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The Kuznets curve of the Rich

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Abstract

A long-standing interest in the relationship between inequality and sustainable growth continues to fascinate economists among other social scientists. It must be noted, however, that most empirical efforts have been focused on the income-inequality-growth nexus, while studies on wealth inequality are much more scarce. In this article, it is our purpose to fill such a gap in the literature by assessing the correspondence between the top 1 percent wealth-share and economic growth. Making use of time-series cointegration techniques, we study the experience of France and the United States between 1950 and 2014. Our estimates suggest that the growth rate of output is an inverted-U shaped function of the wealth-share of the top 1 percent. The estimated relationship is robust to variations in control variables and estimation methods. We compute a sort of *optimal wealth-share*, understood as the share of wealth compatible with the maximum rate of growth, and show that France is growing close to its long-run potential while the United States is significantly below it.

Keywords: Growth, wealth inequality, top wealth-shares, France, United States

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1 Introduction

Since ancient times, societies have been concerned about the effects of inequality on peace and prosperity. Socrates, for example, in his dialogue with Adeimantus reproduced in *The Republic*, demonstrated awareness of the pervasive consequences of indiscriminate wealth in deteriorating peace and order. Aristotle, in *Rhetoric*, also presented inequity as a source of conflict and anger. From Adam Smith to Karl Marx, there has been a long-standing interest in the relationship between income-wealth distribution and sustainable growth that continues to fascinate economists among other social scientists.

Different mechanisms have been identified linking these variables. The classical literature, for instance, has emphasised that increasing inequality might actually foster growth by channelling resources towards individuals with higher savings propensities, which in turn intensifies capital accumulation (Kaldor, 1957; Goodwin, 1967). Other scholars have suggested that concentrating income and wealth may promote the realisation of higher-return projects and thus may stimulate R&D investments (see, for example, Foellmi and Zweimuller, 2006).

On the other hand, a large body of scholarship has indicated that increasing inequality hampers growth because it promotes institutions that prevent the protection of property rights, weakens social consensus required to sustain growth, and induces the consolidation of an inefficient state bureaucracy (Persson and Tabellini, 1994; Rodrik, 1999; Acemoglu et al., 2011). Moreover, under imperfect credit markets, Galor and Zeira (1993) argue that income and wealth distribution determine the allocation of human capital across individuals. So, unequal societies might end up excluding certain individuals from human capital augmenting investment, with adverse implications in terms of growth rates.

Such a correspondence, however, does not have to be necessarily monotonic. Bhaduri and Marglin (1990) suggest that depending on how capital accumulation responds to profitability, changes in income distribution may have a positive or negative impact on growth. From a different perspective, Galor and Moav (2004) made the case that inequality favours growth in early stages of development, as the economy needs to accumulate physical capital, but it is detrimental later on, when human capital becomes the critical variable.

On the empirical front, data availability has been for a long time a major concern. For almost two decades, the literature was dominated by the data-set collected by Deininger and Squire (1996). More recent studies have either relied on the *World Income Inequality Database* provided by the World Institute for Development Economic Research or on the *Standardized World Income Inequality Database* developed by Solt (2009, 2019). Evidence generally seems to support the view that income inequality impedes growth (for a review, see Herzer and Vollmer, 2012; Berg et al., 2018). Still, results are not conclusive, even frequently contradictory.

For instance, among recent studies, Castelló-Climent (2010) found that higher income inequality reduces growth in low and middle-income countries while has zero or a positive effect in high-income ones. In contrast, Brueckner and Lederman (2018) showed that in low-income countries growth is boosted by greater income inequality whereas in high-income nations inequality has a significant negative effect on transitional growth. Beyond differences in the quality of the data and the econometric technique used, the empirical difficulty to identify a monotonic relationship reflects the heterogeneity underlying theoretical mechanisms, as previously discussed.

For example, Halter et al. (2014) found that a deterioration of income distribution helps economic performance in the short-term but reduces the rate of growth of output in the long-term. The studies by Chambers and Krause (2010) and El-Shagi and Shao (2019) indicated that inequality is beneficial or detrimental to growth depending on income and education conditions. Indeed, in a disaggregated set-up, Erman and te Kaat (2019) obtained that an unequal income distribution increases the rate of growth of physical-capital-intensive industries and reduces the growth rate of human-capital-intensive ones. Top incomes matter, and Herwartz and Walle (2018) have showed that an increase in the share of income that goes to the top 1% is related to higher economic activity. Furthermore, Litschig and Lombardi (2019) presented evidence that, in terms of the subsequent growth effects, it matters whether inequality or redistribution originates from the lower or upper tails of the distribution.

Empirical studies investigating the correspondence between wealth inequality and economic growth are much more scarce. To the best of our knowledge, Bagchia and Svejnar (2015) and Islam and McGillivray (2019) are the only two existing references. The first built a *proxy* of wealth distribution using the *Forbes*'s list of billionaires. The latter relied on recent data published by *Credit Suisse* for a sample of 45 countries between 2000 and 2012. Both articles found that inequality is negatively associated with economic growth. Taking into account that most theoretical contributions have highlighted that both wealth and income distribution are important for growth, it is our purpose in this article to assess such a relationship focusing on the wealth-share allocated to the top 1%.

For three decades, the debate about rising inequality in the United States and Europe has centered on the increased premium for certain types of labour. In recent years, however, there has been an increasing realisation that most of the action is at the very top of the distribution (Alvaredo et al. 2013, 2018). The development of the *World Inequality Database* has allowed the analysis and international comparison of the evolution of top income and wealth-shares. The top 1% wealth-share-growth relationship is not just a *proxy* for the inequality-growth nexus. It is an interesting tax policy issue in its own right. Piketty and Zucman (2015) and Alvaredo et al. (2017) have shown that the share of inherited wealth in several developed countries is back to 50-60% of total wealth with potentially important political and economic implications.

