Università degli Studi di Macerata

Dipartimento di Economia e Diritto

Education Services and Reallocation of Government Expenditure

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Quaderno di Dipartimento n. 73

Giugno 2014

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Abstract

Expenditure on education, beyond being a source of short run changes in output and GDP levels, can contribute to the accumulation of human capital, which is of critical importance in determining a country productive capacity and productivity. General government indicators reveal that in 2010 U.S. National defense expenditure as a percentage of GDP is three times higher than the OECD average and that only Israel exhibits a higher value. Moreover, National defense expenditure accounts for sixteen percent of total outlays in the 2014 proposed U.S. Federal budget. Recent studies on the U.S. economy suggest that a relocation of Federal funds from investments in National defense to the education system can have an overall positive or recessive impact on output and GDP levels depending on the way in which the funds reinvested are distributed between capital and current expenditure. Furthermore, short run effects can be accompanied by medium and long run benefits due to the enhanced productivity stemming from efficient expenditure on education. The aim of this paper is to design and evaluate balanced budget policies that foster the U.S. education system by relocating Federal funds from investments in National defense to the education system. National defense expenditure in capital account is reduced by one percent over a period of five years. The education policies proposed differ in the way in which saved funds are reallocated. Funds can be expended in capital or current account, can be partitioned between public and private education industries and between market and non-market education services. The research first focuses on changes in income of the institutional sectors, then on output changes, in aggregate and by commodity. Finally, on the basis of the changes in the production of human-capital related services, the increase in the stock of human capital is estimated by a cost-based approach. A suitable framework for conducting this kind of analysis is a dynamic extended multisectoral model where final consumption depends on the institutional sectors income level of the previous period and investments react to institutional sectors income changes. While traditional multisectoral analysis is purely static and doesn't deal with the complexity of evolving systems, the introduction of structural relationships that link variables belonging to different time periods allows for multisectoral economic dynamics. The model proposed is based on the Social Accounting Matrix (SAM) approach and the economic process is represented as a circular flow. In this framework it is possible to account for direct, indirect and induced effects produced by the policy proposed.

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1. Introduction

Interest in the field of human capital is not as recent as it may appear. As reported in Folloni and Vittadini (2010), Adam Smith, although didn't use the term human capital, sustained that the expenses for the acquisition and the maintenance of skills and competencies of the labour force can be considered as they were investments in capital incorporated in the labour force itself. He considered the division of labour and school education as sources of accumulation of this sort of capital and compared its utilization to the introduction of new machines or instruments in the productive process.

Shultz (1961) observes that skils and knowledges are a form of capital since they can be accumulated with deliberated investment choice, and, through choices of this kind, human beings can increase their welfare. OECD (2013) presents a number of studies on the impact of education on different social and economic aspects of human life. Education achievements not only influence participation in the labour market and wage levels but also the likelihood of smoking and of be obese.

A key aspect of human capital accumulation mentioned in Shultz (1961) is that it can give a possible explaination of the discrepancies in the growth rate of income and factors of production at the national level. Between eighties and nineties significant researches have been produced establishing a connection between human capital literature and neoclassical growth theories. Mankiw et al. (1992) augment a Solow growth model by incorporating human capital; this strongly enhances the performance of the model and removes its inconsistencies. Lucas (1988) and Romer (1990) consider endogenous growth models with human capital accumulation.

However, progresses in the field of human capital have been frustrated by measurement issues; measurement methods are various and generally not easy to obtain. Indeed, the definitions of human capital prevailing in the literature are not operational. For example, OECD (2001) defines human capital as "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being". Human capital is considered as an assortment of eterogeneous intangible characteristics embodied in the human beings, hence its measurement methods cannot be direct and difficultly capture all of its aspects (Nosvelli, 2009).

There are two main approach to obtain a monetary measure of human capital stock of a country. In the first approach human capital is measured by the cost (inputs) sustained for its accumulation, i.e. by the public and private investements in those sectors of the economy associated with the formation of human capital; in the second approach it is measured by the income (outputs) that will result from its accumulation, i.e. by summing the discounted value of the future stream of income of the population of a country (Le et al., 2003; Oxley et al., 2008). While the cost-based measures are backward-looking, the income-based ones are forward looking. The Jorgenson and Fraumeni (1989) variant of the income-based approach is probably the method most used in measuring the stock of human capital (Mira and Liu, 2010). However, the cost-based approach lend itself to be utilized in multisectoral analysis, which is the framework adopted in this paper.

The aim of this work is to design and evaluate through a dynamic multisectoral model fiscal policies that fostering the U.S. education system contribute to the process of human capital accumulation. While the one in OECD (2001) is a broad definition of human capital that includes personal experiences and individual attributes like innate capacities, competencies are mainly acquired through learning. Since the policies proposed have also indirect and induced effects on the activity of industries other than education, human capital accumulation take place in other sector of the economy too.

However, the idea of employing expenditure in those industries associated with the formation of human capital as a proxy of the increase in the stock of human capital is debated (Oxley et al. (2008)). Expenditure in education, for example, is not necessarily correlated with learning achievement. There is an enourmous and contrasting body of literature on the effectiveness of schooling resources on student performances. This branch of reaserch, mainly focusing on the study of the education production function, have originated with the "Coleman report".

Coleman et al. (1966) unexpected findings suggested that the differences in students intellectual skills, assessed with standard achievement tests, were not explained by differences in schools' resources but only by the socioeconomic background of the students. Conviction arised that all schools were the same. After their publication, "Coleman report" results have been both validated and rejected by a number of new studies on the same topic. However, even the scholars who defend the results in Coleman et al. (1966) agreed upon the fact that their strongest interpretation–according to which school characteristics simply doesn't matter–proved to be inexact; it is not true that difference in schools' and teachers' characteristics cannot explain differences in student performance, simply the characteristic that make a difference are usually not measurable or controllable (Hanushek (1997)). As a consequence, the debate ingenerated by the conflicting literature originated by Coleman et al. (1966) has moved from the question "does schools' characteristics matter?" to the question "does schools' resources that money can buy matter?" (Baker (2012)). This debate has clear implications in terms of education policies.

Hanushek (1986) and Hanushek (1997) are two of the most relevant studies asserting the ineffectiveness of increases in education expenditure on education outcomes. On the contrary Hedges et al. (1994) and Greenwald and Hedges (1996) are two of the most relevant studies sustaining the opposite position, i.e. that differences in student outcomes can be explained not only by the socioeconomic background of the students but also by differences in controllable school resources. Furthermore, as reported in Baker (2012), recent investigations that replicated the analyses in Coleman et al. (1966) with up-to-date statistical techniques obtained different outcomes; they found that difference in schools' resources have explaining power.

