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Health Care Services and economic impact: a dynamic CGE approach

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Abstract

The sustainability of the health care expenditure is a matter of concern for the policy maker especially when it is financed by public funds. The public health care spending definitely represents one of the major part of total expenditure for many Governments and the economic literature constantly debates on the profitability of its restraint. Indeed the "health" good can be considered as a key sector for the economy since it interacts with the other commodities/institutional sectors and is able to activate other production processes and promote income generation. The policy maker accomplishment should therefore aim at implementing a Health care policy able to achieve a composite objective. This policy target involves that the level of public health care expenditure should be consistent with economic growth. In this perspective, we focus on the importance of "Health care expenditure" in the income generation and analyse the impact of a different composition of the health expenditure between private and public Institutional sectors. This is one of the main point in the recent reform of health care system in USA and our attempt is to quantify the impacts of the announced new allocation of Health care expenditure in the long term and along the income circular flow. For this purpose, a dynamic Computable General Equilibrium model (CGE) is calibrated on the Social Accounting Matrix (SAM) for USA economy for 2009. In this database se identify the health care sectors, thus we are able to measure the direct and indirect effects of the Health Policy on the main macroeconomic variables such as total production, prices and income distribution along a period of 20 years.

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1. Introduction

The increase in health care expenditure emphasizes the relevance of health sector in world production and confirms the importance of health commodity within national economy (Works, 2003).

Economic literature on this subject typically focuses on theoretical reasons allowing public involvement in production of health commodity. Even if the main criticism related to health commodity is represented by the efficiency in its production and the equity in its distribution among people, this type of analysis normally does not take into account the production aspect and its impact on income and employment (Hughes and Walker, 2003). Since health commodity interacts with the other commodities and the Institutional Sectors, it is crucial to verify whether the health good is able to affect the most important macroeconomic aggregates (Clair et al., 2005).

The debate on U.S. health policy, in particular, focuses on limiting the growth of health spending that is now around 18 percent of real GDP and its public share accounts for almost half of the total[2]. In this debate, many of the important questions related to rising health expenses involve the definition of the Institutional Sector that should provide its funding. Nevertheless the mainstream suggests to reduce the public involvement in health care expenditure, an understanding on better public policies is emerging. These policies should be able either to ensure society's efficient consumption of health and prevent increasing expenditures by taking into account the driving force of health care services in determining the total output of U.S. economy. Indeed rising health care spending is a topic of absolutely general concern, but unlike the past, increasingly literature focuses on the positive relation between health demand, income growth and better health interventions (Hall and Jones, 2007).

Following this approach, the health sector is considered as a leading activity whose expenditure has the potential to pull forward a wide array of other industries including the traditional sector of manufacturing, education, financial services, communications and construction[3]. This fact suggests a fundamental repositioning of the debate about health care from how governments can limit spending to how to obtain economic positive direct and indirect effects from undertaken health spending.

The size and the scope of the federal Patient Protection and Affordable Care Act (PPACA - 23.03.2010) demonstrates the economic importance of health care spending in U.S. economy and perhaps a new thought on this direction. This reform is one of the largest laws ever approved by the Member States and aims to expand access to insurance, increase consumer protections, emphasize prevention and wellness, improve quality and system performance, expand the health workforce, and curb rising health care costs.

As known, in U.S. the health care system revolves around insurance contract that are directly stipulated by people or by employers. The elderly are protected by the Medicare program and low income people by Medicaid program. The PPACA does not revolutionise this logic but substantially expands the health care coverage in three different ways: expanding health insurance through shared responsibility, expanding eligibility for Medicaid to lower income persons and improving the quality and efficiency of U.S. medical care

[2] The health spending rose from 5.2 percent in 1960 to 16.2 percent in 2008. The expectation are for an increase of the share to more than 19 percent by 2019 (BEA, 2009).

[3] "*Just as electricity and manufacturing were the industries that stimulated the growth of the rest of the economy at the beginning of the 20th century, healthcare is the growth industry of the 21st century.*" (Fogel, 2008).

services for everyone, and especially for those enrolled in Medicare and Medicaid. The Federal Government will assume responsibility for much of the cost of this expansion.

Since the US Health care system is strongly integrated with all other production processes, this huge policy measure will generate effects on US economic system on the whole income circular flow. Then an analysis that is able to quantify the direct and indirect effects of the health care policy in a multisectoral framework is required. Computable General Equilibrium models (CGE) are widely considered in the literature as suitable instruments of analysis to quantify the impacts of an exogenous shock on macroeconomic variables along the income circular flow (Ciaschini et al., 2013). Moreover, since the health care reform approved by the U.S. economy is supposed to embrace at least a 10 years time period, the analysis must be carried out taking into account these long term targets and move from the static to the dynamic approach.

