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Abstract

Pre-COVID 19, countries with universal health care have experienced a rising demand for health care services without a corresponding rise in public supply. This has led to a debate on whether to increase private health care services - especially in hospitals and second-tier health care. Proponents for increasing private health care highlight gains in efficiency and innovation, while opponents emphasize its risk to social welfare. However, the monetary value of these gains and losses is seldom quantified. In this paper, we contribute to the debate by imputing the *social* value of public health care, which does not have a market and therefore cannot be monetized. Similar to contingent valuation methods that use hypothetical markets, we incorporate a hypothetical health care market into a general equilibrium model. Social value is modeled as a byproduct of health care services and enters a well-being household function. The model is calibrated to our unique Health Social Accounting Matrix of Israel. Using a Monte-Carlo method, we impute the minimum social value at around 26% of public health care financing. We furthermore simulate health care scenarios that internalize the social value to show that when assessing the best type, policymakers should weigh the economic gains of deregulation against the lost social value. We show that well-being may decrease in some cases from over-privatization.

Key Words: Contingent Valuation Method (CVM), General Equilibrium Model, Hypothetical labor market, Private-public health care, Social value of public health care, Israel
JEL: I18, I38, C68, D58, D62, D64, E16, E17

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Highlights

- Demand for health care has been rising without a corresponding rise in public supply.
- It is difficult to monetize the *social* value of public health care.
- There is an optimal balance between private and public health care.
- A general equilibrium model simulates a hypothetical health care market in Israel.
- The *minimum* social value of health care is around 26% its public financing.

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1 Introduction

In the past two decades pre-COVID 19, countries with universal health care have experienced a rising demand for health care services without a corresponding rise in public supply. This has led to a debate on whether to increase private health care services - especially in hospitals and second-tier health care. Proponents for increasing private health care highlight gains in efficiency and innovation, while opponents emphasize its risk to social welfare. However, the monetary value of these gains and losses is seldom quantified.

Health care services provide benefits above and beyond the marketed *economic*[1] value of production because they also generate *non*-marketed positive externalities. We define these as *social* value and group them into two types: (*i*) Tangible *use value*, such as preventative medical care, health promotion and communicable disease prevention. These promote economic growth through improvements in presenteeism, morbidity and mortality. (See for example Barlow, 1967; Bhargava et al., 2001; Bleakley, 2003; Bloom et al., 2004; Weil, 2007; Stuckler, 2013, and many others).[2] They furthermore promote equal access and quality (Morris et al., 2005; Filc, 2018), health education and empowerment of people, funding of health-related R&D, enforcement of laws and regulations, and modification of unhealthy behavior (Carande-Kulis et al., 2007; Stuckler, 2013). (*ii*) Health care also generates less-tangible *non-use value*, such as the caring externality (from knowing that a service is available for others to use), the option value (from knowing a service is available to use in the future given that demand is uncertain) (Ryan, 1996; Culyer, 1989; Olsen and Smith, 2001), solidarity, equity and fairness (Maarse and Paulus, 2003; Olsen et al., 2004b; Glied, 2008; Morris et al., 2005)[3] and medical altruism (Batifoulier and Silva, 2014; Hurley and Mentzakis, 2013).

Both types of non-marketed social value are difficult to value in monetary terms and are typically not internalized by the health care providers that create it. This causes health care to be undervalued and suboptimally allocated from society's point of view (Arrow, 1963; Chernew, 2001). The result is lower well-being, which is defined as the sum of the economic and social value in society (Culyer, 1971; Glied, 2008).[4] The recent COVID-19 pandemic is an example of the importance that public health care systems have in coordinating and delivering health care services and the high social cost from being underfunded. It is therefore highly important to measure and consider the implications of the social value of health care in order to design effective policy, assign public funding and manage supply given unknown potential risks such as COVID-19 and antimicrobial resistance (CCA, 2019; Taylor et al., 2014). To address this issue, this paper aims to impute (in monetary terms) some of the non-marketed social value of public health care.

A few studies address the non-marketed value of health care through *willingness to pay* (WTP) for health care and *willingness to accept* (WTA) to forgo specific programs (e.g., Olsen et al., 2004b; Grutters et al., 2008). The most common method used is contingent valuation methods (CVM) whereby consumers are asked to consider specific questions about paying for/accepting particular services in

[1]The economic value is recorded by traditional national accounts, e.g., GDP

[2]Yet, the literature supporting a clear link between health and economic growth is still inconclusive (Lynch et al., 2004; Acemoglu and Johnson, 2007).

[3]For example, Olsen et al. 2004b show that respondents in Denmark value health care differently when framed in terms of insurance premium or as tax contribution. The former is seen as an individual benefit, while the latter is a tax contribution to the community with benefits beyond one self (i.e., activates altruistic preferences for fellow citizens, solidarity, equitable access to health care, etc.)

[4]Culyer (1989); Brouwer et al. (2008b) and Coast et al. (2008) discuss this issue in more detail, including defining the term Extra-Welfarism.

a hypothetical market setup. However, most studies focus on micro-level programs, e.g., a specific treatment (see Diener et al. (1998) and Olsen and Smith (2001) for a systematic review).

Our paper contributes in three ways: first, we use a novel computational CVM simulation, not previously seen in health care analysis, in which we model a hypothetical health-labor market to impute the social value of health care. Second, whereas most studies are micro-level, ours is a macro-level approach using a general equilibrium model with Monte Carlo analysis. Finally, we illustrate a special situation whereby regulation in the health care system can be used as a *proxy* to elicit the implied social value that the public attributes (internalizes) to health care. Our novel approach could be similarly used not only in the specific field of health care but also to other sectors (e.g., education, public transportation, environment and others) that are heavily regulated by the government.

In the model, we introduce a hypothetical health care labor-market that simulates moving from a regulated to a fully deregulated health care market. It also distinguishes between public and private health care in two dimensions: (*i*) the provision of health care (i.e., production) and (*ii*) the financing of health care (i.e., demand). The model incorporates social value as a byproduct of health care production, and relies on the property that health-labor (i.e., physicians, nurses and paramedics) are limiting factors in the production of health care. The government, therefore, can use wage setting and quotas as effective tools for targeting health care policy.[5]

We then impute a minimum (conservative) value of the public's WTA the current regulated health care system, even though it creates distortions because the rise in *economic* welfare generated by a hypothetical health care market exactly offsets the lost net *social* welfare from less available public health care. A deregulated labor-health care market improves welfare because workers will be able to move freely across the health care sectors, which improves the use of resources. It also allows public and private health care production to adjust accordingly. But it reduces net social welfare (unaccounted for in traditional national accounts) because the production of public health care falls, which lowers the level of social welfare to households.

Environmental economics has had a long history of quantifying the value of environmental amenities.[6] Our approach resembles Yerushalmi (2018) and Thiene and Tsur (2013) that impute the non-marketed value of environmental amenities by analyzing the regulated pricing of water inputs which are a limiting factor in agricultural production. Furthermore, in hindsight, we have developed an approach that resembles literature on the Marginal Excess Burden (from public economics), which compares the dead-weight loss generated by distortionary taxation with the social value created by providing the public service.[7] Here, it is the regulatory distortions to provide the government health service (GHS) which cause the dead-weight losses rather than taxes.

Our model is calibrated to Israel, a country with universal health care, but could similarly be applied to many others (e.g., Denmark, Canada, UK, etc). At the margin, we impute the non-marketed social value at around 26% of public health care financing.[8] Alternatively, the annual per capita social value must be at least higher than USD 472 (2019 prices) for the public to accept the current regulated system. The inframarginal value may be much larger, suggesting that for Israel, a reasonable level of health care regulation provides higher socioeconomic welfare compared to a purely market-based

[5]For example, Blinski et al. (2018) estimate that in Israel, public physicians earn 30% to 74% less than private physician, while performing the same tasks with similar skills.

[6]Hanley et al. (2003), for example, makes clear parallels between environmental and health economics, and suggests future research avenues for health economics.

[7]See applied work by Ballard et al. (1985) for various industries and Brent (2016) specifically on health care.

[8]I.e., each $1 spent on public financing creates $0.26 in social value.

health care system.

Finally, we note that any sort of allocation mechanism that internalizes social value will do better *ceteris paribus* than ones which does not. A market mechanism that considers social value might improve well-being because it would allocate resources and production more efficiently. In this paper, we "commodify" the social value of health care. This does not mean however that we necessarily support a complete commodification as it might not be feasible or appropriate in the first place (Pellegrino, 1999; Timmermans and Almeling, 2009). Rather, our objective is to add to the debate on the privatization of health care. Filc (2018) discusses the dangers of health care commodification in the context of Israel, including for example the inequitable distribution of health care. Similarly, Glied (2008) suggests imposing a tax on the financing of private health care, to help fund the public sector and minimize the negative fiscal externalities placed on the public sector. We test such a tax at the end of the paper and conclude that the current regulated system in Israel is more efficient in its current form.

In what follows, Section 2 extends the debate on public versus private health care system and provides a brief background on the health care services in Israel. Section 3 presents the basic model. Section 4 collects data on Israel for model calibration and extends the model to apply to the country. Next, Section 5 provides results, while Section 6 tests the efficiency of the current system in Israel. Finally, Section 7 concludes. The online supplementary appendix provides additional information and results, and also provides the computer code to reproduce this approach for other countries.

2 A mix of public and private health care

To impute social value, this paper compares two alternative health care systems (i.e., regulated versus deregulated). Opinions are mixed on whether public and private health care should operate side-by-side and on their optimal weight (e.g., Propper (2000) in the context of the UK and Hanson et al. (2008); Drechsler and Jütting (2007) in the context of low-income countries).

Support for more private health care focuses on the need to respond to the rising excess demand, to promote cost control, support research and development (R&D), and promote the efficient use of resources through healthy competition (Andritsos and Tang, 2014; Cooper et al., 2011; Maarse and Paulus, 2003). Competition in health care is also argued to lower prices, and enhance quality and treatment decisions (see review by Gaynor et al., 2015). But some of these same arguments are used to support the protection and extension of the public sector. In the case of the US, Chernichovsky and Leibowitz (2010) argue that the lack of an integrated public health care system actually lowers efficiency.

More closely related to our paper, Culyer (1989) discusses the many social benefits beyond the market value that the public system generates, which are of secondary importance to the private sector and would require regulation to internalize them. Some examples are the moral arguments that all patients should have access to treatment, training of junior staff, and protecting against "supplier induced demand" whereby the private sector pushes unnecessary treatments and procedures on patients (Batifoulier and Silva, 2014).

Furthermore, in a mixed public-private system, where private health care is supplemental to public services, the unmet demands of households with income above the median voters drive them to top-up with private financing (spending), which in turn lowers their public financing (if allowed to partially opt-out). Aggregate health care financing rises overall, but at the cost of public financing (Epple and

Romano, 1996). Tuohy et al. (2004) confirm this empirically for OECD countries. The departure of the wealthier (and usually healthier) from the public health care pool would reduce revenues more than proportionally while decreasing costs less than proportionally (Glied, 2008).

A mixed system also imposes negative fiscal externalities on public provision. For example, when patients can opt-out of public health care altogether,[9] private insurers can vary premiums (to reflect health status), making sicker patients better-off in the public system. But even-if private insurers cannot vary premiums, mechanisms could be designed to "cream skim" the system to attract the healthier and deter the sicker, placing an unequal burden of care on the public sector (Glied, 2008; Frank et al., 2000).

Negative fiscal externality also occurs when private health care insurance is complementary to services in public health care (e.g., pharmaceuticals), or when it is possible to substitute a non-price rationing mechanism (e.g., a longer waiting list for non-life-threatening MRI scans) with direct purchase of services (out-of-pocket), which is complementary to treatments in the public system. Both compound the moral hazard effect inherent in the public system and raise the demand for the services covered, but without raising the premiums of private insurance or the costs of direct purchases (Glied, 2008).

Finally, because the health insurance market is not perfectly competitive, premiums are not actuarily fair. Additional costs are loaded onto insurance premiums, causing the more risk averse consumers to opt-out of private insurance. Competition between the public and private systems increase welfare losses because additional loading represents costs above opportunity cost. Also, the opportunity costs themselves are higher because of lowered scale economies, and because other activities to reduce costs are foregone (Culyer, 1989).

To mitigate some of these market failures, private-public partnerships (PPP) have been set up, whereby the private party provides public services and bears significant risk and management responsibility. Roehrich et al. (2014) provide a systematic literature review of this type of partnerships, and find that opinions are mixed: PPP may allow the public sector to access idiosyncratic resources and capabilities that would help innovative and improve health service quality (e.g., Kivleniece and Quelin, 2012). However, it could also create low value for money, higher cost of capital and stifle innovation. In the case of Israel, Filc and Davidovitch (2016b) argue that PPP blurred the boundaries of health care services between private and public, leading the system towards lower equity and efficiency.

2.1 A brief overview of health care in Israel

Rosen et al. (2015); Filc and Davidovitch (2016b) and Filc (2018) provide a detailed overview of the health care system in Israel and its historical background. Briefly, the introduction of the National Health Insurance Law (adopted in 1995) transformed the country from a corporatist/social security system into a universal one, secured through a managed competition model. Every citizen, or permanent resident, must be a member of one of four competing, non-profit, health maintenance organizations (HMO). The HMOs are required to supply a list of medical services and treatments selected for the government's benefits package (called the "health care basket"). To separate payment from care, the system is financed primarily through a combination of a health-specific payroll tax and general taxation. The government distributes funds among the HMOs according to a capitation formula that

[9] As in Germany and Netherlands.

accounts for the number of members in each plan, their age mix, gender and place of residence (i.e., country center/periphery). To foster competition and attract new members, HMOs can furthermore provide additional service top-ups not covered by the basic health care basket.

Similar to many other western countries, in the mid-1980s, Israel began a process of neoliberalization which saw the privatization of various social welfare services including health care. The aim was to improve efficiency, but also due to changes in ideology (Filc and Davidovitch, 2016b). The process of neoliberalization coincided with a period of accelerated growth in net demand for health care services that stemmed from a rise in household incomes, the widening variety of health care services on offer and an aging population. For example, even though GDP per capita increased by 1.6% (WB, 2020), the number of physicians per 1,000 people declined from a high of 3.85 in 1999 to 3.1 in 2018 (BoI, 2019).