In 2018, the average net personal wealth of the so-called top 1 percent was 5.8 million US$ in France and almost 12 million US$ in the United States. Its average pre-tax income was 500 thousand US$ in the former country and 1.4 million US$ in the latter. While it is certainly not an homogeneous group, such an elite holds a significant (and perhaps disproportionate) amount of skills and power in society. Complementing the channels previously discussed, this means that a very small or a large wealth-share might be harmful to economic performance. In the first case, very skilled individuals are not properly rewarded, leading to an inefficient allocation of resources. On the other hand, high wealth concentration might weaken the social consensus required to sustain growth, inducing the consolidation of equally inefficient institutional arrangements in both public and private sectors.

From a technical point of view, the use of time-averaged data in a panel context is common practice in the inequality-growth literature. This approach allows the inclusion of a larger number of economies while it is supposed to eliminate business cycle effects. However, it comes with several shortcomings. One of the main criticisms is the implicit assumption of a common economic structure across countries. Panel methods allow controlling for country-specific omitted variables. However, in dynamic models, they might produce inconsistent and potentially misleading estimates when the slope of coefficients differs across cross-section units (Pesaran and Smith, 1995; Attanasio et al., 2000).

Moreover, averaging data over time may induce spurious contemporaneous correlations. Both their sign and magnitudes might differ from those in the underlying data, a problem not to be solved by instrumental variable estimation, nor even the Generalised Method of Moments (see Ericsson et al. 2001). Finally, of course, annual data provides information that is lost when averaging, especially when series are highly persistent (Nair-Reichert and Weinhold, 2001). It is not clear if business cycle effects are effectively eliminated as the length of the interval over which averages are computed is arbitrary (Herzer and Vollmer, 2012).

In this article, we rely on time-series cointegration techniques to study the experience of France and the United States (US). Our estimates suggest that the growth rate of output follows an inverted-U shaped function of the wealth-share of the so-called top 1 percent. The estimated relationship is robust to variations in control variables and estimation methods, having some similarities with Banerjee and Duflo (2003) results. It is possible for us to compute a sort of *optimal wealth-share* defined as the share of wealth controlled by the top 1 percent compatible with the maximum rate of growth. Any divergence from this level, in whatever direction, is associated with a reduction in long-run growth. We show that France is growing closer to its long-run potential while the United States is 1-2% below it.

The remaining of the paper is organised as follows. In the next section, we describe the existing evidence regarding the evolution of top wealth-shares showing how wealth inequality is arguably more important than income inequality. Section 3 presents our empirical exercise identifying the inverted-U relationship. In section 4, we explore the robustness of our findings to alternative specifications and estimators. Some final considerations follow.

2 The top 1 percent in perspective

There are many reasons why societies might have a concern for inequality and wish to measure it. A step of crucial importance becomes the selection of the index used to measure income or wealth distribution. The choice of such an index embodies fundamental normative judgements that are important to be aware of when interpreting any results (for a recent review of different indicators, see Ninõ-Zarazúa et al., 2017).

As pointed out by Alvaredo et al. (2013), in recent years, there has been a growing realisation that rising inequality in the United States and Europe is very much related to what has been happening at the very top. Hence, we should start by looking at the factual importance of the top 1 percent. Data from the *World Inequality Database* indicates that, in 2018, the average net personal wealth of this group was 5.8 million US$ in France and almost 12 million US$ in the United States.[1] Its average pre-tax income, one the other hand, was 500 thousand US$ in the former country and 1.4 million US$ in

[1]The *World Inequality Database* was initially created as the *World Top Incomes Database*, providing access to all the existing series constructed by T. Piketty, E. Saez and co-authors in past years. Its key novelty was the combination of fiscal, survey and national accounts data in a systematic manner. This allowed the computation of more reliable top income shares series than previous inequality databases.

the latter.

Using the same source, Fig. 1 (a)-(b) present the time-series of wealth distribution of the top 1 percent, the next 9 percent, and the middle 40 percent in these two countries. While until the 1980s the wealth-share going to the first group has been stable or decreasing, the trajectory was reverted afterwards. In France, this share fell from 30% to 15% and seems to have stabilised close to 25%. In the US, on the other hand, the top 1 percent wealth-share fell from 30% to 20% in 1980 and has consistently grow reaching almost the 40% threshold in 2014.

Such trajectories are in sharp contrast with the wealth-share controlled by the other two groups. For instance, the French next 9 percent has presented an almost monotonic reduction from 40% to 30%. The middle 40 percent, on the other hand, was stable from 1950 to 1970 around 25%, it jumped to 40% during the seventies apparently stabilising afterwards. In contrast, both groups in the US have experienced a reduction in their share on wealth over the past three decades. These dynamics further motivate our interest in the top 1 percent.

We proceed by providing some motivation to which extent wealth inequality might be more relevant than income inequality. Davies et al. (2011), for example, found that the global wealth-holding is by far more concentrated than income. While in most countries the Gini coefficient for disposable income lies within the range of 0.3-0.5, when it comes to wealth inequality it is normally between 0.6-0.8. Fig. 1 (c)-(d) show that both dimensions of inequality move together but wealth is two to three times more concentrated. In 2014, the US top 1 percent controlled 20% of income and almost 40% of total wealth.

It is useful to compare the different characteristics of the underlying data we are about to use in our econometric exercise. Fig. 1 (e)-(f) plot, in red, the top 1 percent wealth-share and, in blue, the rate of growth of output. Once more the 1980s divide time-series in two parts. The first thirty years of our sample are characterised by higher and more volatile growth with stable-decreasing wealth concentration. On the other hand, the last twenty to thirty years are marked by relatively lower and less volatile growth, with an increasing share of wealth going to the top 1 percent.

Such trajectories might suggest a negative correspondence between our relevant variables. For instance, in the US, the period referred to as the Great Moderation was marked by increasing wealth concentration. Still, as indicated in the Introduction, we have reasons to believe that this relationship is not monotonic. Hence, we shall proceed by investigating the properties of this correlation.

