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A global race to the bottom: The neo-Goodwinian aggregative-systems estimation of income distribution and capacity utilization interactions

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Abstract:
The neoliberal reforms since the 1980s have resulted in rapid globalization paralleled by worsening income distribution. In this paper, I first show that most countries worldwide (58 of 81) have experienced a decline in the labor share of income, or the wage share, during 1950-2019. Second, I estimate the demand and distributive regimes from 81-country panel data based on the neo-Goodwinian model. At the global level, the short-run estimation shows that the distributive regime appears to be Marxian/profit-squeeze and the demand regime exhibits profit-led. I further separate the estimation into two groups: advanced and developing countries. The estimation still confirms the profit-led/profit-squeeze regimes in both groups, even though the demand and distributive regimes are stronger in advanced economies. In the long run, the results reveal a global race to the bottom: a decline in the long-run wage share. Neither positive nor negative gain is founded on capacity utilization in advanced and developing countries.

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Income distribution has become one of the hottest economic topics in the past few decades (Atkinson, 2015; Galbraith, 2012; Milanovic, 2005, and 2016). Piketty (2014) revived the interest in functional income distribution (the shares of income between labor and capital)[1] among mainstream economists. Several scholars on both the mainstream and the heterodox sides, including Piketty himself, found that the labor share of income or the wage share has fallen across the world (UNCTAD, 2012; Karabarbounis and Neiman, 2014; IMF, 2017; Dao et al., 2019; Suzuki et al., 2019; Autor et al., 2020; Paul, 2020; Stansbury and Summers, 2020). This phenomenon contrasts with one of Kaldor's stylized facts (Kaldor, 1957), that the share between labor and capital should be constant across time. Although the main culprit of this labor share decline is still

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[1] Functional income distribution is separated into the income share of labor (labor share or wage share) and the income share of capital (capital share or profit share). The sum of both shares is always 1 (or 100%). For instance, if the wage share equals 60% (or 0.6), the profit share is 40% (or 0.4). Note that the wage share, the labor share, the labor income share, and the labor share of income are the same. All terms will be used interchangeably in this paper.

inconclusive, the possible drivers include rapid globalization in trade and finance, automation, financialization, and welfare state retrenchment (Amsden and Hoeven, 1996; Crotty et al., 1998; Jayadev, 2007; Onaran, 2009; Onaran and Galanis, 2012; Stockhammer, 2013).

The characteristics of dynamics between aggregate demand and income distribution have become one of the main research questions in post-Keynesian economics. In contrast to neoclassical economists, post-Keynesian economists believe that a change in income distribution impacts aggregate demand. The neo-Goodwinian model (Barbosa-Filho and Taylor, 2006), one of the post-Keynesian macroeconomic business cycle models, considers the economy to be composed of two regimes: the demand regime and the distributive regime. The demand regime captures the causal effect from income distribution to effective demand. In a closed economy without a government, the demand regime is considered profit-led[2] when a positive effect of a higher profit share on investment dominates the negative effect of a higher profit share on consumption. The opposite case is called wage-led, when the positive effect of a higher wage share on consumption is significant enough to offset the negative effect of a higher wage share on investment. The distributive regime, on the other hand, captures the causal effect from effective demand to income distribution. The distributive regime could act in two main ways. If increasing economic activity hurts the wage share, we say the distributive regime is wage-squeeze, forced-saving, or Kaldorian.[3] However, if higher demand, which usually causes lower unemployment, lifts the bargaining power of labor and leads to a rising wage share, the distributive regime is labeled as profit-squeeze or Marxian.

In this paper, based on the neo-Goodwinian model, I examine the interactions between income distribution, in terms of the wage share, and capacity utilization, in terms of the output gap, along the lines of the *aggregative-systems* approach (see below). To the author's knowledge, this is the first panel data analysis of a neo-Goodwinian model that examines both advanced and developing countries. The primary dataset is the latest Penn World Table (PWT) 10.0. I created an unbalanced panel dataset of the wage share and output gap for 81 countries (47 developing and 34 advanced) covering 1950-2019, to investigate the global dynamics of output and distribution in the short and the long run. First, comparing the first five years and the last five years of data available for each country, I find that 58 of 81 countries experienced a decline in their wage shares. Second, I apply the neo-Goodwinian framework to test the unbalanced panel data.

Several recent studies relied on the conventional Hodrick-Presscott filter to obtain the potential output and the output gap. However, the filter has been exposed to criticism, as it may create spurious cycles (Cogley and Nason, 1995) or force the long-term output gap to be zero (Blecker, 2016), ruling out the variations in the output gaps (see appendix B for more details on the filters). I therefore use five filters to estimate the potential output and obtain the output gap: the Hodrick-Presscott (HP), the Baxter-King frequency (band-pass), the moving average, the Beveridge-Nelson (BN), and the Hamilton. Different filters are used to avoid selection bias and ensure the robustness of the results. Using the panel data econometric regression based on the standard seemingly unrelated regression (SUR) model, I find that, in the short run, the global distributive regime is profit-squeeze or Marxist and the global demand regime is profit-led. The results are robust across different output gaps. I also estimate the panel and allow for coefficients

[2] The profit-led/wage-led definition was coined by Taylor (1991); the meaning is comparable to the terms in Bhaduri and Marglin (1990), exhilarationist/stagnationist, respectively.

[3] Kaldor (1956) hypothesized that an economy needs to shift distribution in favor of capitalists during the booming period, so they can have sufficient funds to make investments in the following period. Marx, on the other hand, emphasized the role of the reserve army of unemployed, which makes labor's bargaining power, and thus the real wage, vary procyclically.

varying between two groups of countries: advanced and developing countries. In both groups, the demand and distributive regimes are still profit-led/profit-squeeze. However, both regimes are stronger in advanced economies than in emerging economies. Lastly, the long-run estimation reveals no long-term gain or loss on the output gap, but the wage share has a long-term decline. The decline in the wage share is more perverse in developing countries. These results suggest that, although countries implement wage repression for short-term benefits, there are unclear gains in the long run. The global race to the bottom results in a long-term decline in only the labor share.

The structure of this study is as follows: After the introduction, the theoretical model section explains the construction of the neo-Goodwinian model. The subsequent section, empirical analysis, is separated into four subsections. The first and second subsections explore the wage share and the output gap data. The third subsection explains the econometric models on which this study is based and analyzes the findings. The fourth subsection considers the implications of the results. Finally, the last part summarizes the essence of this work.

1. The Neo-Goodwinian model

Following Marx's idea on social conflict and the Lotka-Volterra mathematical model on the competition between species, Goodwin (1967) constructed a macroeconomic model to show that a business cycle can be explained by two endogenous variables: income distribution, or the predator, and employment, or the prey. Based on the literature from Keynes, Kalecki, and Steindl, post-Keynesian works, including Bhaduri and Marglin (1990), Dutt (1984), Taylor (1991), Rowthorn (1981), Foley and Michl (1999), and Blecker (1989), among others, have developed a Keynesian economic growth theory in which effective demand is emphasized as crucial to economic growth. The importance of income distribution is revived along the lines of classical economics dating back to Smith, Ricardo, and Marx. The neo-Goodwinian model presented below closely follows the business cycle model developed in Barbosa-Filho (2001), Barbosa-Filho and Taylor (2006), and Taylor (2004), in which income distribution and capacity utilization are endogenized.[4] In particular, this heterodox business cycle model incorporates effective demand into social conflict to examine how income distribution interacts with business fluctuations. The concept of distribution-demand interactions has been further scrutinized in a nonlinear fashion (Tavani et al., 2011; Nikiforos and Foley, 2012).

Suppose a closed economy produces only one good and a government has no role. A society is divided into two classes: capitalists, whose income is mainly derived from profit, and workers, whose income is mainly derived from wage. Capacity utilization (u) is defined as real output (X) over existing capital or potential output (K). Wage share (ψ) is defined as real wage (ω) over labor productivity (ξ). By differentiating u and ψ with respect to time (given that $\hat{x} = \frac{\dot{x}}{x}$ when x is continually differentiable), we have:

$$\hat{u} = \hat{X} - \hat{K} \tag{1}$$

$$\hat{\psi} = \hat{\omega} - \hat{\xi} \tag{2}$$

[4] This model was originally called the structuralist Goodwin model (Barbosa-Filho and Taylor, 2006). Stockhammer (2017) and Blecker and Setterfield (2019) later popularized the titles the neo-Goodwin cycles and the neo-Goodwinian model. Note that, in this paper, they are all the same.

The growth rate of utilization relies on the difference between the growth rates of output and capital (suppose there is no capital depreciation), whereas the growth rate of the wage share is the difference between real wage growth and labor productivity growth. The relationship between utilization and wage share can be further scrutinized using the Two-Species Model (Shone, 2002, chapter 14) since they can be considered two species demonstrating either rivalry or predation. Output, capital, real wage, and labor productivity are constructed as a linear function consisting of our two species, utilization and wage share, as follows:

$$\hat{X} = \alpha_0 + \alpha_u u + \alpha_\psi \psi \quad (3)$$

$$\hat{K} = \beta_0 + \beta_u u + \beta_\psi \psi \quad (4)$$

$$\hat{\omega} = \gamma_0 + \gamma_u u + \gamma_\psi \psi \quad (5)$$

$$\hat{\xi} = \delta_0 + \delta_u u + \delta_\psi \psi \quad (6)$$

Theoretical foundations justify the signs of all coefficients α_j, β_j, γ_j, δ_j (see appendix A for more details). Then equation (3) and equation (4) are substituted into equation (1). Equation (5) and equation (6) are substituted into equation (2). Also, let $\phi_j = \alpha_j - \beta_j$ and $\theta_j = \gamma_j - \delta_j$ for $j = 0, u$ or ψ. We can obtain:

$$\dot{u} = u(\phi_0 + \phi_u u + \phi_\psi \psi) \quad (7)$$

$$\dot{\psi} = \psi(\theta_0 + \theta_u u + \theta_\psi \psi) \quad (8)$$

Equation (7) and equation (8) can be constructed as the utilization nullcline and distributive nullcline, respectively, after they are equated to zero. The slopes of both nullclines, the stationary solution, the long-run solution, and the stability analysis are elaborated in appendix A. The slope of the utilization nullcline depends on the sign of ϕ_ψ or the difference between the effects of wage share changes on output and capital. When the sign of ϕ_ψ is positive, the utilization nullcline is positively sloped or the demand regime is wage-led. The negative ϕ_ψ causes the utilization nullcline to be negatively sloped, or the demand regime is profit-led. The slope of the distributive nullcline, on the other hand, largely rests on the sign of θ_u or the difference between the effects of utilization changes on real wage and labor productivity. The positive θ_u results in a positively sloped distributive nullcline, or the distributive regime is profit-squeeze. The distributive regime is considered as wage-squeeze when θ_u is negative, which causes the slope of the distributive nullcline to be negative as well.

