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Andrea Beltratti and Claudio Morana

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Does the stock market affect income distribution? Some empirical evidence for the US

Andrea Beltratti (a) and Claudio Morana[1] (b)

(a) (Bocconi University)
(b) (University of Piemonte Orientale and
International Centre for Economic Research (ICER))

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Abstract

What is the relation between the stock market and income distribution? There are many potential links between the two, some of which associated with the relations of each of these with the rate of economic growth. An empirical analysis set in the framework of the neoclassical growth model shows that the key mechanisms explaining income distribution in the US operate through the labour market rather than through the stock market, even though stock market shocks appear to have some short term relevance for the dynamics of income distribution.

J.E.L. classification: C32, O41, G10, D33

Key words: common trends model, economic growth, stock market, income distribution

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1 Introduction

Can the stock market affect the distribution of income between wages and profits? As shown in Figure 1, it is possible to note some variability in the functional distribution of income for the US since the thirties, with a tendency towards a reduction in the wage share since the eighties. The latter has taken place simultaneously to the exuberant growth of the stock market. It is unclear whether there is any form of causality between the two variables. On the one hand, one would expect that the price of stocks is the present discounted value of future dividends, themselves connected with profits. A rising stock market could therefore anticipate a declining relevance of wages in the income distribution. On the other hand, the dynamics of the stock market can directly affect the distribution between wages and profits. The famous option mechanism used in the 1990s by many technological firms has certainly affected the income distribution by inducing young talents to accept remuneration under the form of the right to sell in the future company stock at fast appreciating prices. Such a change in the remuneration mechanisms has affected the income distribution, increasing the share of profits. Options granted to workers have decreased the amount of wages and increased the measured level of profits.

The importance of studying the linkage between the functional distribution of income and the stock market can be understood also on the basis of the relevance of the former for long-run growth and of the importance of growth for stock market valuation. The direct linkages between income distribution and growth and between the stock market (and financial markets in general) and growth have been widely studied. Hence, from the existing contributions an indirect linkage between the stock market and income distribution can be envisaged, relying on the effects that the stock market may exercise on economic growth and the latter on income distribution.[2] On the other hand, much less studied is the direct linkage relating the stock market to income distribution (Levine, 1997).

Concerning this latter linkage, most of the literature has focused on the impact that the stock market may exercise on the financial structure of firms. For instance, Holmstrom e Tirole (1997), Stiglitz (1985), Aghion e Bolton (1997), Piketty (1997) have pointed out the role of the stock market for investment financing in the presence of asymmetrical information, the latter leading to moral hazard and adverse selection, and to credit rationing (see Bernanke and Gertler, 1989). Alternative forms of financing to bank lending are therefore fundamental for the development of particular sectors of the economy, as the high-tech sector, for which asymmetrical information is strongly relevant and the amount of collateral firms can provide is in general low (Carpenter and Petersen, 2002). The stock market can then certainly influence income distribution, since an increase in the stock market

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[2] The literature on the linkage between income distribution and growth has grown rapidly in the recent years. We point the reader to the survey of Bertola (2000) and reference therein.

may favour the financing and development, also through Tobin's "Q" effects, of particular sectors in the economy, which may be characterised by a functional distribution of income different from what observed on average.

In this paper we provide an empirical assessment of the impact of the stock market on income distribution, controlling for the contribution of economic growth. In the framework of a common trends model we identify different structural shocks, which may be interpreted in terms of labour supply and productivity shocks (the economic growth shocks), and in terms of a pure stock market/financial shock. We find that only growth shocks have a permanent effect on the wage share, with a positive productivity shock exercising a negative short-run impact and a positive long-run impact, and a positive labour supply shock exercising a negative impact at all the horizons. Also the effect of a positive stock market shock on the wage share is negative, albeit the affects tends to disappears within five years. Hence, the key mechanisms explaining income distribution in the US operate through the labour market rather than through the stock market. However, it should not be excluded that the effects of recent changes in the structure of the economy, as for instance the diffusion of option-based compensation, may lead to a stronger role of the stock market in determining income distribution directly