To this aim, this paper develops a multisectoral dynamic CGE model for the US economy in order to verify the compatibility between the need of redistributing the burden of the health care expenditure between public and private Institutional sectors without neglecting the economic growth. The analysis is carried out on U.S. Social Accounting Matrix (SAM) that is the suitable instrument to describe all phases of income generation (Ciaschini et al., 2010). Furthermore, the aim to identify the potential economic impact of health system among all components of total output in a multisectoral framework drove to identify and emphasize all the flows concerning this sector within the economy. This detailed database represents the benchmark for the CGE model that is calibrated on it, and allows discussing the results of the policy proposals in terms of changes in prices, total output, final demand and value added.

The next section defines the main features of the database and the dynamic CGE model used to analyse the policy reform. Then the third section describes some characteristics of the Institutional framework of U.S. health care system and the policy implemented. The fourth section presents the major results stressing the impact of the policy in terms of changes in prices, total output, final demand and value added. Thus, the last part offers a discussion on the role played by the health product and the health policy reform in the US economy.

2. Dynamic CGE model and Social Accounting Matrix

2.1. Dynamic CGE model

Healthmac14, is a multisectoral dynamic Computable General Equilibrium model developed to investigate the role and the potential impact of health care policies within the economic system. In Helthmac14 the evolution path is a sequence of single period static equilibria linked each other by the capital accumulation condition (Lau et al., 2002). It is a recursive dynamic model that can be illustrated in two phases: the first refers to the description of the single period equilibrium, the second introduces the dynamic component.

The model considers an open economy with m commodities, c components of value added, h Institutional Sectors including Households, Firms, Government and Rest of the World. In every time period for all commodities and for all primary factors markets demand is equal to supply (*market clearing* conditions) and extra profits are not allowed (*no profit* conditions) (Pretaroli and Severini, 2009).

Healthmac14 can be described as an integrated representation of the income circular flow (Socci, 2004a) where the entire process of generation, primary and secondary distribution of income is represented by a

system of behavioural equations and income constrains for agents (they are all maximisers and price takers). Referring to the classical walrasian approach these relationships are typically known as market clearing and zero profit condition as well as budget constraints.

The total output (**X**) resulting from the sum of domestic and imported output (**M**)[4] is equal to intermediate demand (**B**), final consumption expenditures (**C**), final consumption expenditure incurred by Government ($\mathbf{C_G}$), gross fixed capital formation (**I**) and exports (**E**). Likewise the primary factors' endowments correspond to the primary factors' demands in the production process (**Y**) and their markets are perfectly competitive. We do not consider any rigidity on wage formation and thus we assume that there is no unintentional unemployment.

Domestic production is formalized by a nested constant return to scale technology. Assuming the Leontief production function, domestic output is the combination of intermediate goods (**B**), depending on total output and prices, and value added that is affected by total production and primary factors compensations (**Y**). Then assuming a CES technology, the value added is generated by combining capital and labour that are perfectly mobile across activities.

Following the logic of the Ramsey model, all the Institutional Sectors maximise the present value of their intertemporal utility function which depends on final consumption expenditure (**C** and $\mathbf{C_G}$) and gross saving (**S** and $\mathbf{S_G}$) subject to the lifetime budget constraint. The budget constrain for Households is verified when the total disposable income (**Rd**) is equal to the final consumption expenditures (**C**) and savings (**S**). The primary factor compensations (**R**) plus net transfers from Institutional Sectors (**Tr**), minus income taxes (**Ta**), determine consumers total endowments in every time period. As to Government, public savings (or deficit) ($\mathbf{S_G}$) result as the difference between total tax revenue (**Ta**), the sum of final consumption expenditures by Government ($\mathbf{C_G}$) and transfers to other Institutional Sectors (**Tr**). Taxes can be divided into direct income taxes and a set of indirect taxes (tax on products, value-added tax and payroll taxes). The single period equilibrium regarding the condition on gross capital formation requests that total gross fixed capital formation (**I**) becomes equal to gross savings by Institutional Sectors (**S** and $\mathbf{S_G}$).

The dynamic component in the model is given by the inter temporal capital accumulation condition. According to the market clearing condition for capital, any change in gross fixed capital formation must affect the capital yearly growth given a constant rate of capital depreciation (δ)[5]. Than in a dynamic model the optimization problem for all the consumers becomes:

$$max \sum_{t=0}^{\infty} \left(\frac{1}{1+\rho} \right)^t u[\mathbf{C}_t(y_{d_t}, p_t)] \tag{1}$$

s.t.

$$\mathbf{C}_t = f(\mathbf{Y}_t, \mathbf{M}_t, \mathbf{Ta}_t) - \mathbf{I}_t - \mathbf{E}_t \tag{2}$$

[4] Following the Armington's hypothesis (1969), imported and domestically produced commodities are not perfect substitutes. This solves the problem that the same kind of good is found to be both exported and imported.