To catch up with demand, the health care system moved towards faster growth in private health care production, and a small number of public hospitals were allowed to introduce private services.[10] Between 1995 and 2018, private health care production per capita increased by 3.5% (in real terms, on average per year) compared to 1.2% in public health care. The result was a decline in the weight of public health care production from 67% in 1995 to around 60% in 2018 (CBS, 2019, Table 9a).[11] Public health care financing also dropped sharply from 66% to 61% between 1995 to 2012, later rising to 64% by 2018 (CBS, 2019, Table 5). This trend was supplemented by high growth in private financing through private insurance and patient co-payments (Chernichovsky, 2013; BoI, 2015; Rosen et al., 2015).

This private supply response only partially solved the acute excess demand, dubbed a "health care crisis". As a reaction, the Israeli government set up the *German Committee* to critically assess and suggest policy reforms (German, 2014). Discussions included lowering regulatory barriers (e.g., by easing access to private services, removing frictions in the labor market and relaxing wage settings in the public system). But the committee's main focus centered on policies to strengthen public health care, to mitigate the rising negative fiscal externality and inequitable access associated with rising private health care. Indeed, since 2013, public financing has reversed course and gradually climbed to 64% in 2018 (CBS, 2019, Table 5), a reaction to the rising risk of damaging (or even destroying) the public system. The aim of this paper is therefore to quantify the social value of health care internalized by the pubic using a formal quantitative model.

Several Israeli studies provide anecdotal evidence of the lost social value but seldom include a quantitative approach. For example, they discuss the use of public hospital resources for commercial gains (Ombudsman, 2013), physicians moonlighting in the private health care system during hours devoted to the public health care, the rising workload of residual employees in public hospitals, and rising wage gaps between physicians in the private and public health care systems (Chernichovsky, 2013; Chernichovsky and Regev, 2014; Ben Naim and Blinksy, 2019). Furthermore, duplication of health care payments (i.e., first, through taxes and second, privately), and inefficient use of publicly funded infrastructure (e.g., underutilized facilities during afternoon and evening hours) parallel to booming investments for similar facilities in the private sector (Chernichovsky, 2013; Achdut, 2019). Finally, studies in Israel link the rising privatization with a rise in poverty and inequality (Navon and Chernichovsky, 2012; Filc and Davidovitch, 2016b). While these developments have galvanized

[10] Filc and Davidovitch (2016b) provide a detailed background of private services within public hospitals.

[11] Not to confuse later on, our model focuses on the hospitals and second-tier health care. Our definition of private health care mainly relies on out-of-pocket payments and premiums for supplementary and commercial insurance. This lowers the weight of the private sector from 40% (as reported by CBS, discussed above) to around 25%. Further details are provided in the data collection section 4.1.

support for protecting the public system, the debate on the optimal mix is still ongoing. The next section describes our health model with which we use to impute the net social value of public health care.

3 The basic health care model

Economy-wide, computable general equilibrium (CGE) models have been used in health care policy (Hsu et al., 2015; Rutten and Reed, 2009; Borger et al., 2008; Kabajulizi et al., 2017), skilled medical personnel (Rutten, 2009), value of physical activity (Hafner et al., 2020), HIV/AIDS (Kambou et al., 1992; Thurlow et al., 2009), pandemic influenza (Smith et al., 2011), antimicrobial resistance (Smith et al., 2005; Taylor et al., 2014; CCA, 2019), Alzheimer disease (Keogh-Brown et al., 2016) and Malaria vaccine (Yerushalmi et al., 2019). But to our knowledge, our paper is the first to use this method to elicit the non-marketed social value of public health care.

Our novel contribution is the acknowledgment that public health care also creates a byproduct value that could be lost when deregulating the health care market - a point not mentioned in CGE health models. Here, we elicit the non-marketed social value of public health care by weighing the additional economic benefits of a deregulated market with the losses incurred by a reduction in the non-market social value.

3.1 Model Setup

To simplify our model to its core, we present a 'mock-up' that focuses on the health care sector. For the moment, it omits other accounts such as other (non-health) government services, the rest of the world and investment. These will be incorporated later, in section 4.3, when fitting the model to Israel based on our unique 2012 Israel Health Social Accounting Matrix (SAM). These amendments, however, will not alter the overall structure presented below.

In the model, a government regulates the provision of health care (e.g., through operating permits for private hospitals, wage capping and price control). Public hospitals are non-profit organizations that technically belong to the private sector but classified as a public sector. Both private households and the government demand health care services, which are supplied by public and private firms (e.g., hospitals and other medical clinics). Public health care services provide *social* value, as a byproduct of production, which however they do not internalize.

In the counterfactual simulations, the government deregulates health care and enables a hypothetical pure health care labor market. The model measures the quantity of health-labor units that would migrate between private and public health care firms, changes to health care services and changes to welfare.

To sharpen the focus on the model and its results, without risking losing too much, we omit various properties of market imperfections (e.g., economies of scale, excludability, cost of coordination, imperfect information, etc). We set up an Arrow–Debreu equilibrium as a complementarity problem.[12] The model is coded in GAMS[13] using the MPSGE sub-language (Rutherford, 1995). (The online supplementary content includes further equations, model code, and calibration.)

[12] A complementarity constraint enforces that for variables x and y: $x \cdot y = 0,\ x \geq 0,\ y \geq 0$. See Rutherford (1995) for further information.

[13] http://www.gams.com/

3.2 Production of health care and other goods (supply)

Output y_i is supplied at price p_i by three production sectors: private health care services, public health care services and all other production defined by set $i = [pri, pub, other]$, with j alias to i. The two health care products (i.e., private or public) are close substitutes but *not* homogeneous.[14]

Firm i maximizes profits given a multi-level, differentiable, constant return to scale (CRS) production function:

$$\begin{aligned} \text{Max} \quad \pi_i = & \quad p_i y_i - \left(r_i k_i + w_i l_i + \sum_j p_j y_{ji} \right) \\ \text{s.t.} \quad y_i \geq & \quad CES\left(y_{ji}, KL_i, \mathcal{A}_{ji}, \sigma_{1i}\right) \qquad (1) \\ KL_i \geq & \quad \delta_i CES\left(k_i, l_i, \alpha_i, \sigma_{2i}\right) \qquad (2) \end{aligned}$$

In the lower-level, (2) combines capital k_i and labor l_i inputs through a Constant Elasticity of Substitution (CES) function that have prices w_i and r_i (respectively).[15] σ_{2i} is the elasticity of substitution between labor and capital, α_i their share parameter, and δ_i a scaling factor.[16] In the top-level (1), the capital-labor value added, KL_i, is combined with intermediate inputs y_{ji} to form y_i, with $\mathcal{A}_{ji}$ their share parameters and σ_{1i} the substitution elasticity between them.

3.3 Financing health care (demand)

Households obtain health care services through three main channels: (*i*) through G^d, the government health services (GHS) that produces health care services in-house, or through outsourcing services to the private sector.[17] (*ii*) Through c_{pri}, privately-financed private-health care services (i.e., out-of-pocket expenditures and premiums for supplementary and commercial insurance), and (*iii*) through c_{pub}, privately-financed public-health care, which is an out-of-pocket expense beyond the normal health basket provided by GHS. (Figure 1 helps to visual how the supply of health care is financed by private and public demand.)

3.3.1 Government Health Service (GHS)

We assume that the budget of the Government Health Service (GHS) is always balanced[18], and is obtained in two ways: (*i*) tx_h revenue from a health tax that is levied on households consumption c_i at

[14] For example, the public service offers accessibility to all, emergency and trauma care, and links to research activities. The private sector, on the other hand, suggests higher accessibility to the medical team, a more customer friendly environment, and easier possibility to choose a doctor (surgery). However, it could choose to reject specific patients (e.g., high-risk complex procedures, or elderly patients with longer recovery time), which forces the public sector to feel these gaps.

[15] Labor units for health care, pri or pub are defined as the combination of physicians, nurses and paramedic staff that deliver the necessary labor inputs for medical care. In the applied model to Israel (starting from Section 4), we also include non-health care labor as an additional separate input.

[16] This represents the functional form $KL_i = \delta_i CES\left(k_i, l_i, \alpha_i, \sigma_{1i}\right) = \delta_i \left(\alpha_i^{\frac{1}{\sigma_{2i}}} k_i^{\frac{\sigma_{2i}-1}{\sigma_{2i}}} + (1-\alpha_i)^{\frac{1}{\sigma_{2i}}} l_i^{\frac{\sigma_{2i}-1}{\sigma_{2i}}} \right)^{\frac{\sigma_{2i}}{\sigma_{2i}-1}}$. Solving this type of problem is quite standard. Note that when $\sigma = 0$, the CES function converges to a Leontief (fixed shares) function, while when $\sigma = 1$ it would be a Cobb-Douglas (CD) function.

[17] For example, the government owns hospitals and equipment (i.e., capital) and pays for labor inputs to provide health care services, in-house. The government could also outsource health care production to the private sector, whereby the government buys privately produced health care using public financing. Note, furthermore, that in Israel, HMO's also own hospitals and other medical clinics, which we included in the public system.

[18] In Israel, the government makes up for the hospitals chronic deficits.

Figure 1: The production and finance of health care services

		Financing (demand)			
		Public		Private	
Production (supply)	Public, y_{pub}	Public financing of public health care services	G^d	Private financing of public health care services	c_{pub}
	Private, y_{pri}	Public financing of private health care		Private financing of private health care	c_{pri}

The figure summarizes the distinction between public-private production and financing.

rate τ_h

$$tx_h = \tau_h \sum_i p_i c_i \tag{3}$$

and (*ii*) from ownership of capital (e.g., hospitals and equipment) k_g with rental rate r.

GHS supplies G_h^s by

$$\begin{aligned} \max \quad & G_h^s && \geq CES\left(y_{pub}, y_{pri}, \mathcal{G}, \sigma_h\right) \\ \text{s.t.} \quad & p_G G_h^s && = rk_g + tx_h \end{aligned} \tag{4}$$

with $\mathcal{G}$ the share parameter, and σ_h a high substitution elasticity between public and private health care production.

Three limitations need to be mentioned. First, we assumed (in section 3.2) that private health care services are perfectly competitive. This is a simplification as they are, in fact, a Cournot-competitive sector with a degree of market power. Second, public health care is a monopsony in demand for health-labor inputs, though this issue is already implied within the calibrated stage of the regulated system. For simplicity, we omitted these to reduce the level of additional assumptions required for calibration. We are aware that we lose these strategic behavioral elements when simulating a deregulated scenario, but we believe that the results will not be significantly different and simpler to interpret. Finally, deep parameters (e.g., elasticities, production technology) are invariant across the scenarios.[19] This further simplification is justified given the level of additional uncertainty it would add to the model.

3.3.2 Household economic welfare

Household well-being W has two components: *economic* welfare (utility) U and *social* welfare E. The former is calculated from the national accounts, and the latter will be developed in Section 3.5 and imputed for Israel in Section 5.

A social planner maximizes a continuous, multi-level, CES function with an implementability constraint, as follows:

$$\max \quad U = CES\left(c_{health}, c_{other}, \alpha_2, \sigma_1\right) \tag{5}$$

$$\text{s.t.} \quad c_{health} = \delta_h CES\left(c_{pri}, c_{pub}, G_h^d, \alpha_1, \sigma_h\right) \tag{6}$$

$$\sum p_i c_i = \underbrace{rk^s + \sum_i w_i l_i^s - tx_h + p_{G_h} \cdot G_h^d}_{=budget} \tag{7}$$

[19]For instance, a healthier person or rise in income may change household consumption behavior and price sensitivity.

In the lower-level (6), households bundle health care goods c_{health} using a CES function. σ_h is a high substitution elasticity, α_1 is their share parameter, and δ_h a scale parameter. In the top-level (5), health care goods are bundled with all other goods, with σ_1 a low substitution elasticity (i.e., compliments), and α_2 the share parameter.

Note that this utility function implies a unit income elasticity of health care demand (i.e., a normal good). Martín et al. (2011) review empirical studies and find ambiguous results (some estimate a luxury good, others closer to a normal good, and others a necessity good). We choose to assume a normal good because households are aggregated (rather than being heterogeous by income level, region, or ethnic group) and to simplify our model.

Household $budget$ is composed of capital endowments $k^s = \sum_i k_i$ and labor l_i^s, each having its own separate labor market i. tx_h is the health tax revenue for GHS, explained previously.

Since GHS provides free health care at the point of services, we "mechanically" endow households with G_h^d that has a price p_{G_h}. Two complementary slackness constraints are added

$$G_h^d \geq 0, \quad G_h^s - G_h^d \geq 0, \quad G_h^d \left(G_h^s - G_h^d\right) = 0 \tag{8}$$

$$\tau_h \geq 0, \quad p_G - p_{G_h} \geq 0, \quad \tau_h \left(p_G - p_{G_h}\right) = 0 \tag{9}$$

G_h^d is a slack parameter of public health care consumption, and τ_h from (3) a slack health tax parameter. Both adjust endogenously to maintain constraints (8) and (9). In such a way, whatever GHS provides in (4) is actually endowed and consumed by the households in (6); the optimal level of public health care provision is such that maximizes the household's welfare. Note that this is a simplified Samuelson Rule (Samuelson, 1954) because there is only one representative household and we do not need to consider how G_h^d is allocated among them.[20]

3.4 Deregulating the health care labor market

The health-labor markets $pub, pri \in i$ are sector specific that have market clearing conditions $l_i^s = l_i$.[21] The regulated public health care system sets wages that are different from the private sector, $w_{pub} \neq w_{pri}$. In each market, production hires as many workers as required so that the marginal productivity of labor (MPL_i) equal their real wages:

$$l_i \geq 0,\ \frac{w_i}{p_i} - MPL_i \geq 0,\ l_i \left(MPL_i - \frac{w_i}{p_i}\right) = 0,\ \forall i \tag{10}$$

which do not necessarily equal across the sectors, i.e., $MPL_{pub} \neq MPL_{pri}$.[22]

In a deregulated (counterfactual) scenario, a hypothetical labor market allows health-workers to move freely between the private and public health care sectors. Following from (10), if say $\frac{w_{pub}}{p_{pub}} = MPL_{pub} < MPL_{pri} = \frac{w_{pri}}{p_{pri}}$, the private sector would prefer to hire additional workers (and the public sector to shed worker), up to a point where $MPL_{pub} = MPL_{pri}$.

[20] The Samuelson Rule shows that the sum of the marginal rate of substitutions between the private and public good (X and G, respectively), across all households, equals the marginal rate of transformation between the private and public good, i.e., for two households, $U_G^1/U_X^1 + U_G^2/U_X^2 = F_G/F_X$. In our case, there is only one representative household, which removes this complication.

[21] Labor equations for $other \in i$ are omitted for simplicity because they are not relevant to the main issue. They are included in the full model.

