of this class of CGE models).

The behavioral relationships in this model are a mix of non-linear and linear relationships that govern how the model's agents respond to exogenous shocks. A Social Accounting Matrix (SAM) provides the database to which the model is calibrated. Domestic agents – activities, households, (incorporated business) enterprises, government and investment – consume composite aggregates of domestic and imported commodities based on a constant elasticity of substitution (CES) formulation (Armington, 1969). The distribution of domestically produced commodities among domestic demand and exports is governed by relative prices on these markets, using constant elasticity of transformation (CET) functions, which reflects imperfect product transformation.

In the base version, domestic production is modeled as a three-stage production process with either constant elasticity of substitution (CES) or Leontief technologies applied. At the first stage, intermediate input and value added generate the output of each activity based on CES technology. At the second stage, the use of intermediate inputs is in fixed proportions using Leontief technology, while the CES technology is used to form value added by primary production factors at the second and the third level where the optimal ratio of factors is determined by relative prices. Household demand is specified as a Linear Expenditure System.

For this study, the STAGE-2 model is extended[4]. To depict some special features of the West Bank economy and its interaction with the rest of the world, a multiple trade partner specification is used to separate Israel from the other trade partners. Second, the domestic production module is extended from the initial three-level structure to a seven-level production process that reflects the composition of the labor force in the West Bank in some detail (see an illustration of the extended production nest in Appendix 1). Each level of the production process involves Constant Elasticity of Substitution (CES) functions.

[3] The code and all relevant equations of STAGE model are documented in McDonald (2015).

[4] Technical details about the model extensions can be found in Agbahey (2018, pp. 237-260).

Third, a factor mobility function adopted from McDonald and Thierfelder (2009) and Flaig (2014) is incorporated in the model and is activated by changes in relative wages. This mobility function allows for imperfect substitution between the 'same' type of labor used by different activities, i.e., it relaxes the assumption that labor categories are only defined by reference to the type of labor, irrespective of the activities that employ the labor. The intensity of mobility is governed by a response elasticity, which is defined for each pair of market segments and captures the influence of structural features such as transaction costs, efficiency of factor markets and preferences to stay with the current occupation on labor mobility.

By allowing labor to be mobile, the standard specification of labor income being distributed to households in fixed proportions is no longer valid. Accordingly, the supply of each type of labor by each representative household group (RHG) is made variable, which also ensures that the functional distribution of labor income is endogenous.

Fourth, the consumption bundle is extended to include leisure in addition to goods and services. Leisure is broadly defined to include the production of all services outside the SNA production boundary. Leisure is considered a normal good and households choose their level of leisure consumption based on relative price changes. Leisure is valued at the opportunity cost of labor, i.e. the marginal income forgone (wage). Leisure "commodities" are included in the Linear Expenditure Systems and are paired with the respective household groups. This ensures that leisure can only be consumed by the RHG whose labor produces the leisure.

3.2 Disaggregation and processing of the raw data

The macroeconomic closures reflect the economy of the West Bank. For trade, the small country assumption of fixed import and export prices is adopted; Israel is the West Bank's main trading partner. A balanced macro closure is imposed; this is a 'neutral' assumption that fixes the shares of private and government consumption and investment in absorption. The savings and investments account is cleared by equiproportionate changes in, household and enterprise savings rates. The government deficit (saving) is fixed and the account is cleared by equal multiplicatively changes in direct tax rates. The CPI is the numéraire, meaning that transfers and wages are in real terms.

A fixed exchange rate reflects the fact that the Israeli Shekel is the main currency in the West Bank and overwhelmingly determined by events in the Israeli economy. Moreover, the West Bank is dependent on foreign transfers that reflect a sustainable deficit on the current account; hence the current account deficit is fixed. The rest of the world account is cleared by equal multiplicative changes in the VAT rates, which requires that total absorption adjusts. This is not a common closure setting but reflects the 'reality' that absorption in the West Bank economy adjusts in response to exogenous factors.

The initial factor market clearing condition is modified to reflect the employment of Palestinian labor in domestic market activities and in the Israeli market. Across the four model specifications, a new parameter $fd\_w_{f,w}$ is introduced to capture the demand of factor f in foreign region w.

In the model with a fixed labor supply, the market is at full employment and labor is only used in the market activities, either domestically or in a foreign region. The factor market clearing condition is defined in Equation [1] as follows:

$$FS_f = \sum_a FD_{f,a} + \sum_w fd\_w_{f,w} \quad [1]$$

Where FS_f is the total supply of factor f, $FD_{f,a}$ is the demand of factor f by activity a within the production boundary of the domestic market, and $fd\_w_{f,w}$ is the demand for factor f in foreign region w.

In the model with surplus labor, a new variable is added to the market clearing condition [1] to capture the pool of labor outside the SNA production boundary (see equation [2])

$$FS_f = \sum_a FD_{f,a} + \sum_w fd\_w_{f,w} + \sum_{insw} UNEMP_{insw,f} \quad [2]$$

Where $UNEMP_{insw,f}$ is the pool of labor f outside the SNA boundary in institution $insw$.

The size of the pool of labor outside the SNA boundary in each labor market segment is determined based on the official data provided by the Palestinian Central Bureau of Statistics (PCBS, 2012). In this paper, a surplus labor specification with switching regime is used. Accordingly, the labor supply function has two segments, a perfectly elastic (horizontal) one implying that additional workers can move into production at fixed real wages as long as there is labor outside the SNA boundary, and a perfectly inelastic (vertical) one reflecting full employment. An additional equation is required for this model specification, to allow the variable $UNEMP_{insw,f}$ to change subject to the condition that the size of labor outside the SNA boundary cannot be negative. Moreover, if there is a pool of a labor outside the SNA boundary, then the real wage rate for that labor is fixed (Equation [3])

$$UNEMP_{insw,f} > 0 \quad [3]$$

In the model with an upward-sloping curve, the market clearing equation is the same as in equation [2]. The additional equation that is required is not an inequality but a log-linear equation (Equation [4]), which implies that the size of the pool of each labor f outside the SNA boundary in institution $insw$ can change subject to changes in real wages and to a pre-determined supply elasticity.

$$ln\left(\frac{WF_f*(1-TYF_f)}{CPI}\right) = \alpha^0_{insw,f} + \alpha^1_{insw,f}\, ln\left(\frac{UNEMP_{insw,f}}{FSI_{insw,f}}\right) \quad [4]$$

where TYF_f are factor taxes, CPI the consumer price index, $\alpha^0_{insw,f}$ the intercept of the function and $\alpha^0_{insw,f}$ the wage curve elasticity[4] for Palestine (-0.072).

[4] The curve elasticity is derived from empirical panel data in the West Bank's governorates between 2000 and 2015 (PCBS, 2017a, 2017b). The variability between regions is controlled with a fixed effect estimation procedure. The estimated model is $ln(w_f) = -0.072\, ln(urate_f) + \varepsilon$, where $\ln(w_f)$ is the logarithm of the

In the labor-leisure trade-off specification, all labor is fully employed. The market clearing condition is modified to reflect the use of labor outside the boundary (leisure), as shown in Equation [5].

$$FS_f = \sum_{alein} FD_{f,a} + \sum_w fd\_w_{f,w} + \sum_{insw} FSIE_{insw,f} \quad \forall alein_a \; and \; f_{ff} \qquad [5]$$

Where factor demand $FD_{f,a}$ is only aggregated over the set $alein$, which refers to market activities in the domestic market. $FSIE_{insw,f}$ is the pool of factor f supplied by institution $insw$ to activities outside the SNA boundary. The demand of labor in activities outside the SNA boundary is defined in Equation [6], where the mapping (*map_hh_alei*) pairs non-market activities $alei$ with households (hh).

$$FSIE_{insw,f} = \sum_{a\$map\_hh\_alei(insw,a)} FD_{f,a} \quad \forall alei_a \; and \; f_{ff} \qquad [6]$$

3.3 Data

The analysis of the interactions between the Palestinian and Israeli economies require, due to the complexity of the labor movements between, a database with a detailed representation of labor, including the physical labor quantities and wages per labor type and labor market. Other elements of the database, such as household groups, production sectors and commodity groups also need to be represented in sufficient detail to investigate the distributional effects of changes in the labor mobility throughout the entire Palestinian economy.