[5] According to the literature on dynamic CGE we employ the term "depreciation" in place of the term "consumption of fixed capital" used by the SNA. The term "consumption of fixed capital" refers to the decline, during the course of the accounting period, in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage. It is used in the SNA to distinguish it from "depreciation" as typically measured in business accounts (United Nations, 2008).

$$\mathbf{K}_{t+1} \quad = \quad (1-\delta)\mathbf{K}_t + \mathbf{I}_t \tag{3}$$

Every institutional sector maximizes inter temporal utility which depends on consumption, under the constraint represented by two main conditions: i) total commodity output $\mathbf{X}_t$ is divided into personal consumption expenditures ($\mathbf{C}_t$) and government current expenditures ($\mathbf{C_G}_t$), gross fixed capital formation $\mathbf{I}_t$ and exports $\mathbf{E}_t$ (market clearing conditions); ii) the capital stock in period $t+1$ is equal to the capital stock in period t ($\mathbf{K}_t$)[6], less depreciation (δK_t) plus gross fixed capital formation in period t ($\mathbf{I}_t$)[7]. The rate of capital depreciation is fixed in every period and exogenously specified as the steady state interest rate r and the steady state growth rate g[8].

Table 1: Fundamental relationship in CGE model

	Commodities (1,..,n)	*Factors (1,..,c)*	*Ins. Sectors (1,..,s)*	*Government (1,..,g)*	*CF (1)*	*RoW (1)*
Commodities (1,..,n)	$\mathbf{B}(x,p)$		$\mathbf{C}(y_d,p)$	$\mathbf{C_G}(y,p)$	$\mathbf{I}(r)$	$\mathbf{E}(e,p)$
Primary Factors (1,..,c)	$\mathbf{Y}(x,p_f)$					
Institutional Sectors (1,..,s)		$\mathbf{R}(y)$		$\mathbf{Tr}(y)$		
Government (1,..,g)	$\mathbf{Ta}(x)$	$\mathbf{R}(y)$	$\mathbf{Ta}(y)$			
Capital Formation (1)			$\mathbf{S}(y_d)$	$\mathbf{S_G}(y)$		
Rest of World (1)	$\mathbf{M}(x,e)$			$\mathbf{Tr}(y)$		$(+/-)a$

In order to solve the model for a finite number of periods, we approximate the infinite horizon equilibria with endogenous capital accumulation condition according to Lau et al. (2002). Thus in order to obtain the terminal period equilibrium we set the terminal gross capital formation growth rate equal to the growth rate of aggregate output (see the appendix Appendix B).

Since there is a set of commodities, primary factors and Institutional sectors the model produces a disaggregate set of information on prices, output and incomes.

2.2. Social Accounting Matrix for health expenditure: the U.S. case

The basic organization of the data base is inspired by the SAM scheme and follows the matrix presentation of national T-Accounts (Socci, 2004b). The income circular flow is quantified and connects data on the production process (final demand, total output and value added generation) gathered by activities which play the role of industries, with data on the distribution process (factor allocation of value added, primary and secondary distribution of incomes) collected by Institutional Sectors.

The production and the demand for health care services are included into the income circular flow as all the other types of commodities. Highlighting health care services therefore, requires the construction of a database that integrates health sector within the production and income accounting. The Social Accounting Matrix is the accounting scheme that properly provides this integration. This instrument is able to identify

[6] The capital stock in period t is calibrated on the SAM data following Paltsev (2004).

[7] For the specification of the dynamic model see the appendix Appendix B.

[8] In our model we assume $r = 5\%$ (nominal interest rate) and $g = 2.4\%$ (real growth rate). According to the rule for investment on a steady state $I_t = (d+g)K_t$ we calibrate the value of the depreciation rate δ on the SAM data.

all the flows related to health care services within the production and to detect the ability both to generate value added and to distribute income. It finally registers the relevance of health care production in final demand.

The Social Accounting Matrix for the United States, year 2009 and at market prices[9], is obtained through the link between the I-O table and the national accounts by institutional sectors (BEA, 2009).

The matrix can be broken up into quadrants which can be further divided into blocks. A brief sketch of blocks in each of the six sub matrices, as shown in table 1, can be easily described as follows:

- quadrant I - Production and Final Demand formation;
- quadrant II - Primary allocation of income;
- quadrant III - Secondary distribution of income and Capital Formation;
- quadrant IV - Economic transaction with the Rest of the World.

Accounts are given in rows and columns corresponding to eight headings: Output, Compensation of employees, Other Incomes, Households, Business, Capital formation, Government and Rest of the World.

Each Quadrant in figure 1, then, gives account of the national flows and their allocation in different blocks in order to describe the whole circular flow. Table 1 gathers data from 67 Input-Output sectors, 5 Institutional Sectors[10], 3 Value Added components[11]. Last quadrants (V and VI) describe the flows between regions and the public administration and the Rest of the World [12].

Inside the phases of generation, distribution and redistribution of income that the SAM for the U.S. economy describes, health care services can be identified. First the health care services derive from the final consumption programmed by Households and others Institutional Sectors.

This part of private health care output can be generated by two types of activities: *Ambulatory health care services* (54) and *Hospitals and nursing and residential care facilities* (55). The amounts are respectively 823.703 and 889.594 million of dollars. The remaining part is qualified as Federal Government health production (884.400 million of dollars) and State and Local government (431.200 million of dollars). In particular the final consumption by Households for the *Ambulatory health care services* is 783,734 million of dollars and for the *Hospitals and nursing and residential care facilities* is 884,167 million of dollars.