[22] (10) is a complementarity problem, i.e., if demand for labor $l > 0$, then $MPL = w/p$, else if $l = 0$, then $MPL < w/p$.

Thus, when a labor market is enabled, two mutually exclusive channels transfer $\mathcal{L}$ units from one sector to the other by

$$\mathcal{L}_{pub \to pri} \geq 0, w_{pub} - w_{pri} \geq 0, \mathcal{L}_{pub \to pri} \left(w_{pub} - w_{pri} \right) = 0 \tag{11}$$

$$\mathcal{L}_{pri \to pub} \geq 0, w_{pri} - w_{pub} \geq 0, \mathcal{L}_{pri \to pub} \left(w_{pri} - w_{pub} \right) = 0 \tag{12}$$

with w_{pub} and w_{pri} the real wages for the public and private sectors, respectively.[23]

When (11) is enabled, $\mathcal{L}_{pub \to pri} > 0$ workers are exchanged up to the point where public and private have equalized wages, $w_{pub} = w_{pri}$. If, however, the unit wage of the public is higher than the unit wage of the private, $w_{pub} > w_{pri}$ (a strict inequality), the activity goes slack, $\mathcal{L}_{pub \to pri} = 0$. In this case, (12) becomes an active channel.

Finally, the counterfactual health-labor market clearing condition is updated to $\sum_i l_i = \sum_i l_i^s$ and $w_{pub} = w_{pri}$.

3.5 Modeling the non-marketed social value

Thus far, we excluded the possibility for non-marketed social value. Now, in addition to the production process from (1), public health care production y_{pub} also creates positive non-marketed externality E. This byproduct is modeled in fixed proportion to public health care production with a shadow price p_E. The sector does not internalize the social value it generates because a *fictive* tax rate set to $\tau_E = 100\%$, which removes any of its revenue.

Omitting the subscript pub, the updated public health care production is

$$\begin{aligned} \text{Max } \pi &= \underbrace{(1 - \tau_E)\, p_E E}_{=0} + py - Cost\,(\cdot) \\ \text{s.t. } y &\geq \min\{y, \theta E\} \\ y &\geq CES\,(k, l, y_j) \end{aligned} \tag{13}$$

with θ the calibrated share parameter of the social value. When $\theta = 0$, social value is omitted from the calibration, and otherwise when $\theta > 0$.

On the demand side, households consumes goods as in (5), and also the non-marketed social value E. The fictive tax revenue, $p_E E$ from (13) is directly transferred to households as an endowment, which they consume entirely. Thus, households maximizes well-being W by

$$\begin{aligned} \max \quad & W &&= CES\,(U, E, \alpha_5, \sigma_5) \\ \text{s.t.} \quad & budget^W &&= budget + \tau_E p_E E \end{aligned} \tag{14}$$

$budget^W$ is the updated budget constraint (that combines (7), the "traditional" national accounts, with the social value of health care), α_5 the share ratio of the externality and $\sigma_5 = 0$ that converges the function to fixed proportion. Note that when $\alpha_5 = 0$, the social value is omitted from the baseline calibration, and $W = U$. Else, when $\alpha_5 > 0$, $W \neq U$.

[23] In the calibrated baseline, total costs are set to unity, so wages are in real terms.

Three points to note: First, it is important to realize that in this setup, different *baseline* calibrations of the social value will *not* affect the *counterfactual* general equilibrium outcomes of the marketed commodities. There is only one counterfactual solution for the goods markets because (*i*) firms produce according to their profit maximizing problem without internalizing the byproduct social value they create, and (*ii*) households consume as many byproducts provided to them. In this setup, the only difference between a model with and without the social value of health care will be the interpretation of welfare. Second, as previously discussed, the private health care sector imposes negative externality on the public sector, but it also creates social value. Since health care policy was set while considering this issue, the social value that we impute represents the *net* social value. Using CRS functions maintains this in the counterfactual scenarios. Finally, using a fixed transformation function imply a zero transformation elasticity between the public health care production and its social value, and therefore imputes a lower-bound value.[24] It also means that its change in value is constant, i.e., *not* diminishing, as more of it is available. This is a simplification of reality.

4 Calibrating the health care model to Israel

To calibrate the model to Israel, we construct a unique health-focused social accounting matrix (SAM) for the year 2012 (provided in Table 1). This is a balanced table of incomes and expenditures across multiple aggregate national accounts. A few obstacles were considered while constructing the Health SAM: first, due to the blurred boundaries between public and private health care (as previously mentioned), official data that disaggregates health-labor input hours and wage differentials among these sectors is not available.[25] Second, the best available symmetric input-output table provided by the Israeli Central Bureau of Statistics (CBS) is from 2006. This is rather old. When intersecting these issues, 2012 was chosen as the base year because it best fitted the data at an aggregate level. Though newer health data is available, the differences at a macroeconomic level are insignificant, and would not alter our main results.

4.1 Health Social Accounting Matrix

To generate a health-focused SAM (Table 1), CBS provided us with a 205 industry level disaggregation of Use and Supply tables 2012.[26] We furthermore used the 2012 national accounts data (CBS, 2018), 2012 labor force survey (CBS, 2015), the national expenditure for health 2014 (CBS, 2019), and the 2006 symmetric Input-Output table (CBS, 2014). These are combined to create a detailed health SAM with five health sectors.[27]

To simplify the model, we then aggregated the detailed SAM into four industries: (*i, ii*) Private and Public health care services: the two main competitors of health care provision and the focus of this paper. These are mainly hospitals and second-tier health services. (*iii*) Other health: a fully *private* Pharma industry that supplies medicine manufacture, medical supplies, private dental care,

[24] Using a higher parameter would only raise the imputed social value of public health care.

[25] Examples of the blurrred boundary are when operating theaters and physicians/nurses work for the public health care services during the day, but then for the private health care later in the evenings. Another is when public hospitals offer additional private services such as private lodging for women in post-natal care and medical tourism. See further discussion in Chernichovsky (2013); Filc and Davidovitch (2016b) and Filc (2018).

[26] CBS provided these tables by special request; they are not online.

[27] The detailed Israeli health SAM is available in the Online Supplementary Appendix. See Section A, Table 8.

Table 1: Health social accounting matrix for Israel, 2012

		A1	A2	A3	A4	F	F	F	F	H	G	GHS	TAX	TAX	TAX	TAX	S	R	
Industry code		Private health	Public health	Other health	Other goods	Labor private health	Labor public health	Labor other	capital	Households	Government	Gov health services	Production Taxes	sales Taxes	Income tax	Health tax	Savings-investment	Rest of world	**total**
187,190	Private health	1,075	13,022	9	1,049					14,094							-	60	**29,310**
188,189	Public health	25	10,857	-	402					2,447		46,796					-	1,069	**61,597**
82	Other health	2,049	12,769	5,232	10,866					11,755							1,982	30,088	**74,741**
Other	Other goods	5,674	1,761	33,425	895,286					526,939	176,034						208,245	(18,467)	**1,828,899**
	Labor private health	10,664																-	**10,664**
	Labor public health		18,766																**18,766**
	Labor other			7,075	453,403													(26,769)	**433,709**
	capital	6,148	1,437	29,121	309,380														**346,086**
	Households					10,664	18,766	433,709	346,086		116,391							15,639	**941,255**
	Government									1,948			60,460	104,589	149,259			13,746	**330,002**
	Gov health services															46,796			**46,796**
	Production Taxes	1,122	2,985	(122)	56,475														**60,460**
	sales Taxes	2,553	-	-	102,036														**104,589**
	Income tax									148,158								1,101	**149,259**
	Health tax									46,796									**46,796**
	Savings-investment			-						189,118	37,577	-						(16,468)	**210,227**
	Rest of world																		**0**
		29,310	**61,597**	**74,741**	**1,828,899**	**10,664**	**18,766**	**433,709**	**346,086**	**941,255**	**330,002**	**46,796**	**60,460**	**104,589**	**149,259**	**46,796**	**210,227**	**0**	

Source: CBS (2014, 2015, 2018, 2019) and authors arrangement.

and medical equipment to all sectors.[28] Finally, (*iv*) Other goods: all other non-health industries and services, aggregated together for simplicity (including non-health government services, such as education).

Table 1 characterizes the overall structure of production, consumption, investment, and international trade in the Israeli economy. It relies on merging a balanced double-entry national accounts data with the 2012 labor force survey (CBS, 2015). Following basic accounting rules (i.e., income, expenditure, and production approaches), the Health SAM in Table 1 shows that the GDP for 2012 was indeed NIS 1001 million (mln).

On their own, Table 1 and the detailed SAM in the online appendix are a unique piece of information from a health accounting perspective that have not been presented in previous studies in Israel, and rarely for other countries. They provide a detailed process of purchasing intermediate goods in the supply chain of health care.[29] It furthermore uses the 2012 labor force survey (CBS, 2015) to match similar skills and differentiate them from the rest of the non-health-labor. This allows us to calibrate health-labor units, which will migrate across the public and private health care sectors once deregulation is enabled (as discussed in Section 3.4).

Based on the Health SAM (Table 1), Table 2 summarizes the national health care output by operating sector (production) and by financing agent (demand). This cross-tabulation was depicted in Figure 1, previously. In 2012, excluding other health, total health care expenditure stood at NIS 64 billion (bln), around 6.4% of GDP. The public sector provided 78% of health production while the private health care provided 22%.[30] Public health care financing (by government ministries, local authorities and public non-private institutions) amounted to 74%, with private financing (out-of-pocket and premiums for supplementary and commercial insurance) at 26%.[31] Note that CBS include *Other health* within private health care financing, and therefore report private finance at around 40% of total fi-

[28] We separated this sector from the main health sectors because our focus is on hospital and second-tier services. Engelchin-Nissan and Shmueli (2015) used a similar logic.

[29] E.g., public health care purchases NIS 12,769 mln from other health.

[30] From the SAM (Table 1), production for public, 2,447+46,796+1,069 and for private, 14,094+60.

[31] From the SAM (Table 1), financing for public, 46,796 and for private, 14,094+2,447.

Table 2: National health care expenditure by production and financing

	bln NIS, 2012	% of total	% of GDP
Healthcare output by operating provider (production)			
Public	50.3	78%	5.0%
Private	14.2	22%	1.4%
Total	64.5	100%	6.4%
Healthcare expenditure by financing sector (demand)			
Public	46.8	74%	4.7%
Private	16.5	26%	1.7%
Total	63.3	100%	6.3%

Source: CBS (2014, 2018, 2019) and authors calculations. The table shows the split between private-public production and financing.

nance (as discussed in the background section 2.1). Our definition of health care is narrower and thus changes the public-private weights. Others studies provide approximately similar ratios to ours, which they estimate through different means. For example, OECD calculate the 2012 out-of-pocket estimates at 23.4% of total finance OECD (2020), while Engelchin-Nissan and Shmueli (2015) estimate private finance at 15%.[32]

Finally, the SAM furthermore characterizes the tax system, dividing it into four main types: income tax (direct tax), sales tax (indirect tax), production tax (tax on labor and capital) and health tax. Health tax in our model refers to all source of financing of the GHS. This includes the tax collected by the National Insurance Institution designated to the health system, and government tax transfers from the Ministry of Finance to the Ministry of Health. From the data, we calculate the average health tax rate at 4.7% of GDP, which is consistent with the level of public expenditure on health care (CBS, 2018).

4.2 Calibrating labor and wage gaps

Next, we calibrate the baseline health-labor wage differential between the private and public sectors, which adjust freely once deregulation is enabled.[33] This information is not available because health professionals can work on a "dual practice", blurring the boundaries (e.g., physicians can work in the private sector while also holding a salaried job in a public hospital).

Using the 2012 Labour Force Survey (LFS), we estimate that the health sector employed around 191.8 thousand people, of which 25.9 thousand were physicians, 35.4 thousand nurses and 130.5 thousand paramedical and administrative staff (CBS, 2015, tables 2.2 and 2.18). Next, no data is available that further splits into pubic or private health care. We therefore disaggregate health employees into five categories according to ISCO 4 digit classification (based on LFS): (1) General hospitals, (2) Public clinics, (3) Dentistry, (4) Private medical clinics and institutes, and (5) Other human health activities. We collect micro-level evidence for private/public health mix, and finally, calculate a weighted average split.

We estimate that approximately 75% of labor input (143.1 thousand) were employed in the public health sector while 25% (48.7 thousand) operated in the private health sector. By dividing the wage

[32] OECD (2020) use the System of Health Accounts (SHA) 2011, OECD estimates of 2018, and other non-SHA sources. They remove the (supplemental) voluntery private health insurance and expenditures made by non-profit organizations. Engelchin-Nissan and Shmueli (2015) use a different approach all together. They link the 2009 Israel Health survey with the 2010 Incomes Survey. They remove private dental, mental and nursing health care to obtain the out-of-pocket expense.

[33] Recall, health-labor units are a composite of physicians, nurses and paramedical staff.

Table 3: Employee numbers and wage differentials

	Health care production	
	Public	Private
Wage bill (NIS mln)	18,766	10,664
Employees (1000s)	143.1	48.7
Wage per employee (NIS 1000, per year)	131.1	219.0

Source: Health SAM and CBS (2018); The table shows that the average wage gap is 67% higher in the private sector relative to the public health care sector. Similar results are estimated by micro-level studies in Israel.

bill (from the SAM) by the number of employees in the public and private sectors, we calculate the average wage per employee at around NIS 131 and NIS 219 thousand per year, respectively (see Table 3); a wage gap of around 67% higher in the private sector. This matches related, micro-level, studies in Israel (Blinski et al., 2018).[34]

In a pure market economy, wage differences are explained by gaps in marginal productivity of labor, which is linked to the volume and quality of the physical capital stock, the skills/quality of human capital (including the degree of commitment of the employees to their place of work) and other sources of productivity. In Israel, since the quality of health-labor inputs is the same for both private and public sectors, one would expect the same level of productivity and therefore a much narrower gap in wages. Indeed, if private and public services are close substitutes, the private and public wages should be the same. But in practice, they are quite different because of the heavily regulated health care system, wage caps in the public sector and labor quotas. As we show later, we use this source of distortion to impute the social value of public healthcare.