The view adopted in this study is the latter, i.e. that expenditure in education generally affects education system outcomes. This doesn't mean, however, that the way in which money is spent doesn't make a difference and that school reforms that change the pattern of spending cannot improve schooling results, but simply that expenditure in education contributes to the process of human capital accumulation.

The policies proposed in this paper are new Federal programs oriented toward an improvement of the U.S. education system. The funds necessary to finance those policies are obtained without increasing the Federal Government deficit. The idea is that of maintaining constant the overall level of Federal expenditure by relocating Federal funds from investments in National defense to the education system. Indeed, data for the U.S. indicates unreasonable high levels of expenditure in National defense for a country that doesn't experience military threats. General government indicators reveal that in 2010 U.S. National defense expenditure as a percentage of GDP is three times higher than the OECD average and that only Israel exhibits a higher value. Moreover, National defense expenditure accounts for sixteen percent of total outlays in the 2014 proposed U.S. Federal budget.

The evaluation of the policies is performed through a dynamic multisectoral model. Only in a disaggregated framework, where industries are considered separately, it is possible to estimate the effects of policies that operate at the industry level.

A first attempt to evaluate the direct and indirect effects on output and employment of a reallocation of funds from defense to other elements of final demand in a multisectoral framework can be found in Leontief and Hoffenberg (1961). The authors emphasize the fact that the commodities demanded for military use differ from those demanded for other purposes and even if the aggregate final expenditure level were maintained constant, when rearranging final demand composition, there would be changes in indutry output and employment levels. The same kind of problems have been tackled by Leontief et al. (1965) in a multiregional framework, where output and employment changes occur on a regional basis.

The multisectoral model presented in this paper differs from the one in Leontief and Hoffenberg (1961) in two main aspects. First, it considers the circular process that links production to income generation and distribution and final demand formation, hence accounting also for the induced effects generated by changes in the exogenous part of final demand (Ciaschini and Socci, 2006; Ciaschini and Socci, 2007; Ciaschini et al., 2013). Second, it is dynamic; final consumption depends on the institutional sectors income level of the previous period and investments react to institutional sectors income changes. Therefore, the direct, indirect and induced effects on industry output and income of the policies presented are spread over time. While traditional multisectoral analysis is purely static and doesn't deal with the complexity of evolving systems, the introduction of structural relationships that link variables belonging to different time periods allows for multisectoral economic dynamics. A Social Accounting Matrix (SAM) of the U.S. for the years 2012 is the database on which the parameter of the model are calibrated. The policies proposed are first evaluated in terms of the effects they have on the in income of the institutional sectors and on the industries' output, then in terms of the effects they have on the process of human-capital accumulation.

2. The Social Accounting Matrix

The U.S. SAM for the year 2012 represents the monetary transaction that took place in the year 2012 among seventy-three commodities, seventy-one industries, three components of value added, four institutional sectors, three capital accounts and the rest of the world. The SAM has been built combining Input-Output data and data of the National Income and Product Accounts (NIPA) (BEA, 20014).

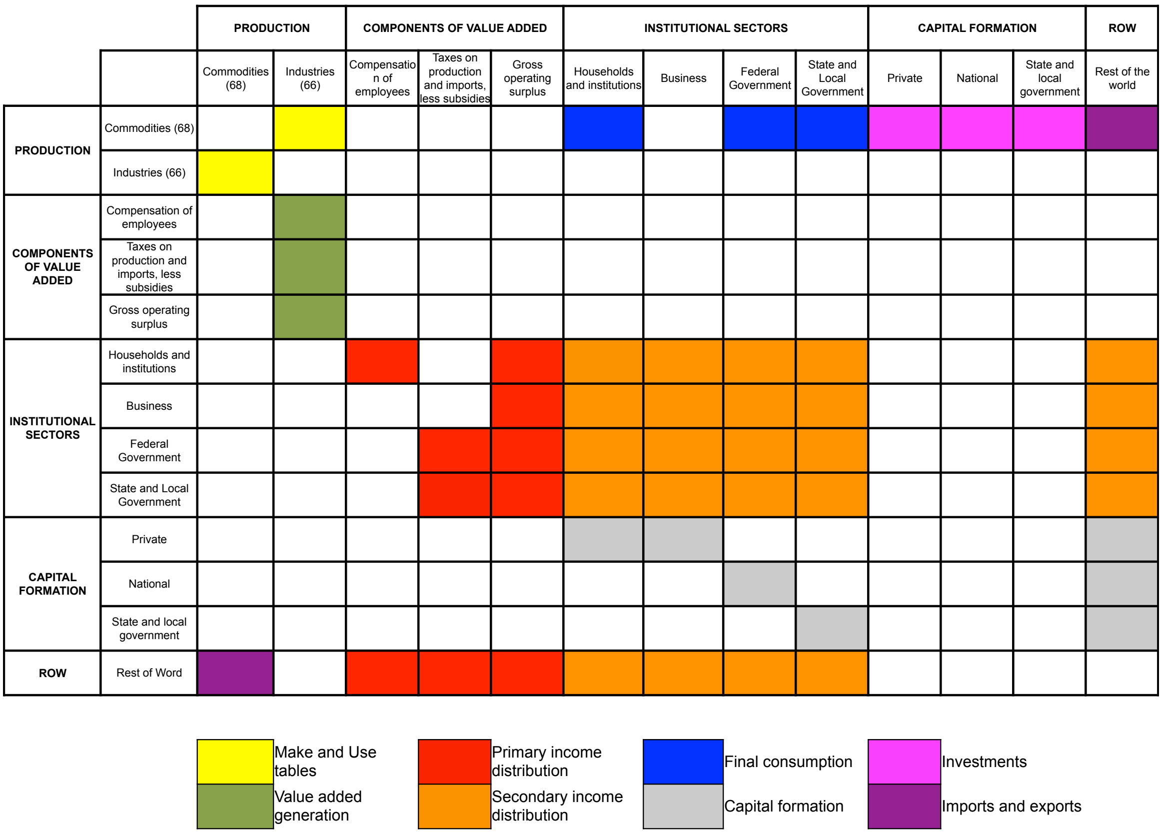
The production and final demand formation block of the SAM has been built combining BEA Make and Use tables after redefinition[2] at producers' prices (BEA, 20014). While commodity taxes are part of the producers' prices, margins and transportation costs are excluded and are considered as separate commodities (Horowitz and Planting, 2006). The number of industries and commodities of the BEA Make and Use tables is respectively sixty-nine and seventy-one but they have been expanded in order to consider two new industry, "Public education" and "National defense", and two new commodities, "Education services non-market" and "National defense".