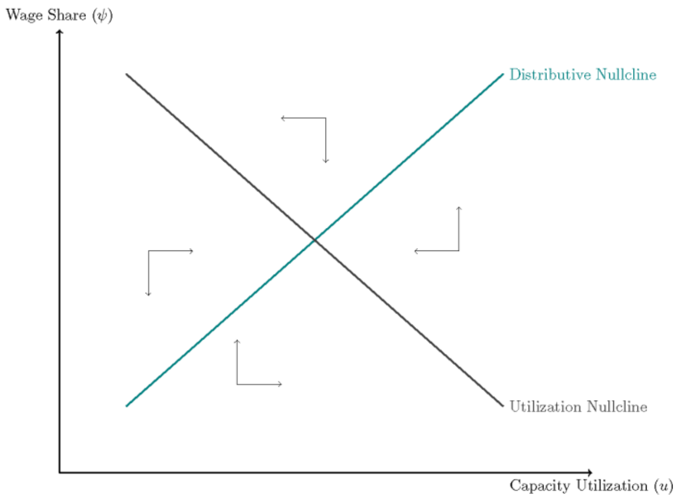
Figure 1a illustrates the system with profit-squeeze distributive and profit-led utilization regimes. The system manifests counterclockwise predator-prey dynamics, where the wage share is a predator, and capacity utilization is the prey. At the beginning of the business cycle, a reduction in the wage share induces a higher investment that overshadows a fall in consumption. An increase in capacity utilization strengthens labor's bargaining power, eventually leading to a higher labor share, which would set the stage for an economic slowdown, ending the cycle. The new cycle will start when a lowering wage share stimulates aggregate demand again. The dynamic behavior can be characterized as *spiral sink* as it converges to the long-run steady state. In this system, a prolabor distributive shock, or a leftward shift of the distributive nullcline, will improve the wage share while worsening utilization. A positive demand shock, or a rightward shift of the utilization schedule, will improve wage share and utilization in this system.

Wage-led and wage-squeeze dynamics regimes are shown in figure 1b. The system exhibits clockwise predator-prey dynamics, where a predator is instead performed by capacity utilization while the wage share turns out to be the prey. The business cycle starts when an increase in the wage share boosts the economy. Higher consumption is large enough to compensate for a reduction in investment. The economy expands until the profit share starts to increase. The period of recession stalls the economy until the wage share rises again, and the new cycle begins. Likewise, the dynamic behavior is still considered as *spiral sink*. Nevertheless, a prolabor shock in this system will improve both labor share and utilization, whereas a positive demand shock will improve only utilization but discourage the labor share.

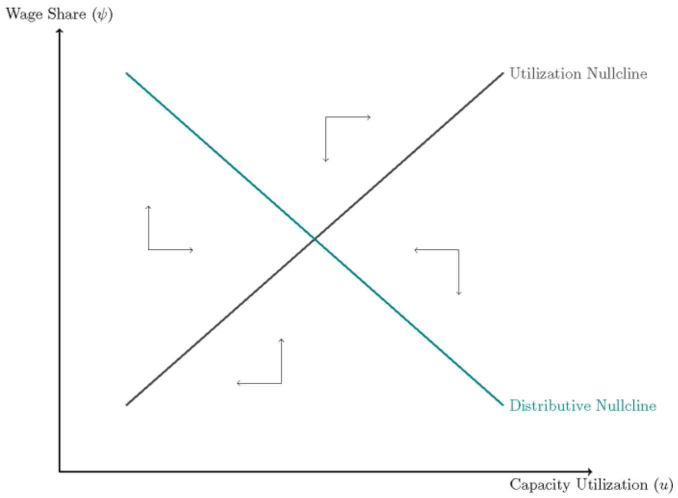
In figure 1c, the distributive curve shows the forced-saving/Kaldorian characteristic of the profit-led demand regime. In this case, the distributive schedule must cut the demand schedule from above to make the system stable (Taylor, 2004). In other words, the distributive schedule must be steeper than the demand schedule to have a positive determinant for the Jacobian matrix (see appendix A). As a result, the system also embraces counterclockwise predator-prey, *spiral sink* dynamics, as in the first case. However, whereas a prolabor distributive shock causes the same effect as the case above, a positive demand shock will, in this case, cause the wage share to suffer. In the next section, the panel data analysis is utilized to see how the distributive and demand regimes look in advanced and developing countries.

Figure 1 – *Three scenarios of the neo-Goodwinian model*

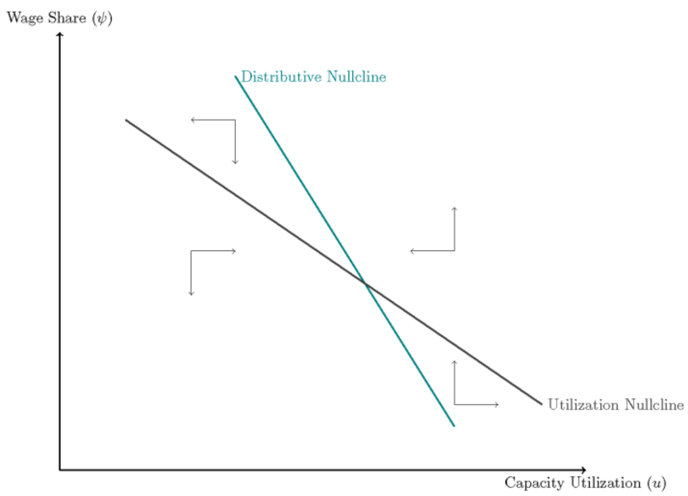
1a – *Profit-led/profit-squeeze*



1b – *Wage-led/wage-squeeze*



1c – *Profit-led/wage-squeeze*



Note: Figure 1a represents the profit-led/profit-squeeze neo-Goodwinian model with stable wage share dynamics. Figure 1b represents the wage-led/wage-squeeze neo-Goodwinian model with stable wage share dynamics. Figure 1c represents the profit-led/wage-squeeze neo-Goodwinian model with unstable wage share dynamics.

2. Empirical analysis

This section will translate the neo-Goodwinian model described earlier into the empirical model. Regarding the theoretical model above, we recognize that any econometric model that attempts to empirically test the model requires two endogenous variables' time series data: labor share and capacity utilization. The two variables are defined below.

2.1. Wage share data

For the wage share data in this paper, I use the labor shares (LABSH) from the Penn World Tables (PWT) 10.0 dataset, since it covers more than 100 countries across continents, and many series are dated from 1950 up to right before the COVID-19 pandemic in 2019. According to Feenstra et al. (2015, pp. 21-27), the dataset also adjusts for self-employment income, which is prevalent in developing countries following Gollin (2002), Timmer et al. (2012), and their estimations.[5]

Table 1 summarizes the list of countries and the wage share for each country. Overall, there are 81 countries from all regions around the world. Countries are categorized into advanced and developing countries, according to the IMF (2023). The low-income developing countries are excluded. Selected countries must have at least 10 years of wage share data. Overall, there are 81 countries: 34 advanced economies and 47 developing economies. The average wage share is 0.52 (0.58 for advanced and 0.47 for developing countries). Unfortunately, only a handful of countries have the full range of data for wage share, but most countries have different ranges, from more than 68 years to only 14 years.

Figure 2 shows advanced countries that experience a long-term decline in their wage shares, including Australia, Canada, France, Netherlands, and the United States. In Australia, for example, the wage share peaked in 1974 at 0.72 before it bottomed out in 2008 at 0.57. Figure 3 shows the trends for selected developing economies. Many countries, such as Bolivia, India, South Africa, China, and Mexico, exhibited a declining trend before 2008, with the shares picking up afterward. In India, for instance, the wage share decreased from 0.7 in the 1970s to 0.48 in 2007. In China, the wage share declined from 0.6 in 2002 to 0.55 in 2010 before increasing to 0.59 in 2016. This U-shaped trend in China is confirmed by several studies, including those by Zhou (2015), Qi (2020), and Vechsuruck (2023). In Mexico, the wage share did not have a clear trend. However, the absolute level of the wage share was already low, at less than 0.4, the lowest in these five countries.

[5] According to Feenstra et al. (2015), three methods were used to construct a 'best estimate' labor share. First, when mixed income data are available, they calculate the labor share of income as Compensation of Employees over GDP – Mixed Income. This method applies to almost half the countries in the sample (Feenstra et al., 2015, sec. Appendix C). Second, for a few countries whose unadjusted labor share exceeds 0.7, the unadjusted labor share is used since it already includes the self-employed labor income. This method applies only to a few countries in the dataset. Third, when the mixed income data are not available and the unadjusted labor share is below 0.7, the estimation of labor share for this group of countries compares two methods. The first method estimates the labor share of income as compensation of employee multiplied by the total number of wage employees over total employees over GDP. The second method uses the value added of agriculture as a proxy for mixed income. It follows the calculation that the labor share equals compensation of employees + mixed income over GDP. The final step is to pick the lower number from the two methods as the labor share of income of the country. Overall, 127 countries are covered (out of 167). In 2005, the average labor share was 0.52, which is lower than the 0.7 that Gollin (2002) preferred or the two-thirds (0.67) rule of thumb.