The disaggregated SAM compiled for this study is unique. It uses the most recent official data available, mainly from the Palestinian Central Bureau of Statistics, and reflects the West Bank economy in the year 2011. The SAM, data sources and data processing procedures conducted are documented in Agbahey *et al*. (2016). The SAM comprises 229 accounts (production activities, commodities, factors and economic agents), among which there are 33 factor accounts: 31 labor groups and accounts for capital and land. The labor groups are categorized so that labor working abroad is separated from labor in domestic markets, which is further disaggregated based on skill level and gender. Male workers who represent most of the West Bank labor in Israel are further classified based on their eligibility for a work permit in Israel. Three levels of eligibility are considered according to social characteristics such as age and marital status: ineligible, weakly and highly eligible. There are 20 household groups classified based on income quintile (measured by expenditure per adult equivalent), and socioeconomic characteristics of their economically active members (see Appendix 2 for an overview of the labor and household groups as well as other SAM accounts).

The SAM focuses exclusively on the West Bank economy, which is currently the only Palestinian territory with workers employed in Israel. The SAM includes a foreign account for Israel in addition to one for the rest of the world.

wage, $\ln(urate_f)$ the logarithm of the unemployment rate, and ε stands for the fixed effects. The model estimates are statistically significant at the 1% level.

The SAM has multi-product activities with 68 commodity groups produced by 56 activities. Among the 68 commodity groups are 48 goods and services that can be sold in the markets, and 20 leisure services, i.e. one for each RHG. Similarly, among the 56 activities are 36 market activities and 20 leisure activities. The 20 leisure activities and commodities are paired with the 20 RHGs (see Equation [6]). Pairing each RHG with a leisure activity requires that only the RHG's own time is used to produce leisure that is consumed by that household. Subsequently, the factor ownership matrix must also be extended to account for the labor each household uses to produce leisure, in addition to the labor that is supplied to the market. In this database, the time available to RHGs as leisure time is the time endowment of their members in working age who are outside the SNA production boundary. Table 1 summarizes the employment data in the base period.

Table 1. Employment data in base period (unit = physical person)

Categories		**Size of labor**
Employment in the market activities	In the domestic market	519,148
	In foreign markets	74,814
Employment in non-market activities		123,892
Total		717,854

3.4 Simulations

A counterfactual scenario of a return of Palestinian employment in Israel to its pre-intifada level of 1999 is assessed in this paper and compared to the base situation without such a scenario. In 1999, the number of Palestinians from the West Bank employed in Israel amounted to 99,974 workers. This number is simulated, because it is unlikely that the number of Palestinians permitted to work in Israel in the future will exceed the pre-2000 levels (Aix Group, 2004).

The shock is implemented by changes in the parameter $fd\_w_{f,w}$. This mechanism reflects the empirical evidence that Palestinian employment in Israel is demand-driven. The shock keeps the composition of Palestinian labor in Israel unchanged compared to the base period. Table 2 summarizes the number of Palestinian workers in Israel in the base period in physical units and in the scenario as percentage change compared to the base.

The change in the number of workers is accompanied by a proportional increase in the factor income from Israel for each labor group. This reflects the implicit assumption that this relatively small shock compared to the size of the Israeli labor market (see section 2.2) will not affect wages.

The shocks are implemented for the four different labor market specifications.

Table 2. Number of Palestinian workers in Israel in the base period (physical units) and in the scenario (%)

	Base (unit = physical person)	Scenario (%)
Low-skilled ineligible males	17,364	+ 35.7%
Low-skilled weakly eligible males	19,065	+ 35.7%
Low-skilled highly eligible males	29,128	+ 35.7%
Low-skilled females	1,162	+ 35.7%
High-skilled ineligible males	3,123	+ 35.7%
High-skilled weakly eligible males	1,254	+ 35.7%
High-skilled highly eligible males	2,559	+ 35.7%
High-skilled females	32	+ 35.7%
Total	73,687	+ 35.7%

4 Results and Analyses

This section starts with a discussion of the effects of the shock in the factor markets across the four model specifications. Afterward, it compares the changes in the commodity markets, before discussing the macroeconomic and welfare effects. Due to space contingency, the results are displayed for aggregated categories. Sensitivity analyses were conducted with respect to the values of key elasticities. The results of the sensitivity analyses are displayed in Appendix 3. There is no parameter causing a sign change or large changes in the results, except the elasticity of labor supply in the upward-sloping labor supply curve specification. The full set of results can be obtained from the authors upon request in the GDX format that is readable with Demo GAMS[5].

4.1 Comparative analysis of effects in factor markets

An increase in the demand for Palestinian labor in Israel triggers four effects: i) a movement of labor out of the West Bank market activities into Israel, ii) a movement of labor out of non-market activities into Israel, iii) a replacement of workers who left the domestic market to take employment in Israel by labor previously in non-market activities, and iv) a feedback effect of the increased factor income from Israel, stimulating domestic production with domestic market activities absorbing more labor out of non-market activities. The net effect of these movements depends on the model specification.

Figure 1 shows that in the model with a fixed labor supply, the extra demand for Palestinian labor in Israel is entirely drawn out of employment in the domestic West Bank market. In this model specification, the other three effects listed above do not take place because there is no

[5] Free to download from www.gams.com.

spare capacity from which labor could be taken either to meet the extra demand in Israel or to meet the feedback effects of increased labor income from Israel in the domestic market.

In the model with a labor-leisure trade-off, the net effect is a reduction in employment in the domestic market activities by 25.2 thousand workers, while about 1.1 thousand workers move out of the non-market activities. Compared to the fixed labor supply specification, a transfer of labor across the production boundary takes place in the model with a labor-leisure trade-off. The opportunity cost of labor in non-market activities being equal to real wages in market activities attaches a cost to the transfer of labor across the production boundary, and hence relatively few workers move out of the non-market activities into the market activities.

In the model with an upward-sloping labor supply curve, about 30.3 thousand persons moved out of the non-market activities. The transfer of labor across the production boundary is substantially more than in the model with a labor-leisure trade-off. The finding that 4.0 thousand workers start employment in the domestic market shows that the feedback effects of labor income from Israel on the economic activity in the West Bank overcompensate the effect of labor moving out of the domestic market activities.

These feedback effects are even stronger in the model with surplus labor, as 18.5 thousand workers join the domestic market activities. A total of 44.8 thousand workers move out of the non-market activities. These results show that the surplus labor specification by providing the option to transfer labor across the production boundary, while keeping real wage rates constant, generates the most optimistic results regarding the level of Palestinian employment in the market activities.

