Technological development and income inequality: a role of financial market[a]

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Abstract. In this paper we study the effects of financial markets on an increase in income inequity. The notion, which is employed as a working hypothesis that the market equilibrium around the fair price and unbiased changes in prices has a neutral effect on inequity while the systematic underreaction accompanied by time trends contributes to its growth, has been considered. In order to check this hypothesis we have studied the long-term cycles in dynamics of the US stock index and income inequity and shown that the stock market growth observed in 1980-2017 is correlated to an increase in income inequity. The presence of causality in this relationship has been found through the evidence of systematic underreaction given by the share prices of fast-growing companies to the information about the diffusion of technological innovations. The research results prove that the free financial markets with technological development in progress contribute to instability, as they while enhancing income inequality increase the unemployment growth risks and require additional efforts from the state to redistribute income.

1 Introduction

The growing income inequality in the period after 1980th is a subject of research by many authors. It is well-known that the income inequity indexes including the capital gains are higher that the inequity indexes taking into account only the salary and wages growth [1]. This reflects the fact of capital concentration in the hands of more wealthy people and explains a favorable effect of inequity on the development of economics as a whole. However, much too high inequity of incomes can also be a depressive factor for economic development [2-4]. Against this background it remains an open question how the stock markets affect the income inequity. On the one hand, if the markets are efficient, in other words, if the stock prices fairly reflect the fundamental information then the fact of propertyconcentration should have no effect on an increase in inequity and there is no volatility. On the other hand, the presence of time trends and the systematic underreaction of prices to the fundamental information [5-7] develop conditions for wealth multiplication in hands of a small circle of persons, therefore the financial market with the fact of property concentration turns out to be in the situation of unstable equilibrium, in which further technological development goes along with a permanent increase in inequity. Researching this issue will make it possible to substantiate additional state control of inequity as well as proactively prevent unemployment and support stable development.

2 Research hypothesis and methodology

A hypothesis for neutral effects of financial markets on the income inequity is closely related to possible market self-control. The supporters of neoclassical synthesis adhere to an opinion that the policy of minimum state interference in the issues of inequity control is optimal, as long as the market mechanisms aid in optimal distribution of resources including the ability of financial markets to provide credit (financial assets in a more comprehensive sense) from redundant economic sectors to more deficient sectors thus making it possible to reduce inequity. These market mechanisms should be supplemented by necessary institutional environment, namely, the protection of civil rights and freedoms, equal access of society members to public information, developed competitive environment etc., and then the financial system will be able to control inequity in the society by itself. However, at the present time this hypothesis can be placed in doubt. A striking example of how the financial system actually controlled

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inequity was a crisis in 2008 when a temporary decrease in inequity was provided by illusively supplying credit to the disadvantaged population. Another evidence of how the financial system is unable to self-control are the facts of time series in stock prices and systematic deviations from market efficiency, which imply profitable investment opportunities made accessible to a small circle of persons by the asset market and therefore contributing to a systematic increase in income inequity.

Our empiric study consists of two parts. In the first part we show the presence of relationship between the price cycles in the US stock market expressed in the terms of switching model and in the level of income inequity within the USA. The main discussion is about whether these cycles and identified relationship between them are fictitious, in other words, result from a mere concurrence of circumstances or this relationship is of system-based nature. For the purpose of analysis we have employed such tools as the Markov switching model [8-14], that means that the evidence of market efficiency based on the independency of consecutive price increments is not an indisputable proof; it is restricted by the assumption of the autoregression model linearity, and ignores the case where non-linear laws exist in the real world. Taking into account this alternative, namely, the fact that the Markov switching model may be considered as a competitive alternative for the random walk model, we draw attention to the fact that there are four approximately 30-year cycles in the dynamics of the S&P500 index in constant prices and it has a significant threshold correlation with the income inequality.

In the second parts of this study we disclose the indentified relationship between the stock market cycles and inequity at a micro level, drawing attention to the role of technological development in creating the stock market cycles and generating the income inequity growth respectively. We study in detail the systematic underreaction of innovative companies' stock prices to the information about diffusion of innovations and demonstrate that the influence of financial markets on inequity is related to the deviations from market efficiency, which allows some society sectors to make systematic profits due to this underestimate and thus contributes to the inequity growth.