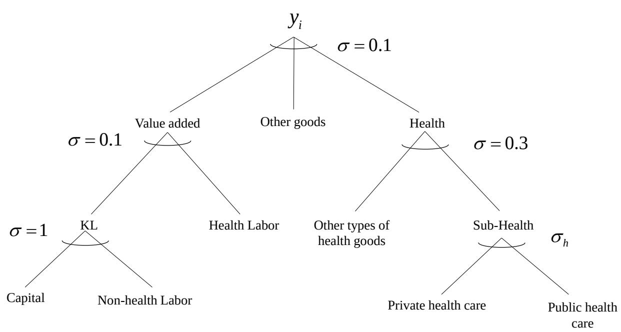
4.3 The applied model

We calibrate the "mock-up" model (from section 3) to the Israeli Health SAM described previously. The applied model has four production sectors, two public/private sector specific health-labor inputs, and a non-health labor input which is flexible across all sectors. Figure 2 depicts the nested production structure based on equations (1) and (2). As in many standard applied models, capital and (non-health) labor are assumed a Cobb-Douglas function. Next, health-labor inputs are assigned a low substitution elasticity of 0.1 to capture their specialized nature. On the intermediate inputs side, we use low substitution elasticities of 0.1 and 0.3 (see figure 2). Finally, in the lowest nest, private and public health care are bundled as intermediate inputs with a high substitution elasticity to express their competing nature and close similarity, though not perfect substitutes. Unfortunately, there is no available literature to help narrow down its value. Based on other applied CGE models that consider high substitute goods or inputs, we assign a mid-point value of $\sigma_h = 5$. Since this is an important parameter, we test for a wide range of values between 2 to 10, and finally incorporate this into a Monte-Carlo simulation, to provide a distribution of the possible result.

Next, Figure 3 illustrates the application of the economic welfare U (described in 5 and 6). Goods are bundled into consumption within a multi-level nested structure. In the lowest-nest, households demand *privately* and *publicly* financed health care, again with the high substitution elasticity of $\sigma_h =$

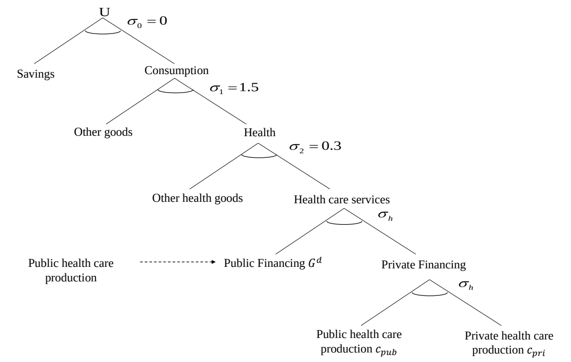
[34] For example, the Israeli Ministry of Finance estimate that for the same procedures and skills, the relative wages of physicians (with more than 10 years of experience) in private health care to public health care is 74% higher in plastic surgery, 63% higher in Ophthalmology, and 50% higher in Orthopedic surgery and EEG. For most other specialization, private health care wages are at least 30% higher (Blinski et al., 2018).

Figure 2: Production



The figure shows the multi-level nested production function used in the full model.

Figure 3: Utility



The figure shows the multi-level nested utility function in the full model. Fixed savings ratio, with consumption aggregated by the goods.

Table 4: Exogenous Parameters

Parameter	Definition	Lower	Mid	Upper
σ_h	Substitution between private and public health care	2	5	10
σ_1	Substitution between health and other goods	0.25	1.5	3

5.[35] Health care services (i.e., hospitals and second tier services) is then combined with other types of health goods (e.g., Pharma) with a substitution elasticity of $\sigma_2 = 0.3$, representing quite different products.

Finally, another key parameter is σ_1, the substitution elasticity between health and other goods in the second nest. As shown for general cases by Shoven and Whalley (1992) and Perroni and Rutherford (1995), we can narrow the range of the substitution elasticity by $\sigma_1 = \frac{\epsilon + \sigma_0(\theta_1 - \theta_0)}{(\theta_1 - 1)}$ that links empirical estimates of the compensated demand elasticity, ϵ, and expenditure shares, θ_0 and θ_1 (from our Health SAM).[36]

Borger et al. (2008) and Ringel et al. (2002) summarize many empirical studies that estimate ϵ. The consensus falls on an inelastic demand elasticity of 0.2 to 0.8 (in absolute terms), and a highly cited empirical estimate from the RAND Health Insurance Experiment find it to be 0.2 (Manning et al., 1987). These however assume that the health market is unregulated. But in the case of Israel, and similar countries, the true elasticity needs to reflect the unmet excess demand generated by a regulated system, before simulating deregulation. We therefore expect demand to be more price responsive, i.e., more elastic.

In a new study, Kowalski (2016) uses a censored quantile instrumental variable (CQIV) that allows estimates to vary across conditional expenditure distributions. She finds that the demand price elasticity on health services is substantially higher, and varies from 0.76 to 1.49 (in absolute terms). Using these values and the expenditure shares from the Health SAM, we can narrow σ_1 (based on the calibrating equation from above) to around 0.87 and 1.7. Borger et al. (2008), for example, assumes

[35] In Figure 3, differentiating the top nest *health care services* into two sub-nets is redundant when they have the same substitution elasticity. We do this for reporting purposes to calculate separately public and private financing and production.

[36] The equation is derived in the online Supplementary Appendix B. θ_1 is the share of health expenditure from total consumption, and θ_0 is the share of health expenditure from total utility.

a substitution elasticity of 1 between health and other goods. For simplicity, we assign a mid-point elastic value of $\sigma_1 = 1.5$, which will capture the movement from a regulated to de-regulated health system with unmet demands for health services. We furthermore conduct sensitivity tests for a range between $0.25 \leq \sigma_1 \leq 3$, and also incorporate this into a Monte-Carlo simulation. Table 4 summarizes the main unknown parameters.

4.3.1 Other closure rules

We conclude with three closure rules that "fit" the applied model to the data and ensure that we can interpret welfare correctly. First, we assume that the government provides a fixed level of non-health services, in real terms. A constraint is added whereby any budget surplus (or deficit) is transferred (received) from the household so that the government maintains a balanced budget.[37] Second, being a static model, the current account is fixed to baseline levels, and the government, household and rest of the world save a fixed proportion of income. Otherwise when the current account deficit rises, for example, it would act as a 'free gift'. In the long-run, the current account should balance on average. Finally, a capital account equates total savings (i.e., private, public and foreign) with demand for investment.

5 Results

To impute the social value of public health care E from (13), we simulate the introduction of a health care market. Deregulation allows health workers to freely migrate between the public and private health care sectors, wages in the public sector are no longer capped, and private health care providers can choose the level of services to produce based on profit maximizing rules.

Results are presented in stages: first, *excluding* the social value of public health care. Second, *including* the social value, and finally, we search for a deregulated health care system that also internalizes some of the social value.

5.1 Results *excluding* the social value

In the case where the social value of public health care is *not* accounted for, welfare is equivalent to total household expenditure, i.e., $W = U$ in (5) and (14) is redundant. The simulation finds that deregulating the health care system would raise welfare U by 0.2% to 0.7% in real expenditure, relative to the baseline. This range depends on σ_h, the level of the substitution elasticity between private and public health care. With a higher value, it becomes easier to substitute one for the other, and deregulation yields higher economic benefits. In monetary terms, this is an increase of NIS 1.4 to 5.7 bln (2012 prices), equivalent to 0.13% to 0.45% of additional GDP. As an extreme test, in a case where $\sigma_h \to \infty$ (i.e., perfect substitutes) the increase in welfare U converges to around 1.8%. As expected, this is a corner solution whereby the public sector completely shuts down.

Table 5 reports the simulated changes to (*i*) health care production by the operating provider and (*ii*) expenditure by financing sector. For mid-value parameters, total health care production rises by 10.1% after becoming more efficient and relatively more affordable. However, the share of public health care production falls from 78% (in the baseline regulated regime) to 62% of the total (after

[37]The government receives income from non-health taxes, net-funds from the households and rest of the world (see Table 1).

Table 5: Public and private production and financing (% share, bln NIS real 2012)

	Regulated (Baseline)	**Deregulated** (counterfactual) $\sigma_h = 2$	$\sigma_h = 5$	$\sigma_h = 10$
	Healthcare output by operating provider			
Public	78%	72%	62%	49%
Private	22%	28%	38%	51%
Total (bln NIS, real 2012)	64.5	67.2	71.0	76.0
% change from baseline		*4.3%*	*10.1%*	*17.8%*
	Healthcare expenditure by financing sector			
Public	74%	68%	58%	45%
Private	26%	32%	42%	55%
Total (bln NIS, real 2012)	63.3	66.1	69.8	74.8
% change from baseline		*4.4%*	*10.3%*	*18.1%*

The table reports on the changing weights (% share) and monetary value of public and private health care production and financing. σ_h is the substitution elasticity between public and private health care.

deregulation). Similarly, total health care financing rises by 10.3%, while the share of public financing falls from 74% to 58%. Not shown in the table, expenditure for other health goods (i.e., Pharma industry and others) rises by 10.3% in real term because it is a complimentary intermediate input for health care production. Finally, expenditure for other goods in the economy falls by 1.1% because health care becomes relatively more affordable. (Further detailed results are presented in the online supplementary appendix, Tables 9 and 10.)

The intuition behind the rise in utility is the elimination of resource misallocation. Based on the calibration, private health-labor wages are 66% higher than the public, but have similar skills. Deregulation allows public health care workers to migrate towards the private sector until a new equilibrium is reached where real costs are the same. Production in the economy adjusts, and households have access to more goods for a given level of budget. For mid-value parameters, Table 6 reports that 27.3 thousand health-workers would migrate from the public to the private health care sector (a 19% decrease in public health care workforce). Real-wages in the private sector falls by around 41% but could rise (or fall) in the public sector depending on σ_h. For example, with lower elasticity such as $\sigma_h = 2$, demand for public health care remains strong and wages rise by 11%. But with higher elasticities, the decrease in demand for public health care is stronger than the decrease in supply, and therefore, public health care output price and real wage fall. This outcome is due to general equilibrium effects which would not be captured by partial equilibrium analysis.

We furthermore perform sensitivity tests with $0.25 \leq \sigma_1 \leq 3$, the substitution elasticity between health and other goods. As expected, an increase in σ_1 (i.e., better substitutes) raises the real expenditure on health care goods relative to other goods, welfare rises, and the number of public health care employees migrating to the public sector rises.[38]

The overall conclusion, so far, is that introducing a market mechanisms into the health care system would raise welfare. However, this is a partial view that excludes the lost social value that the public health care generates, which we impute in the next section.

[38] For further results from the sensitivity tests, see Section C.1 of the online Supplementary Appendix.

Table 6: Changes to wages, prices, and worker reallocated

	Regulated	**Deregulation** (counterfactual)								
	(baseline)	$\sigma_h = 2$			$\sigma_h = 5$			$\sigma_h = 10$		
# of workers (000s)		Level	%	diff	Level	%	diff	Level	%	diff
Private healthcare	48.7	61.0	25.3%	12.3	76.0	56.0%	27.3	96.2	97.5%	47.5
Public healthcare	143.1	130.8	-8.6%	-12.3	115.8	-19.0%	-27.3	95.6	-33.2%	-47.5
Wage (000s, per year)	NIS	NIS	%	diff	NIS	%	diff	NIS	%	diff
Private healthcare	219.0	145.5	-33.5%	-73.5	129.3	-41.0%	-89.7	107.7	-50.8%	181.2
Public healthcare	131.1	145.5	11.0%	14.4	129.3	-1.4%	-1.9	107.7	-17.9%	93.4
Output prices	Index	Index	%		Index	%		Index	%	
Private healthcare	1.0	0.85	-15.2%		0.82	-18.0%		0.78	-21.7%	
Public healthcare	1.0	1.0062	0.62%		0.95	-5.2%		0.87	-12.7%	
Other health goods	1.0	1.0065	0.65%		1.02	2.0%		1.04	3.9%	
Other goods	1.0	1.0056	0.56%		1.02	1.8%		1.04	3.5%	

The table compares labor market outcomes (regulated vs. deregulated regime) with varying levels of the public-private health care substitution elasticity, σ_h.

5.2 Adding the social value of public health care, E

The previous section reported results with only the economic welfare U, as in standard models. In this section, we extend the definition of welfare towards well-being W. We include some of the non-marketed social value of health care E from (13), which is unknown in monetary terms, and thus $U \neq W$. We show situations whereby deregulating the health care system could risk lowering well-being.

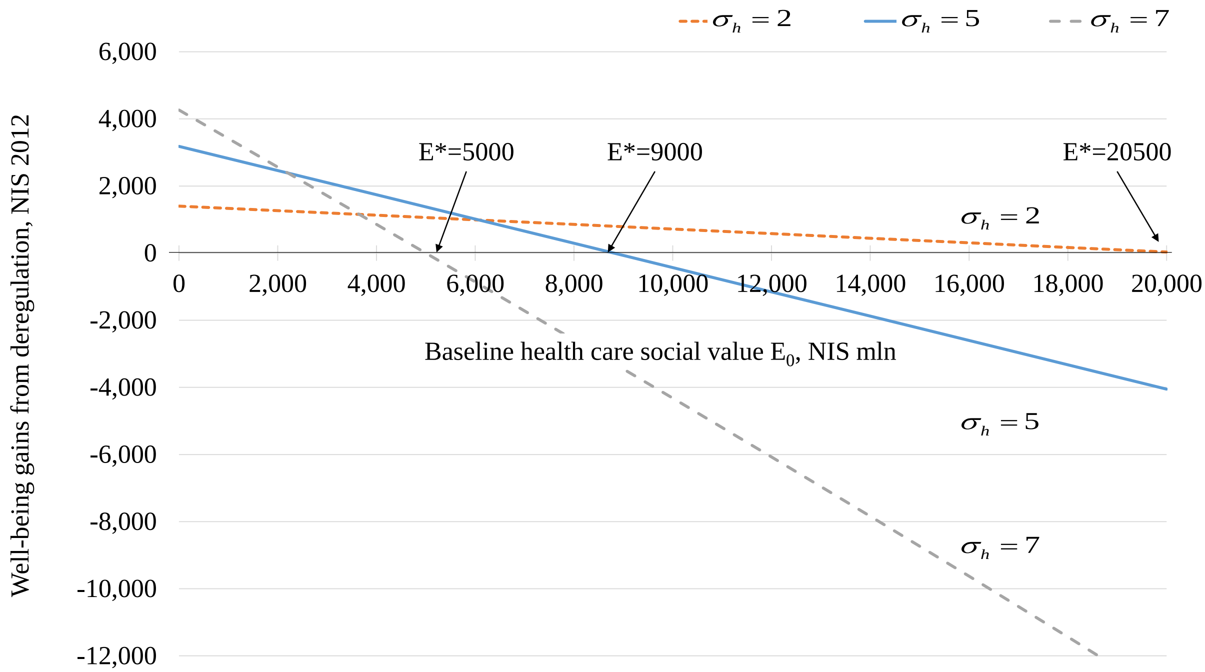
To impute the social value, we raise its unknown baseline value E_0 from 0 to NIS 30 bln and search for a value E^* that would make households *indifferent* between the baseline-regulated and counterfactual-deregulated health care systems. In other words, E^* in the baseline will lead to a no change in well-being in the counterfactual deregulated system.