3 On the relationship between growth and wealth concentration

A common set-up for investigating the relationship between the rate of growth of output (g) and a vector of explanatory variables (X) is the following:

$$g_t = \psi y_{t-1} + \gamma X_{t-1} + \epsilon_t \tag{1}$$

where y is the logarithmic of Gross Domestic Product (GDP); ψ and γ are the coefficients associated with y and X; ϵ stands as the error term. Recalling that $g_t = y_t - y_{t-1}$, this

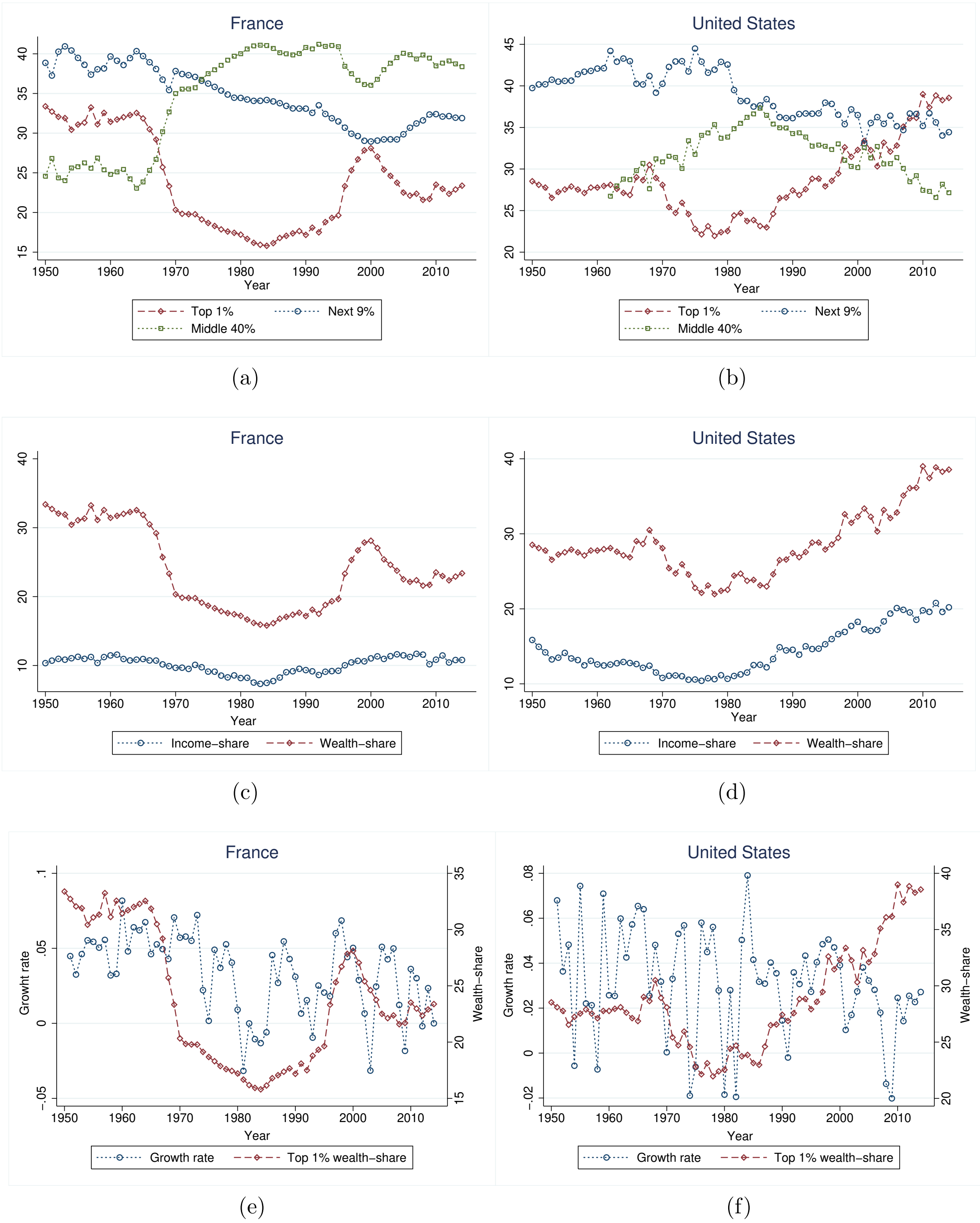


Figure 1: The Top 1% in perspective.

is equivalent to estimating:

$$y_t = (1 + \psi)\, y_{t-1} + \gamma X_{t-1} + \epsilon_t \tag{2}$$

In this Section, it is our purpose to study the correspondence between g and the top 1 percent wealth share (ω) in France and in the US, taking into account the possibility of non-linearities in the underlying long-run relationship. Therefore, we make use of different specifications of Eq. (1), including alternative controls in the vector of explanatory variables. In Section 4, we proceed by performing a series of robustness checks that consider the specification of Eq. (2).

The choice of working with these economies is twofold motivated. On the one hand, they roughly represent two different institutional arrangements in developed countries, namely, the anglo-saxon and the continental Europe. On the other hand, from a more practical point of view, data is available for a sufficiently long period allowing the performance of time-series analysis.

3.1 Dataset and order of integration

Our dataset is annual and comprehends the period between 1950 and 2014. The growth rate of output was obtained as the difference of the logs of Output-side real GDP at chained PPPs from the *Penn World Table* (PWT) version 9.0. The top 1 percent wealth-shares come from the *World Inequality Database*. Our set of controls comes from the PWT and includes the size of the population, the capital stock, a human capital index, and the degree of trade openness. This last variable is measured as the sum of exports and imports over GDP. We also include dummy variables for each decade to take into account the possibility of structural breaks. They assume value 1 for years belonging to the respective decade, and zero otherwise.

Research has assessed the impact of inequality on economic growth, but also from growth to distribution. Table 1 shares some light on the direction of causality. Both ω and its variation ($\Delta\omega$) Granger cause g. The predictive power of wealth concentration seems to be stronger in France though it is still relevant for the US.