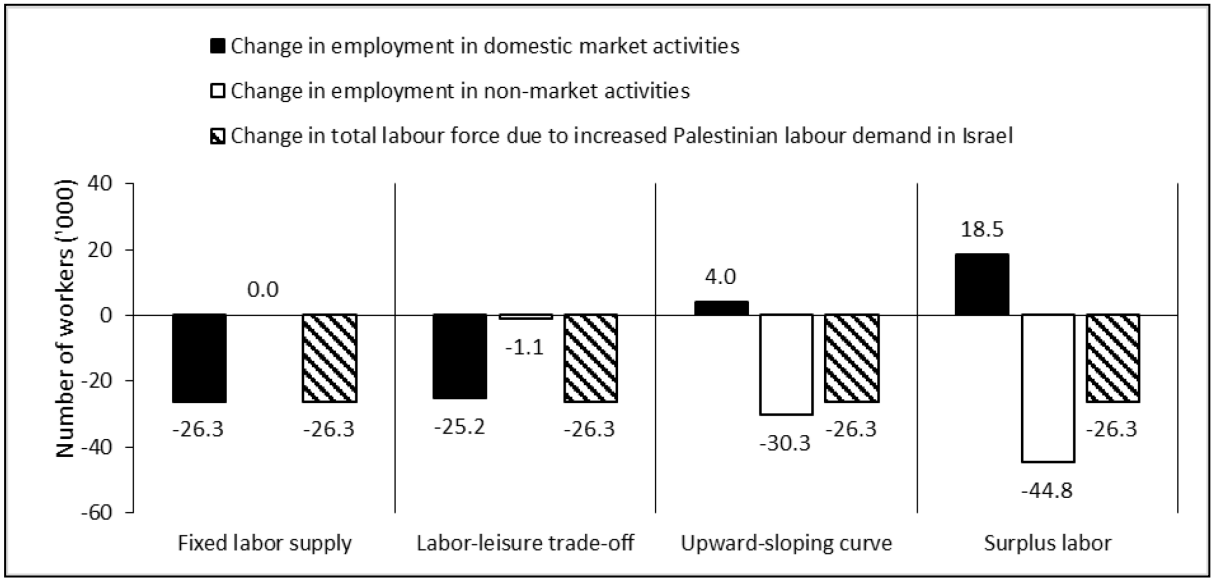

Figure 1. Net effects of the increased demand of Palestinian labor in Israel on employment in both market and non-market activities

In the model specifications with labor-leisure trade-off, upward-sloping curve and surplus labor, the net employment effect (Figure 1) mask several individual effects that are worth a deeper analysis.

With regard to the previous occupation of the Palestinian workers who take the additional jobs offered in Israel, the analysis shows for the model specification with surplus labor that 98% of the additional labor demand in Israel, corresponding to 25.8 thousand Palestinian workers, is met with labor previously in non-market activities. Only 2% of the shock, i.e. about 500 workers, are displaced from the domestic market activities to take jobs in Israel. This analysis needs to be put into perspective with the model mechanism that allocates labor out of the domestic market activities only after the pool of labor in non-market activities has been emptied.

In the model with an upward-sloping labor supply curve, the analysis shows that 25% of the additional labor demand in Israel, corresponding to 6.7 thousand Palestinian workers, is met with workers previously employed in the domestic market activities. The remaining 75% of the additional Palestinian labor employed in Israel, i.e. 19.6 thousand workers, come from labor previously in non-market activities.

In the model with a labor-leisure trade-off, the results show that 92% of the additional demand for Palestinian labor in Israel, corresponding to 24.0 thousand workers, is met with workers moving out of domestic market activities, and the remaining 8%, i.e. 2.2 thousand workers, were previously involved in non-market activities.

Decomposing the net effect on employment in the domestic markets shows that in the model with surplus labor, those who moved from the domestic market to Israel are replaced and 18.5 thousand new jobs are created in the domestic economy due to the feedback effects of additional income from Israel stimulating the West Bank economy.

In the model with an upward-sloping curve, about 10.7 thousand workers start working in the domestic market, overcompensating those who left the domestic market for Israel with a net addition of about 4.0 thousand new jobs as reflected in Figure 1.

The results of the model with a labor-leisure trade-off show that the amount of labor transferred by households from non-market activities to the Israeli market is partially offset by the withdrawal of labor from domestic market activities into non-market activities. These findings point to a “Dutch disease” effect of Palestinian employment in Israel that reduces incentives to work in domestic market activities.

4.2 Comparative analysis of the outcomes on factor prices, output and demand

The labor market specifications have direct implications for factor prices. When labor supply is fixed, the additional Palestinian labor demand in Israel creates a labor shortage in the domestic market, leading to a substantial increase in real wages by 8.1% on average. At the other end of the spectrum, a surplus labor specification with a switching regime barely affects

real wages as they start to increase only when the pool of labor in non-market activities is emptied. Subsequently, under this specification, wages increase only by 0.4% on average (Figure 2).

Between these two extremes, the labor-leisure trade-off and upward-sloping curve specifications generate intermediate results. The average real wage increases by 7.4% in the labor-leisure trade-off specification and by 2.9% in the upward-sloping curve specification. The stronger real wage increase under the labor-leisure specification derives from the opportunity cost that this model specification attaches to labor in non-market activities, compared to the model specification with an upward-sloping curve.

The prices of capital and land increase under the surplus labor and upward-sloping curve specifications reflecting the strongly increasing supply of the complementary factor labor and increased economic activity under these two model specifications. In contrast, the price of capital and land decrease under the fixed supply and labor-leisure trade-off specifications as the economic activity slows down due to less labor available in the domestic market (Figure 2).

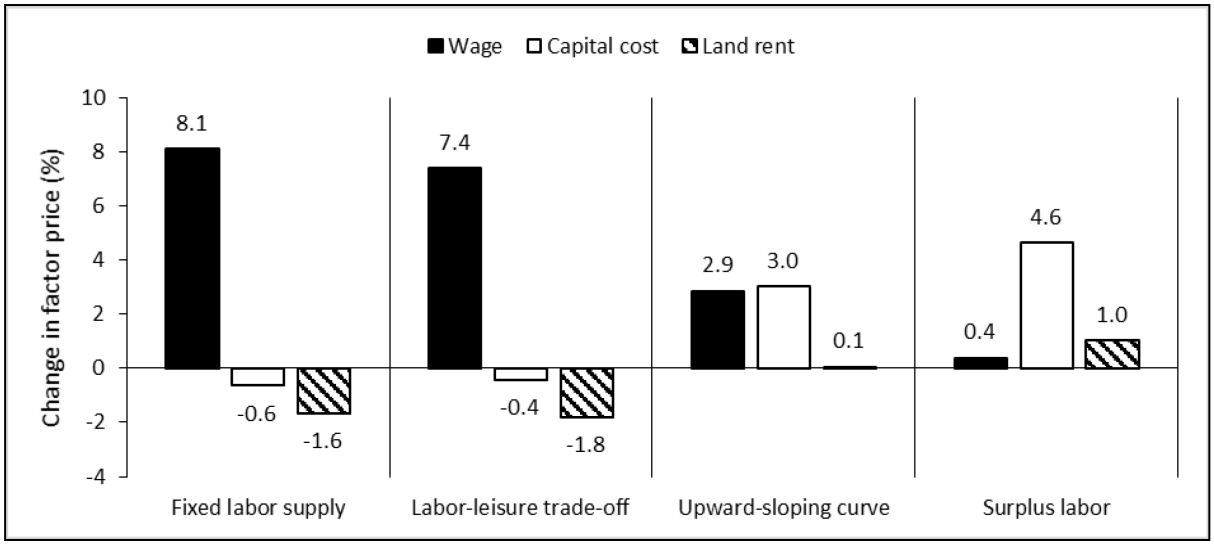

Figure 2. Change in factor prices

The increase in factor prices, especially real wages under the fixed supply and labor-leisure trade-off specifications, and capital rent under the surplus labor and upward-sloping curve specifications generates an increase in production cost across the four model specifications (Figure 3). The production cost increases more under the fixed supply and labor-leisure trade-off specifications than under the surplus labor and upward-sloping curve specifications. This finding can be put into perspective with labor being the main production input in the West Bank (the share of labor in total factor demand in the West Bank economy is 62%) and its price, i.e.

real wage, increases more under the fixed supply and labor-leisure trade-off specifications (see Figure 2).

Figure 3 also shows that domestic market output decreases under the fixed supply and labor-leisure trade-off specifications, while it increases under the surplus labor and upward-sloping curve specifications. This finding is not only associated with the change in the production cost, but also with signals coming from the demand side. In fact, the increased production under the surplus labor and upward-sloping curve specifications, despite the increase in the production cost results from increasing demand. Household consumption surges due to the additional income from Israel and extra income generated by household members in the domestic market activities. By contrast, under the fixed supply and labor-leisure trade-off specifications, household demand is also increasing, but that increase is only driven by the additional income from Israel, while the income generated in domestic market activities decreases. Subsequently, the signals from the demand side are not strong enough to compensate for the higher production cost.