2 Long-run growth, the stock market and income distribution

2.1 The theoretical framework

The theoretical framework of reference is the neoclassical growth model. In a stochastic version of the model there are two sources of shocks, which determine the long-run evolution of the economy, namely technical progress and the labour supply. Other shocks also matter, i.e. consumption, investment, real rate, wage and stock market shocks, but only for transitory fluctuations. The model is then composed of the following equations

$$
\begin{aligned}
&a_t = \gamma_1 \theta_t \\
&\theta_t = \mu_\theta + \theta_{t-1} + v_{\theta,t} \quad (1) \\
&v_{\theta,t} \sim i.i.d.(0, \sigma^2_{v,\theta})
\end{aligned}
$$

$$
\begin{aligned}
&e^s_t = \gamma_2 \xi_t \\
&\xi_t = \mu_\xi + \xi_{t-1} + v_{\xi,t} \quad (2) \\
&v_{\xi,t} \sim i.i.d.(0, \sigma^2_{v,\xi})
\end{aligned}
$$

where $\gamma_1 > 0$, $\gamma_2 > 0$, a_t and e^s_t, i.e. technical progress and labour supply, are the two exogenous growth engines. These latter variables are determined by the stochastic processes θ_t and ξ_t, which evolve over time according to a random walk model with drift.

The deviations from the log steady state for per capita log output (*y*), log consumption (*c*), log investment (*i*) and log capital (*k*), measured in efficiency units, are reported in (3), from which it is possible to verify the stationarity of the great-ratios, given the stationarity of the innovations ε_i $i = y, c, i, k$,

$$\begin{aligned} y_t - a_t - e_t^s &= y^* + \varepsilon_{y,t} \\ c_t - a_t - e_t^s &= c^* + \varepsilon_{c,t} \\ i_t - a_t - e_t^s &= i^* + \varepsilon_{i,t} \\ k_t - a_t - e_t^s &= k^* + \varepsilon_{k,t} \end{aligned} \quad (3)$$

From the above results then the following three long-run relationships may be posited

$$\begin{aligned} c_t - y_t &= c^* - y^* + \varepsilon_{c,t} - \varepsilon_{y,t} \\ i_t - y_t &= i^* - y^* + \varepsilon_{i,t} - \varepsilon_{y,t} \\ k_t - y_t &= k^* - y^* + \varepsilon_{k,t} - \varepsilon_{y,t} \end{aligned} \quad (4)$$

Two additional long-run relationships can be obtained from the assumption of stationarity of labour demand errors and the real interest rate

$$e_t^d = \lambda y_t - \eta w_t + \varepsilon_{e,t} \quad (5)$$

$$r_t = \mu_r + \varepsilon_{r,t} \quad (6),$$

where $\varepsilon_i \;\; i = r, e$ are stationary innovations.

From the assumption of perfectly competitive labour market it follows the assumption of market equilibrium ($e_t^d = e_t^s$) and unitary income and real wage elasticities ($\lambda = \eta = 1$). These imply the stationarity of the wage share

$$w_t + e_t - y_t = \varepsilon_{e,t} \;\; ,$$

or an homogeneous relationship between the real wage and productivity

$$w_t = y^* + \gamma_1 \theta_t + \varepsilon_{y,t} + \varepsilon_{e,t} \, .$$

Lastly, given the stationarity of the real interest rate and of the capital-output ratio we also have

$$r_t \frac{K_t}{Y_t} = \varepsilon_{z,t},$$

i.e., the stationarity of the capital share.

Following Tobin's "q" theory, it is possible to assume a relationship between the market value of the (log) stock of capital of the economy (*f*) and its replacement cost. We would have $f_t = q + k_t + \varepsilon_{q,t}$, from which, through appropriate substitutions, it follows that the stationarity of the capital/output ratio implies the stationarity of the stock market/output ratio

$$f_t - y_t = q + k^* - y^* + \varepsilon_{k,t} - \varepsilon_{y,t} + \varepsilon_{q,t} \quad (7).$$

This relationship[3] accounts not only for the stock of physical capital installed in the economy, but, as suggested by Hall (2001), also for the human capital employed in production. Hence, this also allows to set the analysis in the framework of the Solow model augmented for human capital (Mankiw et al., 1992). Moreover, it should be noted that equation (7) contains also a financial shock (stock market shock) $\varepsilon_{q,t}$, which may capture various forms of misevaluations and liquidity shocks.