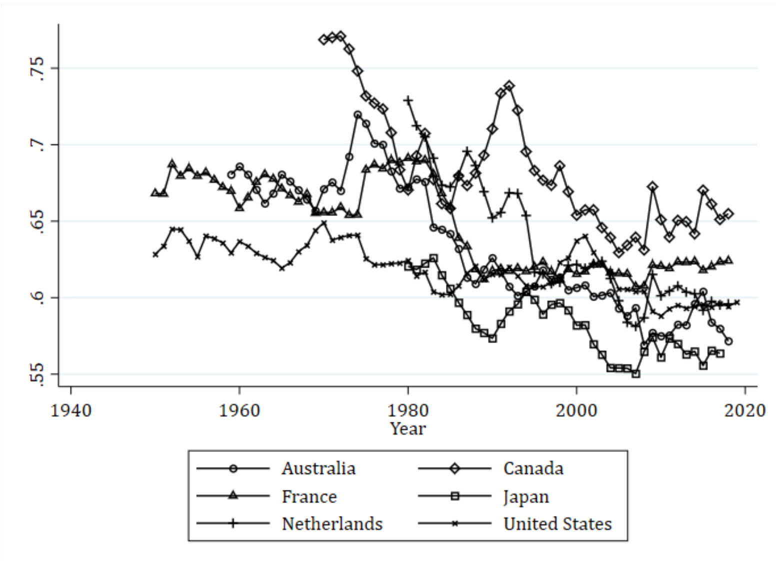
Table 1 – *Wage share summary of all countries*

Country	Period	Advanced or developing	Mean	Median	Min	Max	First 5-year average	Last 5-year average	Change
Angola	2002-2018	Developing	0.29	0.29	0.23	0.36	0.26	0.33	0.07
Argentina	1993-2013	Developing	0.40	0.39	0.31	0.54	0.4	0.48	0.08
Armenia	1991-2017	Developing	0.65	0.64	0.55	0.75	0.74	0.57	−0.17
Australia	1959-2018	Advanced	0.63	0.62	0.57	0.72	0.68	0.59	−0.09
Austria	1995-2018	Advanced	0.58	0.58	0.55	0.63	0.62	0.58	−0.04
Azerbaijan	1994-2017	Developing	0.33	0.32	0.21	0.57	0.48	0.26	−0.22
Bahrain	1992-2010	Developing	0.33	0.34	0.30	0.38	0.35	0.3	−0.05
Belarus	1990-2015	Developing	0.55	0.55	0.43	0.63	0.49	0.57	0.08
Belgium	1985-2018	Advanced	0.62	0.62	0.59	0.64	0.63	0.6	−0.03
Bolivia	1970-2015	Developing	0.53	0.53	0.45	0.72	0.53	0.47	−0.06
Brazil	1992-2017	Developing	0.55	0.55	0.49	0.58	0.53	0.52	−0.01
Bulgaria	1995-2018	Developing	0.48	0.48	0.39	0.54	0.46	0.52	0.06
Canada	1970-2018	Advanced	0.68	0.67	0.63	0.77	0.76	0.66	−0.1
Chile	1996-2009	Developing	0.46	0.48	0.38	0.52	0.5	0.41	−0.09
China	1992-2016	Developing	0.58	0.57	0.55	0.61	0.58	0.58	0
Colombia	1992-2018	Developing	0.48	0.48	0.45	0.51	0.49	0.49	0
Croatia	1995-2018	Developing	0.64	0.64	0.59	0.71	0.67	0.59	−0.08
Czech Republic	1992-2018	Advanced	0.52	0.52	0.51	0.55	0.52	0.53	0.01
Denmark	1995-2018	Advanced	0.64	0.64	0.62	0.67	0.65	0.62	−0.03
Dominican Rep.	1991-2016	Developing	0.54	0.52	0.43	0.67	0.64	0.44	−0.2
Ecuador	1970-2013	Developing	0.48	0.47	0.35	0.68	0.57	0.66	0.09
Egypt	1996-2015	Developing	0.37	0.38	0.31	0.42	0.4	0.35	−0.05
Estonia	1994-2018	Advanced	0.59	0.59	0.55	0.66	0.64	0.58	−0.06
Finland	1975-2018	Advanced	0.62	0.61	0.56	0.71	0.68	0.58	−0.1
France	1950-2018	Advanced	0.65	0.65	0.61	0.69	0.68	0.62	−0.06
Gabon	1972-2004	Developing	0.37	0.37	0.28	0.50	0.37	0.33	−0.04
Georgia	1999-2018	Developing	0.35	0.37	0.23	0.45	0.36	0.43	0.07
Germany	1991-2018	Advanced	0.64	0.63	0.59	0.68	0.67	0.63	−0.04
Greece	1996-2018	Advanced	0.53	0.54	0.48	0.55	0.49	0.53	0.04
Guatemala	2001-2018	Developing	0.51	0.50	0.48	0.55	0.53	0.49	−0.04
Hong Kong	1980-2017	Advanced	0.49	0.49	0.45	0.52	0.47	0.52	0.05
Hungary	1995-2018	Developing	0.59	0.59	0.55	0.65	0.62	0.56	−0.06
Iceland	1995-2018	Advanced	0.61	0.61	0.51	0.68	0.63	0.6	−0.03
Indonesia	2000-2014	Developing	0.45	0.45	0.44	0.47	0.45	0.46	0.01
India	1975-2017	Developing	0.62	0.62	0.48	0.75	0.74	0.52	−0.22
Iran	1994-2016	Developing	0.32	0.31	0.25	0.41	0.38	0.32	−0.06
Iraq	1997-2010	Developing	0.20	0.21	0.09	0.32	0.14	0.27	0.13
Ireland	1995-2018	Advanced	0.46	0.48	0.32	0.56	0.53	0.35	−0.18
Israel	2000-2018	Advanced	0.56	0.55	0.54	0.60	0.58	0.54	−0.04
Italy	1980-2018	Advanced	0.54	0.52	0.50	0.60	0.59	0.52	−0.07
Jamaica	1970-2018	Developing	0.56	0.58	0.46	0.63	0.58	0.6	0.02
Japan	1980-2017	Advanced	0.58	0.58	0.55	0.63	0.62	0.56	−0.06
Jordan	1970-2009	Developing	0.48	0.49	0.45	0.50	0.49	0.46	−0.03
Kazakhstan	1990-2016	Developing	0.48	0.45	0.38	0.61	0.52	0.4	−0.12
Korea	1970-2017	Advanced	0.56	0.56	0.50	0.65	0.63	0.52	−0.11
Latvia	1994-2018	Advanced	0.52	0.52	0.46	0.62	0.56	0.54	−0.02
Lithuania	1995-2018	Advanced	0.51	0.51	0.46	0.58	0.54	0.51	−0.03
Luxembourg	1995-2018	Advanced	0.56	0.56	0.54	0.60	0.55	0.55	0
Mauritius	1990-2010	Developing	0.48	0.48	0.43	0.55	0.53	0.43	−0.1
Mexico	1993-2018	Developing	0.38	0.38	0.36	0.43	0.4	0.37	−0.03
Mongolia	1995-2018	Developing	0.40	0.40	0.33	0.46	0.42	0.41	−0.01
Morocco	1998-2018	Developing	0.49	0.49	0.47	0.51	0.5	0.49	−0.01

Namibia	1989-2018	Developing	0.58	0.58	0.51	0.66	0.63	0.52	−0.11
Netherlands	1980-2018	Advanced	0.63	0.62	0.58	0.73	0.7	0.6	−0.1
New Zealand	1982-2018	Advanced	0.56	0.55	0.53	0.63	0.6	0.55	−0.05
North Macedonia	1990-2017	Developing	0.60	0.59	0.47	0.86	0.78	0.49	−0.29
Norway	1978-2018	Advanced	0.53	0.53	0.45	0.60	0.55	0.54	−0.01
Panama	1996-2018	Developing	0.38	0.41	0.30	0.46	0.45	0.3	−0.15
Paraguay	1994-2018	Developing	0.46	0.45	0.42	0.51	0.49	0.45	−0.04
Philippines	1992-2018	Developing	0.44	0.44	0.37	0.50	0.44	0.49	0.05
Poland	1995-2018	Developing	0.59	0.57	0.55	0.65	0.64	0.56	−0.08
Portugal	1995-2018	Advanced	0.63	0.63	0.57	0.66	0.65	0.58	−0.07
Qatar	1997-2014	Developing	0.21	0.19	0.15	0.33	0.28	0.17	−0.11
Romania	1995-2018	Developing	0.48	0.48	0.41	0.54	0.47	0.47	0
Russia	2002-2018	Developing	0.54	0.54	0.49	0.59	0.5	0.57	0.07
Serbia	1997-2011	Developing	0.66	0.65	0.60	0.82	0.68	0.63	−0.05
Singapore	1980-2010	Advanced	0.44	0.44	0.40	0.49	0.44	0.44	0
Slovakia	1993-2018	Advanced	0.54	0.53	0.50	0.58	0.55	0.55	0
Slovenia	1995-2018	Advanced	0.65	0.65	0.63	0.72	0.68	0.64	−0.04
South Africa	1990-2018	Developing	0.56	0.56	0.51	0.60	0.6	0.56	−0.04
Spain	1995-2018	Advanced	0.60	0.62	0.55	0.65	0.64	0.56	−0.08
Sri Lanka	1994-2018	Developing	0.39	0.39	0.36	0.44	0.42	0.4	−0.02
Sweden	1950-2018	Advanced	0.58	0.58	0.50	0.66	0.57	0.55	−0.02
Switzerland	1995-2018	Advanced	0.68	0.68	0.65	0.71	0.68	0.69	0.01
Taiwan	2000-2013	Advanced	0.70	0.70	0.65	0.75	0.74	0.67	−0.07
Trinidad Tobago	1970-2009	Developing	0.49	0.49	0.27	0.66	0.57	0.3	−0.27
Tunisia	1992-2011	Developing	0.51	0.51	0.47	0.55	0.53	0.48	−0.05
Turkey	1998-2018	Developing	0.40	0.40	0.37	0.47	0.39	0.44	0.05
United Kingdom	1987-2018	Advanced	0.58	0.59	0.53	0.60	0.56	0.59	0.03
United States	1950-2019	Advanced	0.62	0.62	0.59	0.65	0.64	0.6	−0.04
Venezuela	1997-2015	Developing	0.41	0.40	0.35	0.49	0.44	0.42	−0.02

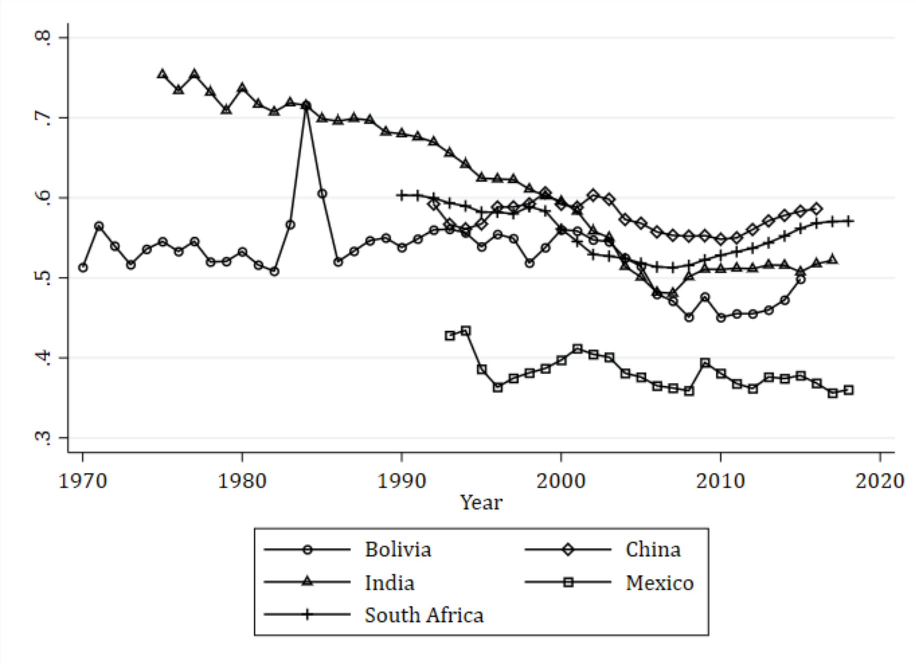
Source: based on the Penn World Tables (PWT) 10.0.
Note: The average change was −0.04: −0.04 for advanced and −0.045 for developing countries.

