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# KOF Working Papers

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# Testing the Bhaduri-Marglin Model with OECD Panel Data

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## Abstract

The Bhaduri-Marglin model is a post-Kaleckian model that allows for studying the impact of functional income distribution on the growth in demand. Over recent years, a number of empirical studies based on this model have aimed at determining whether a redistribution towards profits harms or fosters demand growth. The focus so far has been on a very limited number of countries. This paper is the first to test the Bhaduri-Marglin model with panel data. It finds that demand growth is reduced by a redistribution towards profits in the average OECD country. Productivity growth is also impaired.

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## 1. Introduction

The Bhaduri-Marglin model is a post-Kaleckian model that allows for studying the impact of functional income distribution on the growth in demand. While ‘standard’ (neoclassical) growth theory is supply-side oriented – it explains economic dynamics in terms of technical progress and the growth in the factors of production (labour, physical capital, sometimes human capital) – the Kaleckians turn the tables on growth. They claim that if in every short period output is determined by effective demand – which is a fixture of both Kaleckian and Keynesian economics – then there is no reason to believe that this should be different in the long run.<sup>1</sup> The factors having an impact on the dynamics of demand thus take centre stage while the supply side takes a back seat. Economic growth is seen to be ‘demand-led’ (Setterfield, ed., 2002), and income (re-)distribution is one important factor having an impact on demand (growth).

But in which direction does a redistribution of income push demand? The answer to this question is not straightforward from a Kaleckian perspective. For instance, a higher wage share in total income stimulates the demand for consumption goods if the propensity to consume out of wages is higher than out of profits. On the other hand it reduces the demand for investment goods if investment is dependent on profits. And the demand for export goods declines if the rise in real unit labour costs impairs the international competitiveness of the economy. Bhaduri and Marglin (1990) have designed a model in the Kaleckian tradition which formalises these aspects.

Whether or not a rising wage share – in other words, a change in the functional distribution of income in favour of the factor labour – promotes employment and output (growth) thus becomes an empirical question. If it does, the demand regime is said to be ‘wage-led’; otherwise it is called ‘profit-led’.

Over recent years, a number of empirical studies have aimed at determining whether the demand regime is wage-led or profit-led in certain countries. Thus far, the main focus has been on seven countries: Austria, France, Germany, Japan, the Netherlands, the U.K. and the U.S. (see Bowles and Boyer, 1995; Stockhammer and Onaran, 2004; Naastepad, 2006; Naastepad and Storm, 2006-7;<sup>2</sup> Ederer and Stockhammer, 2007; Stockhammer and Ederer, 2008; Hein and Vogel, 2008, 2009; Onaran *et al.*, 2011; Stockhammer *et al.*, 2011). From these studies, the broad picture emerges that the “demand regime in large and medium-sized

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<sup>1</sup> “In fact, the long-run trend is but a slowly changing component of a chain of short-period situations; it has no independent entity ...” (Kalecki, 1968, p. 263).

<sup>2</sup> This study also examines Italy and Spain.

open economies, as in Germany, France, the UK and the USA, tends to be wage-led, whereas for small open economies, as the Netherlands and Austria, some studies have obtained profit-led results” (Hein and Tarassow, 2010, p. 750). This conclusion is by and large buttressed by studies focussing on other countries or regions than the above-mentioned seven, such as Onaran and Stockhammer (2005), Stockhammer *et al.* (2009), Stockhammer and Stehrer (2011), Onaran and Galanis (2012), Hartwig (2013), and Kinsella (2013). It should be noted, however, that wage-led demand regimes have been found for small open economies also by some studies as well as profit-led regimes for large economies.

None of these papers is a panel-econometric study. This is quite surprising given that the mainstream of the empirical growth literature has been moving away from individual-country or cross-country studies towards panel regressions since the 1990s already. Single-country regressions with annual data run up against the problem of few degrees of freedom, which impairs the statistical reliability of the estimates.<sup>3</sup> Panel data, on the other hand, “give *more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency*” (Baltagi, 2008, p. 7),<sup>4</sup> which results in more reliable parameter estimates. Both Stockhammer *et al.* (2009, p. 156) and Stockhammer *et al.* (2011, p. 20) acknowledge this and call for panel-econometric analysis. Still, up to now, the Bhaduri-Marglin model has never been tested with panel data. The present paper intends to fill this gap in research.

The paper is organised as follows. The next section introduces the theoretical model. Section 3 discusses the poolability issue, and section 4 presents results and a robustness analysis. Section 5 concludes.