[2] "Redefinitions are made when the input structure for a secondary product of an industry differs significantly from the input structure for the primary product of that industry. In such cases, the output of the secondary product is "redefined" by moving it from the industry in which it originates to the industry in which it is primary" (Horowitz and Planting, 2006).

Primary and secondary distribution of income blocks, capital formation block and the operation with the rest of the word block have been created combining National Income and Product Accounts (NIPA) data (BEA, 20014).

Figure is a scheme of the U.S. SAM for the year 2012.

Figure 1: A scheme of the U.S. SAM for the year 2012.



3. The dynamic multisectoral model

Consider as given a SAM representing the monetary transaction among n industries, m commodities, p components of value added, s domestic institutional sectors, u domestic capital accounts and the rest of the world for year t. Consider as given also the disposable income of the s domestic institutional sectors for the years $t-1$ and $t-2$.

The equilibrium condition on the commodity market at time t can be written as

$$\mathbf{r}_t + \mathbf{q}_t = \mathbf{z}_t + \mathbf{c}_t + \mathbf{i}_t + \mathbf{e}_t \tag{1}$$

where $\mathbf{r}_t$ is the $m \times 1$ vector of imports by commodity, $\mathbf{q}_t$ is the $m \times 1$ vector of output by commodity, $\mathbf{z}_t$ is the $m \times 1$ vector of intermediate demand by commodity, $\mathbf{c}_t$ is the $m \times 1$ vector of final consumption by commodity, $\mathbf{i}_t$ is the $m \times 1$ vector of investments by commodity and $\mathbf{e}_t$ is the $m \times 1$ vector of exports by commodity.

Assuming that the values of the intermediate transactions of any commodity are proportional to the quantity of output produced by the purchasing industry, intermediate demand at time t can be expressed as

$$\mathbf{z}_t = \mathbf{B}\mathbf{x}_t \tag{2}$$

where $\mathbf{x}_t$ is the $n \times 1$ vector of output by industry and $\mathbf{B}$ – under the Industry Technology Assumption (ITA) (Miller and Blair, 2009) – is the $m \times n$ matrix of technical coefficients. Matrix $\mathbf{B}$ is obtained by normalizing the columns of the Use table, that is part of the SAM, and isolating the commodity by industry block.

Final consumption at time t is specified in line with the approach of the linear multiplier-accelerator models (Samuelson, 1939; Puu and Sushko, 2004)

$$\mathbf{c}_t = \mathbf{C}\mathbf{y}_{t-1} \tag{3}$$

where $\mathbf{y}_{t-1}$ is the $s \times 1$ vector of disposable income of the domestic institutional sectors at time $t-1$ and the $m \times s$ matrix $\mathbf{C}$ is equal to

$$\mathbf{C} = \mathbf{C}^1\mathbf{C}^0 \tag{4}$$

where $\mathbf{C^0}$ is a $s \times s$ diagonal matrix whose elements are the propensity to consume of the domestic institutional sectors and $\mathbf{C}^1$ is the $m \times s$ matrix of the input-output consumption shares.

Investments at time t can be expressed as the sum of two different components

$$\mathbf{i}_t = \mathbf{i}_t^{Pr} + \mathbf{i}_t^{Pu} \tag{5}$$

where $\mathbf{i}_t^{Pr}$ is the $m \times 1$ vector of private investments and $\mathbf{i}_t^{Pu}$ is the $m \times 1$ vector of public investments. Considering the fact that public investments are strongly related to political choices, they are considered an exogenous variable and only private investments are considered as endogenous.

Private investments are specified as follows

$$\mathbf{i}_t^{Pr} = \mathbf{K}(\mathbf{y}_{t-1} - \mathbf{y}_{t-2}) \tag{6}$$

where $\mathbf{y}_{t-1}$ and $\mathbf{y}_{t-2}$ are the $s \times 1$ vector of disposable income of the domestic institutional sectors at time $t-1$ and $t-2$ respectively and the $m \times s$ matrix $\mathbf{K}$ is equal to

$$\mathbf{K} = \mathbf{K}^1\mathbf{K}^0 \tag{7}$$

where $\mathbf{K}^0$ is a $s \times s$ diagonal matrix whose elements are the ratios of total investment to the change in disposable income between $t-1$ and $t-2$ for each private institutional sector and zero for the others; $\mathbf{K}^1$ is the $m \times s$ matrix of the input-output investment shares.

The equilibrium condition in equation (1) can be rewritten as

$$\mathbf{r}_t + \mathbf{q}_t = \mathbf{B}\mathbf{x}_t + \mathbf{C}\mathbf{y}_{t-1} + \mathbf{K}(\mathbf{y}_{t-1} - \mathbf{y}_{t-2}) + \mathbf{i}_t^{Pu} + \mathbf{e}_t \tag{8}$$

Removing imports from intermediate and final demand equation (8) can be rewritten as

$$\mathbf{q}_t = \mathbf{B}^d\mathbf{x}_t + \mathbf{C}^d\mathbf{y}_{t-1} + \mathbf{K}^d(\mathbf{y}_{t-1} - \mathbf{y}_{t-2}) + \mathbf{i}_t^{dPu} + \mathbf{e}_t \tag{9}$$

where $\mathbf{B}^d$, $\mathbf{C}^d$ and $\mathbf{K}^d$ are the domestic counterparts of matrices $\mathbf{B}$, $\mathbf{C}$ and $\mathbf{K}$ and $\mathbf{i}_t^{dPu}$ is the vector of domestic Public investment.

Assuming that the economic system evolves in the absence of structural changes, matrices $\mathbf{B}^d$, $\mathbf{C}^d$ and $\mathbf{K}^d$ can be considered constant over time. Thus, output by commodity at time $t+1$ can be expressed as

$$\mathbf{q}_{t+1} = \mathbf{B}^d\mathbf{x}_{t+1} + \mathbf{C}^d\mathbf{y}_t + \mathbf{K}^d(\mathbf{y}_t - \mathbf{y}_{t-1}) + \mathbf{i}_{t+1}^{dPu} + \mathbf{e}_{t+1} \tag{10}$$

Equation (10) can be simplified expressing the disposable income of the domestic institutional sectors at time t as a function of output by industry at time t (Ciaschini and Socci, 2006; Ciaschini et al., 2013).

In a first step output by industry can be linked to value added at the industry level

$$\mathbf{v}_t = \mathbf{L}\mathbf{x}_t \tag{11}$$

where $\mathbf{v}_t$ is the $n \times 1$ vector of value added by industry and $\mathbf{L}$ is a $n \times n$ diagonal matrix whose elements represent the shares of value added on total output for every industry.