Figure 2 – *Decreasing wage share trends in advanced economies*



Source: based on the Penn World Table (PWT) 10.0.

Figure 3 – *Decreasing wage share trends in developing countries*



Source: based on the Penn World Table (PWT) 10.0.

On average, the world has experienced a long-term decline in the wage share. The last three columns of table 1 record the average wage share of the first five years, the last five years, and the total change, respectively. Of the 81 countries, 58 experienced a lower wage share in the last five years compared to the first five years. The average decline was 0.04 or 4%: 0.04 for advanced and –0.045 for developing countries. Among the highest decline, India, for instance, experienced a 0.22 decline in its wage share from 0.74 to 0.52. South Korea's wage share went from 0.63 to 0.52.[6]

For econometric estimations, all the labor shares are converted into the wage share index for which the labor share in 2002 is the base year, i.e., the labor share of all countries in 2002 equals 100. The index transformation allows us to compare the changes in wage share across time and location, since absolute values are very different across countries.

2.2. Output gap data

Capacity utilization cannot be defined straightforwardly as in the theoretical model. Although effective output is generally defined as the current gross domestic product (GDP), difficulty exists in how to measure capital or potential output. This study defines capacity utilization as the output gap, which is calculated by the percentage difference between actual (or effective) and potential

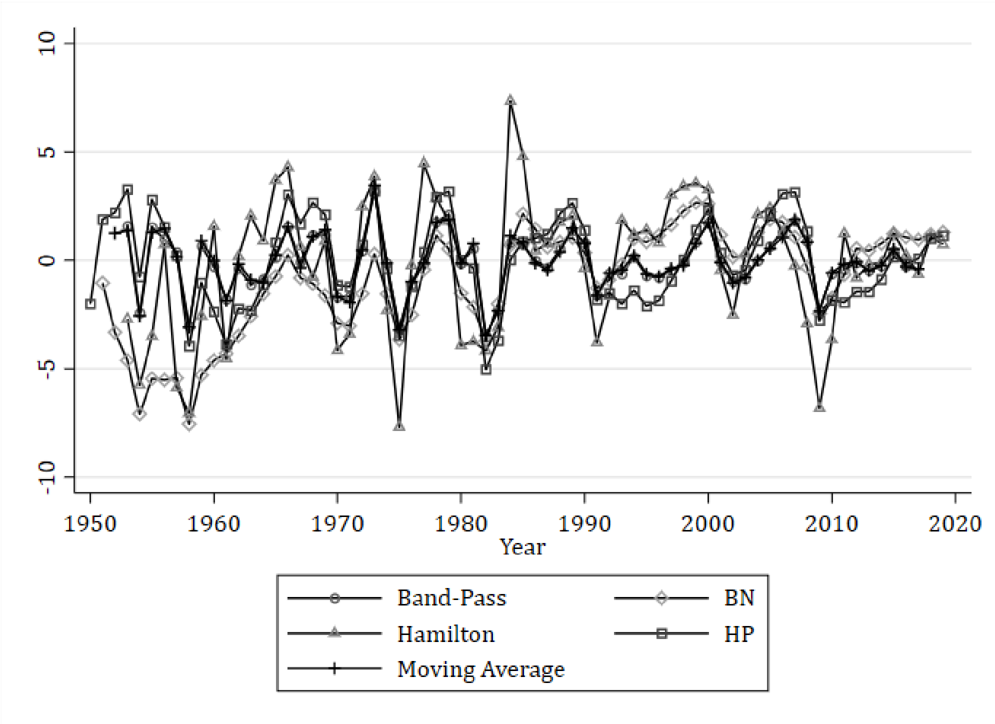
[6] To compare the five-year average labor share across countries is not straightforward here, as the timespans of labor share data vary across countries. The timespans for most advanced countries went back before the 1990s, while most developing countries' timespans are shorter. While countries with longer timespans show the declining trend of their labor shares, most countries with shorter timespans exhibit an increase in the five-year average labor shares. I thank one of the reviewers who pointed out this caveat.

GDP. The actual real GDP is the real GDP at constant 2017 national prices (in millions 2017 U.S. dollars) gathered from the Penn World Table (PWT) 10.0.

The potential output is obtained from five filters to detrend the real output series: the Hodrick-Presscott (HP), the Baxter-King frequency (band-pass), the moving average, the Beveridge-Nelson (BN), and the Hamilton. The full range of real GDP for 1950-2019 is used to create the series of potential output for all countries, even though not all numbers are used since the wage share indexes for many countries are shorter. The main goal of using different filters is to prevent the bias caused by using a particular filter and to ensure the robustness of the results. For more details of the filters, see appendix B.

For example, figure 4 shows the U.S. output gap obtained from the five filters. All output gaps usually move in the same direction. The standard deviations equal 2.03 for the HP gap, 3.14 for the Hamilton gap, 1.32 for the band-pass gap, and 2.43 for the BN gap. The output gap based on the Hamilton filter therefore exhibits the highest variation. For instance, whereas other output gaps fell to around –3% during the 2008 Great Recession, the output gap based on the Hamilton filter fell to more than –6%.

Figure 4 – *U.S. output gaps obtained on different filters, 1950-2019*



Source: based on the Penn World Tables (PWT) 10.0. The five filters are the Hodrick-Presscott (HP), the Baxter-King frequency filter (band-pass), the moving average, the Beveridge-Nelson (BN), and the Hamilton.

2.3. Panel data analysis

According to Blecker (2016), the empirical studies on distribution-demand interactions can be approximately separated into two categories. The first category is called the *structural approach*. Most studies in this category have applied a single equation method to measure the effects of the wage share, or the profit share, on consumption, investment, and net exports. Whether the open-economy demand regime is wage-led or profit-led is calculated from the sum of all partial effects. For the close-economy demand regime, the calculation disregards the net exports effect. The empirical results have been inconclusive (Bowles and Boyer, 1995; Naastepad and Storm, 2006; Ederer and Stockhammer, 2007; De Oliveira and Souza, 2021; Blecker et al., 2022).

The second category is called the *aggregative approach*. This approach often directly regresses output on the wage share and other control variables. In some studies, the approach is called *aggregative-systems,* when the model corrects the simultaneity bias by endogenizing wage share or regressing the demand equation and wage share equations simultaneously. This approach has been widely adopted by empirical studies whose theoretical models are primarily based on the neo-Goodwinian model (see below). Recent studies using this approach include Barbosa-Filho and Taylor (2006), Carvalho and Rezai (2016), Kiefer and Rada (2015), Cauvel (2023), Barrales-Ruiz et al. (2022), Barrales-Ruiz et al. (2023), and Mutlugün (2022). Most of them employed bivariate distribution-output vector autoregression (VAR) or structural vector autoregression (SVAR) models and found the profit-led demand and the profit-squeeze distributive regimes.

Most previous studies focused on advanced countries. Barbosa-Filho and Taylor (2006) investigated the U.S. economy during 1948-2002 by using quarterly data on the business sector's labor share and output. The potential output was derived using the HP filter and data from the Congressional Budget Office (CBO) to compare the results. They applied the VAR model to estimate the demand and the distributive regimes. For the distributive regime, they found that a percentage increase in capacity utilization lead to a 1.92% increase in wage share. For the demand regime, a percentage increase in wage share resulted in a 0.31% decrease in capacity utilization. The economy therefore exhibited profit-squeeze/profit-led behavior.

Kiefer and Rada (2015) examined 13 of the organizations for economic cooperation and development (OECD) countries during 1971-2012. The quarterly data on wage share and capacity utilization, all gathered from the OECD database, allowed them to construct the unbalanced panel data to which the SUR model applied. The demand regime appeared to be profit-led, as a percentage increase in wage share resulted in a 0.06 decrease in capacity utilization. The distributive regime indicated the profit-squeeze type, when a percentage increase in capacity utilization lead to a 5.386% increase in wage share. The study further showed a long-run shift to lower wage share and capacity utilization.

Based on the VAR model, Cauvel (2023) estimated the U.S. wage share and aggregate demand relationship. He argued that the conventional estimation is biased toward the profit-led/profit-squeeze regime because it did not correct for the pro-cyclical labor productivity component.[7] Most

[7] Rowthorn (1981) introduced the neo-Kaleckian model with overhead labor, which includes supervisory, administrative, and maintenance employees. This group of employees must be hired as a proportion of the capacity of the enterprise. Therefore, when the capacity utilization increases during the upswing of the business cycle, the declining ratio of overhead labor to output instantaneously leads to a decline of the labor share. Lavoie (2014, pp. 323-325; 2017) argued that labor productivity varies pro-cyclically due to overhead labor making the wage share vary countercyclically.

VAR estimations had an assumption that a shock in capacity utilization does not have a contemporaneous effect on the wage share, while it assumes that a shock in the wage share does have a contemporaneous effect on capacity utilization. Once the estimation is corrected for this bias by reordering the estimations, which allows a contemporaneous effect of utilization on the wage share, the demand is wage-led demand, and the result on the distribution regime is mixed or inconclusive. Rolim (2019) also confirmed this effect by showing that a positive shock on utilization has a negative contemporaneous effect on overhead labor share.

Along the same line, Mutlugün (2022) explored the demand-distribution dynamics of 10 developing countries with economic conditions similar to those of Turkey. Using the heterogenous panel structural vector autoregression (PSVAR), the study found that the demand regime is profit-led in the short run and the distribution regime is profit-squeeze in the medium run. Once the estimation is relaxed for the contemporaneous effect of the utilization on the wage share, the demand regime becomes wage-led, and the distribution regime shows wage-squeeze in the short run.

In this study, I also follow the footsteps of the *aggregative-systems* estimation based on the neo-Goodwinian model. Two time series datasets from 81 countries are combined into the unbalanced panel data. The empirical method below follows the method in Kiefer and Rada (2015), where the SUR model with coefficients iterated to convergence is applied to two equations simultaneously. In this manner, when income distribution is endogenized, the simultaneity bias between income distribution and demand regime ceases to be an issue. The benefits of the SUR model are manifold. First, according to Henningsen and Hamann (2007), when more than one equation is estimated based on theoretical models, the disturbance terms tend to be contemporaneously correlated, leading to inefficient estimates of the coefficients. To solve this issue, the SUR model estimates all equations simultaneously with a “generalized least squares” (GLS) estimator, considering the covariance structure of the residuals (Zellner, 1962). Second, the simultaneous estimation approach allows for estimating the coefficients under cross-equation restrictions. Third, the SUR model enables me to adjust equations more freely. This flexibility allows me to obtain estimations for the short-term and the long-term scenarios. The estimated equations can be modified such that I can estimate all coefficients corresponding to the theoretical model.