3 Cycles in income inequity and dynamics of US stock indexes

3.1 Long cycles in US stock price indexes

Since the ARIMA model [15] has become the standard model of the time-series analysis in economics, the majority of researchers abandoned the use of the Fourier analysis [16, 17]. However, in case of the model of Markov process switching, the Fourier analysis remains a tool that allows for describing the historically established temporal trends (cycles) and for assessing the model's parameters. For this reason, in order to characterize the cyclicality in the S&P500 series during the period from 1889 to 2010, let us conduct en elementary harmonic analysis, using the following cyclical model:

$$y = a \cdot \sin(T) + b \cdot \cos(T) + c \tag{1}$$

Let us build a series of chain growth rate with regard to real values of S&P500 for 10 years from the Shiller database. Let us then define cycles of the first order. The maximum value of the determination coefficient is observed with the cycles of the period of 32 years (R^2=0.38). Let us define the cyclical component in the obtained series of remainders under the additive model once again. Now the maximum value of the determination coefficient is observed with the cycles of the period of 40 years (R^2=0.13). Finally, one more type of cycles (65 years) can be defined in the series of third remainders (after removal of two previous cycles). Its determination coefficient equals to 0.09.

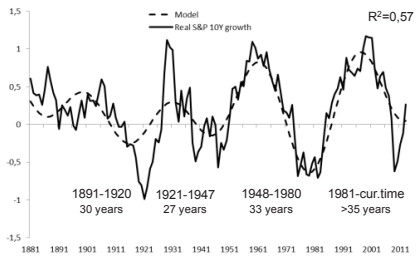

Fig. 1. Kuznets cycle in stock prices.

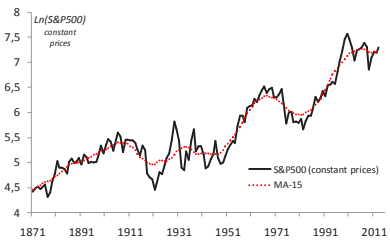

Fig. 2. Cycles of the stock market represented by the moving average.

The general cyclicality model with regard to the studied indicator is represented in Fig. 1. In dynamics of stock prices, we can observe four cycles with the period of approximately 30 years. The growth phase of the first cycle corresponded to growth of the stock market in 1897-1906. The second cycle (1921-1947) had the clear growth phase falling in 1921-1929. The third cycle (1948-1980) was characterized by growth in 1949-1965. Finally, the fourth cycle observed from 1981 had the growth phase falling in 1982-1999. It is obvious that these 30-year cycles can be classified as Kuznets cycles in dynamics of stock prices. They do not disappear upon analysis of nominal return.

Let us use the obtained result to assess the parameters of the Markov switching model. Fig. 2 shows the S&P500 dynamics in constant prices (annual data); the above found cycles are represented using moving average with a smoothing period of 15. Let us calculate the average duration of the growth/recession. We find that the average duration of the growth periods is 23.25 years, which corresponds to average annual possibility of switching equal to 0.0430, and the average duration of recession periods is 14.3 years, which corresponds to the average annual possibility of switching equal to 0.0698. The assessment of the average trend rate at the growth stage is 4.15 pct per annum, at the decline stage, 2.16 pct per annum. Residuals after the removal of the trend have an autocorrelation equal to 0.59 and are stationary. White noise is characterized by a zero average and a standard deviation of 0.15. Thus, the final model of the price logarithm may be represented as follows (2):

$$p_t = p_0 + \sum_{i=1}^{t} \lambda_i \mu_i + \sum_{i=1}^{t} \omega^{t-i} \cdot \varepsilon_i \tag{2}$$

Where λ_i is the trend rate;

$\mu_i = \{-\mu_{i-1}, p;\ \mu_{i-1}, 1-p\}$, $\mu_0 = \{1, 0.5; -1, 0.5\}$ is the parameter characterizing the trend direction, with a switching possibility p;

ω – is the coefficient of residuals autocorrelation after removal of the trend;

E_i – is white noise with the given standard deviation.