## 2. The Model

For reasons that will be given below, I follow Naastepad (2006) in writing down the model. Table 1 collects the symbols for the relevant variables and parameters.

*<Insert Table 1>*

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<sup>3</sup> Only Stockhammer and Stehrer (2011) work with quarterly data in order to examine higher than annual frequency effects of changes in distribution on demand. The rest of the literature uses annual data.

<sup>4</sup> The emphasis is in the original. See Baltagi (2008, pp. 6-11) for more advantages – as well as limitations – of panel estimation methods.

Demand ( $x$ ) is the sum of private consumption ( $c$ ), investment ( $i$ ) and net exports ( $e - m$ ) (see Equation 1).<sup>5</sup> Wage and profit receivers are assumed to have different propensities to save (Equation 2). If the propensity to save out of wages ( $\sigma_w$ ) is smaller than the propensity to save out of profits ( $\sigma_\pi$ ), a redistribution of income towards labour increases consumption demand.

$$x = c + i + e - m \quad (1)$$

$$c = (1 - \sigma_w) \frac{w}{\lambda} x + (1 - \sigma_\pi) \pi x = [(1 - \sigma_w) \nu + (1 - \sigma_\pi)(1 - \nu)]x; \quad \sigma_\pi > \sigma_w \quad (2)$$

Investment is assumed to depend positively on the profit share ( $\pi$ ), output ( $x$ ), and other factors like the ‘animal spirits’ of entrepreneurs ( $b$ ) (Equation 3). Exports on their part depend positively on the level of world demand ( $z$ ) and negatively on the ratio of domestic to foreign real unit labour cost ( $\nu/\nu_f$ ) (Equation 4).<sup>6</sup> Imports, finally, are assumed to be a linear function of output ( $m = \zeta x$ ), with ( $\zeta$ ) being the import share. This reflects the fact that the demand for imports is derived from the demand for consumption and investment goods at home, and the demand for export goods from abroad. Changes in real unit labour cost do not affect the demand for imports directly, but indirectly through their impact on consumption, investment and exports.

$$i = a_i b^{\phi_0} \pi^{\phi_1} x^{\phi_2} \quad \phi_0, \phi_1, \phi_2 > 0 \quad (3)$$

$$e = a_e z^{\varepsilon_0} \left( \frac{\nu}{\nu_f} \right)^{\varepsilon_1} \quad \varepsilon_0 > 0; \varepsilon_1 < 0 \quad (4)$$

Under these premises, Equation 1 can be rewritten as Equation 5, with  $\mu^{-1}$  being the Keynesian multiplier.

$$x = \frac{i + e}{[\sigma_\pi - \nu(\sigma_\pi - \sigma_w) + \zeta]} = \frac{1}{\mu} (i + e); \quad \frac{1}{\mu} > 1 \quad (5)$$

The growth rates of  $x$  and  $\mu$  are given by Equations 6 and 7.<sup>7</sup>

$$\hat{x} = -\hat{\mu} + \frac{\iota}{\mu} \hat{i} + \frac{\chi}{\mu} \hat{e} = -\hat{\mu} + \psi_i \hat{i} + \psi_e \hat{e} \quad (6)$$

$$\hat{\mu} = -\frac{\nu}{\mu} (\sigma_\pi - \sigma_w) \hat{\nu} = -\xi (\sigma_\pi - \sigma_w) [\hat{w} - \hat{\lambda}] \quad (7)$$

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<sup>5</sup> Government consumption is assumed away because it should not be affected by changes in the income distribution.

<sup>6</sup> I follow Naastepad (2006) in assuming that foreign real unit labour cost ( $\nu_f$ ) are equal to 1 and that animal spirits do not change, i.e.  $\hat{b} = 0$ .

<sup>7</sup> Growth rates are denoted by hats (^) over the symbols.

In Equation 6,  $(\iota)$  stands for the share of investment in GDP, and  $(\chi)$  stands for the export share. Dividing these shares by  $(\mu)$  yields the expressions  $(\Psi_i)$  and  $(\Psi_e)$ . In Equation 7,  $(\xi)$  is the expression for the real unit labour cost – or the wage share, respectively,  $(\nu)$  – divided by  $(\mu)$ .