The estimable equations below start with the difference equation version of the differential equation seen earlier in equation (7) and equation (8) (see appendix C for more details on derivation). These equations are used as the base equations and will be extended further in the upcoming analysis. The two equations are:

$$\psi_t - \psi_{t-1} = \alpha_0(\psi_{t-1} - (\psi_0^* - \alpha_1 u_0^*) - \alpha_1 u_{t-1}) + \epsilon_t \tag{9}$$

$$u_t - u_{t-1} = \beta_0(\psi_{t-1} - (\psi_0^* - \beta_1 u_0^*) - \beta_1 u_{t-1}) + \upsilon_t \tag{10}$$

where α_0 is wage share scaling, ψ_0^* is a long-run wage trend, α_1 is wage slope, u_0^* is a long-run gap trend, β_0 is gap scaling, and β_1 is a gap slope. ϵ_t and υ_t are error terms. The long-run wage share (ψ_0^*) and capacity utilization (u_0^*) are exogenous.

During the upswing, an increase in labor productivity contemporaneously decreases the labor share. If this pro-cyclical labor productivity bias is not corrected, the results often show profit-led demand or a lower labor share resulting in higher utilization.

Before moving to the panel estimation, I execute the panel unit root tests on the levels and the first differences based on Levin et al. (2002) and Im et al. (2003). The results from table 2 show that the variables are stationary since all the test statistics are significant at a 1% significance level.[8]

Table 2 – *Panel unit root tests*

	Levels		First differences	
Test/Variables	**Intercept**	**Intercept and trend**	**Intercept**	**Intercept and trend**
Common root-Levin, Lin, and Chu				
Wage share	–3.6	–1.47*	–19.52	–15.33
Output gap (HP filter)	–21.38	–19.1	–45.88	–43.8
Output gap (Band-pass filter)	–47.53	–47.59	–63.42	–62.05
Output gap (Moving average filter)	–59.6	–60.53	–75.3	–72.34
Output gap (BN filter)	–17.16	–16.55	–46.59	–47.9
Output gap (Hamilton Filter)	–30.38	–33.45	–67.4	–66.1
Individual root-Im, Pesaran, and Shin				
Wage share	–3.47	–3.27	–22.15	–17.57
Output gap (HP filter)	–33.18	–29.51	–48.88	–44.97
Output gap (Band-pass filter)	–46.74	–43.85	–64.71	–62.09
Output gap (Moving average filter)	–58.1	–56.38	–78.91	–77.45
Output gap (BN filter)	–20.58	–19.79	–53.33	–52.24
Output gap (Hamilton Filter)	–36.21	–32.76	–73.15	–72.03

Note: Levin et al. (2002) and Im et al. (2003) are used to test stationarity here. The null hypothesis of the panel unit root test is that all panels contain unit roots. The alternative hypothesis is that all panels are stationary. The results show that all test statistics are statistically significant at a 1% significance level, except *, which indicates a significance level of 10%.

2.3.1. Global results

Table A1 shows the first set of results. The equations are estimated with different output gaps. The output gap is allowed to be negative or positive in the long run. The results show that all the coefficients are statistically significant at the 1% level. Starting with the wage slope ($\partial\psi/\partial u$) for the HP gap, the coefficient is 2.86. A percentage increase in utilization causes a 2.86% increase in the wage share. All other output gaps also show the positive wage slope, which implies that the distributive regime is Marxist/profit-squeeze. The slope ranges from 0.64 (Hamilton gap) to 5.83 (band-pass gap). These distributive results stay in the same range as what Barbosa-Filho and Taylor (2006) found for the U.S. (less than 5%) and what Kiefer and Rada (2015) found for OECD countries (5.39%).

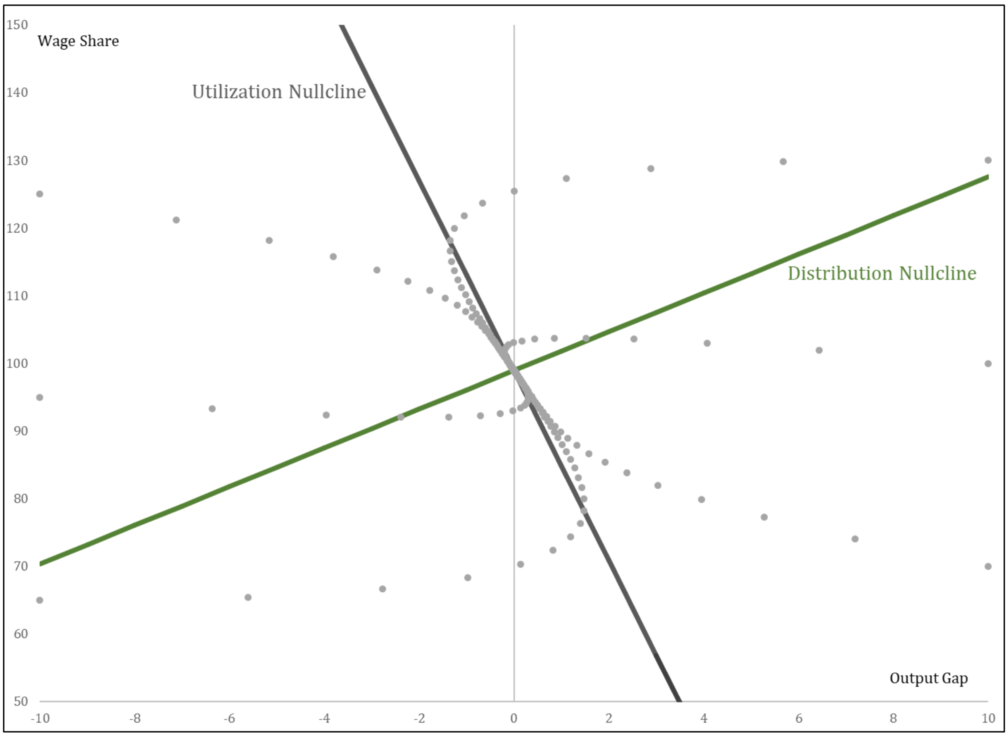
The utilization slope ($\partial\psi/\partial u$) for the HP gap is –14.04. The demand regime is thus profit-led. A percentage decrease in the wage share results in a 0.071% (or 1/14.04) increase in utilization. This result from the HP filter is, however, the strongest one. Other gaps show a positive sign but a weaker demand regime: 0.03% (or 1/39.31) for the band-pass gap, 0.02% (or 1/45.39) for the moving average gap, 0.01% (or 1/95.53) for the BN gap, and 0.03% (or 1/32.36) for the Hamilton gap. We can therefore conclude that, as the slope coefficients are positive for all filters, the demand

[8] In this paper, a coefficient or a test statistic with no asterisk implies statistical significance at the 1% level. Asterisks * and ** are significance levels at 10% and 5%, respectively.

regime is profit-led, ranging from 0.01% to 0.07%. These results are in the same range as the two studies above suggested for the U.S. and OECD economies.[9]

Figure 5 simulates the results from the first column of table A1 (HP filter) to create trajectories of the system when the distributive nullcline is positively sloped (profit-squeeze) and the utilization nullcline is negatively sloped (profit-led). For simplicity, the long-run output gap is assumed to be zero. The counterclockwise convergence to the long-run equilibrium (zero GDP gap) seemingly slows in the very first years but speeds up in later years. This implies that any negative output shock might create prolonged stagnation in the total system before it can reach recovery years.

Figure 5 – *Trajectories from the HP output gap in table A1*



The linear trends for both the long-run coordinates are introduced to test if the long-run equilibrium might move downwards or upwards. The ψ_0^* coefficient is reinterpreted as the 1970 wage share equilibrium and u_0^* as the 1970 utilization equilibrium. The trends can be negative or positive. The equations can be specified as:

[9] Note that this aggregative estimation can be biased for short-run effects and play down the long-run effects. Blecker (2016) stressed the time horizon differences. He argued that aggregate demand tends to be profit-led in the short run and wage-led in the long run because consumption positively responds to a higher wage share more in the longer run. Rolim (2021) agreed and added that most structural analysis still emphasized more the short-run effects and suggested that the cointegration test can be used to detect the existence of the long-run relationship between income distribution and consumption. The economy can become more and more wage-led in the long run if consumption is more positively responsive to a higher labor share.

$$\psi_t - \psi_{t-1} = \alpha_0\big(\psi_{t-1} - \big(\psi_0^* - \alpha_1 u_0^* + (\psi_1^* - \alpha_1 u_1^*)(date - 1970)\big) - \alpha_1 u_{t-1}\big) + \epsilon_t \qquad (11)$$

$$u_t - u_{t-1} = \beta_0\big(\psi_{t-1} - \big(\psi_0^* - \beta_1 u_0^* + (\psi_1^* - \beta_1 u_1^*)(date - 1970)\big) - \beta_1 u_{t-1}\big) + \upsilon_t \qquad (12)$$

where ψ_1^* is a long-run wage share trend, and u_1^* is a long-run utilization trend.

The estimation results are presented in table A2. Most coefficients correspond to the previous results. However, the last two coefficients pose two crucial points. First, the sign of the long-run utilization trend is inconclusive. The coefficients from the band-pass and the moving average gaps are negative, whereas those from the BN and Hamilton filters are positive. The coefficient from the HP filter is insignificant at any level. This ambiguous result implies that there are neither positive nor negative effects of the output gap in the long run. Second, the long-run wage trend is negative and significant across all filters except for the BN gap. In other words, there is a long-term downward movement of wage share. These results suggest that there is a collective effort to suppress labor income even though the benefit is not visible in the long run.