Because of mathematical specifics, this model, as well as the pure random walk, creates the independency of consecutive price increments, that is why, based on the statistical analysis, it is easy to erroneously conclude about the absence of systematic trends. At the same time, unlike the pure random walk, this model means that stock prices are predictable based on the retrospective values, particularly, not only on the basis of the information about the previous prices, but also on the basis of other observed values. This casts some doubt on the market efficiency, which denies existence of cyclicality in stock prices, because, if a cycle existed, then actions of rational market participants would remove the correlation caused by such cycle, i.e. make increments of market prices independent.Therefore, market efficiency concludes that all cycles observed in the economic reality would be cycles of random nature, which do not correlate with other economic indicators. Hence, there is no sense in discussion of cyclicality in stock markets. Along with this there are doubts in the ability of financial markets to control inequity; however, this statement requires additional empirical verification.

3.2 LongcyclesinUSincomeinequality

Now let us study the long cycles in such income inequity index in the USA as income share of 1 of the wealthiest people (see Fig.3). One huge cycle can be observed in it, which is related to a decrease in inequity in the period from 1935 to 1978 and then to an increase in inequity from 1980 up to now. Let us eliminate this cycle by means of centered moving average and let us proceed to a row of additive remainders (Y_t). The main period of inequity growth can be visually observed from 1920 to 1929, from 1950 to 1969, from 1979, from 1986 to 1995 and to 2000 and from 2003 to 2007 (see Fig. 4). Let us check the hypothesis for correlation of observed cycles in the US income inequity with the cycles observed in the stock market dynamics. By employing the logarithmic profitability indexes of income of 1% of the wealthiest people and SP500 in constant prices it possible to calculate regression, which has a correlation factor of 0.21 (see Fig.5). In other words, the dependence between the stock market profitability and the inequity level is present; it is positive but quite weak. At the same time, using the trending stationary mode, namely the correlation analysis between the remainders of both indexes after detrending by means of centered moving average makes it possible to draw a conclusion about a closer relationship between two indexes (see Fig. 3-4).

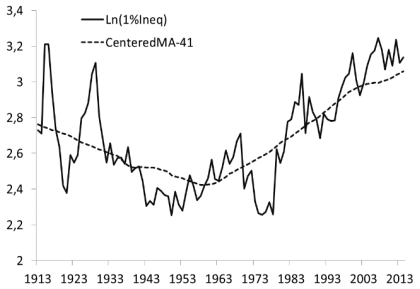

Fig. 3. Income share of 1% the wealthiest people (1%Ineq)

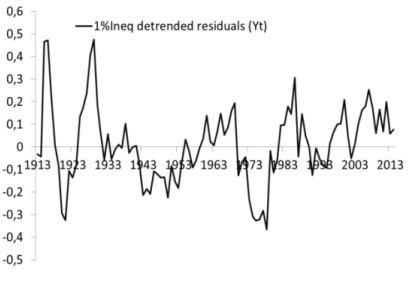

Fig. 4. Detrended remainders (Y_t) for income inequity

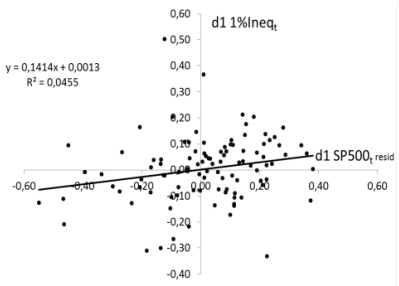

Fig. 5. Regression between the first inequity differences and SP500 in constant prices

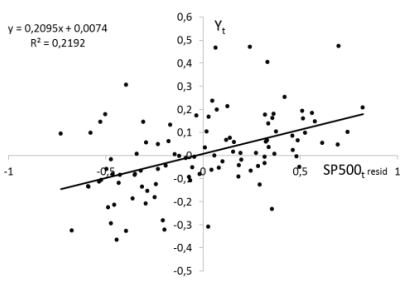

Fig. 6. Regression between detrended inequity remainders and SP500 in constant prices

These results prove that there is a positive relationship between the stock market earning power and income inequity; however, its mechanism is yet to be studied. It is possible that there is an external factor that determines the established correlation between both indexes, at the same time we are interested in particular how the stock market affects the inflation growth. This question needs to be clarified in more detail.