We can derive the equation for the demand regime by calculating the growth rates of investment and exports from Equations 3 and 4 and inserting them into Equation 6. In the equation for investment growth appears the growth rate of the profit share. We can take the latter from Equation 8 in which  $(\theta)$  denotes the ratio between the wage share  $(\nu)$  and the profit share  $(\pi)$ .<sup>8</sup> If Equation 7 is also inserted into Equation 6, we arrive at the final expression for the demand regime (Equation 9).

$$\hat{\pi} = \frac{\Delta\pi}{\pi} = -\frac{\Delta\nu}{\pi} \frac{\nu}{\nu} = -\theta\hat{\nu} = -\theta(\hat{w} - \hat{\lambda}) \quad (8)$$

$$\hat{x}_{DR} = \frac{\psi_e \varepsilon_0 \hat{z}}{[1 - \psi_i \phi_2]} + C\hat{w} - C\hat{\lambda}; \quad C = \frac{[\xi(\sigma_\pi - \sigma_w) - \psi_i \phi_1 \theta + \psi_e \varepsilon_1]}{[1 - \psi_i \phi_2]} \quad (9)$$

Equation 9 shows that the demand regime is driven by two forces: the growth of international demand  $(\hat{z})$  and the growth of real unit labour cost  $(\hat{\nu} = \hat{w} - \hat{\lambda})$ . The term  $C$  describes the impact of wage policy on demand  $(d\hat{x} / d\hat{w})$ .<sup>9</sup> If  $C$  is greater than zero the demand regime is wage-led; it is profit-led if  $C$  is smaller than zero.  $C$  can be disaggregated into three components: the effect of wage policy on consumption growth  $\frac{[\xi(\sigma_\pi - \sigma_w)]}{[1 - \psi_i \phi_2]}$ , its effect on investment growth  $\frac{-[\psi_i \phi_1 \theta]}{[1 - \psi_i \phi_2]}$  and its effect on export growth  $\frac{[\psi_e \varepsilon_1]}{[1 - \psi_i \phi_2]}$ .

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<sup>8</sup> Remember that the growth rate of the wage share – or of real unit labour cost, respectively,  $(\frac{\Delta\nu}{\nu})$  – is equal to

the difference between real wage growth  $(\hat{w})$  and productivity growth  $(\hat{\lambda})$ .

<sup>9</sup> If we want to determine the impact of real wage variations on demand “it is necessary to perform at least ‘thought experiments’ based on exogenous variations in the real wage rate” (Bhaduri and Marglin, 1990, p. 376). In reality, however, the real wage rate is likely to be an endogenous variable. Schütz (2012) endogenises the real wage rate and shows that the basic conclusion on whether the demand regime of a country is wage-led or profit-led remains unaffected by whether the real wage rate is treated as exogenous or endogenous except when productivity growth increases strongly in response to growing real wages. An elasticity greater than one, necessary to produce what Schütz (2012, pp. 315-6) calls a “paradoxical result” according to which “an increase in the real wage rate leads to so much labor rationalization to cause an *increase* in the profit share” has never been documented in the literature.



One reason for me following the modelling of Naastepad (2006) is that her article was the first to endogenise productivity.<sup>10</sup> ‘Verdoorn’s Law’ famously postulates a positive impact of demand growth on productivity growth; and productivity growth feeds back on demand growth in the Bhaduri-Marglin model because of its impact on the profit share (see Equation 8). In addition to Verdoorn’s Law, Naastepad embraces a proposition that can be traced back to Hicks (1932), for instance, but also to Marx, namely that high real wage growth induces entrepreneurs to innovate in order to realign productivity growth with high real wage growth. Equation 10 captures these ideas.<sup>11</sup> Rearranging Equation 10 yields Equation 11 for the productivity regime.

$$\hat{\lambda} = \beta_0 + \beta_1 \hat{x} + \beta_2 \hat{w}; \quad \beta_0, \beta_2 > 0; \quad 0 < \beta_1 < 1 \quad (10)$$

$$\hat{x}_{PR} = -\frac{\beta_0}{\beta_1} - \frac{\beta_2}{\beta_1} \hat{w} + \frac{1}{\beta_1} \hat{\lambda} \quad (11)$$