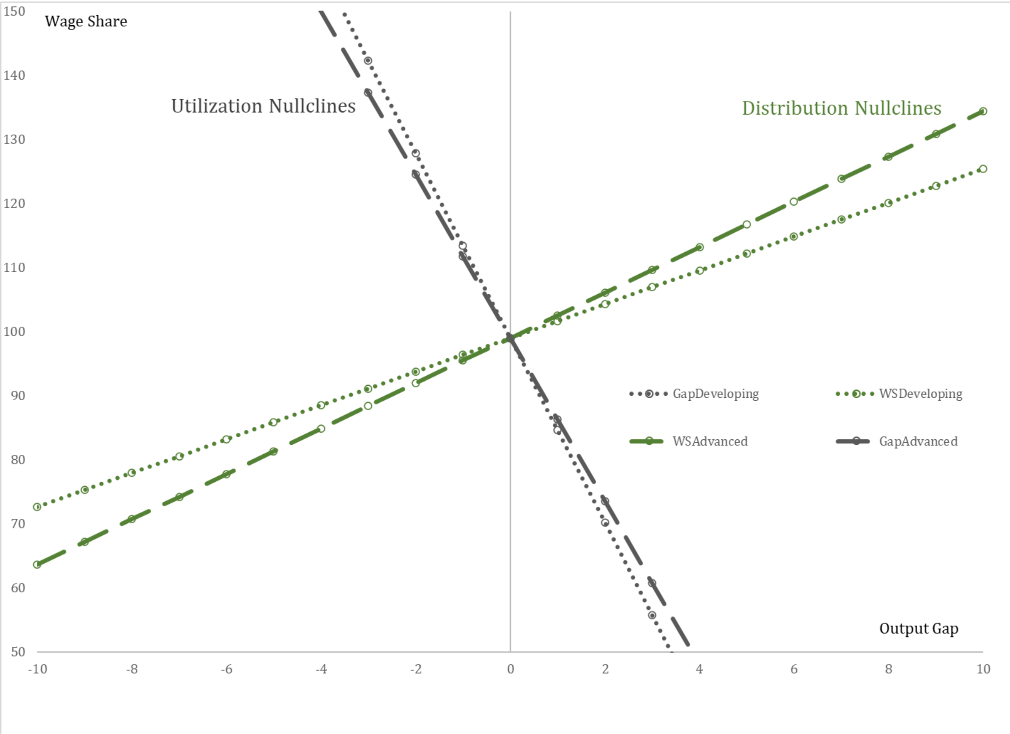
2.3.2. Advanced vs. developing country results

The estimation when the world economy is divided into developed and developing groups of countries is presented in table A3. The magnitudes across different filters vary. However, some patterns are conclusive. First, the wage slope coefficients are all positive across all filters. The distributive regime is still Marxist/profit-squeeze. However, the results show that this pattern is always stronger in advanced than in developing countries. For example, from the HP gap, a percentage increase in the output gap results in a 2.64% increase in the wage share in developing countries, but it increases to 3.54% in advanced countries. These results can reflect stronger labor institutions or unions, tighter labor markets with less informal employment, and a larger welfare state in the advanced countries that allow wages to increase in tandem with economic upswings.

The profit-led demand regime can be observed across the board (negative utilization slopes). This regime is also stronger in developed countries than in developing countries based on all different filters. For example, from the HP gap, a percentage increase in the wage share results in a 0.08% (or 1/12.74) increase in the output gap in advanced countries, whereas it leads to a 0.07% (or 1/14.42) increase in developing countries. The results of the long-run utilization intercept are still ambiguous. The coefficients are negative for the band-pass and the moving average gaps, but they are positive for the HP, BN, and Hamilton gaps. These unclear results confirm the result above, that there is no movement of the output gap in the long run.

In sum, both distributive and demand regimes in developing countries are profit-led/profit squeeze. However, the regimes in developing countries are weaker than in advanced countries. To better illustrate this point, figure 6 compares the demand regimes and distributive regimes between two groups of countries. This diagram is based on the coefficients from the HP gap. The dotted lines represent developing countries' distributive/demand regimes, and the dashed lines represent advanced countries' two regimes. As analyzed above, the advanced countries' distributive curve is stronger or steeper, indicating the higher bargaining power of labor unions in advanced countries that are more likely to be able to pressure for higher wages amidst the economic upturns. The steeper slope of developing countries' demand regime in this $u - \psi$ plane automatically translates into the flatter slope of the regime in the $\psi - u$ plane. In other words, in the short run, higher utilization can be achieved more for developed countries for every percentage reduction in wage share, given other conditions.

Figure 6 – *Comparison of demand-distribution regimes in advanced vs. developing countries (HP output gap)*



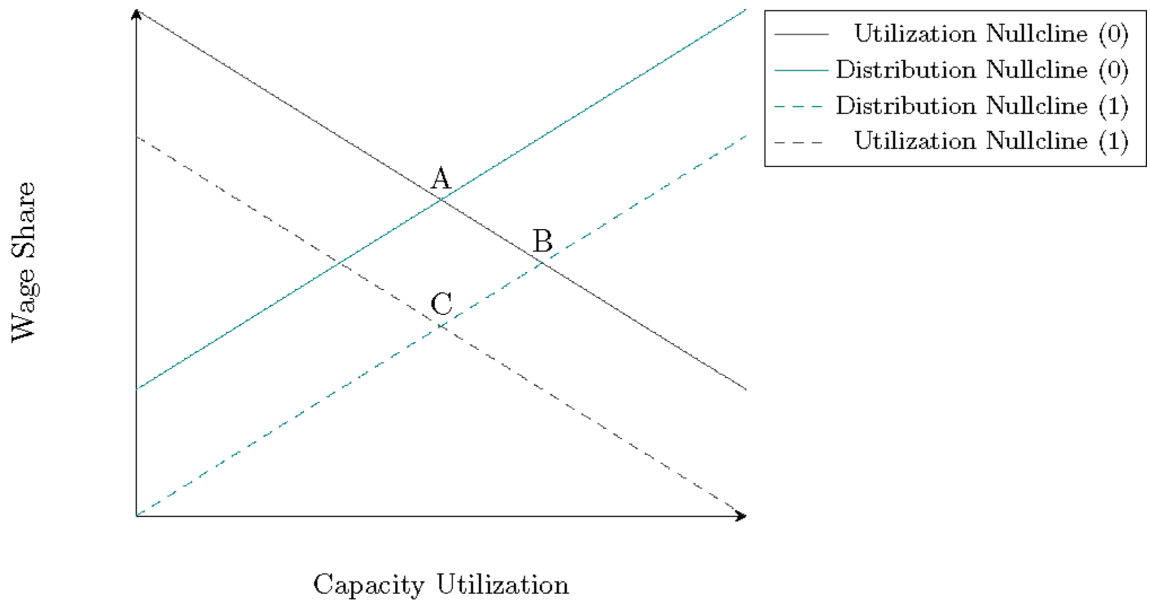
Lastly, the estimation with linear trends is separated between developing and advanced countries to analyze if there is any difference in terms of their coefficients and long-term trends. The results are in table A4. Similar to the results in table A3, it reveals that the long-run utilization trends are still inconclusive for both groups of countries. On the other hand, the long-run wage trend is negative and significant for all filters. The results also show that the wage trend is worse or more negative in developing countries than in advanced countries. This finding implies that, even though all the countries have attempted to suppress wages, the labor share in developing countries has suffered more in the last few decades.

2.4. Discussion: A global race to the bottom

A nation may aim to reduce a unit labor cost to become more competitive internationally. However, once every nation commits to the same strategy, it can result in unfavorable outcomes for all nations as a whole. Robinson (1947) argued that an increase in the balance of trade is tantamount to an increase in investment, which usually leads to an increase in employment. As the global market does not grow fast enough to accommodate all sales, each nation seeks to increase the share in the market that will benefit its people; but this comes at the expense of other nations, because the balance of trade of the world as a whole must be zero. This zero-sum game means an increase in exports for one country implies an increase in imports in another. In other words, under international competition, countries aim to increase their employment by exporting unemployment to the rest of the world. Therefore, a so-called beggar-my-neighbor game is played between nations, such as during the interwar period (Rothermund, 2002, pp. 6-9). After one nation succeeds at the expense of others, the other nations will retaliate. The principal devices to increase a trade balance entail import restrictions, export subsidies, exchange rate depreciation, and wage cuts. For instance, an exchange rate depreciation or a fall in money wages would stimulate a primary increase in employment in export industries, assuming the Marshal-Lerner condition holds. Put simply, there are four suits in the pack, and a country tries to play a higher card out of any suit to be ahead of others (Robinson, 1947, p. 69).

The long-run consequence of the global race to the bottom can be illustrated by the profit-led/profit-squeeze neo-Goodwinian model extended from figure 1a. The comparative statics is shown in figure 7**.** When countries try to gain competitiveness by using any one of the four cards above, it can be interpreted as the antilabor distributive shock or a rightward shift of the upward-sloping distributive curve (nullcline). The steady-state moves from point A to point B. With a lower long-run wage share, the profit-led regime should allow the economy to move toward a higher long-run capacity utilization because investment responds positively to a rise in profit share. However, this might not be the case regarding the weakening profit-investment nexus recently manifested in many countries. Instead, it could imply that a negative demand shock may occur, and the utilization curve is simultaneously shifted to the left. Investment in this situation does not positively respond to the lower wage share, which implies that the long-run utilization might increase only a little or not at all. The outcome can be simply a fall in wage share without any gain in capacity utilization in the long run, shown by the steady state moving from point B to point C. The global economy has been trapped in the so-called secular stagnation (Hein, 2016).

Figure 7 – *The race to the bottom in the neo-Goodwinian model*



This global shift corresponds to the econometric results shown above; in the short run, the demand is profit-led and the distribution is profit-squeeze. However, in the long run, the race to the bottom, captured by falling wage shares, yields neither positive nor negative outcomes on the long-run capacity utilization. The shift in the demand regime dominates the shift in the distributive regime. The short-run, cyclical behavior can be reconciled with the medium-term and long-term trends in falling labor shares and slowed-down economic growth observed worldwide in the past few decades (Blecker, 2020).

3. Conclusion

In this study, I show that in the era of rapid globalization of the past few decades, there is evidence of the race to the bottom across the world. First, from the PWT 10.0, I studied the relationship between income distribution and capacity utilization for 34 advanced and 47 developing countries. Of 81 countries, 58 have experienced a decline in the wage share. The average wage share in developing countries is also lower than in advanced countries.

Second, I employed the neo-Goodwinian model to estimate the interactions between the wage share and the output gap across the globe. The output gap is obtained through five filters to prevent any bias and to strengthen the results' robustness: the Hodrick-Presscott (HP), the Baxter-King frequency (band-pass), the moving average, the Beveridge-Nelson (BN), and the Hamilton. The panel data estimation shows that the world system exhibits a counterclockwise oscillatory convergence to the equilibrium point where wage share is the predator and capacity utilization is the prey. The distributive curve is upward-sloping, which represents a Marxian/profit-squeeze regime. The demand curve is downward-sloping, which implies the regime is profit-led. The results have been confirmed both in advanced and developing countries. However, the demand and distributive regimes are stronger in advanced economies than in developed countries. In the long run, there is no positive gain in utilization but the decline in wage share is intensified, especially in developing countries. The outcome could be interpreted as a result of the global beggar-my-neighbor game in which nations attempt to suppress labor income shares while the global demand becomes stagnant. The global race to the bottom benefits countries in the short run but not in the long run.