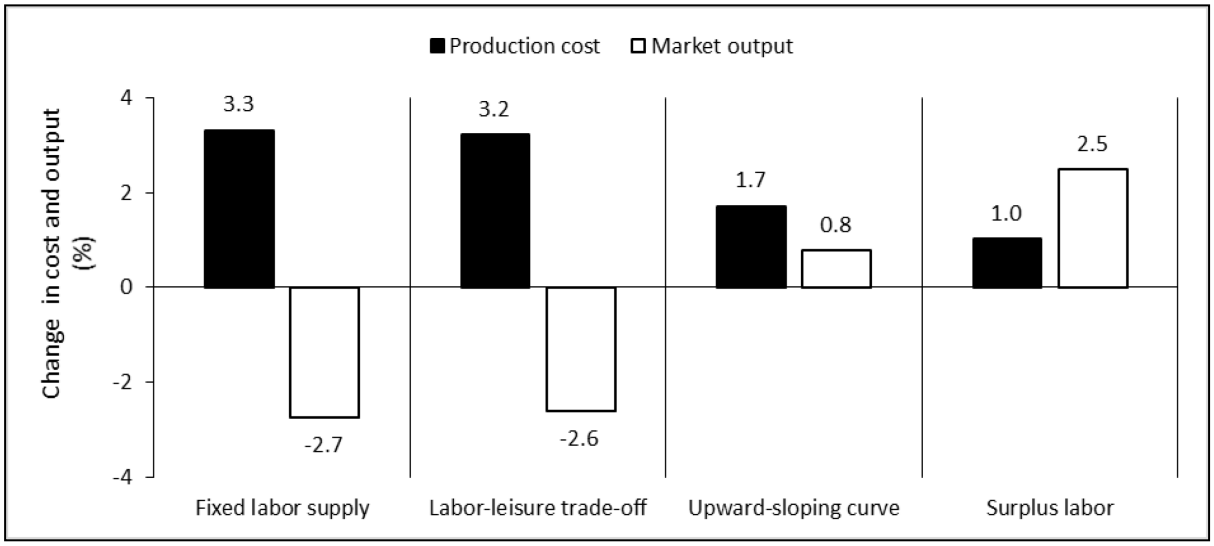

Figure 3. Changes in production cost and domestic market output

Across all four model specifications, household consumption of goods and services increases (Figure 4). This finding mainly stems from households deriving additional labor income from Israel. In the two model specifications with surplus labor and an upward-sloping labor supply curve, household consumption of goods and services increase substantially more than in the model specifications with a fixed labor supply and a labor-leisure trade-off. In the latter two model specifications, household income increases less than under the first ones. Although real wages increase strongly in these two model specifications, the labor exiting employment in domestic market activities is not replaced. By contrast, in the model specifications with surplus

labor and upward-sloping labor supply curve, not only factor prices increase (see Figure 2), but also labor exiting employment in domestic market activities to Israel is overcompensated by a movement of labor from non-market activities into domestic market activities (see Figure 1). Accordingly, households derive more income from employment in the domestic market and can consume more.

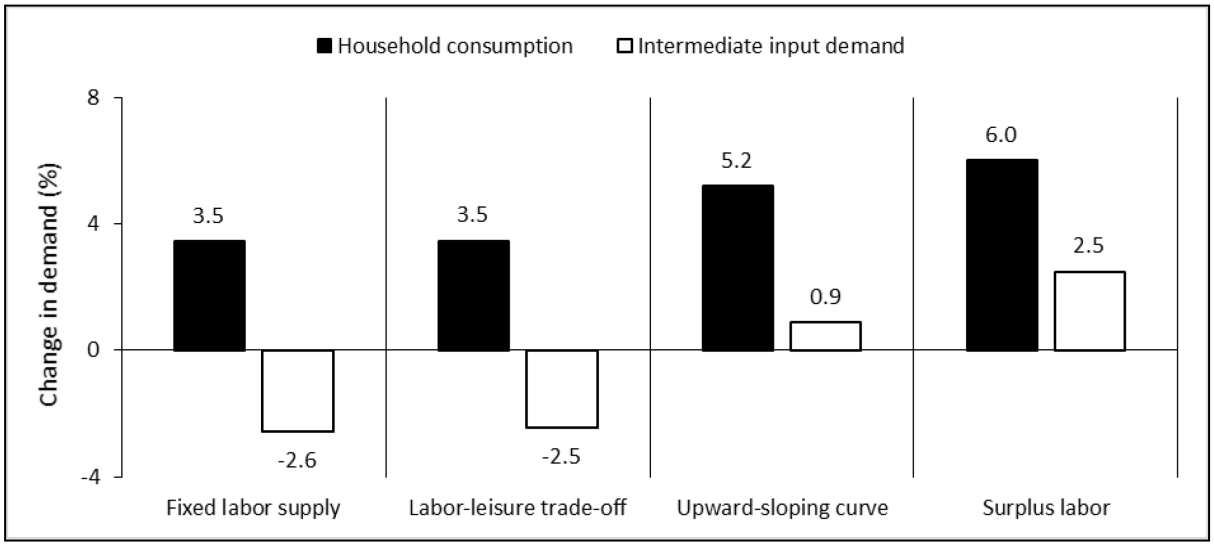

Figure 4. Changes in household consumption and in intermediate input demand

While the change in household consumption of goods and services produced by market activities can be captured in all model specifications, the change in the consumption of services produced by non-market activities (i.e. leisure) can only be captured by the labor-leisure trade-off specification. The model results show that household consumption of leisure decreases by 1.0%, which is consistent with the finding in Figure 1 that households supply labor out of non-market activities to market activities, especially for employment in Israel.

Figure 4 also highlights that demand for intermediate inputs decreases in the model specifications with fixed labor supply and labor-leisure trade-off, while it increases in the model specifications with surplus labor and upward-sloping labor supply curve. This finding is related to changes in domestic production. In the model specifications with fixed labor supply and labor-leisure trade-off, domestic output decreases (see Figure 3) and accordingly demand for intermediate inputs by domestic market activities also decreases. The opposite holds for the model specifications with surplus labor and an upward-sloping labor supply curve.

4.3 Welfare effects

Welfare effects measured by the Slutsky equivalent variation[6] as a share of initial household expenditure are positive for all RHGs under all model specifications. This is an indication that additional Palestinian labor demand in Israel improves welfare of Palestinian households. Figure 5 shows that in all four model specifications, welfare gains are higher for the poor households in the lowest quintile than for the rich households in the top quintile. This reflects the fact that among all production factors, the labor price increases the most and lower income groups have a higher share of their income from labor than higher income groups. Palestinian labor in Israel can thus serve as a lever to reduce inequality.