Then, value added at the industry level is allocated to the p components of value added

$$\mathbf{v}_t^c = \mathbf{V}\mathbf{v}_t \tag{12}$$

where $\mathbf{v}_t^c$ is the $p \times 1$ vector of value added by components and $\mathbf{V}$ is a $p \times n$ matrix whose columns represents for each industry the share of value added that is allocated to the p components of value added.

Then, in the process of primary distribution of income value added by component is allocated to the s institutional sectors

$$\mathbf{v}_t^s = \mathbf{P}\mathbf{v}_t^c \tag{13}$$

where $\mathbf{v}_t^s$ is the $s \times 1$ vector of primary income and $\mathbf{P}$ is a $s \times P$ matrix whose columns represents for each component of value added the share of value added that is allocated to the s institutional sectors.

Primary incomes are redistributed among the institutional sector in the process of secondary distribution of income. The outcome is the disposable income

$$\mathbf{y}_t = (\mathbf{I} + \mathbf{T})\mathbf{v}_t^s \tag{14}$$

where $\mathbf{I}$ is the $s \times s$ identity matrix and $\mathbf{T}$ is the $s \times s$ matrix that redistribute income among the institutional sectors.

Equation (10) can thus be rewritten as

$$\mathbf{q}_{t+1} = \mathbf{B}^d\mathbf{x}_{t+1} + \mathbf{C}^d(\mathbf{I} - \mathbf{T})\mathbf{PVL}\mathbf{x}_t + \mathbf{K}^d((\mathbf{I} - \mathbf{T})\mathbf{PVL}\mathbf{x}_t - \mathbf{y}_{t-1}) + \mathbf{i}_{t+1}^{dPu} + \mathbf{e}_{t+1} \tag{15}$$

The assumption of no structural changes implies also that matrices $\mathbf{L}$, $\mathbf{V}$, $\mathbf{P}$ and $\mathbf{T}$ are constant, therefore, for $t+2$ the equilibrium condition on the commodity market can be written as

$$\mathbf{q}_{t+2} = \mathbf{B}^d\mathbf{x}_{t+2} + \mathbf{C}^d(\mathbf{I} - \mathbf{T})\mathbf{PVL}\mathbf{x}_{t+1} + \mathbf{K}^d(\mathbf{I} - \mathbf{T})\mathbf{PVL}(\mathbf{x}_{t+1} - \mathbf{x}_t) + \mathbf{i}_{t+2}^{dPu} + \mathbf{e}_{t+2} \tag{16}$$

Assuming constant commodity output proportions – i.e. that each commodity is produced in all the industries that produce that commodity in proportion to the market shares given in the Make table – it is possible to write for a generic period t

$$\mathbf{x}_t = \mathbf{D}\mathbf{q}_t \tag{17}$$

where $\mathbf{D}$ is the $n \times m$ matrix of commodity output proportions obtained by normalizing the Make table by column. Equation (16) can be rewritten as

$$\mathbf{q}_{t+2} = \mathbf{B}^d\mathbf{D}\mathbf{q}_{t+2} + \mathbf{C}^d(\mathbf{I}-\mathbf{T})\mathbf{PVLD}\mathbf{q}_{t+1} + \mathbf{K}^d(\mathbf{I}-\mathbf{T})\mathbf{PVLD}(\mathbf{q}_{t+1}-\mathbf{q}_t) + \mathbf{i}^{dPu}_{t+2} + \mathbf{e}_{t+2} \tag{18}$$

Since the aim of this paper is to investigate the effects of economic policies that act as changes in final demand, equation (18) is valid for every period; indeed, all the variables that refer to periods preceding the first one can be considered zero. The general equation for the dynamics of the system can be expressed as

$$\mathbf{q}_t = (\mathbf{I}-\mathbf{B}^d\mathbf{D})^{-1}(\mathbf{C}^d+\mathbf{K}^d)(\mathbf{I}-\mathbf{T})\mathbf{PVLD}\mathbf{q}_{t-1} - (\mathbf{I}-\mathbf{B}^d\mathbf{D})^{-1}\mathbf{K}^d(\mathbf{I}-\mathbf{T})\mathbf{PVLD}\mathbf{q}_{t-2} + (\mathbf{I}-\mathbf{B}^d\mathbf{D})^{-1}(\mathbf{i}^{dPu}_t + \mathbf{e}_t) \tag{19}$$

4. Policy evaluation

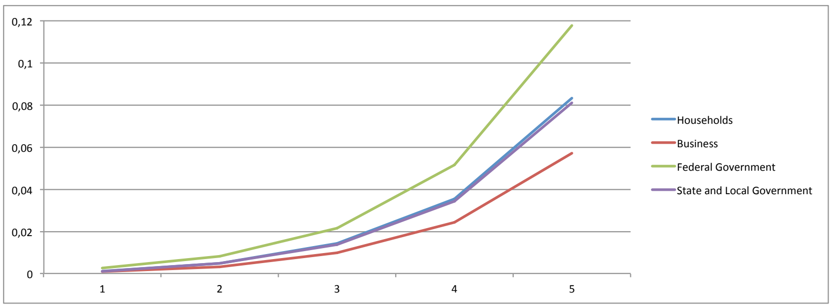
The dynamic model in equation (19) is used to investigate the effects of new federal programs oriented toward an improvement of the U.S. education system. The U.S. Social Accounting Matrix for the year 2012 presented in section 2 is the source of the parameter of the model. The funds necessary to finance the policies are obtained without increasing the Federal government deficit. The idea is that of maintaining constant the overall level of federal expenditure by reallocating federal funds among different expenditure items.

The research first focuses on changes in income of the institutional sectors, then on aggregate and disaggregated output changes. Finally, an index of human capital accumulation is estimated by a cost-based approach. The index put together the expenditure in higher education occurring both in public and private institutions. Indeed, while expenditure on other types of education cover also socialization and supervision aspects expenditure on higher education is almost completely focused on educational purposes.

The first program investigated ($p1$) consist in a reallocation of federal funds from investments in national defense to investments in public education system. Every year, for five years, national defense expenditure in capital account is reduced by an amount equal to one percent of the 2012 national defense investments. State and local government investments in public education are increased every year by the same amount.

Figure 2 represents the time evolution of the disposable income percentage change generated by the application of $p1$.

Figure 2: Time evolution of the disposable income percentage change generated by the application of $p1$ (%).



The strongest effects on disposable income occur for "Federal government" while the disposable income of "Business" is the less affected.

Figure 3 represents the time evolution of the aggregate output percentage change generated by the application of $p1$.

Figure 3: Time evolution of the aggregate output percentage change generated by the application of $p1$ (%).