The part of these health care services outputs, not allocated to the final demand, represents the intermediate consumption by all other commodities of *Ambulatory health care services* (39,967 million of dollars) and *Hospitals and nursing and residential care facilities* (5,178 million of dollars).

The difference between the total output of health care services and the intermediate consumption by the other production processes represents the final demand that includes exports (252 million of dollars).

[9] The flows are expressed in Million of US dollars.
[10] The Households, Business, Federal Government, State and Local Government and Rest of the World.
[11] Compensation of employees, Taxes on production and imports, less subsidies, Gross operating surplus
[12] The detailed classification of all the SAM accounts is showed in appendix Appendix A, table A.6.

Figure 1: SAM for the USA economy, year 2009 (million of dollars)

	Commodities	Compensation of employees	Taxes on production and imports, less subsidies	Gross operating surplus	Households and istitutions	Business	Federal Government	State and Local Government Current	Rest of Word	Private investment	National Gross investment	State and local government gross investment	TOTAL
Commodities	10685115	0	0	0	10001330	0	987138	1424388	1421693	1589202	152427	350953	26612245
Compensation of employees	7819518	0	0	0	0	0	0	0	0	0	0	0	7819518
Taxes on production and imports, less subsidies	964357	0	0	0	0	0	0	0	0	0	0	0	964357
Gross operating surplus	5335164	0	0	0	0	0	0	0	0	0	0	0	5335164
Households and istitutions	0	7808700	0	3203600	0	236400	1604700	470512	216200	0	0	0	13540112
Business	0	0	0	1819564	216782	0	168918	109400	239861	0	0	0	2554525
Federal Government	0	0	35500	120100	1821000	339100	0	0	14456	0	0	0	2330156
State and Local Government Current	0	0	928900	191900	384100	195600	484600	0	0	0	0	0	2185100
Rest of Word	1808092	10818	-43	0	166000	254025	212200	0	0	0	0	0	2451092
Private investment	0	0	0	0	950900	1529400	0	0	-891098	0	0	0	1589202
National Gross investment	0	0	0	0	0	0	-1127400	0	1279827	0	0	0	152427
State and local government gross investment	0	0	0	0	0	0	0	180800	170153	0	0	0	350953
TOTAL	26612245	7819518	964357	5335164	13540112	2554525	2330156	2185100	2451092	1589202	152427	350953	

3. Policy scenarios for US Health care system

The federal Patient Protection and Affordable Care Act (PPACA - 23.03.2010) would allow anyone who earns less than 133% of the federal poverty level (about 29 thousand dollars per year for a family of four people) to be included in Medicaid program. This will result in an increase of health care services for 16 million people.

According to OECD official statistics, the per capita current expenditure for individual and collective health care financed by Government in US is around 3850 US dollars in 2010[13]. Therefore, the total amount of resources needed to include 16 million people in the program is approximately 60 billion dollars per year (64 billion if we consider the per capita current expenditure of 2011). In ten years the total expenditure is around 600-640 billion dollars.

The Federal Government can directly finance the increase in health care services and/or provide a set of transfers to Households tied to health care spending. In both cases, to avoid the increase in Federal government public deficit, the amplification of health care expenditure should be compensated with the cut in other public expenditure or new taxes on particular activities.

In order to provide a preliminary evaluation of the health care policy reform, we assume that the Government would finance the policy through an increase in taxes on pharmaceutical products (embodied in

[13]The per capita current expenditure for individual and collective health care financed by Government is 3849.8 dollars in 2010. The per capita current expenditure financed by both Government and Private is 7923.1 dollars.

commodity *25.Chemical products*) and Insurances carrier (commodity *43.Insurance carriers and related activities*). Then, to separate the effects on the economic system of the direct and indirect Federal Government action, we simulate two different policy scenarios:

- in the first scenario (*S1*) the Federal Government directly increases the demand for Medicaid by means of an expansion in Federal Government Health Services (commodity n.62);
- in the second scenario (*S2*) the Federal Government uses the tax revenue to provides new transfers to Households tied to increase the demand for private health care services (commodities *54.Ambulatory health care services* and *55.Hospitals and nursing and residential care facilities*).

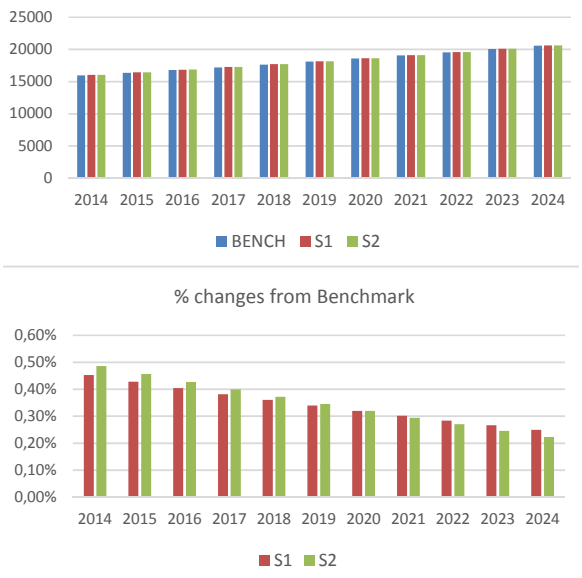
The total amount of the policy is 64 billion dollars per year. The direct and indirect effects of this policy on total output and welfare are measured in a time period of 10 years (from 2014 to 2024) in order to capture the dynamic opportunities of the health care system reform.