Remember that because the marketed economy does not internalize the byproduct social value E that it creates, the counterfactual equilibrium for commodity markets is identical to those already reported in the previous sub-section 5.1. This means that production, output prices, health-labor movement and wages do not change when $E_0 > 0$. The baseline social value is therefore irrelevant for economic welfare, but relevant for well-being.

Figure 4 reports the gains (losses) to well-being for various levels of E_0 and σ_h. Starting with $E_0 = 0$ (i.e., omitting the social value) would raise welfare - as previously reported. However, when gradually raising E_0, the increase in well-being falls in the counterfactual scenarios. Health-workers migrate to the private sector, which increases its production but lowers public production. The result is a reduction in the byproduct social value compared to the baseline that lowers household well-being. In Figure 4, the arrows point to E^* that would make well-being indifferent between the regulated and deregulated systems. For example, with $\sigma_h = 5$, the required baseline value would be around NIS 9 bln. This is a minimum social value that covers for the distortions created by the regulated system. The true social value is unknown: If its true value is higher than the minimum, deregulation would then lower well-being (i.e., a regulated system is preferable). But if it is lower, deregulation would raise well-being.

Figure 4 furthermore shows that higher σ_h would lower E^* (e.g., when σ_h rises from 5 to 7, E^* falls

Figure 4: Well-being gains from deregulating, NIS mln



The figure shows the social value of public health care E^* that would make the regulated and deregulated systems indifferent. E^* falls as private and public health care become better substitutes (i.e., a rise in σ_h).

from 9 to NIS 5 bln).[39] The explanation is the following: when private health care becomes a better substitute for public health care, a smaller E^* is required to impute an indifference because social value becomes more precious. It also means that it becomes more likely that the true social value is greater than the imputed value, and that deregulation would lower well-being. Brent (2016) similarly explains this within the Marginal Excess Burden literature. As the demand price elasticity of public health care becomes more inelastic, the Marginal Cost of Public Financing (MCF) becomes smaller. In our case, this is analogous to an increase in σ_h.[40]

5.2.1 Imputing E^* with a Monte Carlo simulation

To provide a concrete result of the indifference social value E^*, we use a Monte Carlo simulation to randomly generate a range of $\sigma_h \in [2, 10]$, $\sigma_1 \in [1, 2]$ and baseline social value $E_0 \in [2000, 22000]$. Due to a lack of a prior, parameters are generated from a uniform Probably Density Function (PDF), which jointly enter the model.[41] The model is executed 80,000 times, and all results close to *no* change in well-being are analyzed (i.e., 599 occasions of 80,000 that fall between $\Delta W = [-0.005\% \leq 0 \leq 0.005\%]$).

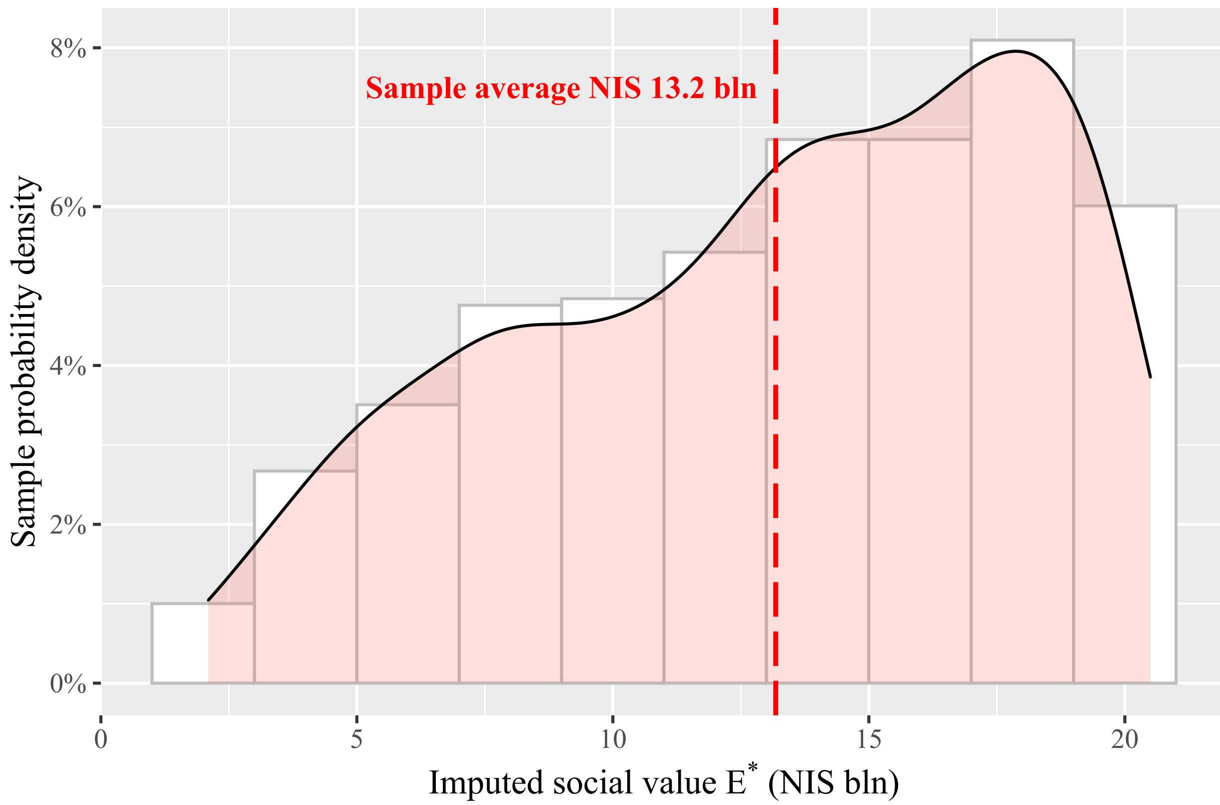
Figure 5 plots the imputed sample density of the social value E^* that would make households indifferent between a regulated and deregulated health care system. The imputed average is NIS 13.2 bln, with standard deviation of NIS 4.9 bln. The 99% confidence interval falls between NIS

[39] Not shown in the graph, with $\sigma_h = 10$, $E^* = 2.1$ bln.

[40] For example, in the extreme case of $\sigma_h \to \infty$, the imputed social value required to offset the additional economic gains of deregulation approaches zero because the public sector shuts down, and any low level of social value becomes highly valuable.

[41] A uniform PDF gives equal probability to all randomly selected values along their chosen range.

Figure 5: The probability density of the imputed social value E^*



The figure presents the probability density of the imputed social value E^* that would make households indifferent between the regulated and deregulated health care systems. The model is executed 80,000 times and 599 results with $\Delta W = 0$ are collected. The sample average is NIS 13.2 bln and the 99% large sample confidence interval falls between NIS $[12.6, 13.7]$ bln.

Table 7: Components of social welfare

	bln NIS 2012	Social value as % of
Indifference social value	13.2	
Public health care finance	50.3	26%
Private consumption	555.2	2.4%
GDP	1001	1.3%
Per capita social value	NIS 1,668	USD 472 in 2019

Source: Model results and CBS Israel; In 2012, Israel's population was 7.9 mln.

$[12.6, 13.7]$ bln.[42] As we summarize in Table 7, at the margin, the baseline social value must be at least 26% of public health care financing. The intuition is the following: social value is partially lost by deregulation, but balanced by the gains in economic value, making well-being unchanged.

To our knowledge, this type of result is novel and therefore hard to compare with other studies. To test its magnitude, we turn to related literature on the marginal excess burden (MEB) of distortionary taxes used to finance public goods provision. Ballard et al. (1985) develop a multisector general equilibrium model of the US economy with various categories of taxes. They find that public projects must produce marginal social benefits of above 17% to 56% to be welfare improving. (The range depends on the domain assumed for the elasticities.) Similarly, to compare the tax implication of a systems change, Brent (2003) uses a partial equilibrium analysis of the US economy that lowers state financial responsibilities for mental health care, and raises it for the federal government. He finds that state-level MEBs are around 16.4% to 28% (for various US states), similar in magnitude to ours. Ballard et al. (1985) and Brent (2003) argue that many projects accepted (rejected) by government agencies, based on cost-benefit analysis, could have been overturned had they considered the MEB of distortionary taxes. We make a similar point here.

More similar to us, Yerushalmi (2018) models the non-marketed agricultural amenities as a byproduct of agricultural production, and imputes a minimum WTA amenity value at around 4% of GDP. This is a minimum value that covers the economic distortions generated by the regulated water pricing mechanism used in Israel. In comparison, we find the minimum net social value of public health care at around 1.3% of GDP (see Table 7).

Finally, an alternative method to compare with others is to divide the social value by the Israeli population in 2012. Table 7 reports that for the public to accept the current regulated health care system, the social value must be at least higher than USD 472 in 2019 per capita (NIS 1,668 in 2012).[43] In comparison, in a CVM study, Al-Hanawi et al. (2018) collect data from a pre-tested interviewer-administered questionnaire and analyze it using a Tobit regression model. They estimate the WTP for a contributory national health insurance scheme, in Saudi Arabia, at around USD 160 per capita. The literature is clear on the discrepancy between WTA and WTP, whereby WTA tends to be three times higher than WTP (Whynes and Sach, 2007; Grutters et al., 2008; Martín-Fernández et al., 2010). We are therefore similar in magnitude to Al-Hanawi et al. (2018).

To our knowledge, no other macro-level studies exist, but there are countless of micro-level studies for specific treatments/programs. Individually, these WTA/WTP estimates are much smaller than ours. A future study could aggregate them into a unified basket to compare with our aggregate result.

[42] For a sample size n, the Central Limit Theorem states that the studentized mean is approximately a standard normal: $\frac{\bar{x}-\mu}{s/\sqrt{n}} \approx N(0,1)$.

[43] Conversion to USD 2019 was based on the yearly average chained consumer price index (CPI) and yearly average exchange rate (Israel CBS and Bank of Israel).

6 Discussion: regulated or deregulated system for Israel?

Since the German Committee in 2013 (see German, 2014), the Israeli Ministry of Finance (MoF), other ministries and the wider public community have debated whether health care should be deregulated and privatization extended. The prevailing trend has been to halt privatization and focus on bolstering the public system. Most of the debate has focused on the negative externalities imposed by private health care on the public system (e.g., rising wage gaps, patients diverted towards private services, and supplier induced demand) with limited economic gains (Ben Naim and Blinksy, 2019).[44] But framing the debate in terms of the social value of public health care is missing.

The Israeli MoF has not supported (and also blocked) the deepening of private services. Since 2018, this has also been the policy of the Ministry of Health, evident by the rise in public health care financing - from 61% in 2012 to 64% in 2018 of total financing (CBS, 2019, Table 5). Our model, calibrated for 2012 data, conveniently captures the peak of privatization under the regulated system. Though we find that the minimum *marginal* social value is at least 26% of the public health care financing, this trend suggests that the *infra-marginal* value is probably higher and that maintaining a regulated system is likely preferable.

Yet, as mentioned previously, any system that internalizes the social value is better than one that does not. A market mechanism might still do better than a regulated system because it would also gain from the improved efficient allocation of resources. Glied (2008) suggests levying a tax on private health care, which would partially fund the public sector and minimize the negative fiscal externalities imposed on it. In this way, society internalizes the negative externalities, while enabling private consumers to continue purchasing private health care and benefiting from efficient resource allocation. The tax would reduce the transfer inequality onto complementary services, and a degree of equality would be preserved. It would also generate revenues earmarked for increasing health services available to non-purchasers, without requiring new distortionary taxes.

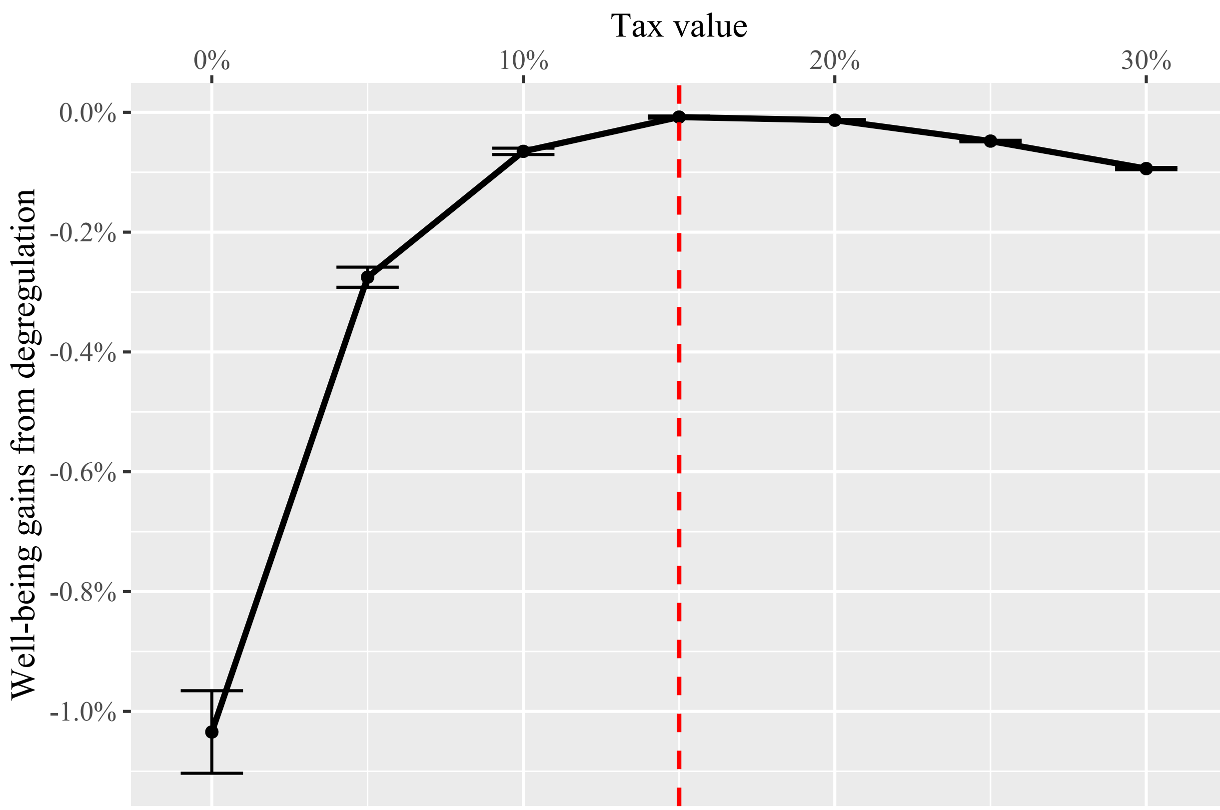
Using a simple over-the-envelope calculation of Canada, Glied (2008) estimates the tax to be around 30%, which would depend on the extent of inequality in health care consumption viewed as acceptable, on assumptions about rates of participation in the private sector, and the rate of growth of private and public health care financing. This would ensure that for the next 20 years, average spending by private purchasers would never be more than 30% higher than the average spending by non-purchasers.