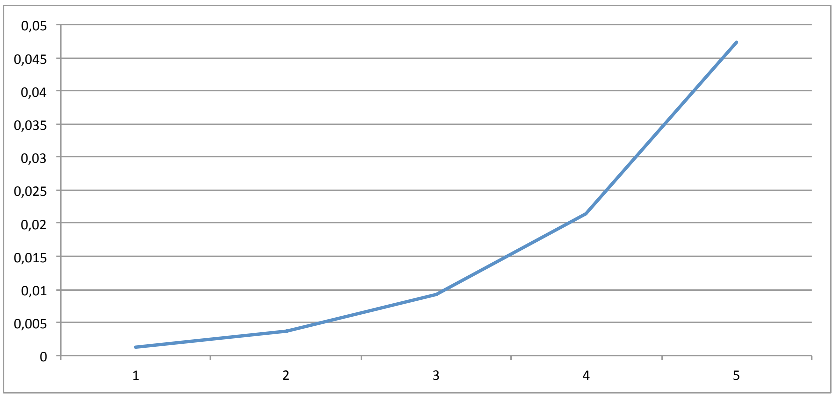
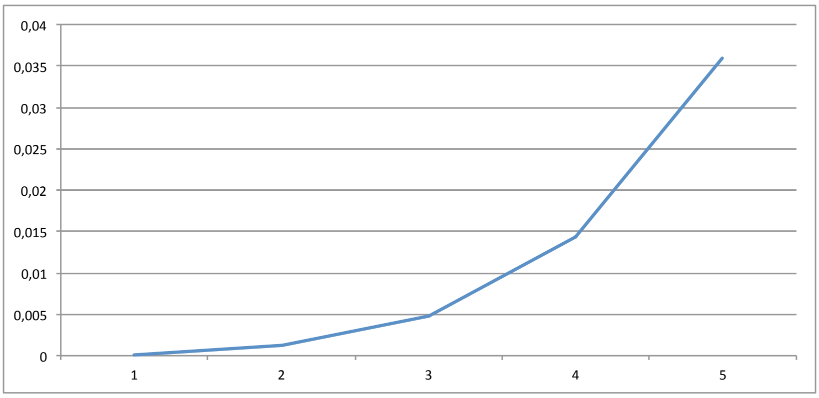


Figure (A.11) in Appendix A represents the time evolution of output by commodity percentage change generated by the application of $p1$. The two industries stimulated the most in terms of percentage expansion are "Support activities for mining" and "Construction". The second one is also the one most stimulated by the policy examined.

Figure (4) represents the time evolution of higher education expenditure percentage change generated by the application of $p1$.

Figure 4: Time evolution of higher education expenditure percentage change generated by the application of $p1$ (%).

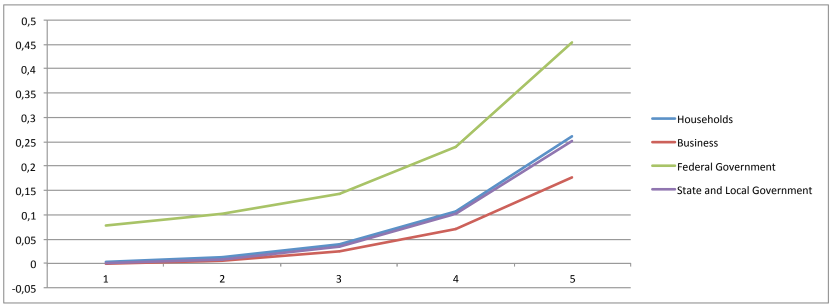


It can be observed that higher education expenditure grows at a lower rate than aggregate output.

The second program investigated ($p2$) consist in a reallocation of federal funds from investments in national defense to current expenditure for the commodity "Education services non-market". Every year, for five years, national defense expenditure in capital account is reduced by an amount equal to one percent of the 2012 national defense investments. State and local government expenditure in "Education services non-market" is increased every year by the same amount.

Figure 5 represents the time evolution of the disposable income percentage change generated by the application of $p2$.

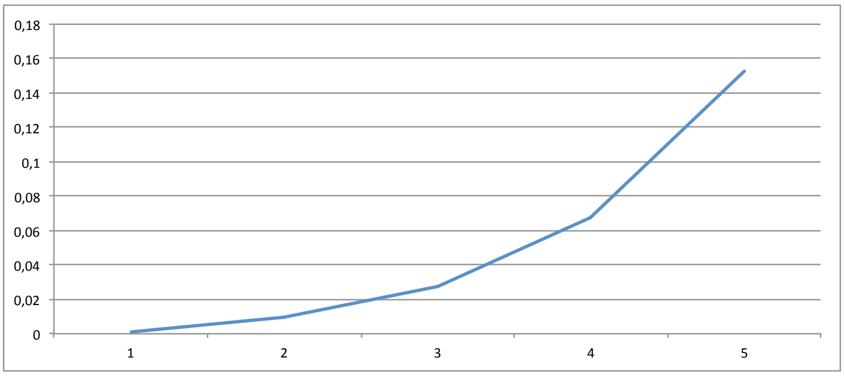
Figure 5: Time evolution of the disposable income percentage change generated by the application of $p2$ (%).



The strongest effects on disposable income occur for "Federal government" while the disposable income of "Business" is the less affected. Comparing figure 5 with figure 2 it can be observed that policy $p2$ has a stronger impact on the income of the institutional sectors.

Figure 6 represents the time evolution of the aggregate output percentage change generated by the application of $p2$.

Figure 6: Time evolution of the aggregate output percentage change generated by the application of $p2$ (%).

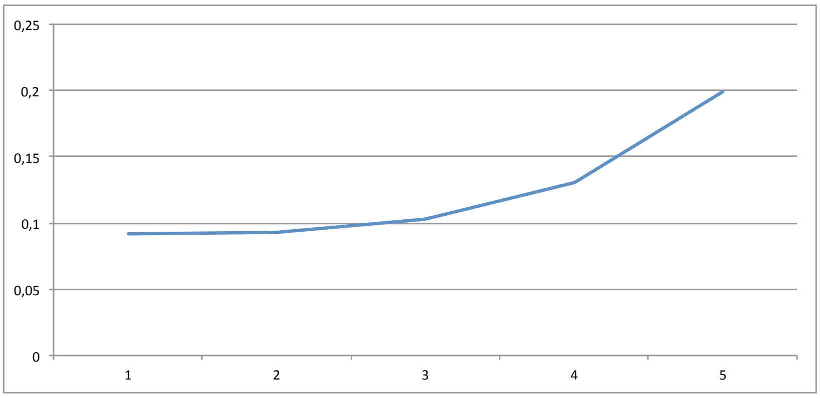


Comparing figure 6 with figure 3 it can be observed that policy $p2$ has a stronger impact on the aggregate performance of the economic system.