4. The dynamic effects of Health Care Policy

The simulations compare the baseline equilibrium (or *benchmark* equilibrium) without any Health care policy measure, and the aftershock equilibrium resulting from the health policy reform. The distance in every period (year) between the baseline trend path and the path generated after the simulations represents the impacts of the policy on the main macroeconomic variables in the each period.

The results of the simulations are discussed starting from the effects on Gross Domestic Production (GDP), Value added by commodity, total output, prices and employment in the time period of 10 years from 2014 to 2024.

Figure 2: Effects on real GDP - billion US$



The health policy introduces two simultaneous shocks in the economic system. The first shock is represented by the introduction of a tax on specific commodities output (pharmaceutical products and insurance carrier). The second shock is related to the different channel used by Federal Government to increase the health care services demand. The final effects on the variables reflect the direct and the indirect effects of these shocks.

In aggregate terms it is possible to observe that in both scenarios the real GDP increases in time, as shown in figure 2. To be more precise, the GDP follows the same growth path as in the benchmark, showing that the policy does not perturbate the economic system but stimulates the growth. In the second scenario the impact on GDP is greater than in the first one. We observe from the graphic in the bottom, that the differences from the benchmark are more significant in *S2* than in *S1*. The reason for this difference between the scenarios can be explained by observing the disaggregate effects of the policy in terms of value added generation by commodity.

Since the policy directly and indirectly stimulates the production of certain commodities and depresses some others, the composition of these effects generates a major result on GDP in the second scenario, where the Federal Government transfers resources to Households to finance the consumption of private Health care services[14]

The increase in Federal Government expenditure for Medicaid (S1) stimulates the total GDP and this effect does not derive from the impact of the policy in private Health care sectors. Indeed, the results in figures 3 and 4 attest that this policy does not affect these commodities whose total output is basically unchanged. As a consequence of this latter effect, also the value added generated by these commodities does not change significantly (see also figure A.8 and A.9 in appendix Appendix B).

The policy aimed at increasing the Medicaid expenditure directly and indirectly influences more other commodities than private health care services. Indeed we observe that in the first scenario, some manufactured commodities (such as *Food and Beverage and tobacco products*, *Apparel and leather and allied products*) and other services (such as *Educational services* and *State and Local government enterprises*) receive an impulse by the policy (see figure A.7).

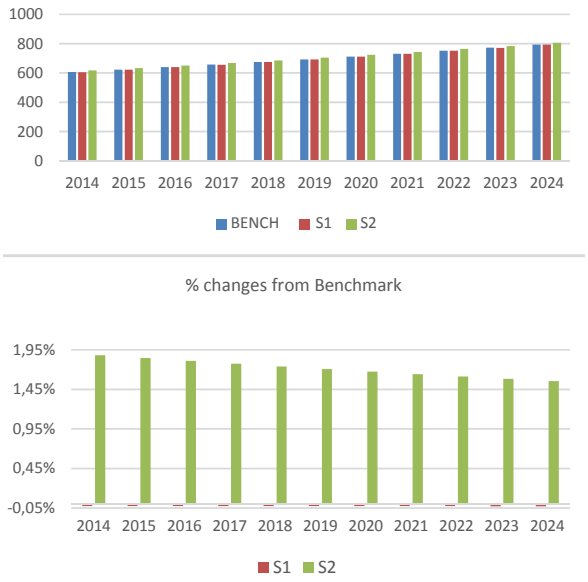
Differently, when the Federal Government provides new transfers to Households tied to increase the demand for private health care services, the effect on the whole economy is greater both in terms of total output and value added. If we look at the value added generated by the private Health care services, we observe a growing trend that overcome the benchmark trend both from *54.Ambulatory health care services* and *55.Hospitals and nursing and residential care facilities*. These commodities that are directly stimulated by the manoeuvre, indirectly drive other production processes in order to generate an increase in total GDP.

The positive effect of the second scenario in terms of economic growth, is also confirmed by the results of the policy in terms of employment. Even if the trend in the 10 years period is similar to the benchmark, in the second scenario we can observe an increase in employment. This effect is reversed in the first scenario.

All the effects discussed in this section must take into account the first shock introduced in the economy, represented by the taxation of pharmaceutical products and insurance carrier. The taxation directly affects the output of these commodities and eventually depress other connected production (as shown in figure

[14]The effects of the policy on total output by commodity for the year 2014 are showed in appendix Appendix B, figA.7.