Table 1: Granger causality insights

H_0	France	United States
g does not Granger cause ω	0.6715	0.8317
ω does not Granger cause g	0.0462	0.1075
g does not Granger cause $\Delta\omega$	0.1692	0.7800
$\Delta\omega$ does not Granger cause g	0.0437	0.0556

Prob. of rejecting the null hypothesis

Ascertaining the order of integration of the variables under analysis is an essential precondition for choosing a consistent estimation technique. In this respect, we performed the Augmented Dickey-Fuller (ADF) test with and without a break, and the Phillips-Perron (PP) test. Results are reported in the Empirical Appendix and indicate that g is stationary, while y, ω, and ω^2 are I(1). Hence, we make use of the Auto-Regressive Distributed Lag (ARDL) cointegrating estimator, developed by Pesaran and Shin (1998) and Pesaran et al. (2001). This methodology has the advantage of allowing to undertake analysis regardless of whether variables are a mixture of I(0) or I(1), which is our case.

Even though we are still constrained by parametric assumptions, our approach overcomes two of the main shortcomings of usual cross-country regressions. On the one hand, by focusing exclusively on the time dimension of the data, we avoid the well-known heterogeneity problems of a panel set-up. On the other hand, under cointegration, the omitted variable issue is unlikely to affect the reliability of our estimates. This is because an omitted variable will either be stationary – in which case the estimated coefficients are invariant to its inclusion – or it will be non-stationary – in which case we will not be able to obtain a stable cointegrating relationship if we leave it out.[2]

3.2 The inverted-U

Our general ARDL model is given by:

$$g_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \psi_i g_{t-i} + \sum_{j=1}^{q} \beta_j \omega_{t-j} + \sum_{k=1}^{l} \beta_k \omega_{t-k}^2 + \gamma X_{t-1} + \epsilon_t \tag{3}$$

where α_0 is a constant term; α_1 and ψ_i are the coefficients associated with a linear trend and lags of g, respectively; β_j and β_k stand as the lag coefficients of ω and ω^2.

If two series are cointegrated, this means that they have a long-term relationship which prevents them from wandering apart without bond. Pesaran et al. (2001) and Narayan (2005) provide supply bounds on the critical values for the asymptotic distribution of the F and T-statistics. Tables 2 and 3 report our main results for France and the United States, respectively. We identify a quadratic long-run relationship between our relevant variables that is statistically significant. The estimated function is robust to the inclusion of different exogenous controls. To simplify presentation, we have omitted the short-term coefficients, which are available under request.[3]

In France, the coefficient of the linear term varies between 0.021 and 0.044 while the quadratic term is in the -0.0004 to -0.0009 interval. On the other hand, in the US, the quadratic coefficient has a similar magnitude to its European counterpart. Still, the linear portion of the relationship is slightly higher, lying between 0.025 and 0.05.

We test for causality by incorporating the lagged error-correction (EC) term that represents the long-run causal relationship. In all cases, a negative and significant EC coefficient implies that there is convergence to the long-run equilibrium solution. Models I and II show an $EC \in [-2, -1]$, which means they produce dampened fluctuations towards equilibrium (Narayan and Smyth, 2006; Loayza and Rancière, 2006). Once some further controls are included, we obtain an $EC \in [-1, 0]$. Between 70 to 90% of any movements into disequilibrium are corrected for within one period.

[2]The presence of cointegration brings a form of robustness to many of the classic empirical problems that lead to the violation of so-called exogeneity condition for the regressors. Examples include measurement error, simultaneity, omitted variables, reverse causality, or indeed anything that leads the data generating process. For a review of the super-consistency properties under cointegration, see Pedroni (2019).

[3]In order to avoid potential serial correlation issues, the order of lags was obtained using the Akaike informational criteria. We allow for automatic lag selection imposing a maximum of 4 lags for dependent and independent variables. Some models were found to have serial correlation, in which case, we adjusted the number of lags accordingly.

Table 2: Growth and the 1% top wealth-share – France

Dependent variable: g_t					
	I	II	III	IV	V
	ARDL(4,1,0)	ARDL(4,1,0)	ARDL(1,0,1)	ARDL(1,0,1)	ARDL(1,0,0)
ω_{t-1}	0.026661***	0.021230***	0.042191***	0.044655***	0.027659***
ω^2_{t-1}	-0.000534***	-0.000429***	-0.000894***	-0.000948***	-0.000506***
Time dummies	-	yes	yes	yes	yes
y_{t-1}	-	-	yes	yes	yes
Pop_{t-1}	-	-	yes	yes	yes
Capital stock_{t-1}	-	-	-	yes	yes
HC_{t-1}	-	-	-	yes	yes
Openess_{t-1}	-	-	-	-	yes
EC	-1.183436***	-1.383853***	-0.743183***	-0.741968***	-0.735099***
Bounds F-stat.	11.89728	13.57796	16.76351	16.70782	12.35320
Bounds T-stat.	-6.090281	-6.522596	-7.234860	-7.228857	-6.215835
LM F-stat	0.087211	0.494021	1.623887	1.728071	0.962236
ω^*	24.9634	24.7435	23.5967	23.5522	27.3310

*,**,*** stand as 10%, 5%, and 1% of significance

Table 3: Growth and the 1% top wealth-share – United States

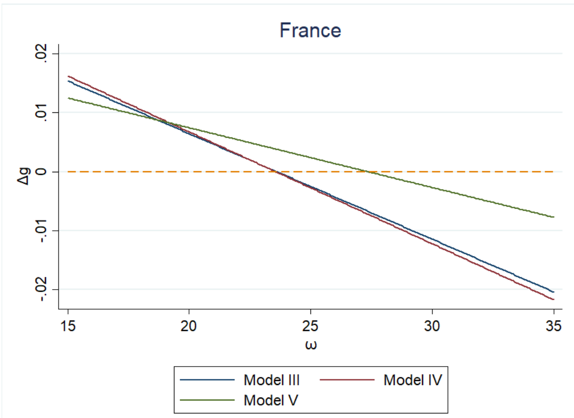
Dependent variable: g_t					
	I	II	III	IV	V
	ARDL(1,2,0)	ARDL(3,2,1)	ARDL(1,2,1)	ARDL(1,1,1)	ARDL(1,1,1)
ω_{t-1}	0.008177	0.025966**	0.052312***	0.049682**	0.046443*
ω^2_{t-1}	-0.000143	-0.000482**	-0.000972***	-0.000937**	-0.000875*
Time dummies	-	yes	yes	yes	yes
y_{t-1}	-	-	yes	yes	yes
Pop_{t-1}	-	-	yes	yes	yes
Capital stock_{t-1}	-	-	-	yes	yes
HC_{t-1}	-	-	-	yes	yes
Openess_{t-1}	-	-	-	-	yes
EC	-0.909584***	-1.426662***	-0.847356***	-0.933362***	-0.920554***
Bounds F-stat.	15.46214	15.44247	13.43589	19.38177	16.18611
Bounds T-stat.	-6.933484	-6.956034	-5.825986	-7.789312	-7.121550
LM F-stat.	0.062140	0.609969	0.982702	1.522882	1.322403
ω^*	28.5909	26.9356	26.9094	26.5112	26.5388