While the long-run evolution of the stock market in this model is fully determined by the growth shocks, which may also affect income distribution, there also exist an autonomous source of short-run stock market fluctuations, which may affect income distribution.

Neglecting constants and setting shocks to zero, the long-run evolution of the per capita variables can be stated as

$$\begin{bmatrix} y_t - e_t \\ c_t - e_t \\ i_t - e_t \\ f_t - e_t \\ w_t \\ e_t \\ r_t \end{bmatrix} = \begin{bmatrix} \gamma_1 & 0 \\ \gamma_1 & 0 \\ \gamma_1 & 0 \\ \gamma_1 & 0 \\ \gamma_1 & 0 \\ 0 & \gamma_2 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} \theta_t \\ \xi_t \end{bmatrix}, \quad (9)$$

[3] Not all the installed capital is quoted. Yet, by assuming a proportional relationship between the log of quoted capital and the log of the replacement cost, the long-run analysis can still be carried out in the proposed framework.

i.e. only the technological variable influences the per capita variables and real wages, while employment is determined by labour supply only. Finally, given its stationarity, none of the shocks exercise a long-run impact on the real interest rate.

2.2 Empirical results

The sample employed for estimation is 1920-2001. Data on real GDP, consumption, investment, employment, and wages have been obtained from Liesner (1989). Stock market data (S&P500 index) have been obtained from Shiller (2000). Updating of the data has been carried out relying on FRED. The econometric model employed is the common trends model of Stock and Watson (1989) and King et al. (1991), modified to account for structural change as in Morana (2003).

The results of cointegration analysis are reported in Table 1.[4] As is shown in the Table there is evidence of four cointegration relationships at the 5% level and of five cointegration relationships just above the 10% significance level. Also on the basis of the estimated eigenvalues is possible to conclude in favour of five cointegration relationships, result consistent with the theoretical framework of the analysis. The hypothesis of joint homogeneity for the five cointegration relationships can be rejected at the 1% significance level. Yet this result is only due to the labour demand elasticities, which significantly differ from the theoretical unitary values. From the labour demand cointegration relationship the following expression can be obtained $e_t = 0.43 y_t - 0.34 w_t$, pointing to a rigid response of employment to the real wage. The non stationarity of the wage share for the period analysed is coherent with the NIPA series reported in Figure 1, which points to an increase in the wage share since the second World War up to the end of the seventies, and a strong reduction thereafter. In the Table we also report the estimated factor loadings matrix for the common trends model, which can be interpreted in terms of the empirical equivalent of the structure denoted by (9). This latter matrix reports the long run impact of unitary permanent innovations. Given the structure of the model, only an additional constraint is needed to identify the permanent shocks as productivity and labour supply shocks.[5] Such constraint requires that the labour supply shock does not have a permanent impact on productivity, the latter, as the other variables apart from employment, being only determined by the technological shock in the long-run. Moreover, the structure of the cointegration space also implies that the neutrality condition is verified for per capita investment, consumption, and capital stock. Finally, a positive labour supply shock should exercise a negative impact on the real wage and a positive impact on employment, since, everything

[4] For reasons of space we do not provide details concerning the specification of the model, which are available upon request from the authors.

else constant, such a shock leads to an outward shift of the labour supply schedule. From the results reported in the Table it is possible to conclude that the identified shocks are consistent with what predicted by the Solow model. In fact, the long-run impact of the productivity shock (+1%) is positive for all the variables (+1% for per capita output, consumption, investment and stock market prices; +0.34% on employment; +1.7% on real wages), apart from the real interest rate. On the other hand, the labour supply shock (+1%) has a positive impact on employment (+1.6%) and a negative impact on the real wage (-2.8%). Moreover, according to the forecast error variance decomposition, the productivity shock explains all the permanent fluctuations in the per capita variables, 27% of fluctuations in real wages, and 4% of fluctuations in employment, while the labour supply shock explains 73% of real wages variability and 96% of employment fluctuations. Interestingly, persistent shocks explain a large proportion of stock market fluctuations already in the short-run: already after one year the persistent shocks jointly explain 89% of fluctuations in this latter variable. The remaining proportion of stock market variability may be related to a transitory financial shock. Such a shock (+4%) influences more strongly investment (+3% after one year) and productivity (+0.5% after one year). The response of consumption is weaker (+0.30% after one year). The impact on employment is initially positive, turning negative after two years and remaining negative in the medium term (-0.46% after six years). Also the short term impact on wages is negative (-0.40% after three years), while the impact on the real interest rate is positive (+0.24% after two years). The effects of the shocks are however not statistically significant.