Equation 9 gives the rate of output growth permitted by productivity growth while Equation 11 gives the rate of output growth required to sustain productivity growth. A deviation of these two rates triggers a process which leads to their equalisation (see Naastepad 2006, pp. 414-416). So we can calculate the equilibrium growth rates of output and labour productivity from  $\hat{x}_{DR} = \hat{x}_{PR}$  (see Equations 12 and 13).<sup>12</sup>

$$\hat{x}^* = -\frac{\beta_0 C}{1 + \beta_1 C} + \left[ \frac{1}{1 + \beta_1 C} \right] \left[ \frac{\psi_e \varepsilon_0}{1 - \psi_i \phi_2} \right] \hat{z} + \left[ \frac{(1 - \beta_2) C}{1 + \beta_1 C} \right] \hat{w} \quad (12)$$

$$\hat{\lambda}^* = \frac{\beta_0}{1 + \beta_1 C} + \left[ \frac{1}{1 + \beta_1 C} \right] \left[ \frac{\psi_e \varepsilon_0}{1 - \psi_i \phi_2} \right] \beta_1 \hat{z} + \left[ \frac{\beta_2 + \beta_1 C}{1 + \beta_1 C} \right] \hat{w} \quad (13)$$

Having now examined the Bhaduri-Marglin model in detail, we should not miss out on taking a bird’s eye view of it as well. An important thing to note is that the model is designed

<sup>10</sup> Stockhammer and Onaran (2004) include labour productivity in a structural vector autoregression (SVAR) model focussing on (amongst others) the effects of changes in functional income distribution on unemployment.

<sup>11</sup> Hein and Tarassow (2010) criticise this equation arguing that the wage share rather than the real wage should be used as cost push variable. However, replacing the growth rate of real wages by the growth rate of the wage share in Equation 10 leads to a formulation equivalent to Equation 10:

$$(10') \hat{\lambda} = \alpha_0 + \alpha_1 \hat{x} + \alpha_2 \hat{w}; \quad \alpha_0, \alpha_2 > 0; \quad 0 < \alpha_1 < 1 \Leftrightarrow \hat{\lambda} = \alpha_0 + \alpha_1 \hat{x} + \alpha_2 (\hat{w} - \hat{\lambda}) \Leftrightarrow \hat{\lambda} = \frac{\alpha_0}{1 + \alpha_2} + \frac{\alpha_1}{1 + \alpha_2} \hat{x} + \frac{\alpha_2}{1 + \alpha_2} \hat{w}$$

$$\text{with } \beta_0 = \frac{\alpha_0}{1 + \alpha_2}, \beta_1 = \frac{\alpha_1}{1 + \alpha_2}, \beta_2 = \frac{\alpha_2}{1 + \alpha_2}$$

<sup>12</sup> Naastepad (2006, pp. 431-432) examines the stability of this equilibrium position. Dynamic stability is always ensured in wage-led demand regimes. In profit-led demand regimes, the PR curve must be steeper than the DR curve in the labour productivity growth / output growth space to ensure dynamic stability.

to explain the impact of distribution on demand in each *short period*. Its focus on the short period is reflected in that it keeps the level of potential output constant and thus disregards the impact of investment on the capital stock.<sup>13</sup> Because of this focus on the short period, it is arguably not appropriate to call the Bhaduri-Marglin model a model of (‘demand-led’) *growth*. I use the term ‘growth in demand’ instead in this paper. ‘Growth’, in this coining, has to be understood as in ‘growth rate’. Statistical offices calculate the ‘growth’ rate of Gross Domestic Product (GDP) for a certain quarter or year as the weighted average of the growth rates of the demand-side components consumption, investment and net exports. Over time, a long ‘chain of short-period situations’ (Kalecki) – each modelled à la Bhaduri-Marglin – ensues.

The short-period orientation of the model has prompted Schütz (2012) to criticise the inclusion of the Verdoorn relation between output growth and productivity growth in the equation for the productivity regime in Naastepad (2006) and Hein and Tarassow (2010). Schütz (2012, p. 313) claims that “(t)he core of this [Verdoorn] concept is related to a structural change in the production process and therefore applies to the long period”. He suggests replacing GDP by the rate of capacity utilisation in Equation 10, a concept more relevant for the short period in his view.

Three things should be noted at this juncture. First, the Verdoorn relation need not apply to the long period. There may also be ‘static’ economies of scale in the short period due to, for instance, fixed cost degression. Second, Schütz’ proposal to replace output by the rate of capacity utilisation does not make much of a difference as he – in line with Bhaduri and Marglin (1990) – defines the rate of capacity utilisation as the ratio of output and potential (full capacity) output and holds the latter constant. In this case, variations in the rate of capacity utilisation are the same thing as variations in output. Finally, in Naastepad (2006) and Hein and Tarassow (2010) the Verdoorn relation does not appear in the Bhaduri-Marglin ‘core’ of the model, which is the demand regime, but in the productivity regime. Productivity growth is usually seen as a supply-side phenomenon, influenced by technological progress. As a matter of fact, Naastepad argues that the parameter  $\beta_2$  in Equation 10 is a measure for ‘wage-induced technological progress’: it “measures the extent to which more expensive labour induces firms to intensify their search for and adoption of labour productivity-raising techniques” (Naastepad, 2006, p. 410). The productivity regime thus brings in the more traditional (long-period) notion of ‘growth’ and combines that with the short-period ‘growth in demand’ core of the model.