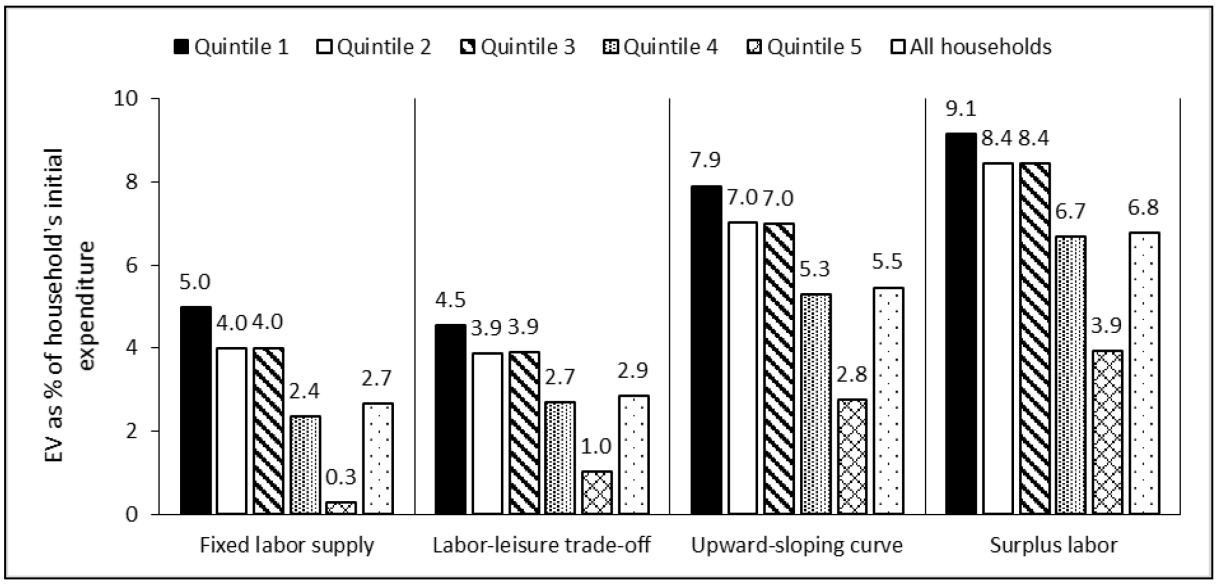

Figure 5. Welfare effects measured in equivalent variation as a share of initial household expenditure

A comparative analysis of the four specifications shows that the model with surplus labor generates the highest welfare gains for Palestinian households. Knowing that this model specification ignores the opportunity cost of labor in non-market activities and that the surplus labor can enter employment in market activities at fixed real wages, these welfare effects may be considered as overestimated.

The model specification with an upward-sloping curve gives the second highest household welfare gains. While this model specification acknowledges that labor enters employment in market activities at a positive price, it ignores the opportunity cost of labor in the non-market

[6] The Equivalent Variation is defined as the amount of compensation, that must be added (subtracted) to (from) household initial income, to leave that household as well off as under the combined price and income changes

activities. Hence, the utility foregone by households when transferring labor across the boundary is considered zero. Accordingly, the welfare estimates are high and may also be considered overestimated.

For the model specifications with a fixed supply of labor as well as a labor-leisure trade off, welfare effects are substantially lower for all household groups than for the surplus labor and the upward-sloping labor supply curve specifications. The model specification with a fixed supply assumes a strict separability between the contributions to welfare from activities within and outside the production boundary. Hence, this treatment is neutral with respect to welfare generated outside the SNA production boundary. Nevertheless, the assumption that there are no trade-offs between uses of labor within and outside the production boundary is neither in accordance in economic theory, nor with empirical evidence and the welfare results disregard the opportunity of alternative uses of labor other than in the market activities.

The model specification with labor-leisure trade-off generates the most consistent and comprehensive welfare results. As additional Palestinian employment in Israel results in higher domestic wages in real terms, households allocate more labor to market activities at the expense of non-market activities. This reallocation enables households to generate more income and increase consumption of goods and services, which increases their utility. However, the utility derived from services produced by the non-market activities decreases. The outcome is an increase in welfare at the level of all household groups. The net welfare effects, which include the losses occurring outside the production boundary, are lower than the welfare estimates found in the fixed supply specification for the three lower income groups, as lower income households have a higher share of factor income from labor and the labor price increases more under the fixed supply specification. For all household groups on average, however, the labor-leisure specification results in higher welfare gains than the fixed supply specification, reflecting the additional opportunity established for households compared to the fixed supply specification: to move labor across the production boundary in order to maximize their utility.

4.4 Macroeconomic aggregates

The macroeconomic aggregates show that in all four model specifications, absorption at constant domestic prices increases. Increased absorption is met by increased import demand and a partial reallocation of domestic production towards domestic consumption at the expense of the export market. Export supply falls in all model specifications. This result is consistent with both empirics and theory, since the inflow of labor income from Israel has “Dutch disease” effects through a real appreciation of the domestic currency and a reduced competitiveness of Palestinian exports in international markets. Real GDP declines in the model specifications with fixed supply and a labor-leisure trade-off, while it increases in the model specifications with surplus labor and an upward-sloping curve (Table 3).

Table 3. Changes in macroeconomic aggregates in real terms

	Model with fixed labor supply	Model with labor-leisure trade-off	Model with upward-sloping curve	Model with surplus labor
Absorption	+ 2.2%	+ 2.3%	+ 4.6%	+ 5.7%
Import demand	+ 2.1%	+ 2.2%	+ 4.2%	+ 5.2%
Export supply	- 17.4%	- 17.0%	- 10.5%	- 7.4%
GDP	- 1.8%	- 1.6%	+ 1.7%	+ 3.4%

The model specification with surplus labor displays the highest increase in absorption, as expected. By ignoring the opportunity cost of labor in non-market activities and assuming that labor can be employed in market activities at fixed real wages, the surplus labor specification tends to overestimate the number of workers who are transferred across the production boundary. Subsequently, the additional income accruing to households is high, as well as changes in absorption. Changes in import demand are likely to be overestimated, while changes in export supply are likely to be underestimated. Finally, changes in real GDP are also high.

The model with an upward-sloping curve also tends to overestimate the positive effects of the movement of labor. While that labor enters employment in market activities at a positive price, the opportunity cost of labor in the non-market activities is ignored. This is not only inconsistent, but it also generates increases in the measured absorption that is at least in part realized from a reduction in the contribution of the welfare derived by households from the activities outside the boundary (McDonald, 2018). Subsequently, the change in real GDP is likely to be overestimated.

The model with fixed labor supply specification tends to underestimate the positive effects of the movement of labor, because of the strict separability between labor uses within and outside the production boundary it assumes. Such an assumption causes the full shock to be solely borne by the labor already in employment in domestic market activities. Subsequently, there is a huge exit from domestic employment. The model results are likely to underestimate total household factor income and its subsequent effects on absorption and GDP.

From a theoretical point of view, the model specification with labor-leisure trade-off generates the most consistent results. Increased Palestinian labor demand raises domestic wages in real terms and households allocate more labor to market activities. From this reallocation, more income is generated, and absorption as well as import demand increase. Export supply decreases, because the large inflows of labor income from Israel cause a real appreciation of the domestic currency. Moreover, the “Dutch disease” effects of Palestinian employment in Israel reduce incentives to work in domestic market activities, with a decline in domestic market output. Ultimately, GDP decreases, though less than under the fixed supply specification.

5 Conclusion

This study analyzed the implications of different labor supply specifications for simulation results in CGE models. Four model specifications are considered: fixed labor supply, surplus labor, upward-sloping labor supply curve and labor-leisure trade-off. A scenario of returning Palestinian employment in Israel to its pre-intifada level of 1999 – a 36% increase in the level of Palestinian employment in Israel – was simulated under each of the four labor supply specifications.

The results show some common trends across the four model specifications. First, increased Palestinian labor demand in Israel increases domestic wages in real terms. Second, the additional inflow of labor income from Israel improves household welfare in the West Bank. Third, Palestinian employment in Israel has "Dutch disease" effects through a real appreciation of the domestic currency and reduced competitiveness of Palestinian exports in international markets.

The results for this study demonstrate that while reopening the Israeli labor market to Palestinian labor has non-trivial benefits for the population of the West Bank, achieving the benefits is not without costs.

However, divergences were observed showing the sensitivity of the results to the labor market specifications; differences that cannot be explained by the parameterization of each labor market specification. This allows the drawing of several general conclusions.

In the model specification with surplus labor, the changes in real wage rates are low because additional workers can be recruited into the labor force from non-market activities at zero opportunity cost, i.e., the marginal product of surplus labor is zero. Consequently, the number of workers transferred across the production boundary is inflated because there are no opportunity costs and hence no welfare lost from non-market activities. The welfare gains will be overestimated, as will changes in absorption and GDP.