*,**,*** stand as 10%, 5%, and 1% of significance

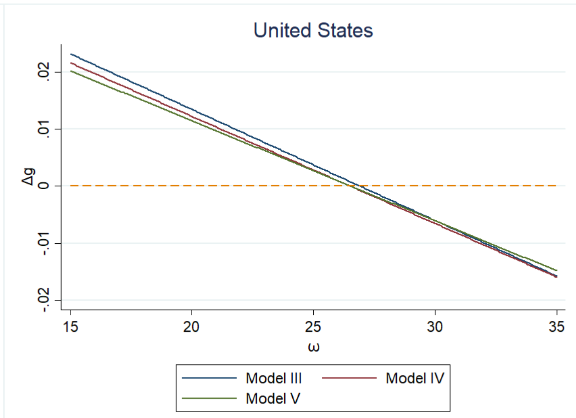
Given that our estimates suggest that the growth rate of output is an inverted-U shaped function of the wealth-share of the top 1 percent, it is possible to compute a sort of *optimal wealth-share*, as the share of wealth which is compatible with the maximum rate of growth. Divergences from this level in any direction are associated with a reduction in long-run growth, an outcome that has some similarities with Banerjee and Duflo (2003). Using non-parametric and cross-country techniques, they obtained that the rate of growth is a function of net changes in inequality. Thus, variations in inequality, in any, direction, were associated with reduced growth in the next period.

Our findings can also be directly compared to Herwartz and Walle (2018). By applying structural-vector autoregressive modelling, they showed that increases in the share on income of the top 1 percent have a long-run positive impact on economic development. We are also able to find a similar correspondence, however, up to a certain turning point. After that, the correlation becomes negative in both countries.

In our case, the last line of Tables 2 and 3 indicates that such an "optimal share" is close to 25%, being slightly higher in the US than in France. Fig. 2 depicts the derivative of g with respect to ω for models III-V. The estimated "optimal" corresponds to the point in which the orange-dashed line is crossed. For values of $\omega < \omega^*$, g is an increasing function of the wealth-share. Once $\omega > \omega^*$, the partial derivative becomes negative and further increases in wealth concentration are associated with a reduction in economic performance.



(a)



(b)

Figure 2: Marginal effects of changes in wealth concentration.

In the previous Section, we showed that the wealth-share of the top 1 percent in France is slightly below the 25% threshold. On the other hand, the wealth controlled by the 1 percent elite in the US has recently approached 40%. This means that while the former is closer to its long-run growth potential, the latter is growing between 1 and 2% less. The over-concentration of wealth in the hands of few is harming the economic performance of the United States, especially after the 2000s.

The so-called *trickle-down* effect postulates that economic growth generated by the rich eventually benefits the poor through job creation and other opportunities. While income inequality might be indeed positively connected to incentive rewards, wealth accumulation has an additional inter-generational component that might play a role in the opposite direction. Alvaredo et al. (2017) has provided historical series on the evolution of the share of inherited wealth in aggregate wealth for different European countries and the US. Inherited wealth represented 80-90% of total wealth in France in the 19th century, this share fell to 40-50% during the 20th century, but it is back to about 60-70% in the early 21st century. Current rates in the United States are not very different with potential implications for economic growth.

Redistributive issues have a political economy of its own and it is not our intention to be irresponsible in those matters. In a recent and detailed study on the topic, Berg et al. (2018) have shown that redistribution appears benign in terms of its impact on growth, except when it is extensive. One should also recognise that the success of any policy implementation is to a great extent conditional to its design. Even though our exercise remains silent regarding those issues, it indicates how harmful an over-concentration of wealth might be.

As pointed out by Piketty (2020), once we accept that private property will continue to play a role in society, it becomes essential to develop institutional arrangements capable of preventing unlimited concentration of ownership which does not serve the general interest. The extreme concentration of wealth observed in European societies up to the early twentieth century did not serve to it. On the contrary, signs of excessive wealth concentration exacerbated social and nationalist tensions, blocking educational and social investments that made possible the development model of the postwar. In a similar vein, Saez and Zucman (2019) have advocated for a tax schedule based on an "economic income" estimated on the basis of wealth. Further research on the impacts of wealth redistribution is certainly to be encouraged.

4 Exploring the robustness of the inverted-U

By estimating an ARDL version of Eq. (1), we were able to identify an inverted-U relationship between wealth concentration at the top 1 percent and growth. It is our purpose in this Section to check the robustness of such a result. This is done in three different ways. First, we adopt the flexible NARDL estimator proposed by Shin et al. (2014). It allows us to simultaneously and coherently modelling asymmetries both in the cointegrating vector and in the patterns of dynamic adjustment.

Second, we present a general ARDL specification of Eq. (2) and show that our estimates are fundamentally the same. Given that this last formulation confronts series that are non-stationary and integrated of order one, we conclude by making use of the Dynamic Ordinary Least Square (DOLS) estimator developed by Stock and Watson (1993). This estimator deals with the problem of second-order asymptotic bias arising from serial correlation and endogeneity.[4]

[4]The DOLS estimator was preferred to single equation alternatives such as the Fully Modified Ordinary Least Square (FMOLS) because it allows to differentiate between leads and lags when specifying the model. This proved to be useful for controlling serial correlation problems. Moreover, Kao and Chiang (2001) have shown, in a panel context, that the DOLS estimator outperforms FMOLS regressions being computationally simpler.