Appendices

A. Theoretical model

Regarding equation (7) and equation (8), a nontrivial stationary solution, where $\dot{u} = 0$ and $\dot{\psi} = 0$, yields the utilization and distributive nullclines of the system, respectively:

$$\dot{u} = 0 \rightarrow u = -\frac{\phi_0}{\phi_u} - \frac{\phi_\psi}{\phi_u}\psi \tag{A.1}$$

$$\dot{\psi} = 0 \rightarrow \psi = -\frac{\theta_0}{\theta_\psi} - \frac{\theta_u}{\theta_\psi}u \tag{A.2}$$

On the $u - \psi$ plane, the slopes of demand and distributive curves are important as they signify the characteristics of each regime. The slopes can be derived as:

$$\frac{d\psi}{du}\Big|_{\dot{u}=0} = -\frac{\phi_u}{\phi_\psi} = \frac{\beta_u - \alpha_u}{\alpha_\psi - \beta_\psi} \lesseqgtr 0 \tag{A.3}$$

$$\frac{d\psi}{du}\Big|_{\dot{\psi}=0} = -\frac{\theta_u}{\theta_\psi} = \frac{\delta_u - \gamma_u}{\gamma_\psi - \delta_\psi} \lesseqgtr 0 \tag{A.4}$$

The long-run solution or stable node, where wage share and utilization are constant, can be solved by equating two nullclines or equation A.1 and equation A.2 to have:

$$u^* = \frac{\theta_0\phi_\psi - \phi_0\theta_\psi}{\phi_u\theta_\psi - \theta_u\phi_\psi} \; \psi^* = \frac{\phi_0\theta_u - \theta_0\phi_u}{\phi_u\theta_\psi - \theta_u\phi_\psi} \tag{A.5}$$

To determine the dynamics and the stability of the system at the stationary points where $\dot{u} = \dot{\psi} = 0$, the Jacobian matrix, trace, and determinant can be obtained as:

$$J = \begin{pmatrix} \phi_u & \phi_\psi \\ \theta_u & \theta_\psi \end{pmatrix} \; Tr(J) = \phi_u + \theta_\psi \; Det(J) = \phi_u\theta_\psi - \theta_u\phi_\psi \tag{A.6}$$

From this system, the stability condition, as well as the characteristics of each curve, cannot be determined *a priori*, since the slopes of both curves, the trace, and the determinant of the Jacobian matrix fundamentally depend on how the wage share and utilization affect output, potential output, real wage, and labor productivity along the economic cycle. In the next step, some economically meaningful closures will be analyzed to have phase diagrams of the system. Note that the focus is more on the cases where the nullclines are stable in isolation ($\phi_u, \theta_\psi < 0$) and the system is locally stable ($Tr(J) < 0$ and $Det(J) > o$), which implies that only the signs of ϕ_ψ and θ_u are left to be explored.

Considering the demand regime, with the Keynesian stability condition, α_u is assumed to be negative to decelerate economic growth in the long run as saving is growing faster than investment. Capital accumulation has responded positively to utilization because, by profit rate accounting, an increase in utilization, given the rates of profit share and organic composition of capital, leads to an increase in the profit rate. Similarly, a rise in profit share can boost profitability and investment demand. Both arguments thus implicitly mean that $\beta_u > 0$ and $\beta_\psi < 0$. From equation A.3, we can determine the sign of the nominator as positive. The sign of the slope now depends only upon the sign of α_ψ or whether the demand schedule is wage-led or profit-led. As the demand regime is determined by whether or not the size of a positive effect of an increasing wage share on consumption can dominate the negative of an increasing wage share on investment, the economy is always wage-led (positive slope) when demand is wage-led ($\alpha_\psi > 0$). On the other hand, if demand is profit-led ($\alpha_\psi < 0$), the overall demand regime is inconclusive. Barbosa-Filho and Taylor (2006) found that, in the United States, the size of the negative effect on demand outperforms the negative effect on investment and capital accumulation ($|\alpha_\psi| > |\beta_\psi|$), which forces the slope to be negative, or a profit-led regime. If the opposite case holds, the demand regime is wage-led.

The distributive regime is slightly more complicated when we try to determine the signs of each coefficient. According to Marx's Reserve Army of Labor hypothesis, an economic upswing will increase labor's bargaining power as the unemployed are depleted. The real wage therefore tends to vary procyclically ($\gamma_u > 0$). Labor productivity is also assumed to react positively to utilization as firms invest more in new technology while they see improving profitability ($\delta_u > 0$). We can see that the sign of the nominator of equation A.5 cannot be determined *a priori*. According to Barbosa-Filho (2001), suppose that the real wage growth rate is a negative function of the real wage level and a positive function of labor productivity. We thus have a negative relation between wage share and real wage ($\gamma_\psi < 0$). Further, since we emphasize the case in which the distributive nullcline is stable in isolation ($\theta_\psi < 0$), δ_ψ must be positive. If the δ_ψ sign is negative, the sign of θ_ψ will depend on the difference between γ_ψ and δ_ψ. In the prior case ($\theta_\psi < 0$), the denominator is forced to be negative. The sign of the distributive curve will rely only upon the nominator sign. In particular, if $\delta_u > \gamma_u$, we will have a forced-saving/Kaldorian distributive regime (negative slope distributive nullcline). If $\delta_u < \gamma_u$, we will instead have a profit-squeeze/Marxian distributive regime (positive slope distributive nullcline). For the stability condition, we disregard the saddle point case, so the determinant of Jacobian matrix in equation A.6 must only be positive.

B. Filters used for obtaining output gaps

In the neo-Kaleckian and neo-Goodwinian literature, it is common to use the filter to obtain the long-term trend of the real output and calculate for the capacity utilization or output gaps. Also, filtering methods can be used to have a long-run economic growth trend, although some methods are exposed to controversies (see for example Nikiforos, 2016, 2020, 2021; José Gahn, 2020; Haluska, 2020).

The Hodrick Presscott (HP) filter has been one of the most popular filters to separate the long-term trend from the short-term fluctuations in the macroeconomic time series. However, there are several criticisms regarding the use of the HP filter for obtaining the potential output. Cogley and Nason (1995) claimed that the HP filter can potentially create spurious cycles. In addition, Hamilton (2017) argued that the HP filter has three main issues. First, it generates series with spurious dynamic relations. Second, filtered values at both ends of the sample differ greatly from those in the middle. Third, it produces values for the smoothing parameter that are very different from common practice. Blecker (2016) compared U.S. utilization rates obtained from the HP filter with those from a survey by U.S. firms. He found that the utilization rates from the HP filter downplayed the adverse effect of the 2008 financial crisis.

Avritzer (2022) examined the relationship between the long-run capacity utilization, economic growth, and the wage share for the US. By applying different filters, including HP, moving average, Hamilton, and band-pass, she found that the long-run capacity utilization is endogenous to the long-run income distribution. Even though she claimed that the results are not much different across different filters, she showed that the band-pass and the HP showed a negative relationship between the long-run wage share and long-run capacity utilization, whereas the Hamilton and the moving-average filters did not show any significant results.

I therefore follow Avritzer (2022) by using different filters to estimate the econometric relationship. The different filters should prevent bias when using any filter alone and they enhance the robustness of the results. The filters used are:

1. Hodrick-Prescott filter (HP filter). This standard filter is often used in macroeconomics to obtain the output trends and cycles suggested by Hodrick and Prescott (1997) after the working paper was circulated during the 1980s. Since the data are at an annual level, I use the smoothing parameter (lambda) equals 100.
2. Baxter-King frequency filter (band-pass filter). The band-pass filter, suggested by Baxter and King (1999), is a linear filter that calculates the two-sided weighted moving average where cycles in a "band," or intermediate values, are "passed" through or extracted, given specified lower and upper bounds. According to Benati (2001), the band-pass filter allows us to target a specific frequency band while discarding all the others. However, the band-pass filter may distort key business cycle stylized facts as captured by the cyclical component of GDP and may create entirely spurious stylized facts (p. 7). Here I set the upper and lower bounds equal to the standard levels at 2 and 8, respectively. This fixed length filter requires that, for every weighted moving average, I use the same number of lead and lag terms at 3.
3. Moving average. I decided to calculate a moving average of five years centered on obtaining the trend of GDP.
4. Beveridge-Nelson filter (BN filter). I use the Kamber et al. (2018) modification of the Beveridge and Nelson (1981) decomposition that imposes a lower signal-to-noise ratio on an AR model, which resulted in a persistent output gap with large amplitude. Unlike the HP or bandpass filter, this modified BN filter also requires fewer estimation revisions to match observable data. Kamber et al. (2018) used AR(12) for the quarterly data, so I use AR(3) for my annual data.
5. Hamilton filter. Hamilton (2017) proposed a much simpler way to extract trends and cycles from a time series. He suggested using a linear time series model shifted ahead by h periods regressed against lags of the series of p periods. In most studies, the data are quarterly with $p = 4$ and $h = 8$, but here I have data at an annual level. Because Hamilton stated that a 2-year horizon should be a standard benchmark if we are interested in business cycles (p. 838), I choose a combination of $p = 2$ and $h = 2$. So a modified autoregressive AR(2) model can be expressed as:

$$y_t = \beta_0 + \beta_1 y_{t-2} + \beta_2 y_{t-3} + \upsilon_t \quad \text{(B.1)}$$

$$\hat{\upsilon}_t = y_t - \left(\hat{\beta}_0 + \hat{\beta}_1 y_{t-2} + \hat{\beta}_2 y_{t-3}\right) \quad \text{(B.2)}$$

where $\hat{\upsilon}_t$ estimates cyclical components and the fitted values are the trends. Note that the Hamilton filter may produce a very noisy measure of potential GDP. Quast and Wolters (2022, p. 152) showed that the filter does not evenly cover typical business cycle frequencies from 6 to 32 quarters. It mutes short and amplifies medium length economic cycles. The extracted GDP trend or potential output is therefore not smooth.

C. Econometric model

Given that the rate of change is defined as $\frac{\Delta x}{x} = \frac{x_t - x_{t-1}}{x_{t-1}}$, the pure or original Goodwin model, rather than in differential equation form, can be estimated by the following difference-equation specification:

$$\psi_t - \psi_{t-1} = \alpha_0 \psi_{t-1}(u_{t-1} - u_0^*) + \epsilon_t \quad \text{(C1)}$$

$$u_t - u_{t-1} = \beta_0 u_{t-1}(\psi_{t-1} - \psi_0^*) + \upsilon_t \quad \text{(C2)}$$

where ϵ and υ are error terms, α_0 is wage share scaling, β_0 is gap scaling, and ψ_0^* is a long-run wage intercept. The long-run gap intercept is u_0^* and restricted at zero.