Figure 3: Value Added by Ambulatory Health Care Services: billion US$



A.7). This effect combined with the redistribution of Health care expenditure generates higher results in terms of output and employment in the second scenario.

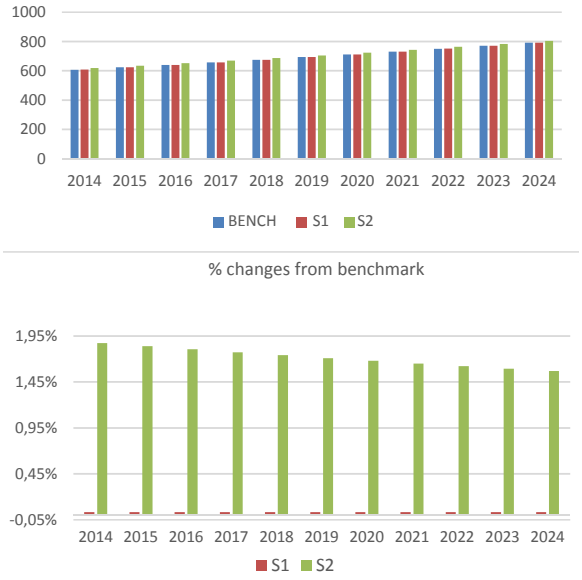
5. Conclusion

In developed countries, especially in US, the health care system is affording a significant makeover in terms of sustainability, social desirability and profitability in economic/employment terms. The economic sustainability of health care services is closely related to the amount of people to be taken care of and the system for sharing the expenditure for the services provided according to the welfare state.

When the economy is characterised by low growth rates, the economic and financial sustainability of public spending, along with other social and demographic variables such as changes in composition and growth of the population, contributes to the desirability of certain types of health care systems. This can be the case of the US economy where the health care system can represent a key sector in terms of stimulating total output and employment.

The characteristics of the demand for health care services are comparable to those of commodities with low elasticity and allow to analyse the role of the health care system likewise all the other market and non-market goods. Following this idea, the importance of health care services can be analysed in terms of income and employment generation, overcoming the criticisms that generally emerge on the desirability of public or private health care expenditure and of universal coverage of the population. In other words, both the concern on the desirability of non-market health care services production and its strong and rigid demand, force to point the attention on economic models able to treat the health care system and analyse its role as an economic policy instrument and objective.

Figure 4: Value Added by Hospitals and nursing and residential care facilities: billion US$



The production of health care services is included in the inter-industry relations in the same way of the other commodities since it is strictly connected with other processes through the absorption of intermediate goods. Its importance derives from its strong ability in activating other production processes. This means that financing the production of health care services is an essential step since it is able to activate the production processes connected to it.

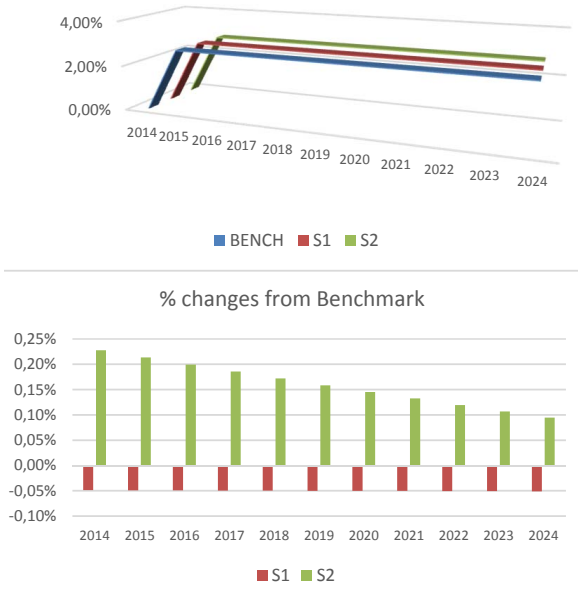
Therefore, even if the universality of the health care system coverage is a principle that leads to a strong pressure on the public budget, it is possible to take advantage of the strong interaction of health care system within the economy to pursue a more complex policy objective that can admit also the economic growth. This is the principle that inspired the federal Patient Protection and Affordable Care Act (PPACA - 23.03.2010), a huge measure of health policy aimed at introducing a new perspective to deal with health care expenditure.

The effects of this manoeuvre are generated along the whole income circular flow and can be measured in the long run by means of a multisetoral dynamic CGE model. Given this general equilibrium scheme, we are able to quantify the impact of the health policy taking into account each singular aspect of its complex act.

In the first step we modeled a tax on specific commodities output to collect the financial resources needed to implement the manoeuvre. In this way we got through the main criticisms related to the health care expenditure funding. Then, in a second step, we analyse two policy scenarios where the health care expenditure is expanded and redistributed between Institutional Sectors, without dampening the economic growth.

The multisectoral CGE model allowed to identify the inter dependencies between economic sectors and highlighted the policy scenario that allows obtaining the best the results in terms of GDP and employment.