The model specification with an upward-sloping labor supply curve, means that workers join the labor force at increased prices, but at zero opportunity cost in terms of reduced welfare from non-market activities, i.e., it is assumed that the marginal product of workers drawn into the labor force is zero in non-market activities. With increased demand for Palestinian labor in Israel, real wages in the West Bank rise and consequently the value of labor used in non-market activities will increase if labor is a normal good, i.e., the opportunity costs of marginal increases in the labor force will increase. Subsequently, welfare (and absorption and GDP) gains from activities within the production SNA boundary will be overestimated because of the increase in the labor force, realized as "manna from heaven", and higher wage rates. Moreover, increased wage rates will increase the value of labor in non-market activities, which will reduce the contribution of non-market activities to welfare.

The fixed supply specification imposes strict separability between labor uses in market and non-market activities, i.e., there are no changes in quantity of labor used outside the production

boundary. Labor market equilibrium is realized through changes in real wages with no labor supply response: the increased demand for Palestinian labor in Israel is met by reductions in employment in West Bank market activities together with increased wages rates. Welfare generated by non-market activities is constant – the separability condition segments the market and non-market labor markets – but welfare generated by market activities increases. More importantly, because there is no transfer of workers across the production boundary the increases in wage rates are not ameliorated by expansions of the labor force.

The labor-leisure trade-off is an appealing framework because, in accordance with economic theory, it recognizes the trade-offs facing households between consuming more leisure, i.e. services produced by non-market activities, and supplying more labor to market activities, resulting in transfers of workers across the production boundary. As the demand for Palestinian labor in Israel increases so domestic real wages in the West Bank rise and households allocate more labor to market activities, because the opportunity cost of 'leisure' increases. The labor market equilibria are realized through changes in real wage rates and the reallocation of labor between market and non-market activities. Monetary incomes increase, leading to increases in welfare from the consumption of goods and services purchased from the market. But these welfare gains are partially offset by reductions in welfare derived by households from services produced by non-market activities. The net effect is an increase in household welfare.

The results provide useful insights for the specification of labor markets in CGE models. The labor-leisure trade-off is the framework most consistent with economic theory; there are opportunity costs associated with transferring labor between market and non-market activities, which necessitate increases in wage rates for the labor force to achieve equilibrium. Moreover, the impacts on welfare generated in market and non-market activities are accounted. Because neither the surplus labor nor upward-sloping labor supply curve specifications impose an opportunity cost on the expansion of the labor force, the increases in wage rates needed to achieve equilibrium are muted: more so for the surplus labor than the upward-sloping labor supply curve specification. The increases in wage rates needed to achieve equilibrium in the full-employment specification are not ameliorated by transfers of workers into the labor force, but are likely to be closest to, although larger than, those in the labor-leisure specification because of the implicit opportunity costs of additions to the labor force. It is possible to make the results from the upward-sloping labor supply curve specification approximate those of the labor-leisure specification: this requires imposing a low labor supply response (elasticity).

This has implications for the interpretation of results from both single and global CGE models. It indicates the probability that surplus labor and upward-sloping labor supply curve specifications may understate increases in wage rates needed for equilibrium and overstate the welfare effects. It also indicates that, counterintuitively, the full-employment and labor-leisure trade-off specifications may produce more similar results. Finally, a clear ranking in terms of increases in wage rates emerges: the wage increases for the surplus labor case will be less than those for the upward-sloping labor supply curve case, which will be less than those for the labor-leisure case that will be less than those for the full employment case.

Consequently, these analyses suggest, *ceteris paribus*, that in the absence of data for production outside the SNA boundary the full-employment assumption may have merit; although it is likely to overstate the changes in wage rates. Moreover, it is argued that this implies that adoption of the surplus labor or upward-sloping labor supply curve specifications should be used only where the analyst can justify these specifications based on the economy specific labor market conditions.

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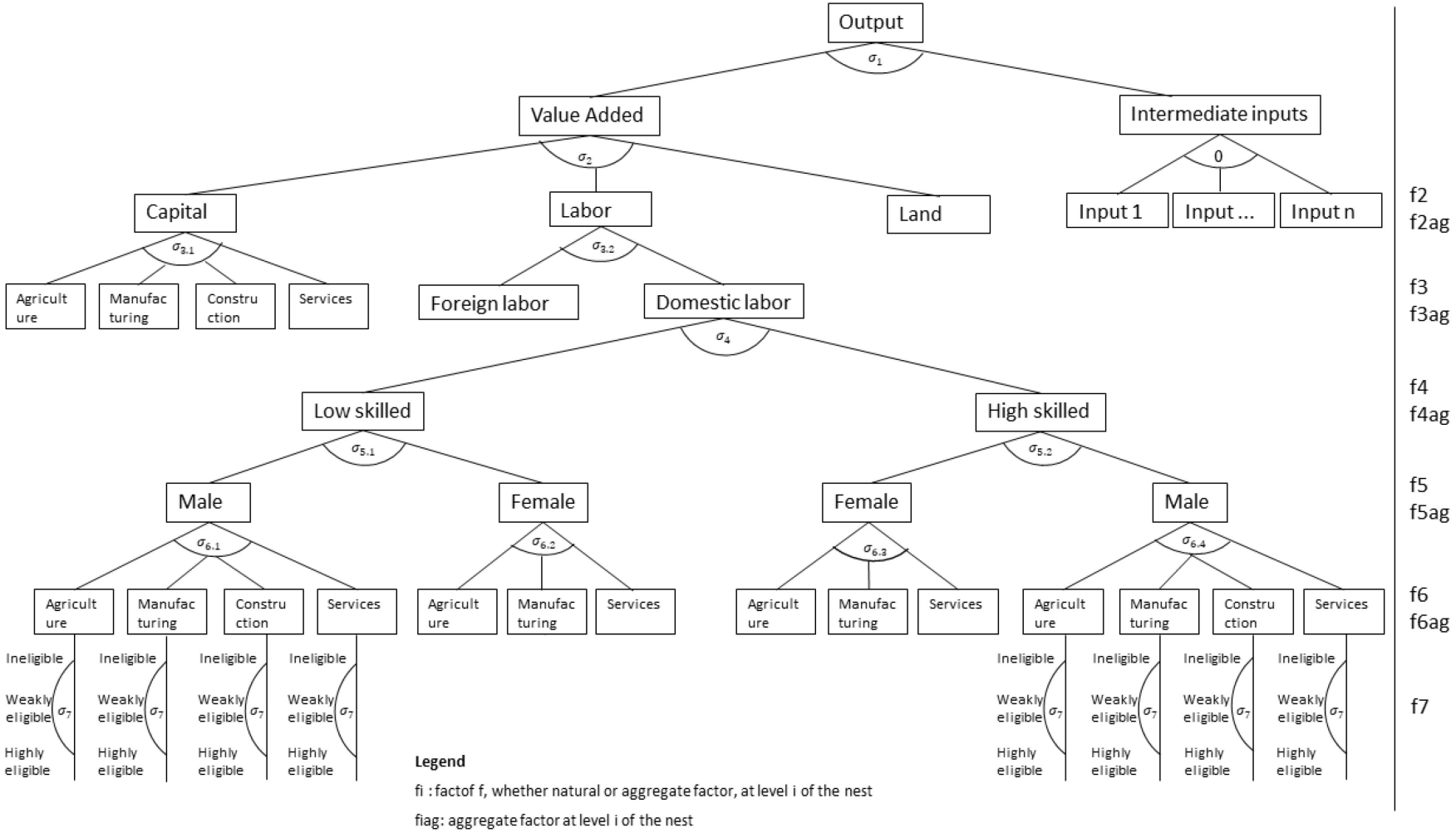
Appendix