We test such a tax using our applied model for Israel. We use the imputed social value of NIS 13.2 bln (previously reported) and randomly sample σ_h and σ_1 using a Monte-Carlo framework. We raise the tax levied on private health care production from 0% to 30%, and transfer its revenues directly to the GHS to support public health care financing. For each tax bracket increment, the model is simulated 3000 times.

Figure 6 reports that the optimal tax on private health care production should be around 15%. (The figure also provides the 99% confidence interval around each point.) This suggests that de-regulation would be a second best strategy because such a policy would only bring well-being (nearly) back up to its baseline levels, or do worse. Hence, in Israel, a regulated system is preferable to a de-regulated system.

[44]For example, a study by Israeli MoF estimates that in those public hospitals that were given permission to introduce private services, physicians wage gaps increased dramatically; top quintile wages were 6.2 times higher than the lowest quintile, compared to 4.7 in the rest of the public hospitals without private services. Furthermore, hospitals that introduced private health care within public infrastructure had many more patients diverted towards the private system, compared to public hospitals without private services (Ben Naim and Blinksy, 2019).

Figure 6: The optimal tax on private health care (%)



The figure presents the average change in well-being for different tax values levied on private health care. A 15% tax on private health would maximize well-being in the deregulated system. (The figure also reports the 99% confidence interval around each point.) However, this strategy is *not* better than the baseline regulated system because welfare (nearly) returns to zero, or does worse; To generate this result, we use the imputed social value $E_0 = 13.2$, and for each tax bracket increment, the model is simulated 3000 times, randomly sampling σ_h and σ_1. The tax revenue accrued is directly transferred to the GHS.

7 Conclusion

It is difficult to pinpoint the optimal balance between private and public health care provision and finance. In recent years, in Israel and many other countries, a heated debate has ensued on the best health care system. Those in favor of deepening the trend towards privatization argue that it promises to improve efficiency and enable supply to catch-up with demand. Others, however, believe that the public system must be protected and expanded because it provides a social value beyond the measurable economic value. Since the social value of health care is non-marketed and hard to value, it is often neglected, which would lead to misallocation of resources from society's point of view. Our novel computational CVM simulation imputes a net social value of around 26% of the public health care financing. This is a minimum value that would make households indifferent between regulated and deregulated health care, in "normal" times. The infra-marginal value is likely to be much higher.

The recent COVID-19 pandemic is an example of the high lost social value when public health care systems are underfunded. Virus spread rates are expected to be higher in countries lacking universal health care because uninsured citizens will refrain from reaching clinics and hospitals, and will continue spreading the disease. Furthermore, the private system focuses on profit generating health activities that weaken preventative medicine. In these conditions, a market allocation is not optimal and forgoes social value. For example, in Lombardy Italy, health care delivery is more focused on private health systems, while in Veneto on the public system. This is said to be one explanation for the dramatic difference in morbidity rates between the two regions. The USA is another example whereby a neo-liberal administration deepened public health care measures and economic subsidies to contain the virus and support the economy. In doing so, it illustrates their internalization of the social value of health care on the economy. A future study could impute this value using a similar setup as ours.

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Supplementary Material for Online Publication ONLY

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A Israel's 2012 Health Social Accounting Matrix

As explained in Section 4 of the paper, we first constructed a detailed Health Israel Social Accounting Matrix (SAM) with 6 sectors. The matrix documents the financial transactions between agents in the economy with rows reporting for income (receipts) and columns expenditures (payments).

Firms respond to demand by producing goods and services which they sell to households and the government. In order to produce these goods and services firms raise capital and employees. Households are the owners of labor and capital which they sell to the firms.

With this data, we constructed a detailed SAM which has four health sectors, pharmaceutical, and all other industries as follows:

1. Manufacture of pharmaceutical products for human and veterinary uses (industry code 82)
2. Health services - general government non-profit institutions (industry code 188)
3. Health services - general government (industry code no 189)
4. Health services - private non-profit institutions (industry code 187)
5. Health services - private commercial (industry code 190)
6. All other industries

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Table 8: Large health social accounting matrix, 2012

			Short description	PHARMA	HMO	GE-GOV	Commercial	Private NP-O	Other	PHARMA	HMO	GE-GOV	Commercial	Private NP-O	Other										
				A1	A2	A3	A4	A5	A6	C1	C2	C3	C4	C5	C6	TM	TM_M	F	F	H	G	TAX	S	R	
		Industry code		82	188	189	190	187	Ot	82	188	189	190	187	Ot			Factors (lab)	Factors (cap)	Households	Government	Tax	Savings-investment	Rest of world	total
Activity	A1	82	Pharma industry, medical supply and equipment							28,301					302										28603.053
	A2	188	Health services, general government non-profit institutions								39,479				513										39,991
	A3	189	Health services, general government									20,687			-										20,687
	A4	190	Health services, private non-profit institutions										17,950		33										17,983
	A5	187	Health services, private commercial											8,338	-										8,338
	A6	Ot	All other industries							302	513	-	33	-	1,743,959										1,744,807
Commodity	C1	82	Pharma industry, medical supply and equipment	5,309	4,436	986	559	311	1,526							-	-			4,991	-	-	842	21,661	40,621
	C2	188	Health services, general government non-profit institutions	-	-	3,408	2	24	91							-	-			1,320	35,099	-	-	49	39,991
	C3	189	Health services, general government	-	6,501	948	-	-	311							-	-			1,128	11,697	-	-	102	20,687
	C4	190	Health services, private non-profit institutions	4	7,377	1,586	1,042	26	873							-	-			10,058	-	-	-	104	21,070
	C5	187	Health services, private commercial	-	2,430	1,628	7	-	183							-	-			4,036	-	-	-	54	8,338
	C6	Ot	All other industries	9,485	5,681	2,509	4,589	1,827	900,296							1,900	3,098			533,703	176,034	-	209,386	347,019	2,195,526
Trade margins			TM_E							1,900	-	-	-	-	-										1,900
			TM_M							-	-	-	-	-	3,098										3,098
Factors	F		Factors (Labour)	2,708	10,875	7,891	6,067	4,597	457,771															29,656	519,564
			Factors (Capital)	11,145	808	629	5,391	757	327,357																346,086
	H		Households															463,139	346,086		116,391			23,836	949,452
	G		Government																	1,948		314,308		14,818	331,074
	T		Taxes	(47)	1,884	1,102	327	795	56,400	1,232	-	-	2,553	-	100,804					148,158				1,101	314,308
	S		Savings-investment																	235,916	(9,219)				226,697
	R		Rest of world							8,886	-	-	534	-	346,817			56,425		8,197	1,071		16,468		438,398
			Total	28,603	39,991	20,687	17,983	8,338	1,744,807	40,621	39,991	20,687	21,070	8,338	2,195,526	1,900	3,098	519,564	346,086	949,454	331,074	314,308	226,695	438,398	

B Calibrating substitution elasticity σ_1

To calibrate the substitution elasticity between health and other goods, σ_1, we use a method outlined by Shoven and Whalley (1992) and Perroni and Rutherford (1995) for any generalized nested-structure. σ_1 is located in the second-level nest of the utility function (see Figure 3), and can be approximated by the compensated demand price elasticity for health ϵ (obtained from the literature) and the cost shares θ (obtained from the Health SAM).

At the baseline, we calibrate input prices and total expenditure to unity. The demand for health is therefore scaled by

$$H = p_H^{-\sigma_1} p_{HO}^{\sigma_1 - \sigma_0} p_U^{\sigma_0} \bar{H}$$

with p_H, p_{HO} and p_U the baseline values for health, H, sub-aggregate health and other goods, HO, and utility U (respectively). An over-bar, $\bar{\square}$, indicates values at the benchmark.

The derivative of the demand for health with respect to its price (at the initial allocation point where all prices are unity) is

$$\frac{\partial H}{\partial p_H} |_{p=1} = \left[-\sigma_1 + (\sigma_1 - \sigma_0) \frac{\partial p_{HO}}{\partial p_H} + \sigma_0 \frac{\partial p_U}{\partial p_H} \right] \bar{H} \tag{B.1}$$

By Shephard's Lemma, the derivative of the unit cost function with respect to input prices equals the share of inputs at the benchmark calibration, as follows

$$\frac{\partial p_{HO}}{\partial p_H} = \frac{p_H \bar{H}}{p_H \bar{H} + p_O \bar{O}} = \theta_1$$

$$\frac{\partial p_U}{\partial p_H} = \frac{p_W \bar{W}}{p_U \bar{U}} = \theta_0$$

Note that $\bar{O}$ is the value for other goods, with p_O its price. θ_1 and θ_0 are obtained from the Health SAM.

Combining the above with Equation (B.1), obtain

$$\frac{\partial H}{\partial p_H} |_{p=1} = [-\sigma_1 + (\sigma_1 - \sigma_0)\,\theta_1 + \sigma_0 \theta_0]\, \bar{H}$$

Define the compensated elasticity of demand as $\epsilon |_{p=1} = \frac{\partial H}{\partial p_H} \frac{p_H}{\bar{H}}$, and therefore

$$\epsilon |_{p=1} = [-\sigma_1 + (\sigma_1 - \sigma_0)\,\theta_1 + \sigma_0 \theta_0]$$

Finally, solving for for σ_1 yields

$$\sigma_1 = \frac{\epsilon + \sigma_0 (\theta_1 - \theta_0)}{(\theta_1 - 1)} \qquad \blacksquare$$

C Further Results

Table 9 provides further results (in *real* terms) on the changes to consumption (expenditure) for the various sectors. Column 1 provides the baseline levels, while columns 2 through 4 report results for varying degrees of substitution elasticity between private and public health care goods (i.e., for $\sigma_h = 2$, 5 or 10 in equation 6). Note that the externality associated with health care is *not yet* accounted for.

Table 9: Main results, real terms (million NIS)

	Baseline	**Derugalaton (externlity = 0)**								
	Level	Level	Change from		Level	Change from		Level	Change from	
	mln NIS	mln NIS	%	diff	mln NIS	%	diff	mln NIS	%	diff
Substitution elasticity between private and public healthcare			2			5			10	
Public consumption of Public healthcare production	46,796	44,684	-4.5%	-2,113	40,684	-13.1%	-6,112	33,729	-27.9%	-13,067
Private consumption of Private healthcare production	14,094	19,061	35.2%	4,967	26,893	90.8%	12,799	38,793	175.2%	24,699
Private consumption of Public healthcare production	2,447	2,350	-4.0%	-97	2,261	-7.6%	-186	2,270	-7.2%	-177
Private consumption of other health goods	11,755	12,254	4.2%	499	12,963	10.3%	1,208	13,962	18.8%	2,207
Total private health cosumption	**28,296**	**33,665**	**19.0%**	**5,369**	**42,118**	**48.8%**	**13,822**	**55,025**	**94.5%**	**26,729**
Total health cosumption	**75,092**	**79,209**	**5.5%**	**4,116**	**85,157**	**13.4%**	**10,064**	**93,690**	**24.8%**	**18,597**
Total other consumption	526,939	524,591	-0.4%	-2,348	521,228	-1.1%	-5,710	516,745	-1.9%	-10,194
Total consumption	**796,985**	**798,387**	**0.2%**	**1,402**	**800,167**	**0.4%**	**3,182**	**802,661**	**0.7%**	**5,676**

Note: The table provides detailed results (in real terms) of the counterfactual and baseline simulations. The table excludes the social value of public health care.

Table 10 reports the same data in *nominal* terms which accounts for the decline in the prices of health care. Thus, although total health consumption in *real* terms rises, the total expenditure in nominal terms remains stable at around 7.5% to 7.6% of GDP. The share of private financing rises to 49% (given elasticity of 5) compared to 38% in the baseline and reflects the sharp rise in private health care consumption. The decline in the public finance on health means reduction in health tax. Currently, the average health care tax is 8.4% which amounts to around NIS 46.8 billion. In the deregulation simulations, the health tax rate drops to 6.8% - a fall of 17.6%, and the amount of health tax collected drops to NIS 38.6 billion. Income tax rate (net of health care tax) remains fixed at 26.7% throughout the various simulations, but the amount of tax collected rises by 2.3% due to income growth.

C.1 Sensitivity analysis

We furthermore test alternative values for $0.25 \leq \sigma_1 \leq 3$, while holding all else equal. Figures 7 to 10 show a convergences as σ_1 rises, and that model well behaved.

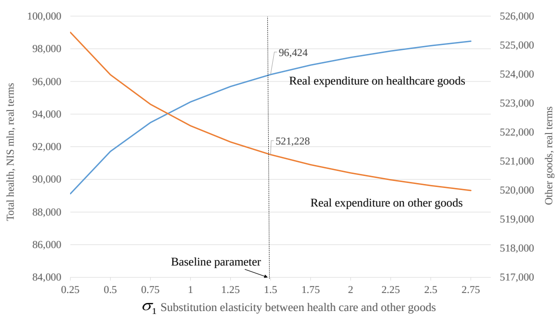
As σ_1 rises, Figure 7 shows that the real expenditure on health care goods increases while it decreases for other good. As Figure 8 shows, the weighted price of private and public health care falls (relative to the baseline), which raises the overall demand for health care goods. This coincides with an increase in health care production due to a greater increase in the production of private health care and a small fall in the production of public health care (see Figure 9). Finally, Figure 10 shows a rise in the number of health-labor employees that migrate from the public to private rises. It furthermore shows that welfare (i.e. total consumption expenditure) rises in the deregulated health care system (relative to the regulated baseline scenario) because the economy is more efficient and resource are allocated more efficiently. The main point in the paper however is that this conclusion might be wrong, and that well-being might fall when we do *not* internalize the net social value that health care creates.