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<sup>13</sup> See Bhaduri and Marglin (1990, p. 377). See also Schütz (2012, p. 313).

While I disagree with Schütz on the (in-)admissibility of the Verdoorn relation in the productivity regime, I do agree with him that long-period concepts should be excluded from the demand regime. I therefore do not join Hein and Tarassow (2010) in criticising Naastepad's investment function (Equation 3) for not accounting for technological progress.<sup>14</sup> Having a short-period orientation, it should not.

### 3. Poolability

This paper is the first to test the Bhaduri-Marglin model using panel data. As was already mentioned, pooling cross-sectional and time-series data in order to test hypotheses has become popular in applied macroeconomics around 25 years ago. Pooling is instrumental in widening the dataset in order to obtain more reliable estimates for the model parameters. However, pooling also puts a restriction on a regression model. The restriction is that the parameters in a behavioural equation are the same across the cross-section members (countries) and over time. The unrestricted model has the same behavioural equation for all countries, but with different parameters across countries and over time. Concentrating on the cross-country dimension, if  $\delta_i$  is a parameter in a behavioural equation for country  $i$ , pooling implies the restriction  $H_0: \delta_i = \delta$  for all  $i$ .

Although it is rarely done in the literature, this null hypothesis can be tested. The most common test is the so-called Roy-Zellner test for poolability (see Baltagi, 2008, pp. 57-63). It implies two steps: (i) running a random effect regression on the unpooled data and (ii) testing for the equality of the individual coefficients using a Wald test (see also Vaona, 2008). Those who apply this test usually find that the null of poolability is rejected (see for instance Wallace, 1972; Vaona, 2008; Schiavo and Vaona, 2008).

It could be objected that even though the panel might be heterogeneous, one is mostly interested in the average coefficients. Unfortunately, if the coefficients are not identical, the established procedures for estimating pooled models can give inconsistent and potentially misleading estimates for the average values of the parameters in dynamic panels (see Pesaran and Smith, 1995; Pesaran *et al.*, 1999).

It is important to stress the words 'in dynamic panels' in the last sentence because in the static case, pooling gives unbiased estimates of coefficient means (see again Pesaran and Smith, 1995). Another reason why I prefer Naastepad's (2006) formulation of the Bhaduri-

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<sup>14</sup> Hein and Tarassow include productivity growth as a proxy for technological progress in their investment function.

Marglin model over alternative formulations in the literature is that its reduced form only has equations without any lagged dependent variables on the right hand sides so that the above-mentioned econometric problems arising in the dynamic panel context are avoided.

Furthermore, since all variables enter the reduced form as growth rates or shares – and can hence be trusted to be stationary – problems of spurious regression are thereby also avoided.

## 4. Results

The empirical strategy in this section is to obtain estimates for the model parameters  $\sigma_w$ ,  $\sigma_\pi$ ,  $\phi_1$ ,  $\phi_2$ ,  $\varepsilon_0$ ,  $\varepsilon_1$ ,  $\beta_1$  and  $\beta_2$  (see Table 1) in order to determine whether the OECD's demand and productivity regimes are wage-led or profit-led. As was mentioned in the previous section, the focus is on the (unweighted) average coefficients over the whole OECD area.<sup>15</sup>

For most countries, the data cover the period 1970-2011. For some countries, however, the starting point of the time series is later, sometimes as late as 1995. The panel is thus unbalanced.