Figure (A.12) in Appendix A represents the time evolution of output by commodity percentage change generated by the application of $p2$. The two industries stimulated the most in terms of percentage expansion are "Support activities for mining" and "Construction". Although the size of the effect is different, these are also the sectors stimulated the most by policy $p1$.

Figure (7) represents the time evolution of higher education expenditure percentage change generated by the application of $p2$.

Figure 7: Time evolution of higher education expenditure percentage change generated by the application of $p2$ (%).

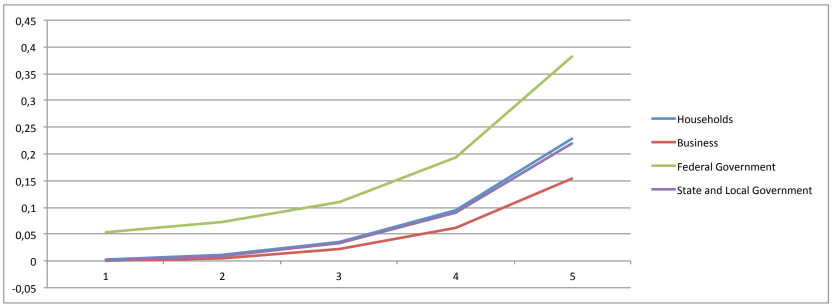


It can be observed that higher education expenditure grows at a higher rate than aggregate output and at a higher rate than in policy $p1$. This depends on the fact that policy $p2$ directly stimulate the production of "Education services non-market", which consist also of higher education.

The third program investigated ($p3$) consist in a reallocation of federal funds from investments in national defense to current expenditure for "Education services market". Every year, for five years, national defense expenditure in capital account is reduced by an amount equal to one percent of the 2012 national defense investments. Expenditure in "Education services market" is increased every year by the same amount.

Figure 8 represents the time evolution of the disposable income percentage change generated by the application of $p3$.

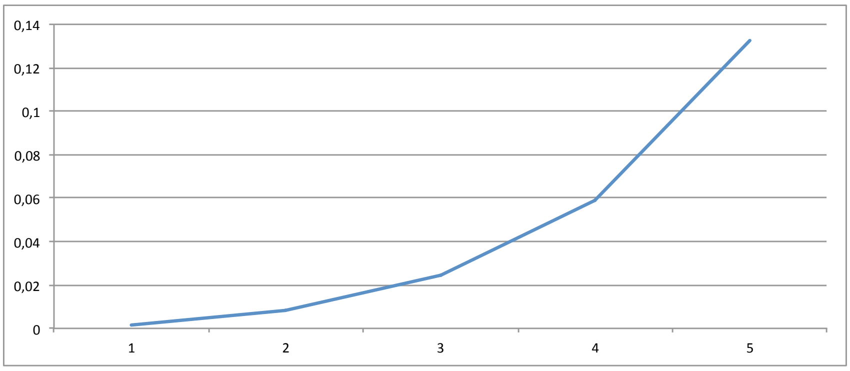
Figure 8: Time evolution of the disposable income percentage change generated by the application of $p3$ (%).



The strongest effects on disposable income occur for "Federal government" while the disposable income of "Business" is the less affected. Comparing figure 8 with figure 5 it can be observed that policy $p3$ has a slightly smaller impact on the income of the institutional sectors with respect to $p2$.

Figure 9 represents the time evolution of the aggregate output percentage change generated by the application of $p3$.

Figure 9: Time evolution of the aggregate output percentage change generated by the application of $p3$ (%).

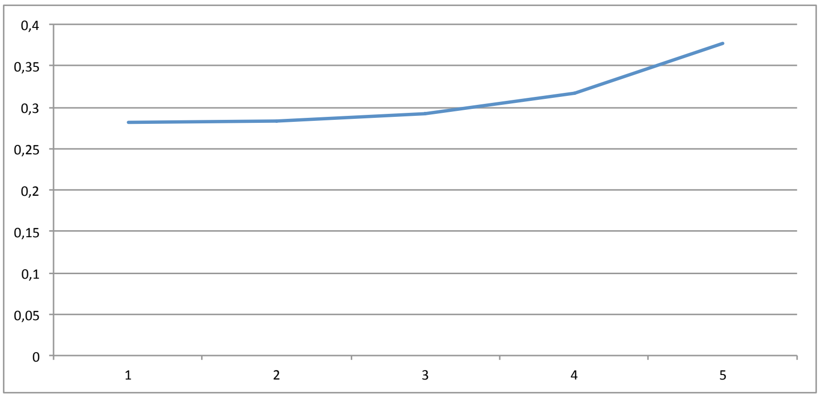


Comparing figure 9 with figure 6 it can be observed that policy $p2$ has a a slightly smaller impact on the aggregate performance of the economic system with respect to $p2$.

Figure (A.13) in Appendix A represents the time evolution of output by commodity percentage change generated by the application of $p3$. The two industries stimulated the most in terms of percentage expansion are "Support activities for mining" and "Construction". Although the size of the effect is different, these are also the sectors stimulated the most by policy $p1$ and $p2$.

Figure (10) represents the time evolution of higher education expenditure percentage change generated by the application of $p3$.

Figure 10: Time evolution of higher education expenditure percentage change generated by the application of $p3$ (%).



It can be observed that higher education expenditure grows at a higher rate than aggregate output. Indeed, policy $p3$ directly stimulate the production of "Education services market", that consist mainly of higher education. For the same reason, higher education expenditure grows at a higher rate than in policy $p2$.

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Appendix A. Graphs

Table A.1: Commodity classification.