Figure 5: Effects on Employment - % changes$



The results of the analysis reveal that health care production plays a key role in US economy. It emerges that increasing the expenditure to finance the Medicaid program slightly encourage the economic growth, but when the financial resources are directly driven to increase the demand for private health care services, we obtain positive effects in terms of employment and income generation. Indeed, the economic structure of the US economy (described by the SAM framework) reveals a strong connection between the private health care services and the other production processes in the income generation.

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Appendix A. Table and figures

Appendix B. CGE model specification

The dynamic computable general equilibrium model developed in this paper is solved using the programming language GAMS (General Algebraic Modeling System) in order to find the equilibrium prices, quantities and incomes over the time periods.

Given the structure of the economy described by the SAM, to determine prices and quantities which maximize producers' profits and consumers's utility, we solve the Arrow-Debreu (1954) problem as an optimization problem of the consumer subject to income, technology and feasibility constraints. When programming on GAMS usually, this maximisation problem is turned into a Mixed Complimentary Problem (MCP) and solved as a system of non-linear equation.

In our model the optimization problem for all the consumers has been settled as:

$$max \sum_{t=0}^{T} \left(\frac{1}{1+\rho}\right)^t u[C_t] \tag{B.1}$$

s.t.

$$C_t = x(K_t, L_t, M_t, Ta_t) - I_t - E_t \tag{B.2}$$

$$K_{t+1} = (1-\delta)K_t + I_t \tag{B.3}$$

The first order conditions deriving from this maximisation problem are:

$$P_t = (\frac{1}{1+\rho})^t \cdot \frac{\delta u(C_t)}{\delta C_t} \tag{B.4}$$

$$PK_t = (1-\delta)PK_{t+1} + P_t \cdot \frac{\delta x(K_t, L_t, M_t, Ta_t)}{\delta K_t} \tag{B.5}$$

$$P_t = PK_{t+1} \tag{B.6}$$

Than the corresponding mixed complimentary problem can be formulated as follows:

Market clearing conditions:

$$X_t \geq B_t, d(P_t, RA) + I_t + E_t, P_t \geq 0, \qquad P_t(X_t - B_t, d(P_t, RA) - I_t - E_t) = 0 \tag{B.7}$$

$$L_t \geq X_t \frac{\delta C(RK_t, PL_t, PM_t, Ta_t)}{\delta PL_t}, PL_t \geq 0, \qquad PL_t(L_t - X_t \frac{\delta C(RK_t, PL_t, PM_t, Ta_t)}{\delta PL_t}) = 0 \tag{B.8}$$

$$K_t \geq X_t \frac{\delta C(RK_t, PL_t, PM_t, Ta_t)}{\delta RK_t}, RK_t \geq 0, \qquad RK_t(K_t - X_t \frac{\delta C(RK_t, PL_t, PM_t, Ta_t)}{\delta RK_t}) = 0 \tag{B.9}$$

$$M_t \geq X_t \frac{\delta C(RK_t, PL_t, PM_t, Ta_t)}{\delta PM_t}, PM_t \geq 0, \qquad PM_t(K_t - X_t \frac{\delta C(RK_t, PL_t, PM_t, Ta_t)}{\delta PM_t}) = 0 \tag{B.10}$$

Zero profit conditions:

$$P_t \geq PK_{t+1}, I_t \geq 0, \qquad I_t(P_t - PK_{t+1}) = 0 \tag{B.11}$$

$$PK_t \geq RK_t + (1-\delta)PK_{t+1}, K_t \geq 0, \qquad K_t(PK_t - RK_t - (1-\delta)PK_{t+1}) = 0 \tag{B.12}$$

$$C(RK_t, PL_t, PM_t, Ta_t) \geq P_t, X_t \geq 0, \qquad X_t(C(RK_t, PL_t, PM_t, Ta_t) - P_t) = 0 \tag{B.13}$$

Income balance condition:

$$RA \geq PK_0K_0 + \sum_{t=0}^{T}(PL_tL_t + PM_tM_t - Ta_t) - PK_{T+1}K_{T+1}, RA \geq 0. \tag{B.14}$$

The variables are:
t time periods,
T terminal period,
ρ individual time-preference parameter,
u utility function,
C_t consumption in period t,
x production function,
X_t total output in period t,
K_t capital in period t,
L_t labour in period t,
M_t imports in period t,
Ta_t diect and indirect taxes in period t,
I_t investment in period t,
E_t exports in period t,
δ capital depreciation rate,
P_t price of output in period t,
d demand function,
PK_t price of capital in period t,
RK_t rental of capital in period t,
PL_t wage in period t,
PM_t price of imports in period t,
RA consumer's disposable income.