The impulse response functions for the wage share to productivity, labour supply, and stock market shocks are also plotted in Figure 1. As is shown in the plots, a productivity increase leads to a reduction in the wage share only in the very short-run (-0.5%), since the effects are positive already after three years, stabilising after ten years (+0.7%). On the other hand, the effects of the labour supply shocks are negative already in the short-run (-0.8%), requiring a longer period to stabilise (about twenty years, -2.8%). Hence, two channels - both operating through the labour market - relate growth to income distribution, the former by leading to an increase in labour demand and wages, the latter by leading to an increase in the labour supply and a reduction in wages. Finally, the stock market shock exercises a negative impact on the wage share (-0.5%), which disappears within five years. The effects of the stock market shock on the wage share may perhaps be explained by the effects that such a shock exercise on productivity and wages directly, and are also coherent with the short-run effects of a permanent productivity shock.

Interestingly, our results allow to account for the dynamics in income distribution in the US since the 1950s. In fact, the trend increase in the wage share may be related to productivity dynamics,

[5] : For reasons of space we do not provide details concerning the methodology followed for the indentification of the

which has been growing at a fast rate up to the mid seventies and slow down thereafter. Hence, given the effects of a productivity shock on the wage share uncovered by the impulse response analysis, the slowdown in productivity dynamics could be at the basis of the reduction in the wage share since the 1980s (see also Hanson and Rose, 1997). The lack of evidence of an increase in the wage share since the mid 1990s, apart from the last three years of the sample, does not necessarily contradicts the above explanation, since, firstly, the positive impact of a productivity shock on the wage share requires some years to manifest, and secondly, because, as pointed out by Gordon (2000), over the period 1995-1999, productivity improvement in the US have been confined in the durable sector only, while the remaining sectors have witnessed a further reduction in productivity.

3 Conclusions

An empirical analysis set in the framework of the neoclassical growth model show that the key mechanisms explaining income distribution in the US operate through the labour market rather than through the stock market. Theoretically, the stock market may exercise important effects on the level of economic activity, for instance through wealth and Tobin' s "q" effects, or by affecting the financial structure of firms. These mechanisms seem to have been empirically important in the US since the mid nineties. We find that only growth shocks have a permanent effect on the wage share, with a positive productivity shock exercising a negative short-run impact and a positive long-run impact, and a positive labour supply shock exercising a negative impact at all the horizons. Also the effect of a positive stock market shock on the wage share is negative, albeit the affects tend to disappear within five years.

common trends model. See for instance Warne (1993), Mellander et al. (1992) and Morana (2003).

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Tab1e 1: Empirical results

Cointegration tests

Eigenvalues	0.553	0.496	0.259	0.251	0.203	0.084	0.007
H_0	r = 0	R ≤ 1	R ≤ 2	r ≤ 3	R ≤ 4	r ≤ 5	r ≤ 6
λ_{TRACE}	196.9**	130.8**	74.69**	50.1**	26.45	7.79	0.56
95% vc	124.2	94.2	68.5	47.2	29.7	15.4	3.8
90% vc	118.5	89.5	64.8	43.9	26.8	13.3	2.7

r denotes the number of cointegrating vectors; "**" denotes rejection of the null hypothesis at the 5% significance level and "*" at the 10% level.

Identified cointegrating vectors

y	*c*	*I*	*f*	*w*	*e*	*r*
-1	1	0	0	0	0	0
-1	0	1	0	0	0	0
-1	0	0	1	0	0	0
-2.315 (0.086)	0	0	0	1	1.705 (0.106)	0
0	0	0	0	0	0	1

Overidentifying restrictions LR-test: $\chi^2_{(8)} = 18.779$ [0.016].