The original version of the Goodwin model often cannot provide strong results, as it shows closed orbits around a unique fixed point (Kiefer and Rada, 2015, p. 7). Therefore, there must be some adjustments to the equations. The general Goodwin model is an adapted version of the original Goodwin model above and can be shown as:

$$\psi_t - \psi_{t-1} = \alpha_0\big(\psi_{t-1} - (\delta_1 + \delta_2 u_{t-1})\big) + \epsilon_t \quad \text{(C.3)}$$

$$u_t - u_{t-1} = \beta_0\big(\psi_{t-1} - (\delta_3 + \delta_4 u_{t-1})\big) + \upsilon_t \quad \text{(C.4)}$$

At the steady state, $\Delta\psi$ and $\Delta u = 0$, errors are gone, and ψ_{t-1} and u_{t-1} turn into ψ_0^* and u_0^*, respectively. We have:

$$\psi_0^* = \delta_1 + \delta_2 u_0^* \quad \text{(C.5)}$$

$$\psi_0^* = \delta_3 + \delta_4 u_0^* \quad \text{(C.6)}$$

Then we solve for δ_1 and δ_3 to have:

$$\delta_1 = \psi_0^* - \delta_2 u_0^* \quad \text{(C.7)}$$

$$\delta_3 = \psi_0^* - \delta_4 u_0^* \quad \text{(C.8)}$$

Then we plug back $\delta_1$and δ_3 into equation (C.5) and equation (C.6) to have:

$$\psi_t - \psi_{t-1} = \alpha_0(\psi_{t-1} - (\psi_0^* - \delta_2 u_0^*) - \delta_2 u_{t-1})) + \epsilon_t \quad \text{(C.9)}$$

$$u_t - u_{t-1} = \beta_0(\psi_{t-1} - (\psi_0^* - \delta_4 u_0^*) - \delta_4 u_{t-1})) + \upsilon_t \quad \text{(C.10)}$$

where α_0 is a wage share scaling, ψ_0^* is the long-run wage trend, δ_2 (or α_1) is a wage slope, u_0^* is the long-run gap trend, β_0 is a gap scaling, and δ_4 (or β_1) is a gap slope. These equations are estimated, and the results are shown in table A1. For advanced/developing countries differences, the wage and utilization slopes are allowed to vary across different groups of countries.

Table A1 – *Econometric results for the globe*

	HP	**Band-pass**	**Moving average**	**BN**	**Hamilton**
Wage slope (α_1)	2.86 (32.12)	5.83 (−60.65)	5.36 (98.55)	3.21 (18.96)	0.64 (33.63)
Utilization slope (β_1)	−14.04 (−39.53)	−39.31 (−62.74)	−45.39 (−105.98)	−95.53 (−6.26)	−32.36 (−30.65)
Wage share scaling (α_0)	−0.07 (−36.82)	−0.07 (−68.09)	−0.07 (−106.92)	−0.02 (−21.95)	−0.07 (−49.64)
Utilization scaling (β_0)	−0.03 (−41.25)	−0.02 (−58.9)	−0.02 (−101.5)	−0.002 (−6.15)	−0.02 (−30.83)
Long-run wage intercept (α_0^*)	98.95 (703.56)	98.2 (884.45)	98.52 (854.15)	88.57 (191.25)	97.92 (930.75)
Long-run utilization intercept (u_0^*)	0.16 (6.69)	−0.1 (−33.82)	−0.09 (−75.46)	1.01 (37.75)	0.74 (34.62)
Schwarz Bayesian Criterion (SBC)	−830.17	−5526.54	−5027.69	−4606.72	4238.9
Akaike Information Criterion (AIC)	−843.58	−5539.5	−5040.83	−4620.04	4225.77

Note: All coefficients are significant at a 1% significance level (t-statistics in the parentheses), except as denoted otherwise. Asterisks * and ** indicate a significance level of 10% and 5%, respectively.

Table A2 – *Econometric results with linear trends for the globe*

	HP	**Band-pass**	**Moving average**	**BN**	**Hamilton**
Wage slope (α_1)	2.72 (30.98)	5.57 (57.67)	5.15 (85.38)	2.89 (15.2)	0.61 (32.56)
Utilization slope (β_1)	−13.41 (−39.2)	−35.95 (−58.63)	−43.06 (−79.21)	−93.15 (−6.3)	−36.94 (−25.58)
Wage share scaling (α_0)	−0.07 (−35.67)	−0.07 (−64.9)	−0.07 (−93.39)	−0.02 (−18.52)	−0.08 (−46.2)
Utilization scaling (β_0)	−0.03 (−41.06)	−0.02 (−57.1)	−0.02 (−78.72)	−0.002 (−6.19)	−0.02 (−25.83)
Long-run wage intercept (α_0^*)	102.16 (192.87)	102.17 (223.1)	101.74 (232.26)	71.56 (30.64)	100.69 (217.16)
Long-run utilization intercept (u_0^*)	0.22 (2.05)**	−0.02 (−0.63)[a]	−0.06 (−5.62)	−1.1 (−8.82)	0.34 (3.2)
Long-run wage trend (ψ_1^*)	−0.1 (−6.95)	−0.13 (−10.04)	−0.1 (−9.03)	0.55 (9.37)	−0.08 (−6.97)
Long-run utilization trend (u_1^*)	−0.002 (−0.64)[a]	−0.003 (−4.54)	−0.001 (−3.08)	0.07 (20.52)	0.01 (4.36)
Schwarz Bayesian Criterion (SBC)	−836.6	−5532.66	−5023.54	−4589.27	4239.7
Akaike Information Criterion (AIC)	−854.47	−5549.93	−5041.06	−4607.02	4222.18

Note: All coefficients are significant at a 1% significance level (t-statistics in the parentheses), except as denoted otherwise. Asterisks * and ** indicate a significance level of 10% and 5%, respectively.
[a] insignificant at any level.

Table A3 – *Econometric results of advanced vs. developing countries*

	HP		Band-pass		Moving average		BN		Hamilton	
	Developing	**Advanced**	**Developing**	**Advanced**	**Developing**	**Advanced**	**Developing**	**Advanced**	**Developing**	**Advanced**
Wage slope (α_1)	2.64 (30.73)	3.54 (31.93)	5.01 (45.76)	8.55 (51.35)	4.43 (45.56)	8.81 (49.99)	1.66 (9.6)	8.77 (25.46)	0.09 (3.78)	2.88 (42.66)
Utilization slope (β_1)	–14.42 (–39.62)	–12.74 (–37.99)	–40.1 (–52.34)	–37.68 (–50.34)	–46.02 (–52.35)	–45.53 (–50.41)	-139.98 (-4.1)	-181.33 (-4.07)	-33.28 (-23.49)	-31.48 (-23.21)
Wage share scaling (α_0)	–0.07 (–36.81)		–0.07 (–57.8)		–0.07 (–54.45)		–0.02 (–24.63)		–0.07 (–46.79)	
Utilization scaling (β_0)	–0.03 (–40.43)		–0.02 (–49.74)		–0.02 (–51.36)		–0.001 (–4.06)		–0.02 (–23.34)	
Long-run wage intercept (α_0^*)	99.03 (686.4)		98.14 (792.66)		98.44 (753.05)		90.43 (273.45)		98.47 (781.36)	
Long-run utilization intercept (u_0^*)	0.14 (5.95)		–0.11 (–26.29)		–0.096 (–23.44)		0.796 (31.81)		0.696 (29.11)	
Schwarz Bayesian Criterion (SBC)	–821.7		–5477.41		–4922.64		–4625.85		4278.82	
Akaike Information Criterion (AIC)	–839.58		–5494.69		–4940.16		–4643.61		4261.3	

Note: All coefficients are significant at a 1% significance level (t-statistics in the parentheses), except as denoted otherwise. Asterisks * and ** indicate a significance level of 10% and 5%, respectively.

Table A4 – *Econometric results of advanced vs. developing countries with linear trends*

	HP		Band-pass		Moving average		BN		Hamilton	
	Developing	**Advanced**	**Developing**	**Advanced**	**Developing**	**Advanced**	**Developing**	**Advanced**	**Developing**	**Advanced**
Wage slope (α_1)	2.5	3.38	4.8	8.22	4.25	8.52	1.15	9.59	0.09	2.8
	(29.66)	(30.51)	(42.44)	(49.05)	(40.95)	(45.09)	(6.27)	(18.97)	(4.11)	(40.58)
Utilization slope (β_1)	−13.74	−11.96	−37.06	−34.78	−44.21	-43.69	-105.45	-140.05	-39.97	-38.03
	(−39.3)	(−37.44)	(−50.06)	(−48.35)	(−45.74)	(-44.51)	(-5.56)	(-5.54)	(-18.08)	(-17.97)
Wage share scaling (α_0)	−0.07		−0.07		−0.07		−0.02		−0.08	
	(−35.62)		(−53.7)		(−48.78)		(−18.95)		(−44.2)	
Utilization scaling (β_0)	−0.03		−0.02		−0.02		−0.002		−0.01	
	(−40.03)		(−48.77)		(−45.62)		(−5.49)		(−17.998)	
Long-run wage intercept (α_0^*)	102.3		102.06		101.63		70.42		101.2	
	(185.88)		(206.2)		(195.97)		(28.72)		(181.1)	
Long-run utilization intercept (u_0^*)	0.18		−0.08		−0.11		−1.25		0.2	
	(1.71)*		(−2.51)**		(−4.24)		(−10.6)		(1.87)*	
Long-run wage trend (α_1^*)	−0.12	−0.07	−0.13	−0.11	−0.1	-0.09	0.64	0.56	-0.11	-0.08
	(−7.89)	(−4.36)	(−9.09)	(−7.73)	(−7.2)	(-6.21)	(9.77)	(9.22)	(-6.85)	(-5.19)
Long-run utilization trend (u_1^*)	−0.004	0.004	−0.003	0.001	−0.001	0.002	0.08	0.06	0.02	0.01
	(−1.33)[a]	(1.47)[a]	(−3.18)	(1.35)[a]	(−1.14)[a]	(3.17)	(24.89)	(18.21)	(7.87)	(2.06)**
Schwarz Bayesian Criterion (SBC)	−819.66		−5490.07		−4920.68		−4583.25		4323.78	
Akaike Information Criterion (AIC)	−846.47		−5515.98		−4946.95		−4609.89		4297.5	

Note: All coefficients are significant at a 1% significance level (t-statistics in the parentheses), except as denoted otherwise. Asterisks * and ** indicate a significance level of 10% and 5%, respectively.
[a] insignificant at any level.

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