Table 10: Main results, nominal terms (million NIS)

	Baseline	**Derugalaton (externlity = 0)**								
	Level	Level	Change from		Level	Change from		Level	Change from	
	mln NIS	mln NIS	%	diff	mln NIS	%	diff	mln NIS	%	diff
Substitution elasticity between private and public healthcare			2			5			10	
Public consumption of Public healthcare production	**46,796**	**44,962**	**-3.9%**	**-1,834**	**38,574**	**-17.6%**	**-8,222**	**29,453**	**-37.1%**	**-17,343**
Private consumption of Private healthcare production	14,094	16,161	14.7%	2,067	22,056	56.5%	7,962	30,384	115.6%	16,289
Private consumption of Public healthcare production	2,447	2,364	-3.4%	-83	2,144	-12.4%	-303	1,982	-19.0%	-465
Private consumption of other health goods	11,755	12,333	4.9%	578	13,222	12.5%	1,467	14,503	23.4%	2,748
Total private health cosumption	**28,296**	**30,859**	**9.1%**	**2,562**	**37,423**	**32.3%**	**9,126**	**46,869**	**65.6%**	**18,573**
Total health cosumption (net taxes)	**75,092**	**75,821**	**1.0%**	**728**	**75,997**	**1.2%**	**905**	**76,322**	**1.6%**	**1,230**
Other consumption	526,939	527,537	0.1%	599	530,605	0.7%	3,666	534,930	1.5%	7,991
Total consumption (net of taxes)	**602,031**	**603,358**	**0.2%**	**1,327**	**606,602**	**0.8%**	**4,571**	**611,252**	**1.5%**	**9,221**
Income tax revenue	148,158	149,001	0.6%	843	151,571	2.3%	3,414	155,246	4.8%	7,088
Health tax revenue	46,796	44,962	-3.9%	-1,834	38,574	-17.6%	-8,222	29,453	-37.1%	-17,343
Total Consumtpion	**796,985**	**797,321**	**0.0%**	**336**	**796,748**	**0.0%**	**-237**	**795,951**	**-0.1%**	**-1,034**
income tax rate	26.7%	26.7%			26.7%			26.7%		
health tax rate	8.4%	8.1%			6.8%			5.1%		

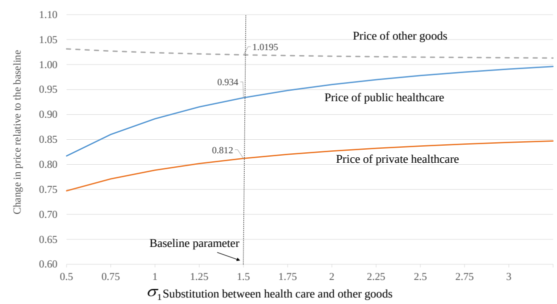
Note: The table provides detailed results (in *nominal* terms) of the counterfactual and baseline simulations, used to calculate the average health tax.

Figure 7: Real expenditure (NIS mln 2012)



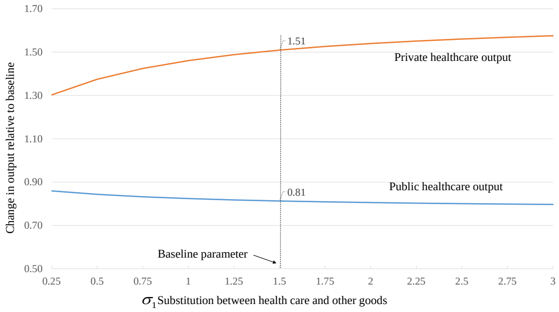
The figure plots the real expenditure on health care and other goods. As the substitution elasticity between them rises, real expenditure on health care rises and falls for other goods.

Figure 8: Change in prices after deregulation (baseline prices = 1)



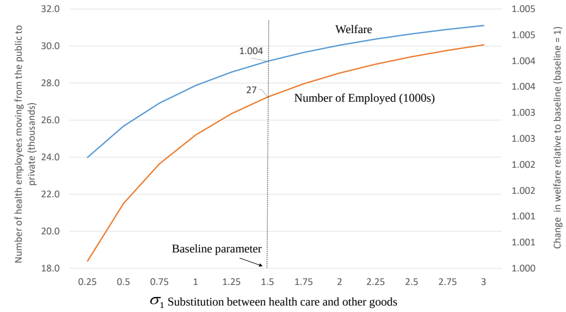
The figure shows the simulated change in public and private health care prices after deregulation relative to the baseline. Private health care becomes relatively cheaper compared to public health care. The overall prices of health care falls relative to baseline.

Figure 9: Health care output (baseline output = 1)



The figure plots the change in private and public output (production) relative to the baseline. As the substitution elasticity rises, private production rises and public production falls.

Figure 10: Welfare and the number of health care employees rise



The figure shows that the higher the substitution elasticity between health care and others, the larger the number of employed workers will shift from the public to private health care. Welfare rises as the substitution elasticity rises.

D The GAMS code

Below is the GAMS code for the simulation. All data in excel format can be obtain upon request.

```
scalar  DocTrade        Scalar flag for health rights trade /0/;

$ontext
$offlisting
$offsymxref offsymlist
option
    limrow = 0,
    limcol = 0,
    solprint = off,
    sysout = off;
$offtext

*==========================================================================================================
* Defines the various sets in the model
*==========================================================================================================
SETS I MATRIX ACCOUNTS /Rel_Wage, Pri_H, Pub_H, Other,  Externality, L_Pri, L_pub, L_oth, K,
                        HH, gov_health, tax_health_N, VAT, tax_lab, tax_direct, tax_exter/
a(i)   activities              /Pri_H, Pub_H, Other/
tx(i)  taxes and subsidy       /tax_health_N,   VAT,    tax_lab,        tax_direct,     tax_exter/
f(i)   factors                 /L_Pri, L_pub, L_oth,  K/
l(i)   labour                  /L_Pri, L_pub, L_oth/
h(i)   households              /HH/
;
ALIAS(i,j), (a,aa);

*===========================================================================================================
* LOADS the Social Accounting Matrix (SAM)
*===========================================================================================================
$CALL GDXXRW Various_SAM.xlsx  O=sam  par=SAM rng=Sam_v5-1!B17:P30   Cdim=1 Rdim=1

$GDXIN sam.gdx
Parameter
SAM(i,j) balanced matrix;
$LOAD SAM
$GDXIN
parameter  number /1/;
SAM(i,j) = SAM(i,j)/number;
display SAM;

*===========================================================================================================
*           Define sub-matrices
*===========================================================================================================

PARAMETERS
Y0(a)            Base year output
Int0(a,aa)       Demand for Intermediate inputs by firm a
LD0(l,a)         Demand for Labor by firms of worker type l
KD0(a)           Demand for Capital by firm
C0(a)            Demand for consumption
CT0              Total Household Expenditure
```

```
LS0(l)           Labour supply Endowment
KS0              Capital Supply Endowment
KGS0             Capital spply governmen endowmnet

G_health0        Government provision of healthcare
G_h0(a)          Government demand for healthcare (which is equivallent to provision)
VAT0(a)          VAT on sector output
VAT(a)           COUNTERFACTUAL change in VAT on sector output
tax_lab0(a)      Tax on labor wages baseline
tax_lab(a)       COUNTERFACTUAL tax on labor wage
direct_tax_rev0  Total direct tax collected from household
direct_tax0      BASELINE Direct household income tax
direct_tax       COUTNERFACTUAL Direct household income tax
health_tax_rev0      Total tax health revenue collected from household
tax_health0      BASELINE  health tax
tax_health       COUNTERFACUTAL health tax

HH0              Transfer from household to household
sub_health       substitution between private and public health products
sub_oth_health   Substitution between other and health products
PL0(l)           Baseline Wage Rates

;
*=============================================
Y0(a)           = sum(i,SAM(i,a));
INT0(a,aa)      = SAM(a,aa);
LD0(l,a)        = SAM(l,a);
KD0(a)          = SAM("K",a);
LS0(l)          = SAM("HH",l);
KS0             = SAM("HH","K");
KGS0            = SAM("gov_health","K");
G_h0(a)         = SAM(a,"gov_health");
G_health0       = sum(a,G_h0(a));
C0(a)           = SAM(a,"HH");
HH0             = SAM("HH","HH");
CT0             = sum(a,C0(a));
VAT0(a)         = SAM("VAT",a)/Y0(a);
VAT(a)          = VAT0(a);
tax_lab0(a)     = SAM("tax_lab",a)/sum(l,SAM(l,a));
tax_lab(a)      = tax_lab0(a);
direct_tax_rev0 = SAM("tax_direct","HH");
direct_tax0     = SAM("tax_direct","HH")/CT0;
direct_tax      = direct_tax0;
health_tax_rev0 = SAM("tax_health_N","HH");
tax_health0     = health_tax_rev0/CT0;
tax_health      = tax_health0;
sub_health      = 10;
sub_oth_health  = 0.1;
PL0(l)          = SAM(l,"REl_Wage");

Parameter
externality0(a)  baseline externality made by eacy sector /Pub_H 0.000001, Pri_H 0.000001,  Other 0.000001/
externality(a)   counterfactual
;
externality(a) = externality0(a);
display Y0, externality, INT0, LD0, PL0, KD0, KS0, INT0, C0, CT0 ,tax_health0,
        health_tax_rev0, VAT0, tax_lab0, HH0, G_h0 , G_health0;

parameters
sub          subsidizing the public health care
tax_exter(a)   hundred percent externality tax
;


sub=0;
tax_exter(a)=1;

$ontext

$model:health

$sectors:
Y1(a)  ! production
Y2(a)
C               !    Consumption (utility) before externality
UTIL            !    utility level
DOC1$DocTrade   !    Doctors transfers
DOC2$DocTrade   !    Doctors transfers
G               !    Production of government services

$commodities:
```

```
PY1(a)          !  Price of output
PY(a)           !  Price of output after CET of externality
P_exter(a)      !     Shadow price of externality
PL(l)  ! wage of various types of laborer
PK              !     rent on capital
PC              !     consumer price index of private goods
PU              !     CPI of total utility
PG      !     Price index of government services
PG_U    !     Price index of gov services as viewed by households


$consumers:
    HH
    GOV_inc
    DEAD      ! Deadweight Loss

$AUXILIARY:
    LGP_operate         ! Level of government provision for operations
    tax_health_N        ! tax on consumption

* allow doctors to move around
$prod:DOC1$DocTrade
    o:PL("L_Pub")     q:0.9999
    i:PL("L_Pri")     q:1

$prod:DOC2$DocTrade
    o:PL("L_Pri")     q:0.9999
    i:PL("L_Pub")     q:1


*production of public health - it also creates the externality
$prod:Y1(a)  s:0  s1(s):1
    o:PY1(a)          q:Y0(a)                                                a:HH   t:VAT(a)
    i:PY(aa)          q:INT0(aa,a)                                     s:0
    i:PL(l)           q:(LD0(l,a)/(PL0(l)))  P:(PL0(l)*(1+tax_lab0(a)))   s1:   a:HH   t:tax_lab(a)
    i:PK              q:KD0(a)                                         s1:

*production of public health - it also creates the externality
$prod:Y2(a)  t:0
    o:P_exter(a)      q:externality(a)                                       a:HH   t:tax_exter(a)
    o:PY(a)           q:Y0(a)
    i:PY1(a)          q:Y0(a)

* Government buys public health production operations
$PROD:G    s:sub_health
    O:PG      q:(G_h0("Pub_H") + G_h0("Pri_H"))
    i:PY("Pub_H")     q:G_h0("Pub_H")
    i:PY("Pri_H")     q:G_h0("Pri_H")


$prod:C        s:sub_oth_health  s_h1(s):sub_health
    o:PC              q:(sum(a,(C0(a)))+G_health0   + health_tax_rev0 )
    i:PY("Pri_H")     q:C0("Pri_H")   P:(1+tax_health0)   s_h1:      A:GOV_inc    N:tax_health_N     A:DEAD  t:DW_tax
    i:PY("Pub_H")     q:C0("Pub_H")   P:(1+tax_health0)   s_h1:      A:GOV_inc    N:tax_health_N
    i:PY("Other")     q:C0("Other")   P:(1+tax_health0)              A:GOV_inc    N:tax_health_N
    i:PG_U            q:(G_h0("Pub_H") + G_h0("Pri_H"))   s_h1:     ! Household gets for free


$prod:UTIL  s:0.1
    o:PU              q:(CT0+G_health0 + sum(a,externality(a))    + health_tax_rev0 )
    i:P_exter(a)      q:externality(a)
    I:PC              q:(CT0+G_health0 + health_tax_rev0 )
*    i:pg_exter         q:3


$demand:HH
    d:PU
    e:PL(l)   q:(LS0(l)/PL0(l))   ! endowment of real people because value/wage
    e:PG_U      q: (G_h0("Pub_H") + G_h0("Pri_H"))               R:LGP_operate
    e:PK        q:KS0
    e:PU        q:HH0
    e:PU        q:direct_tax_rev0
    e:PU        q:(-direct_tax_rev0)

* Gov collects health tax and demands government services
$demand:GOV_inc
    d:PG   q:(G_h0("Pub_H") + G_h0("Pri_H"))
    e:PK      q:KGS0

$demand:DEAD
      d:PC
```

```

* gov produces a services which is given free to hoseholds by making them endowed with it endogensouly.
$CONSTRAINT:LGP_operate
        LGP_operate =E= G;

* the price of the gov price index equals the price index provided to households for free
$CONSTRAINT:tax_health_N
        PG =E= PG_U;


$REPORT:
V:C_pri            i:PY("Pri_H")       PROD:C
V:C_pub            i:PY("Pub_H")       PROD:C
V:C_other          i:PY("Other")       PROD:C
V:Ctot             O:PC                PROD:c
V:Utot             O:PU                PROD:UTIL
V:G_pri            i:PY("Pri_h")       PROD:G
V:G_pub            i:PY("Pub_h")       PROD:G
V:G_tot            i:PG_U              PROD:C
V:G_tot2           i:PG                PROD:G
V:DOC_Mov1         O:PL("L_Pub")       PROD:DOC1
V:DOC_Mov2         O:PL("L_Pri")       PROD:DOC2
V:Lab_all(l,a)     i:PL(L)             PROD:Y1(a)
V:Cap_all(a)       I:PK                PROD:Y1(a)
V:val_exter(a)     o:P_exter(a)        PROD:Y2(a)


$offtext


$sysinclude mpsgeset health
option decimals = 2;
PU.FX=1;
* PC.FX=1;
* PK.FX=1;

**************
* baseline
* no trade between private and public doctors
* externality is zero



tax_health_N.L = health_tax_rev0/(CT0);
* tax_health_N.FX = health_tax_rev0/(CT0+G_health0);
PL.L("L_pri") = PL0("L_pri");
LGP_operate.L = 1;
* LGP_siodi.L = 1;
DocTrade = 0;
tax_exter(a)=1;
health.iterlim = 1000;

* $ontext
$include health.gen
solve health using mcp;

**********************************************
* DOCTOR MOVMENT ALLOWED - Private and public doctors can move around
* externality is zero
* public doctors move to private care to make more money
* utility rises, PUBLIC CARE falls, PRIVATE CARE rises

Y1.L(a) = 1;
Y2.L(a) = 1;
C.L =1;
UTIL.L = 1;
G.L =1;
PY1.L(a)=1;
PY.L(a)=1;
P_exter.L(a)=1;
PL.L(l)=1;
PK.L = 1;
PC.L = 1;
PU.L = 1;
PG.L=1;
PG_U.L=1;

* DW_tax = 0.2;
LGP_operate.L = 1;
tax_health_N.L = health_tax_rev0/(CT0);