Common trends model

	Factor loadings		**Forecast error variance decomposition** (∞)	
Variables	τ_θ	τ_ξ	τ_θ	τ_ξ
$y - e$	0.995 (0.298)	0	1	0
$c - e$	0.995 (0.298)	0	1	0
$i - e$	0.995 (0.298)	0	1	0
$f - e$	0.995 (0.298)	0	1	0
w	1.726 (1.612)	- 2.804 (1.162)	0.27	0.73
e	0.339 (0.828)	1.644 (0.681)	0.04	0.96
r	0	0	0	0

τ_θ denotes the technological shock; τ_ξ denotes the labour supply shock.

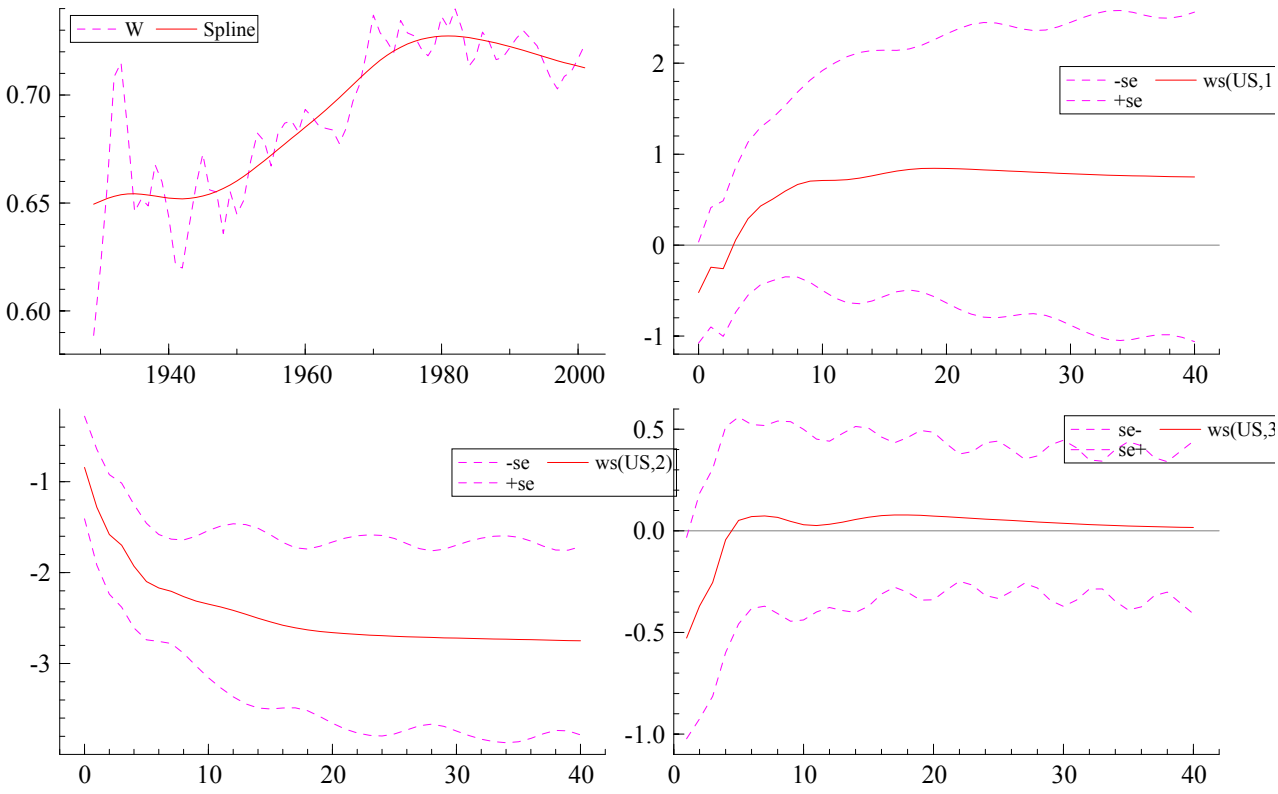

Figure 1: Wage share (W) with spline interpolator and impulse response functions for the wage share: productivity shock (1), labour supply shock (2), stock market shock (3).