1	Farms	38	Other transportation and support activities
2	Forestry, fishing, and related activities	39	Warehousing and storage
3	Oil and gas extraction	40	Publishing industries, except internet (includes software)
4	Mining, except oil and gas	41	Motion picture and sound recording industries
5	Support activities for mining	42	Broadcasting and telecommunications
6	Utilities	43	Data processing, internet publishing, and other information services
7	Construction	44	Federal Reserve banks, credit intermediation, and related activities
8	Wood products	45	Securities, commodity contracts, and investments
9	Nonmetallic mineral products	46	Insurance carriers and related activities
10	Primary metals	47	Funds, trusts, and other financial vehicles
11	Fabricated metal products	48	Real estate
12	Machinery	49	Rental and leasing services and lessors of intangible assets
13	Computer and electronic products	50	Legal services
14	Electrical equipment, appliances, and components	51	Computer systems design and related services
15	Motor vehicles, bodies and trailers, and parts	52	Miscellaneous professional, scientific, and technical services
16	Other transportation equipment	53	Management of companies and enterprises
17	Furniture and related products	54	Administrative and support services
18	Miscellaneous manufacturing	55	Waste management and remediation services
19	Food and beverage and tobacco products	56	Education services market
20	Textile mills and textile product mills	57	Ambulatory health care services
21	Apparel and leather and allied products	58	Hospitals
22	Paper products	59	Nursing and residential care facilities
23	Printing and related support activities	60	Social assistance
24	Petroleum and coal products	61	Performing arts, spectator sports, museums, and related activities
25	Chemical products	62	Amusements, gambling, and recreation industries
26	Plastics and rubber products	63	Accommodation
27	Wholesale trade	64	Food services and drinking places
28	Motor vehicle and parts dealers	65	Other services, except government
29	Food and beverage stores	66	National defense
30	General merchandise stores	67	Federal general government
31	Other retail	68	Federal government enterprises
32	Air transportation	69	Education services non-market
33	Rail transportation	70	State and local general government
34	Water transportation	71	State and local government enterprises
35	Truck transportation	72	Scrap, used and secondhand goods
36	Transit and ground passenger transportation	73	Noncomparable imports and rest-of-the-world adjustment1

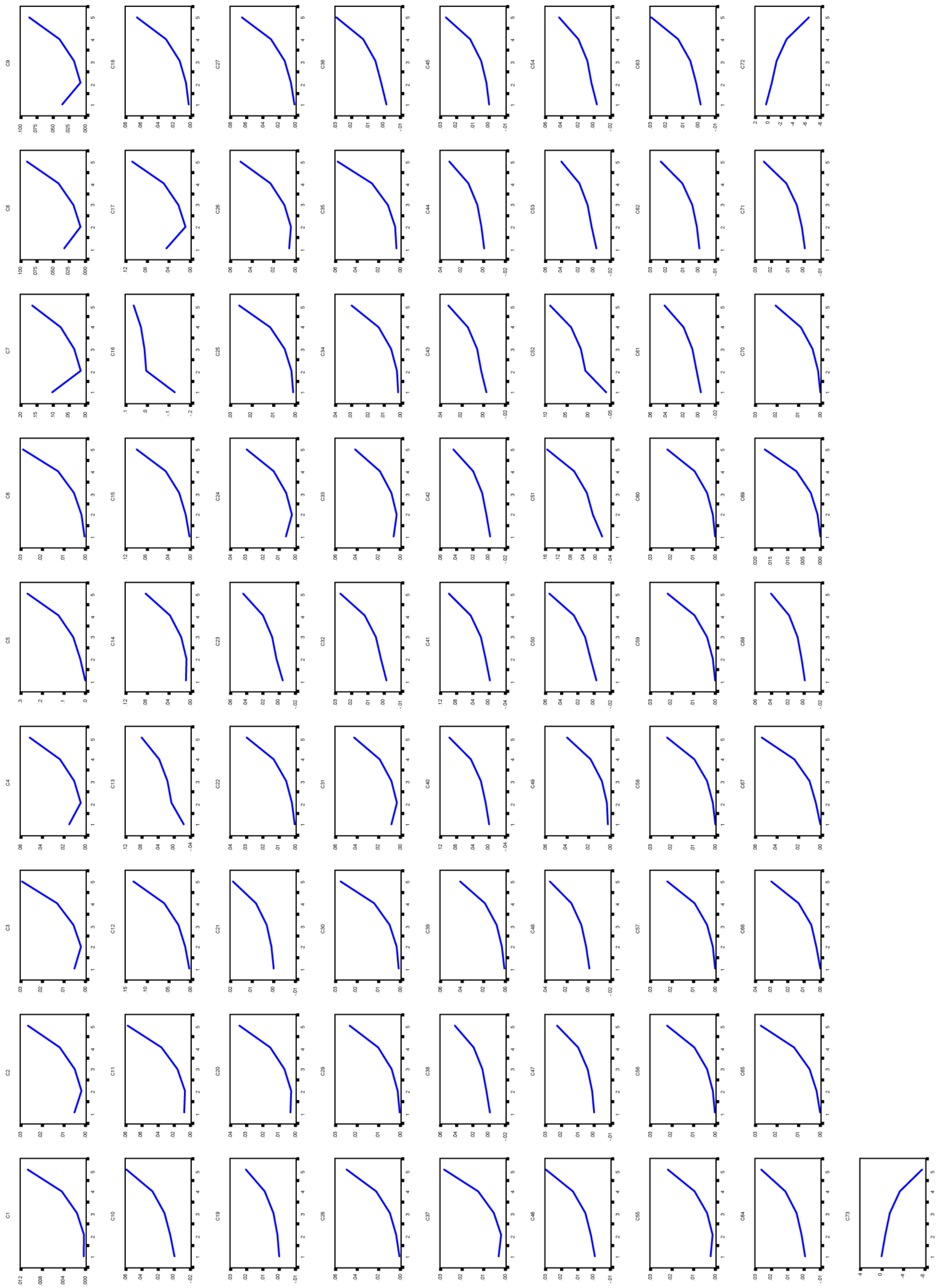

Figure A.11: Time evolution of the output by commodity percentage change generated by the application of $p1$ (%).