Appendix 1: Production module nesting



Appendix 2: List of accounts in the SAM

No	Commodity (c)
1	Olives
2	Cereals, other crops
3	Fruits, nuts and flowers
4	Vegetables, horticultural specialties
5	Animals
6	Milk
7	Forestry products
8	Fishery products
9	Stone, sand, clay and other minerals
10	Meat, meat products
11	Fish, fish products
12	Processed fruits, vegetables
13	Olive oil
14	Oils, fats
15	Grain mills, starches
16	Bakery products
17	Other food
18	Beverages
19	Textiles and wearing apparel and leather
20	Paper and publishing products
21	Coke, petroleum products
22	Other chemical products
23	Other non-metallic mineral products
24	Metals
25	Cars and lorries
26	Machinery, and equipment
27	Furniture
28	Other manufacturing
29	Electricity, gas and water
30	Construction
31	Maintenance and repair of motor vehicles
32	Repair of personal and household goods
33	Other retail sale
34	Other wholesale
35	Hotels and restaurants
36	Freight transport by road
37	Passenger land transport
38	Other transport, storage, travel agencies
39	National post activities
40	Remaining communication
41	Finance, insurance and auxiliary services
42	Real estate, and renting activities
43	Other business activities
44	Public administration, defence
45	Education
46	Health, social work
47	Recreational, cultural and sporting
48	Other services
49	Commodity leisure for RHG 1
50	Commodity leisure for RHG 2
51	Commodity leisure for RHG 3
52	Commodity leisure for RHG 4
53	Commodity leisure for RHG 5
54	Commodity leisure for RHG 6
55	Commodity leisure for RHG 7
56	Commodity leisure for RHG 8
57	Commodity leisure for RHG 9
58	Commodity leisure for RHG 10
59	Commodity leisure for RHG 11
60	Commodity leisure for RHG 12
61	Commodity leisure for RHG 13
62	Commodity leisure for RHG 14
63	Commodity leisure for RHG 15
64	Commodity leisure for RHG 16
65	Commodity leisure for RHG 17
66	Commodity leisure for RHG 18
67	Commodity leisure for RHG 19
68	Commodity leisure for RHG 20

No	Activity (a)
1	Olive
2	Growing of cereals and other crops n.e.c.
3	Farming animals
4	Forestry
5	Mining and quarrying
6	Processing of olive oil
7	Processing of other vegetable oil and fats
8	Processing of basic foods
9	Processing of dairy products
10	Processing of grain mills and starches
11	Processing of other food
12	Manufacture of textile

No	Activity (a)
13	Manufacture of wearing apparels
14	Manufacture of paper and publishing articles
15	Manufacture of chemical products
16	Manufacture of non-metallic mineral products
17	Manufacture of metals
18	Manufacture of machinery equipment
19	Other manufacturing
20	Electricity, gas and water supply
21	Construction
22	Maintenance and repair of motor vehicles
23	Repair of personal and household goods
24	Retail sale
25	Wholesale
26	Accommodation and Restauration
27	Transport, storage
28	National post activities
29	Remaining communication
30	Financial services
31	Other rental of buildings
32	Other real estate and business activities
33	Other business activities
34	Education
35	Health and social work
36	Other services
37	Activity leisure production in RHG 1
38	Activity leisure production in RHG 2
39	Activity leisure production in RHG 3
40	Activity leisure production in RHG 4
41	Activity leisure production in RHG 5
42	Activity leisure production in RHG 6
43	Activity leisure production in RHG 7
44	Activity leisure production in RHG 8
45	Activity leisure production in RHG 9
46	Activity leisure production in RHG 10
47	Activity leisure production in RHG 11
48	Activity leisure production in RHG 12
49	Activity leisure production in RHG 13

No	Domestic institutions
1	Government
2	Enterprise
3	Kapital account
4	Stock change

No	Foreign institutions (w)
1	Israel
2	USA
3	EU-28 + EFTA
4	Turkey
5	Jordan
6	GAFTA zone
7	Rest of the world

No	Factors (f)
1	Low-skilled (LS), male, unqualified (UQ), employed in primary sectors
2	LS, male, UQ, employed in secondary sectors
3	LS, male, UQ, employed in construction
4	LS, male, UQ, employed in tertiary sectors
5	LS, male, weakly qualified (WQ), employed in primary sectors
6	LS, male, WQ, employed in secondary sectors
7	LS, male, WQ, employed in construction
8	LS, male, WQ, employed in tertiary sectors
9	LS, male, highly qualified (HQ), employed in primary sectors
10	LS, male, HQ, employed in secondary sectors
11	LS, male, HQ, employed in construction
12	LS, male, HQ, employed in tertiary sectors
13	LS, female, employed in primary sectors
14	LS, female, employed in secondary sectors
15	LS, female, employed in tertiary sectors
16	High-skilled (HS), male, UQ, employed in primary sectors
17	HS, male, UQ, employed in secondary sectors
18	HS, male, UQ, employed in construction
19	HS, male, UQ, employed in tertiary sectors
20	HS, male, WQ, employed in primary sectors
21	HS, male, WQ, employed in secondary sectors
22	HS, male, WQ, employed in construction

50	Activity leisure production in RHG 14	23	HS, male, WQ, employed in tertiary sectors
51	Activity leisure production in RHG 15	24	HS, male, HQ, employed in primary sectors
52	Activity leisure production in RHG 16	25	HS, male, HQ, employed in secondary sectors
53	Activity leisure production in RHG 17	26	HS, male, HQ, employed in construction
54	Activity leisure production in RHG 18	27	HS, male, HQ, employed in tertiary sectors
55	Activity leisure production in RHG 19	28	HS, female, employed in primary sectors
56	Activity leisure production in RHG 20	29	HS, female, employed in secondary sectors

No	**Factors (f) – contd.**
30	HS, female, employed in tertiary sectors
31	Foreign workers in the domestic market
32	Capital
33	Land

No	**Households (h)**
1	Households in quintile 1 with mostly low skilled members working only for local employers
2	Households in quintile 1 with mostly low skilled members with at least one working in Israel
3	Households in quintile 1 with mostly high skilled members working only for local employers
4	Households in quintile 1 with mostly high skilled members with at least one working in Israel
5	Households in quintile 2 with mostly low skilled members working only for local employers
6	Households in quintile 2 with mostly low skilled members with at least one working in Israel
7	Households in quintile 2 with mostly high skilled members working only for local employers
8	Households in quintile 2 with mostly high skilled members with at least one working in Israel
9	Households in quintile 3 with mostly low skilled members working only for local employers
10	Households in quintile 3 with mostly low skilled members with at least one working in Israel
11	Households in quintile 3 with mostly high skilled members working only for local employers
12	Households in quintile 3 with mostly high skilled members with at least one working in Israel
13	Households in quintile 4 with mostly low skilled members working only for local employers
14	Households in quintile 4 with mostly low skilled members with at least one working in Israel
15	Households in quintile 4 with mostly high skilled members working only for local employers
16	Households in quintile 4 with mostly high skilled members with at least one working in Israel
17	Households in quintile 5 with mostly low skilled members working only for local employers
18	Households in quintile 5 with mostly low skilled members with at least one working in Israel
19	Households in quintile 5 with mostly high skilled members working only for local employers
20	households in quintile 5 with mostly high skilled members with at least one working in Israel