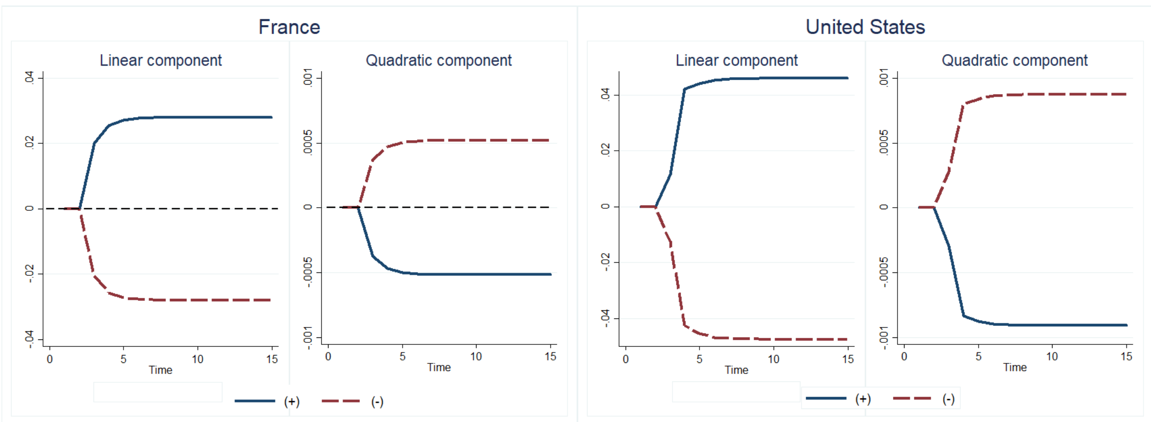
4.1 Allowing for asymmetric effects

The nonlinearity of many macroeconomic variables and processes has long been recognised in the economic literature. Given that asymmetric effects are fundamental to the human condition, we abandon the assumption that the long-run relationship may be represented as a symmetric linear combination of non-stationary regressors. In this respect, the non-linear ARDL estimator provides a straightforward means of testing both long- and short-run symmetry restrictions.

Let $\omega = \omega^{+} + \omega^{-}$ and likewise $\omega^2 = \omega^{2+} + \omega^{2-}$. The superscripts $+$ and $-$ indicate the partial sum processes of positive and negative changes in the wealth-share. We consider the following NARDL (p, q, l) model:

$$g_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \psi_i g_{t-i} + \sum_{j=1}^{q} (\beta_j^{+} \omega_{t-j}^{+} + \beta_j^{-} \omega_{t-j}^{-}) \\ + \sum_{k=1}^{l} (\beta_k^{+} \omega_{t-k}^{2+} + \beta_k^{-} \omega_{t-k}^{2-}) + \gamma X_{t-1} + \epsilon_t \quad (4)$$

Fig. 3 reports trajectories converging to the long-run solution when we re-estimate model V, which contains all our controls. A positive shock in the wealth-share of the top 1 percent corresponds to the blue line while the red dashed one stands for a negative shock. We are not able to identify significant asymmetries in the underlying long-run relationship. Still, given that the linear and quadratic components have opposite signs, it is possible to appreciate the inverted-U. Moreover, in both countries, the adjustment to equilibrium takes around five years to happen, being slightly faster in the US.



(a) (b)

Figure 3: Convergence to the long-run solution in a NARDL model

4.2 An alternative specification for the growth equation

Our ARDL specification of Eq. (2) can be written as:

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \psi_i y_{t-i} + \sum_{j=1}^{q} \beta_j \omega_{t-j} + \sum_{k=1}^{l} \beta_k \omega_{t-k}^2 + \gamma X_{t-1} + \epsilon_t \quad (5)$$

Table 4 reports our estimates for France. Coefficients are slightly higher because now we are estimating the impact of wealth concentration on the level of output. Still, the quadratic correspondence is there. The linear part of the relationship lies between 0.10 and 0.17 while the quadratic term is in between -0.002 and -0.003. As we add exogenous controls, the *EC* term increases in magnitude and stabilises so that 25 to 30% of any deviations from the equilibrium solution are corrected for within one period. The existence of a long-run relationship is confirmed by the F- and T-statistics. As we can see in models VIII-X, the 5% of significance threshold is overcome.

Table 4: GDP and the 1% top wealth-share – France

	Dependent variable: y_t				
	VI	VII	VIII	IX	X
	ARDL(2,2,0)	ARDL(2,1,0)	ARDL(2,0,1)	ARDL(2,0,1)	ARDL(2,0,1)
ω_{t-1}	0.670118	0.173786***	0.107486***	0.128290**	0.111975***
ω_{t-1}^2	-0.013850	-0.003703***	-0.002278***	-0.002725**	-0.002353**
Time dummies	-	yes	yes	yes	yes
Pop_{t-1}	-	-	yes	yes	yes
$\text{Capital stock}_{t-1}$	-	-	-	yes	yes
HC_{t-1}	-	-	-	yes	yes
Openess_{t-1}	-	-	-	-	yes
EC	-0.033058***	-0.160156***	-0.291721***	-0.258262***	-0.280969***
Bounds F-stat.	3.474326	7.362544	8.943439	6.541070	6.635760
Bounds T-stat.	-3.287706	-4.792821	-5.284452	-4.523079***	-4.557720
LM F-stat	0.268345	1.145680	1.623887	1.728071	1.724100
ω^*	24.1919	23.4655	23.5921	23.5394	23.7940

*,**,*** stand as 10%, 5%, and 1% of significance

We proceed by repeating the exercise for the US. Table 5 shows that also for this country the inverted-U relationship is robust. We are not able to find cointegration in models VI-VIII. However, once we control for the stock of physical and human capital, we recover our cointegrating vector. Still, one should notice that further including the degree of openness makes our coefficients to lose statistical significance. The linear part of the relationship lies between 0.08 and 0.21 while the quadratic term is in between -0.0015 and -0.0039.