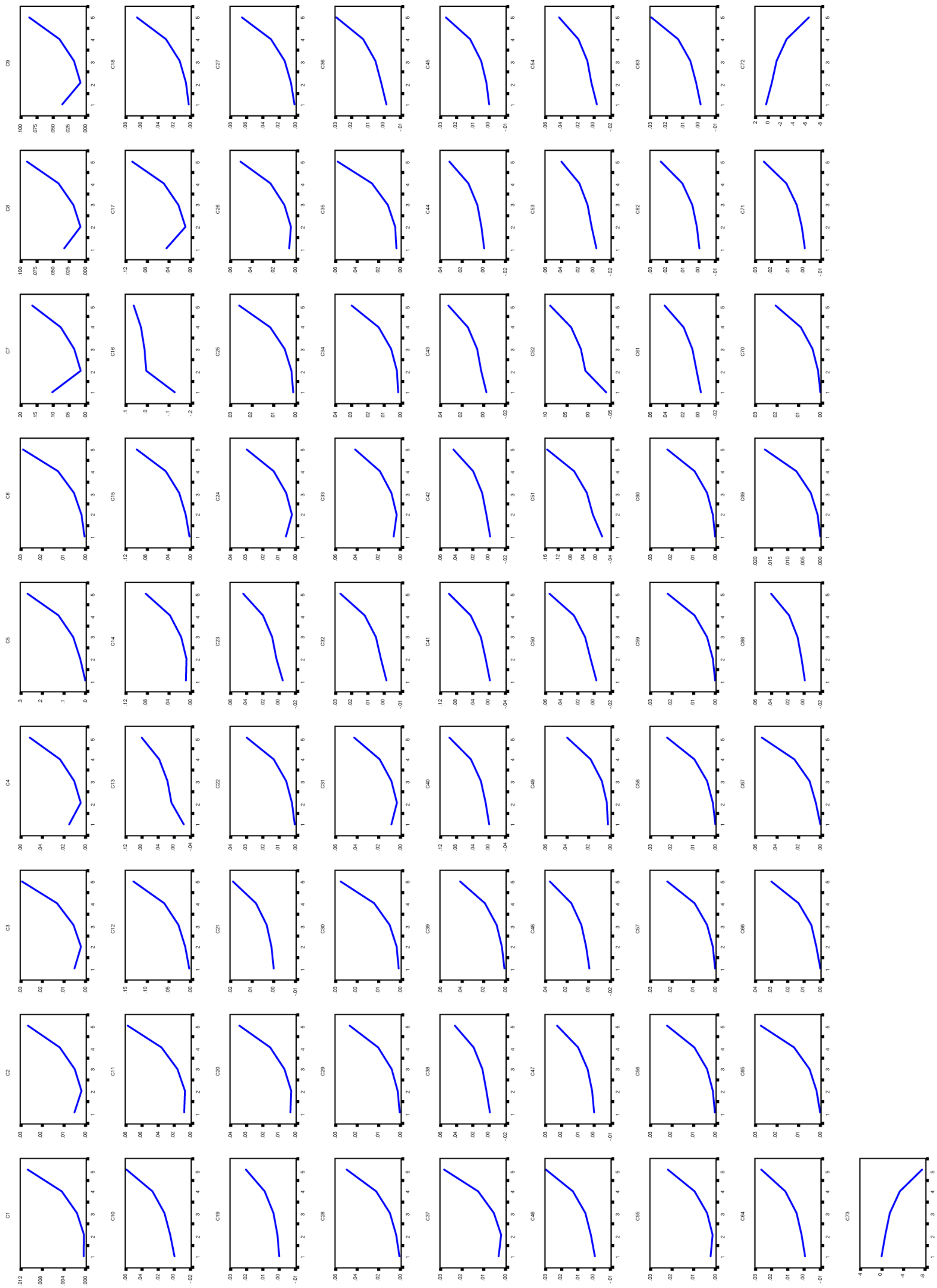

Figure A.12: Time evolution of the output by commodity percentage change generated by the application of $p2$ (%).

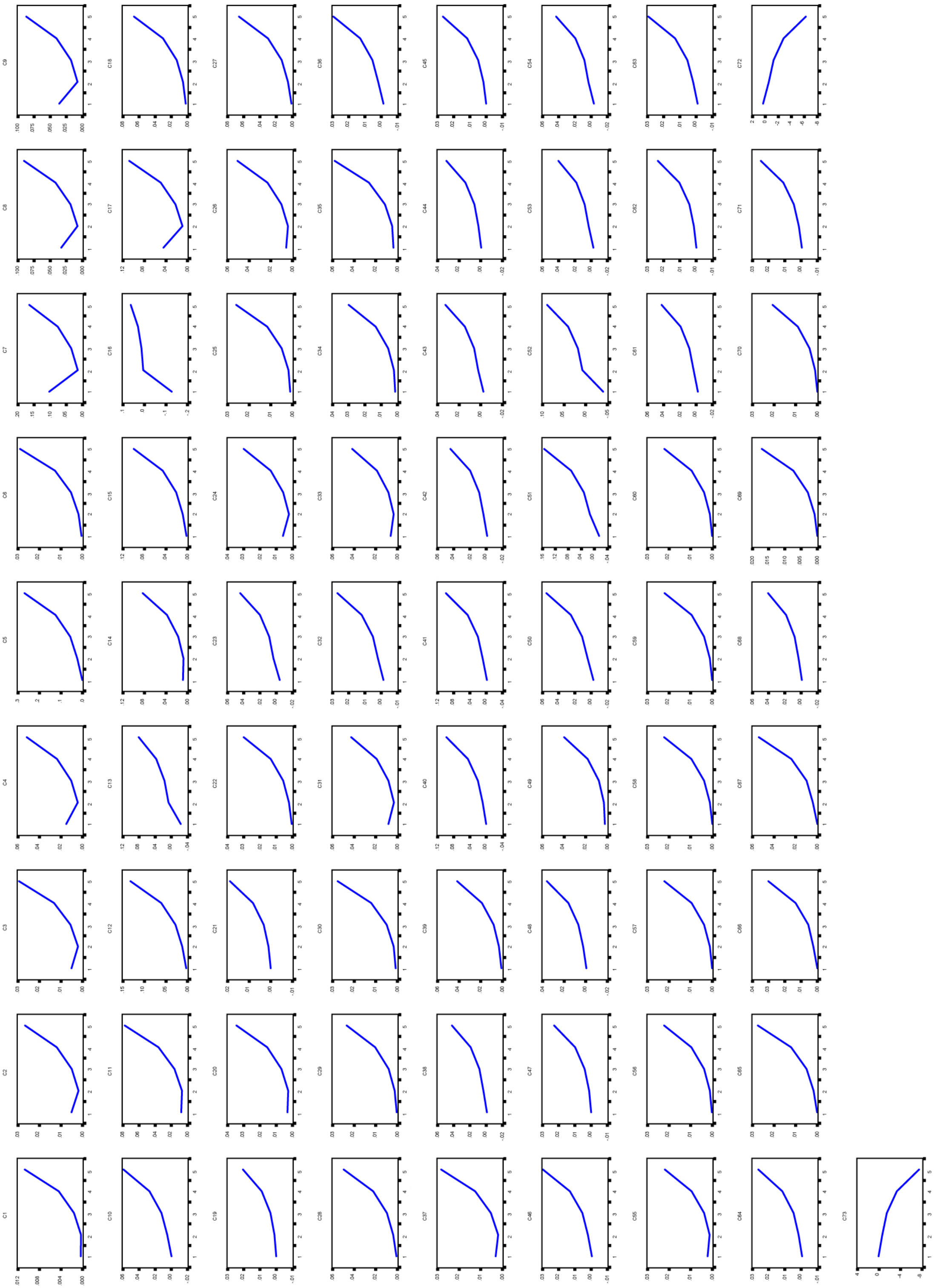

Figure A.13: Time evolution of the output by commodity percentage change generated by the application of $p3$ (%).