No	Taxes (g)
1	Production tax
2	Factor income tax
3	Direct tax
4	Excise tax
5	Value Added Tax
6	Tariff on imports from Israel
7	Tariff on imports from the rest of the world
8	Factor tax use on Low-skilled male unqualified employed in primary sectors
9	Factor tax use on Low-skilled male unqualified employed in secondary sectors
10	Factor tax use on Low-skilled male unqualified employed in construction sectors
11	Factor tax use on Low-skilled male unqualified employed in tertiary sectors
12	Factor tax use on Low-skilled male weakly qualified employed in primary sectors
13	Factor tax use on Low-skilled male weakly qualified employed in secondary sectors
14	Factor tax use on Low-skilled male weakly qualified employed in construction sectors
15	Factor tax use on Low-skilled male weakly qualified employed in tertiary sectors
16	Factor tax use on Low-skilled male highly qualified employed in primary sectors
17	Factor tax use on Low-skilled male highly qualified employed in secondary sectors
18	Factor tax use on Low-skilled male highly qualified employed in construction sectors
19	Factor tax use on Low-skilled male highly qualified employed in tertiary sectors
20	Factor tax use on Low-skilled female employed in primary sectors
21	Factor tax use on Low-skilled female employed in secondary sectors
22	Factor tax use on Low-skilled female employed in tertiary sectors
23	Factor tax use on High-skilled male unqualified employed in primary sectors
24	Factor tax use on High-skilled male unqualified employed in secondary sectors
25	Factor tax use on High-skilled male unqualified employed in construction sectors
26	Factor tax use on High-skilled male unqualified employed in tertiary sectors
27	Factor tax use on High-skilled male weakly qualified employed in primary sectors
28	Factor tax use on High-skilled male weakly qualified employed in secondary sectors
29	Factor tax use on High-skilled male weakly qualified employed in construction sectors
30	Factor tax use on High-skilled male weakly qualified employed in tertiary sectors
31	Factor tax use on High-skilled male highly qualified employed in primary sectors
32	Factor tax use on High-skilled male highly qualified employed in secondary sectors
33	Factor tax use on High-skilled male highly qualified employed in construction sectors
34	Factor tax use on High-skilled male highly qualified employed in tertiary sectors
35	Factor tax use on High-skilled female employed in secondary sectors
36	Factor tax use on High-skilled female employed in tertiary sectors

Appendix 3: Sensitivity analyses

In order to analyze the isolated implications of the labor supply specification, the four labor market specifications are embedded in the same core model and use the same elasticities (Frisch parameter, factor substitution, labor mobility, income and trade elasticities).

The first sensitivity analysis assesses how sensitive the core model is to systematic changes in the value of key parameters that are common to the four model specifications. For this part of the analysis, the model with fixed labor supply is used. The second and the third sensitivity analyses apply to the only elasticities that differ from one model specification to the other. This is the labor supply elasticity in the model with an upward-sloping curve and the elasticity of substitution between leisure and non-leisure commodities in the utility function of the model with a labor-leisure trade-off.

The full set of results is available from the authors in GDX format that is readable with Demo GAMS.

I. Sensitivity of the core model to systematic changes in key elasticities

The results of this sensitivity analysis (see Tables A1 and A2) show that the core model is marginally sensitive to systematic changes in the value of key elasticities such as the elasticity of the labor mobility function, the Frisch parameter, the trade elasticities and production elasticities. There is no parameter causing a sign change or very large changes to the results.

Table A 1. Sensitivity of the result to key elasticities (percentage changes of variables due to the labor shock compared to the base situation under different elasticity levels)

	Labor mobility elasticity			Substitution import and domestic output			Substitution between domestic output and export			Frisch elasticities		
	e=1.0	**e=2.0**	e=4.0	σ/2	**σ**	2*σ	Ω/2	**Ω**	2*Ω	ρ_{Q1} =-1.52 ... ρ_{Q5}=-1.16	**ρ_{Q1}=-1.60 ... ρ_{Q5}=-1.20**	ρ_{Q1}=-1.69 ... ρ_{Q5}=-1.26
Absorption	+2.21	**+2.20**	+2.20	+2.19	**+2.20**	+2.22	+2.22	**+2.20**	+2.19	+2.20	**+2.20**	+2.20
Import demand	+2.17	**+2.09**	+2.04	+1.85	**+2.09**	+2.37	+2.75	**+2.09**	+1.43	+2.11	**+2.09**	+2.08
Export supply	-17.06	**-17.36**	-17.54	-18.00	**-17.36**	-16.64	-15.38	**-17.36**	-1.46	-17.31	**-17.36**	-17.41
Real GDP (%)	-1.78	**-1.77**	-1.77	-1.70	**-1.77**	-1.86	-1.96	**-1.77**	-1.60	-1.78	**-1.77**	-1.77

Table A 2. Sensitivity of the results to substitution elasticities among production factors (percentage changes of variables due to the labor shock compared to the base situation under different elasticity levels)

	Substitution between skilled and unskilled domestic labor			Substitution between male and female workers			Substitution between grades of eligibility for work permit in Israel			Substitution between employment sectors		
	$elast_{fd}^{1}/2$	$\boldsymbol{elast_{fd}^{1}}$	2* $elast_{fd}^{1}$	$elast_{fd}^{2}/2$	$\boldsymbol{elast_{fd}^{2}}$	2* $elast_{fd}^{2}$	$elast_{fd}^{3}/2$	$\boldsymbol{elast_{fd}^{3}}$	2*$elast_{fd}^{3}$	$elast_{fd}^{4}/2$	$\boldsymbol{elast_{fd}^{4}}$	2* $elast_{fd}^{4}$
Absorption	+2.20	**+2.20**	+2.22	+2.18	**+2.20**	+2.22	+2.19	**+2.20**	+1.91	+2.20	**+2.20**	+2.20
Import demand	+2.06	**+2.09**	+2.11	+2.02	**+2.09**	+2.14	+2.07	**+2.09**	+2.21	+2.09	**+2.09**	+2.09
Export supply	-17.44	**-17.36**	-17.30	-17.59	**-17.36**	-17.19	-17.43	**-17.36**	-17.33	-17.36	**-17.36**	-17.36
Real GDP (%)	-1.76	**-1.77**	-1.71	-1.80	**-1.77**	-1.76	-1.79	**-1.77**	-1.77	-1.77	**-1.77**	-1.77

II. Sensitivity of the results of the model with an upward-sloping curve to the labor supply elasticity

For the case study of Palestine, the estimated elasticity is 0.07. For the sensitivity analysis two relatively extreme values are considered: 0.01 (corresponding to a very steep labor supply curve) and 1.0 (corresponding to a more elastic labor supply curve). The results on the macroeconomic aggregates are the following

Table A 3. Sensitivity of results to different labor supply elasticities in the model with an upward-sloping supply curve (percentage changes of variables due to the labor shock compared to the base situation under different elasticity levels)

	Elasticity = 0.01	**Elasticity = 0.07***	Elasticity = 1.0
Absorption	+ 2.8%	**+ 4.6%**	+ 5.5%
Import demand	+ 2.6%	**+ 4.2%**	+ 5.0%
Export supply	- 15.7%	**- 10.5%**	- 8.0%
GDP	- 1.0%	**+ 1.7%**	+ 3.1%

* estimated elasticity for Palestine used in the main text

Table A3 shows that the results of the model with an upward-sloping curve are sensitive to the labor supply curve elasticity. Compared to the results of the other model specifications (see Table 3 in the main text), it can be concluded that a supply elasticity corresponding to a steep/inelastic labor supply curve leads the model with an upward-sloping curve to produce results that are close to those generated by the model with a fixed labor supply, while a more elastic labor supply corresponds to the results under a surplus labor specification. Hence, the parameterization of the labor supply curve is critical and needs to reflect the specific case under investigation.

III. Sensitivity of the results of the model specification with a labor-leisure trade-off to changes in the substitution elasticity between leisure and other commodities

For the model used in the main text, a substitution elasticity of 3.0 is assumed. Halving or doubling this elasticity yields only minor changes in the results (Table A4). It can be concluded that the results of the model with a labor-leisure trade-off are marginally sensitive to systematic changes in the substitution elasticity between leisure and non-leisure commodities.

Table A 4. Sensitivity of the results to different substitution elasticities between leisure and non-leisure consumption in the model with a labor-leisure trade-off (percentage changes of variables due to the labor shock compared to the base situation under different elasticity levels)

	Elasticity = 1.5	**Elasticity = 3.0***	Elasticity = 6.0
Absorption	+ 2.3%	**+ 2.3%**	+ 2.2%
Import demand	+ 2.3%	**+ 2.2%**	+ 2.0%
Export supply	- 16.8%	**- 17.0%**	- 17.5%
GDP	- 1.6%	**- 1.6%**	- 1.8%