4.3 Dynamic OLS

Using Eq. (2) has the advantage of confronting variables that are integrated of order one. Hence, we estimate the following DOLS model:

$$y_t = \alpha_0 + \alpha_1 t + \sum_{j=-q}^{q} \beta_j \Delta\omega_{t-j} + \sum_{k=-l}^{l} \beta_k \Delta\omega_{t-k}^2 + \gamma X_{t-1} + \epsilon_t \tag{6}$$

As we can see in Table 6, our previous results are basically confirmed. Model XI, for instance, does not include lagged GDP as an exogenous control. In this case, we are

Table 5: GDP and the 1% top wealth-share – United States

Dependent variable: y_t					
	VI	VII	VIII	IX	X
	ARDL(2,2,0)	ARDL(1,2,1)	ARDL(2,2,1)	ARDL(1,1,1)	ARDL(1,1,1)
ω_{t-1}	0.083264***	0.210810**	0.150450**	0.126448**	0.116533
ω_{t-1}^2	-0.001567***	-0.003908*	-0.002795**	-0.002409**	-0.002222
Time dummies	-	yes	yes	yes	yes
Pop_{t-1}	-	-	yes	yes	yes
Capital stock_{t-1}	-	-	-	yes	yes
HC_{t-1}	-	-	-	yes	yes
Openess_{t-1}	-	-	-	-	yes
EC	-0.202737***	-0.217234***	-0.294627***	-0.355576***	-0.360936***
Bounds F-stat.	2.798331	3.061499	3.463931	6.948717	6.462920
Bounds T-stat.	-2.950579	-3.093087	-2.527100	-4.661890	-4.497972
LM F-stat	0.442009	0.027167	0.982702	0.983259	0.840403
ω^*	26.5679	26.9715	26.9141	26.2449	26.2225

*,**,*** stand as 10%, 5%, and 1% of significance

closer to Eq. (2) and the obtained coefficients are similar to those of Table 4. On the other hand, models XII-XIV do include lagged GDP as an explanatory variable, leading to estimates closer to those reported in Table 2. In fact, coefficients of the linear part are in between 0.025 and 0.04. In what concerns the quadratic term, we have a negative effect of -0.0005 to -0.0008. Hansen cointegration tests provide a Lc statistic sufficiently low so we cannot reject the null hypothesis that series are cointegrated. An *optimal wealth-share* slightly below 25% is also in line with our previous findings.

Given the emphasis of this article on the share of wealth controlled by the upper classes, model XV tests for a similar quadratic correspondence for the top 0.01 percent of the population. In 2018, this group had an average net personal wealth of 70 million US$ in France and almost 500 million US$ in the United States. The inverted-U function is robust with a linear coefficient equal to 0.08 and the quadratic term equal to -0.009. This leads to a sort of optimal share between 4 and 4.5%.

When it comes to the US, DOLS estimations appear to be more robust than the ARDL alternative. In model XI, the linear part is slightly lower than in France, being equal to 0.099. The quadratic coefficient, has also a smaller magnitude, being equal to -0.001. The remaining models have coefficients of the linear part lying between 0.04 and 0.06 while the quadratic component oscillates between -0.0008 and -0.0012. In all specifications, we cannot reject the null of cointegration and estimated parameters are significant. Furthermore, the so-called *optimal wealth-share* of the top 1 percent is slightly above the 25% line.

Overall, our estimates provide robust evidence that the growth rate of output is an inverted-U shaped function of the top 1 percent wealth-share. Such a long-run relationship is robust to changes in controls and estimation methods. Taking into account that in France the top 1 percent currently controls 25% of total wealth while in the US their share is close to 40%, our exercise provides an important insight to policy makers.

Table 6: DOLS estimations – France

Dependent variable: GDP_t					
	XI	XII	XIII	XIV	XV
ω_{t-1}	0.122176***	0.025298**	0.028325**	0.040833**	0.080579**
ω^2_{t-1}	-0.002789***	-0.000527**	-0.000574**	-0.000829**	-0.009516*
α_0	11.67638***	-0.097293	-0.862095	-0.171434	0.718428
trend	0.026797***	0.002859	0.000419	0.002489	0.004670
GDP_{t-1}	-	0.679245***	0.668748***	0.494433***	0.723198***
$Pop._{t-1}$	-	1.047613	1.211097	1.230602	0.524703
Capital $stock_{t-1}$	-	-	0.009811	0.189335	0.087492
HC_{t-1}	-	-	0.541522	1.404458*	0.613038
$Openess_{t-1}$	-	-	-	-0.002987**	-0.002020
Time dummies	yes	yes	yes	yes	yes
Lc stat.	0.060489	0.132536	0.154888	0.140561	0.159799
Jarque Bera	2.704162	2.124455	2.809664	0.379002	1.885977
ω^*	21.9031	24.0018	24.6733	24.6278	4.2338

*,**,*** stand as 10%, 5%, and 1% of significance

Table 7: DOLS estimations – United States

Dependent variable: GDP_t					
	XI	XII	XIII	XIV	XV
ω_{t-1}	0.099442**	0.066128***	0.055463***	0.042061**	0.060499***
ω^2_{t-1}	-0.001752**	-0.001200***	-0.001008***	-0.000802***	-0.005639***
c	13.23346***	4.092829*	11.06586***	10.78616***	9.886492***
trend	0.037625***	0.015074***	0.023582***	0.023735***	0.019873***
GDP_{t-1}	-	0.686347***	0.587028***	0.639064***	0.506425***
$Pop._{t-1}$	-	-0.079506	-0.141938	-0.139737	0.146402
Capital $stock_{t-1}$	-	-	-0.885167***	-0.900984***	-0.637352**
HC_{t-1}	-	-	0.391599***	0.325186***	0.330485***
$Openess_{t-1}$	-	-	-	-0.000687	0.000479
Time dummies	yes	yes	yes	yes	yes
Lc stat.	0.056466	0.130968	0.232933	0.244682	0.189671
Jarque Bera	0.620701	0.215894	1.046201	1.284475	1.037025
ω^*	28.3795	27.5533	27.5114	26.2225	5.3643

*,**,*** stand as 10%, 5%, and 1% of significance

Redistributive policies targeting the French elite might be desirable for various reasons but growth. Indeed, an increase or a reduction of the share of wealth controlled by the top 1 percent may actually lead to a reduction in the growth rates. On the contrary, there seems to be plenty of space for wealth redistribution in the United States. Bringing down the top 1 percent wealth-share from its current levels to approximately 25% can potentially increase the rate of growth in 1-2%.