Figure A.6: I-O commodities, Primary factors, Institutional Sectors and Capital Formation classification

1 Farms	40 Information and data processing services
2 Forestry, fishing, and related activities	41 Federal Reserve banks, credit intermediation, and related activit
3 Oil and gas extraction	42 Securities, commodity contracts, and investments
4 Mining, except oil and gas	43 Insurance carriers and related activities
5 Support activities for mining	44 Funds, trusts, and other financial vehicles
6 Utilities	45 Real estate
7 Construction	46 Rental and leasing services and lessors of intangible assets
8 Wood products	47 Legal services
9 Nonmetallic mineral products	48 Computer systems design and related services
10 Primary metals	49 Miscellaneous professional, scientific, and technical services
11 Fabricated metal products	50 Management of companies and enterprises
12 Machinery	51 Administrative and support services
13 Computer and electronic products	52 Waste management and remediation services
14 Electrical equipment, appliances, and components	53 Educational services
15 Motor vehicles, bodies and trailers, and parts	54 Ambulatory health care services
16 Other transportation equipment	55 Hospitals and nursing and residential care facilities
17 Furniture and related products	56 Social assistance
18 Miscellaneous manufacturing	57 Performing arts, spectator sports, museums, and related activitie
19 Food and beverage and tobacco products	58 Amusements, gambling, and recreation industries
20 Textile mills and textile product mills	59 Accommodation
21 Apparel and leather and allied products	60 Food services and drinking places
22 Paper products	61 Other services, except government
23 Printing and related support activities	62 Federal general government
24 Petroleum and coal products	63 Federal government enterprises
25 Chemical products	64 State and local general government
26 Plastics and rubber products	65 State and local government enterprises
27 Wholesale trade	66 Scrap, used and secondhand goods
28 Retail trade	67 Noncomparable imports and rest-of-the-world adjustment
29 Air transportation	VA1 Compensation of employees
30 Rail transportation	VA2 Taxes on production and imports, less subsidies
31 Water transportation	VA3 Gross operating surplus
32 Truck transportation	I Households and istitutions
33 Transit and ground passenger transportation	II Business
34 Pipeline transportation	III Federal Government
35 Other transportation and support activities	IV State and Local Government Current
36 Warehousing and storage	V Rest of Word
37 Publishing industries (includes software)	S1 Private investment
38 Motion picture and sound recording industries	S2 National Gross investment
39 Broadcasting and telecommunications	S3 State and local government gross investment

Figure A.7: Total output changes by commodity - year 2014 (basic pts)

Figure A.8: Ambulatory Health Care Services: output changes (basic pts)

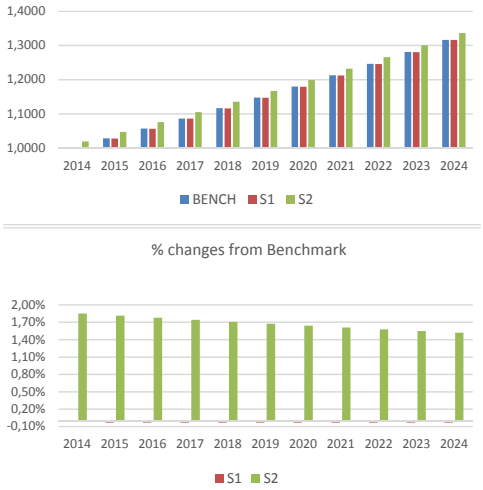

Figure A.9: Hospitals and nursing and residential care facilities: output changes (basic pts)

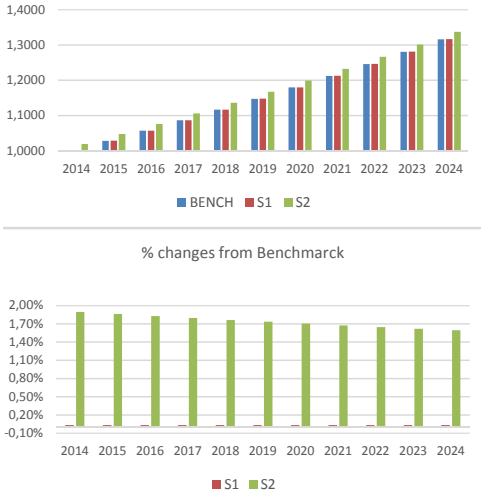

Figure A.10: Ambulatory Health Care Services: price changes (basic pts)

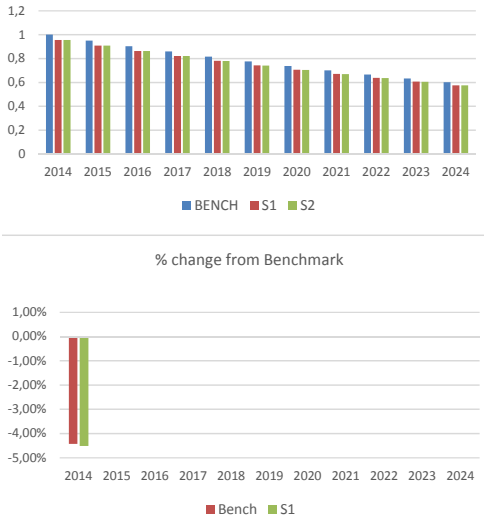

Figure A.11: Hospitals and nursing and residential care facilities: price changes (basic pts)