4 Evidence of underreaction of fast-growing companies' stock prices

The key question in generating time-series in stock prices is the processes of over and underreaction. [18] correctly indicated that the market efficiency remains to be an incontrovertible concept until the over and underreaction periods are unsystematic on the market. However, the theories developed over the last years consider the domination of underreaction in generating time-series in stock prices [5-7]. In this section we empirically check these theories while studying the fair cost of innovative (fast-growing) companies. Our hypothesis is that the underreaction of stock prices is originated by the long-term diffusion of information about innovative processes.

As the basis of fair stock price calculation we use the dividend discounting model, see [19] with a forecast period of 15 years. In particular, we use formula 3.

$$P_f = \sum_{t=1}^{T} \frac{k_d \cdot ROS \cdot S_t}{(1+r_e)^t} + \frac{\left(P/S\right)_T \cdot S_T}{(1+r_e)^T} \tag{3}$$

Where

S_t is the predicted value of profit per 1 share

$\left(P/S\right)_t$ is the predicted value of multiplier $\left(P/S\right)$,

ROS, k_d, r_e are the predeicted values of sale profit margin,devedent payout coefficientand current profit marign rate per stock capital estimated by the CAPM model.

We predict revenues based on the autocatalytic curve extrapolation in accordance with a hypothesis for diffusion of innovations [20, 21] and predict the remaining indexes at the level of average values over the last several years. The results are presented in Fig. 7-10. In the 1990s the market stock price was underestimated for all high-tech companies under consideration (exceptfor McDonalds) in the 2000s there ware underestimation even for McDonalds. At the same time, the fair price calculations for Apple company in the period from 1998 to 2007 show a significant underestimate in comparison with the market price. Partially, it is connected to the fact that the company went back to developing a new product in the period from 2001 to 2005.

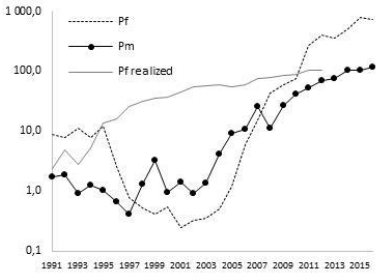

Fig. 7. Fair price and market price of Apple's share

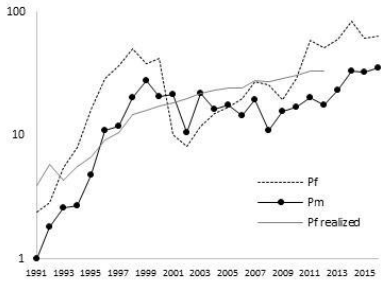

Fig. 8. Fair price and market price of Intel's share

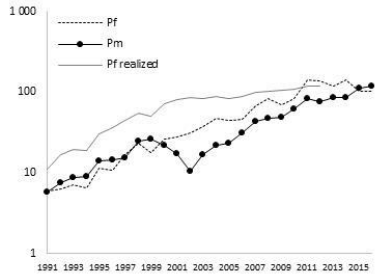

Fig. 9. Fair price and market price of McDonalds's share

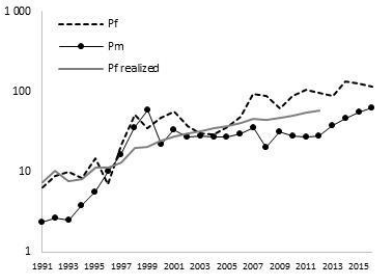

Fig. 10. Fair price and market price of Microsoft's share

5 Conclusions

Taking into account the abovementioned proofs of dependency in the cycles between the income inequity and the stock market dynamics as well as the demonstrated empirical underreaction of stock prices to the diffusion of fundamental information, the hypothesis for the stock market effects on an increase in income inequity seems to be reasonable. This result is backed up by proofs [22] in terms of trends in the global system development and fleshes out the reasons contributing to an increase in income inequity. Further studies are required to strengthen the evidence base, however, already now it is clear intuitively the global financial system operates to the benefits of its major beneficiaries but not to the needs of society. Paul Krugman has phrased this conclusion as follows: "Even when financial magnates earn money for investors, in most cases they do not create value for the society, but, in fact, they expropriate it from other market players" [23].

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