The last column of Table 7 provides estimates for the top 0.01 percent of the population. In this case, a linear coefficient equal to 0.06 and a quadratic part equal to -0.0056 result in an "optimal" wealth-share between 5 nd 5.5%. Since 2010, however, the net personal wealth-share of this group has been above 10%. Such a result confirms one of the main insights of the article, that is, the over-concentration of wealth in the hands of few has damaged economic performance in the US.

5 Final considerations

An interest in the relationship between inequality and long-run growth continues to fascinate economists among other social scientists. However, most empirical efforts have focused on the importance of income inequality, while studies on wealth inequality are much more scarce. Wealth has proven to be more concentrated than income over time. Indeed, while both dimensions move together, the wealth-share of the top 1 percent is two to three times more concentrated. This article fills a gap in the literature by assessing the correspondence between the wealth-share as represented by the top 1 percent and the growth rate of output.

For three decades, the debate about rising inequality in several developed countries has been focused on some sort of premium for certain types of labour. In recent years, nevertheless, there has been an increasing realisation that most of the action has been at the very top of the distribution. Work by T. Piketty, E. Saez and co-authors and the development of the *World Inequality Database* have shown that the top income-wealth measures are not just *proxies* for inequality. They are an interesting policy issue in their own right with potentially important political and economic implications.

In France, the top 1 percent has an average net personal wealth close 6 million US$ that increases to 70 million US$ as we move to the top 0.01 percent. On the other hand, magnitudes are even more impressive in the United States, with values around 1.4 million US$ for the first group and almost 500 million US$ at the very top 0.01 percent. While we acknowledge the intrinsic heterogeneity and mobility of those belonging to these groups, our understanding is that they hold a significant amount of skills and power in society.

By forming a body of decision-makers, both in public and private spheres, we might end up with an inefficient allocation of resources if they are not properly rewarded. However, extremely high wealth concentration levels are also problematic. In this case, inequality may obstruct the supply of people and ideas into the economy, limiting opportunity for those not already at the top. One may also have a subversion of the institutions leading to an ineffective political system and dysfunctional markets.

Making use of time-series cointegration techniques, we have studied the experience of France and the US between 1950 and 2014. Our estimates are robust to controlling for physical and human capital, the degree of trade openness, and to using different estimation methods. We have shown that the growth rate draws an inverted-U shaped function of the top 1 percent wealth-share. We also have computed a sort of optimal wealth-share, i.e the share of wealth compatible with a maximum rate of growth, showing that France is growing close to its long-run potential while the United States is significantly below it. In fact, by reducing wealth concentration to French levels, the US could increase potentially its long-run rate of growth in 1-2%.

A Empirical Appendix

Table A1 and A2 report a summary of the ADF with and without structural break, and PP unit root tests for France. On Tables A3 and A4 we present results of the same tests for the US. Outcomes indicate that the growth rate of output is stationary while the other series are integrated of order one.

Table A1: Unit root tests (levels) – France

	y		g	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.1028	0.7882	0.0019	0.0013
PP	0.0268	0.8549	0.0021	0.0013
ADF - Structural break	0.0692 (1953)	0.9109 (1959)	<0.01 (1973)	<0.01 (1973)
	ω		ω^2	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.4315	0.8886	0.4085	0.8882
PP	0.3857	0.8643	0.3464	0.8482
ADF - Structural break	0.6875 (1964)	0.4508 (1967)	0.4393 (1964)	0.3138 (1967)

Automatic lag selection based on SIC. Newey-West automatic Bandwidth selection.

Table A2: Unit root tests (1st differences) – France

	y		g	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.0019	0.0013	0.0000	0.0000
PP	0.0021	0.0013	0.0000	0.0000
ADF - Structural break	<0.01 (1973)	<0.01 (1973)	<0.01 (1981)	<0.01 (1981)
	ω		ω^2	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.0001	0.0002	0.0000	0.0000
PP	0.0000	0.0001	0.0000	0.0000
ADF - Structural break	<0.01 (1970)	<0.01 (1996)	<0.01 (1968)	<0.01 (1968)

Automatic lag selection based on SIC. Newey-West automatic Bandwidth selection.

Table A3: Unit root tests (levels) – United States

	y		g	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.2211	0.8646	0.0000	0.0000
PP	0.1812	0.8419	0.0000	0.0000
ADF - Structural break	0.7141 (1983)	0.8265 (2007)	<0.01 (2006)	<0.01 (1984)
	ω		ω^2	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.9620	0.9021	0.9759	0.9214
PP	0.9734	0.9021	0.9883	0.9503
ADF - Structural break	0.9621 (1996)	0.3567 (1970)	0.9688 (1996)	0.6861 (1969)

Automatic lag selection based on SIC. Newey-West automatic Bandwidth selection.

Table A4: Unit root tests (1st differences) – United States

	y		g	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.0000	0.0000	0.0000	0.0000
PP	0.0000	0.0000	0.0001	0.0001
ADF - Structural break	<0.01 (2006)	<0.01 (1984)	<0.01 (1976)	<0.01 (1976)
	ω		ω^2	
	Intercept	Trend&Intercept	Intercept	Trend&Intercept
Method	Prob.	Prob.	Prob.	Prob.
ADF	0.0000	0.0000	0.0000	0.0000
PP	0.0000	0.0000	0.0000	0.0000
ADF - Structural break	<0.01 (1988)	<0.01 (1971)	<0.01 (2003)	<0.01 (2003)

Automatic lag selection based on SIC. Newey-West automatic Bandwidth selection.

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