```

```
DocTrade = 1;
tax_exter(a)=1;



health.iterlim = 8000;
$include health.gen
solve health using mcp;
* $offtext


*======================================================================
*        All model RUNS
*======================================================================

set     scall          Scenarios                        /level, base, sc1*sc30/
        scbase(scall)     Baseline                                     /base/
        sc1(scall)        Open doctor trade                            /sc1/
        sc2(scall)        Different elasticity                         /sc2/
        sc3(scall)        Externality                                  /sc3/
        sc4(scall)        Externality                                  /sc4/
        sclev(scall)      Levels in Baseline                           /level/
*        sc(scall)      SCENARIOS TO BE RUN              /base, sc1*sc2/
        sc(scall)      SCENARIOS TO BE RUN              /base, sc1,sc3*sc4/
        ;


****************************************************************************************************
* REPORTING STARTS HERE
****************************************************************************************************



******************************************************************************
****************************************************************************************************
* REPORTING STARTS HERE
****************************************************************************************************

parameter
Y1_sc(a,sc)         Output level without externality
Y2_sc(a,sc)         Output level with externality
C_sc(sc)          Consumption level
Util_sc(sc)       Utility level - includes externality
G_sc(sc)          Government healthcare services
PY1_sc(a,sc)
PY_sc(a,sc)
P_EXTER_sc(a,sc)
PL_sc(l,sc)
PK_sc(sc)
PC_sc(sc)
PU_sc(sc)
PG_sc(sc)
PG_U_sc(sc)
HH_sc(sc)
GOV_inc_sc(sc)
DEAD_sc(sc)
Tax_health_sc(sc)

C_Pri_sc(sc)           Household consumpton of private health
C_Pub_sc(sc)           Household consumpton of public health

C_Oth_sc(sc)           Household consumpton of other
G_Pri_sc(sc)           Household consumpton of private health
G_Pub_sc(sc)           Household consumpton of public health

C_tot_health_sc(sc)    Household total cons of health
G_tot_health_sc(sc)    Gov total cons of health
Doc_mov1_sc(sc)
Doc_mov2_sc(sc)

Lab_all_sc(l,a,sc)
Cap_all_sc(a,sc)
sub_health_sc(sc)      substition elasticity for health products
sub_oth_health_sc(sc)     substitution elasticty between other and health products
externality_sc(a,sc)   externality
val_exter_sc(a,sc)     Value of externality
Ctot_sc(sc)
Utot_sc(sc)

RESULT(*,*,*,*)  Main Table with Aggregate Results
;
```

```
*************************************************************


loop(sc,
* re-initialize baseline
tax_health_N.L = health_tax_rev0/(CT0);
PL.L("L_pri") = PL0("L_pri");
LGP_operate.L = 1;
DocTrade = 0;
tax_exter(a)=1;

Y1.L(a) = 1;
Y2.L(a) = 1;
C.L =1;
UTIL.L = 1;
G.L =1;
PY1.L(a)=1;
PY.L(a)=1;
P_exter.L(a)=1;
PL.L(l)=1;
PK.L = 1;
PC.L = 1;
PU.L = 1;
PG.L=1;
PG_U.L=1;
DOC_mov2.L = 0;

LGP_operate.L = 1;
tax_health_N.L = health_tax_rev0/(CT0);

DocTrade = 1;
tax_exter(a)=1;
******************************
* Baseline
if(scbase(sc),
DocTrade = 0;
sub_health = 10;
sub_oth_health = 0.1;
externality("pub_h") = 0.0000001;
);

* Doctor Trade
if(sc1(sc),
DocTrade = 1;
sub_health = 10;
sub_oth_health = 0.1;
externality("pub_h") = 0.0000001;
);

* Doctor Trade  but lower substitution
if(sc2(sc),
DocTrade = 1;
sub_health = 5;
sub_oth_health = 0.1;
);

* Doctor Trade  but lower substitution
if(sc3(sc),
DocTrade = 0;
sub_health = 10;
sub_oth_health = 0.1;
externality("pub_h") = 400;
);

* Doctor Trade  but lower substitution
if(sc4(sc),
DocTrade = 1;
sub_health = 10;
sub_oth_health = 0.1;
externality("pub_h") = 400;
);

*******************
PU.FX=1;
*******************



$include health.GEN
SOLVE health USING MCP;
ABORT$(health.OBJVAL > 0.001)   "Model does not calibrate.";
```

```
*****************************************
*   Placing scalars into time series
*****************************************

Y1_sc(a,sc)      = Y1.L(a);
Y2_sc(a,sc)      = Y2.L(a);
C_sc(sc)         = C.L;
Util_sc(sc)      = Util.L;
G_sc(sc)         = G.L;

PY1_sc(a,sc)     = PY1.L(a);
PY_sc(a,sc)      = PY.L(a);
P_EXTER_sc(a,sc)= P_exter.L(a);
PL_sc(l,sc)      = PL.L(l);
PK_sc(sc)        = PK.L;
PC_sc(sc)        = PC.L;
PU_sc(sc)        = PU.L;
PG_sc(sc)        = PG.L;
PG_U_sc(sc)      = PG_U.L;
HH_sc(sc)        = HH.L;
GOV_inc_sc(sc)   = GOV_INC.L;
DEAD_sc(sc)      = DEAD.L;
Tax_health_sc(sc)      = Tax_health_N.L;
sub_health_sc(sc)      = sub_health;
sub_oth_health_sc(sc) = sub_oth_health;
externality_sc(a,sc)  = externality(a);
val_exter_sc(a,sc)    = val_exter.L(a);

C_pri_sc(sc)     = C_pri.L;
C_pub_sc(sc)     = C_pub.L;
C_oth_sc(sc)     = C_other.L;
G_pri_sc(sc)     = G_pri.L;
G_pub_sc(sc)     = G_pub.L;

C_tot_health_sc(sc) = C_pri.L + C_pub.L;
G_tot_health_sc(sc) = G_pri.L + G_pub.L;
Ctot_sc(sc)         = Ctot.L;
Utot_sc(sc)         = Utot.L;
Doc_mov1_sc(sc)         = DOC_mov1.L;
Doc_mov2_sc(sc)         = DOC_mov2.L;


Lab_all_sc(l,a,sc)      = Lab_all.L(l,a);
Cap_all_sc(a,sc)        = Cap_all.L(a);



* re-initialize baseline
tax_health_N.L = health_tax_rev0/(CT0);
PL.L("L_pri") = PL0("L_pri");
LGP_operate.L = 1;
DocTrade = 0;
tax_exter(a)=1;
DOC_mov2.L = 0;
Y1.L(a) = 1;
Y2.L(a) = 1;
C.L =1;
UTIL.L = 1;
G.L =1;
PY1.L(a)=1;
PY.L(a)=1;
P_exter.L(a)=1;
PL.L(l)=1;
PK.L = 1;
PC.L = 1;
PU.L = 1;
PG.L=1;
PG_U.L=1;

* DW_tax = 0.2;
LGP_operate.L = 1;
tax_health_N.L = health_tax_rev0/(CT0);

* DocTrade = 1;
* tax_exter(a)=1;
******************************

);
```

```
*************************************************************
* E N D        L O O P
*************************************************************
* other variables made

* RESULTS TABLE

RESULT("Substitution elasticity","pri-pub-health","",sc)           = sub_health_sc(sc);
RESULT("Substitution elasticity","other-health","",sc)             = sub_oth_health_sc(sc);
RESULT("Variable3","health","",sc)                                 = sub_health_sc(sc);
RESULT("Variable4","health","",sc)                                 = sub_health_sc(sc);
RESULT("Externality","health",a,sc)                                = externality_sc(a,sc);
RESULT("Output level before externality","Y1",a,sc)                = Y1_sc(a,sc);
RESULT("Output level including externality","Y2",a,sc)             = Y2_sc(a,sc);
RESULT("Consumption level - no externality","REAL","C",sc)         = C_sc(sc);
RESULT("Utility level - with externality","REAL","Util",sc)        = Util_sc(sc);
RESULT("Gov services level","REAL","G",sc)                         = G_sc(sc);
RESULT("PY1 Price of output - before externality","PY1",a,sc)      = PY1_sc(a,sc)    ;
RESULT("PY Price of output - including externality","PY",a,sc)     = PY_sc(a,sc)     ;
RESULT("Labor Wage","PL",l,sc)                                     = PL_sc(l,sc)     ;
RESULT("Price of Capital","","PK",sc)                              = PK_sc(sc)       ;
RESULT("Consumer Price Index - before externality","","PC",sc)     = PC_sc(sc)       ;
RESULT("Consumer Price Index - including externality","","PU",sc)  = PU_sc(sc)       ;
RESULT("Price index Gov Health Services","PG","",sc)               = PG_sc(sc)       ;
RESULT("Price index HH endowed Gov Health Services","PG_U","",sc)  = PG_U_sc(sc)     ;
RESULT("HH Dispoable Income","","HH",sc)                           = HH_sc(sc)       ;
RESULT("Gov Disposable Income","","GOV_inc",sc)                    = GOV_inc_sc(sc)  ;
RESULT("Dead Weight Loss","","DEAD",sc)                            = DEAD_sc(sc)     ;
RESULT("Endogenous Health Tax","","tax_health_N",sc)               = Tax_health_sc(sc);
RESULT("REAL HH private health","consumption","C_pri",sc)          = C_pri_sc(sc);
RESULT("REAL HH public health","consumption","C_pub",sc)           = C_pub_sc(sc);
RESULT("REAL HH Other","consumption","c_oth",sc)                   = C_oth_sc(sc);
RESULT("REAL Gov private health","consumption","G_pri",sc)         = G_pri_sc(sc);
RESULT("REAL Gov public health","consumption","G_pub",sc)          = G_pub_sc(sc);
RESULT("Doctor Movement","","DOC2",sc)                             = Doc_mov2_sc(sc);
RESULT("NOMINAL HH private health","consumption","C_pri",sc)       = PY1_sc("Pri_h",sc)*C_pri_sc(sc);
RESULT("NOMINAL HH public health","consumption","C_pub",sc)        = PY1_sc("Pub_h",sc)*C_pub_sc(sc);
RESULT("NOMINAL HH Other","consumption","c_oth",sc)                = PY1_sc("Other",sc)*C_oth_sc(sc);
RESULT("NOMINAL Gov private health","consumption","G_pri",sc)      = PY1_sc("Pri_h",sc)*G_pri_sc(sc);
RESULT("NOMINAL Gov public health","consumption","G_pub",sc)       = PY1_sc("Pub_h",sc)*G_pub_sc(sc);
RESULT("NOMINAL HH total consumption of health","consumption","C_tot_health",sc)
        = PY1_sc("Pri_h",sc)*C_pri_sc(sc) + PY1_sc("Pub_h",sc)*C_pub_sc(sc);
RESULT("NOMINAL Gov total health services","consumption","G_tot_health",sc)
        = PY1_sc("Pri_h",sc)*G_pri_sc(sc) + PY1_sc("Pub_h",sc)*G_pub_sc(sc);
RESULT("NOMINAL total consumption","consumption","tot_cons",sc)
        = PY1_sc("Pri_h",sc)*C_pri_sc(sc) + PY1_sc("Pub_h",sc)*C_pub_sc(sc)
        + PY1_sc("Other",sc)*C_oth_sc(sc) + PY1_sc("Pri_h",sc)*G_pri_sc(sc)
        + PY1_sc("Pub_h",sc)*G_pub_sc(sc);
RESULT("REAL Labor Demand",l,a,sc)                                = Lab_all_sc(l,a,sc);
RESULT("REAL Capital demand ","REAL cap",a,sc)                    = cap_all_sc(a,sc);
RESULT("Price of Externality","P_EXTER",a,sc)                     = P_EXTER_sc(a,sc);
RESULT("REAL Value of EXternality","REAL exter",a,sc)             = 999;
RESULT("NOMINAL Value of EXternality","NOMINAL exter",a,sc)       = 999;
RESULT("REAL Value of EXternality","REAL exter",a,sc)             = val_exter_sc(a,sc);
RESULT("NOMINAL Value of EXternality","NOMINAL exter",a,sc)       = P_EXTER_sc(a,sc)*val_exter_sc(a,sc);
RESULT("REAL CTot","REAL","",sc)                                  = Ctot_sc(sc);
RESULT("NOMINAL Ctot","NOMINAL","",sc)                            = PC_sc(sc)*Ctot_sc(sc);
RESULT("REAL UTot","REAL","",sc)                                  = Utot_sc(sc);
RESULT("NOMINAL Utot","NOMINAL","",sc)                            = PU_sc(sc)*Utot_sc(sc);

option decimals=1;
display RESULT;

$ontext
$onecho>task.txt
******************************
* Aggregate Level Tables
******************************
text="Percent change of activity output by scenario"    rng=Act1x45!A1
par=Y_ag_sc        rng=Act1x45!B14
par=Y_sc           rng=Act1x45!B33


$offecho
$offtext


Execute 'xlstalk.exe -S RESULT.xlsx' ;
execute_unload 'RESULT.gdx', RESULT;

execute 'gdxxrw.exe RESULT.gdx O=RESULT.xlsx par=RESULT rng=Agg!a4';
```

```
Execute 'xlstalk.exe -O RESULT.xlsx' ;
```

Reference - Supplementary Appendix

Perroni, C. and T. F. Rutherford: 1995, 'Regular flexibility of nested CES functions'. *European Economic Review* **39**(2), 335–343.

Shoven, J. B. and J. Whalley: 1992, *Applying General Equilibrium*. Cambridge University Press.