### 4.1 Results for the Demand Regime

For the estimation of the workers' and non-workers' propensities to save ( $\sigma_w$  and  $\sigma_\pi$ ) a transformation is used that goes back to Bowles and Boyer (1995). It draws on the fact that (nominal) savings ( $s_n$ ) – which are equal to nominal GDP ( $x_n$ ) minus consumption – are the sum of employees' and profit receivers' savings, as in Equation 14, in which  $\nu$  denotes the wage share and  $\pi$  denotes the profit share.

$$s_n = (\sigma_w \nu + \sigma_\pi \pi) x_n \quad (14)$$

From this follows Equation 15.

$$\sigma = s_n / x_n = \sigma_w + (\sigma_\pi - \sigma_w) \pi \quad (15)$$

So if we regress the savings rate on a constant and the profit rate, the constant will measure the propensity to save out of wages and the coefficient on  $\pi$  measures the difference between the propensity to save out of profits and the propensity to save out of wages. It is expected that  $\sigma_w < \sigma_\pi$ .

The investment and exports equations (Equations 3 and 4) are transformed into growth rates to yield Equations 16 and 17.<sup>16</sup>

<sup>15</sup> The sample covers all current 34 OECD member countries except Chile, Iceland and Turkey for which I found no employment data in the OECD's databases. Information on the data sources is given in the appendix.

<sup>16</sup> Recall that I follow Naastepad (2006) in assuming that  $\nu_f = 1$  and that  $\hat{b} = 0$ .

$$\hat{i} = \phi_1 \hat{\pi} + \phi_2 \hat{x} \quad (16)$$

$$\hat{e} = \varepsilon_0 \hat{z} + \varepsilon_1 \hat{v} \quad (17)$$

Equations 15-17 can be estimated with Pooled Least Squares provided that the right-hand side variables are exogenous. The Durbin-Wu-Hausman test for endogeneity cannot be run with panel data. Previous findings for single countries (see Naastepad, 2006; Hartwig, 2013) indicate however that endogeneity is not an issue with equations 15-17. So the Pooled Least Squares estimator will be applied.

The results are presented in Table 2. For Equations 15 and 16 a (Robertson) lag is added on the profit income variable, and an AR(1) process is allowed for in the error term. Cross-section fixed effects are added because the redundant fixed effects test rejects the hypothesis of their redundancy at the 1% level of significance for Equation 15 and at the 5% level of significance for Equation 16.

*<Insert Table 2>*

In the savings equation, the estimated value for the average propensity to save out of wages is 0.202, which is quite high given earlier findings.<sup>17</sup> The cross-section fixed effects (not shown in Table 2) remove the homogeneity restriction for the propensity to save out of wages. They suggest that the latter varies strongly across countries. The highest coefficient on a country dummy variable is 0.172 (for Luxembourg), the lowest  $-0.088$  (for the U.S.).<sup>18</sup> The estimate for the propensity to save out of profits is  $0.317 (= 0.202 + 0.115)$ . This is somewhat lower than what was found in earlier studies.<sup>19</sup> Still, we can confirm that  $\sigma_w < \sigma_\pi$ .

In the investment equation, redistribution (measured by the lagged growth rate of the profit share) has no significant impact on real investment growth.<sup>20</sup> This result is already familiar from single-country studies. Hein and Vogel (2008), for instance, find a significantly positive impact of a rise in the profit share on real investment growth only for the Netherlands. For Austria and France they find an insignificantly positive, for Germany and the U.S. an insignificantly negative and for the U.K. a significantly negative impact.

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<sup>17</sup> The highest value for the workers' propensity to save found in the single-country estimations of Equation 15 was 0.18 (for France), see Bowles and Boyer (1995).

<sup>18</sup> This means that the workers' propensity to save varies between 0.114 (U.S.) and 0.374 (Luxembourg).

<sup>19</sup> The lowest value found in a single-country study was 0.34 (for the U.S.), see Naastepad and Storm (2006-7).

<sup>20</sup> 'Real' always means: in millions of national currency at constant prices, OECD base year. Since all real data enter the model in growth rates, a purchasing power parity (PPP) conversion is neither necessary nor desirable (see Ahmad *et al.*, 2003).

The accelerator – the coefficient on real GDP growth – is positive and significant at the 1% level. Curiously, however, it is ten times smaller than the accelerators estimated by Naastepad (2006) for the Netherlands and Hartwig (2013) for Switzerland. These two studies, on the other hand, found significantly negative intercepts, while the average intercept estimated from OECD panel data is significantly positive. It indicates an ‘autonomous’ growth in investment – not driven by redistribution or growth in demand – of around 2% per year. The coefficients on the country dummy variables (not shown in Table 2) vary between 0.017 (for Spain) and –0.019 (for Hungary).

Equation 17 is estimated with Pooled Least Squares without allowing for an AR(1) process in the error term. A constant and cross-country fixed effects are added because the redundant fixed effects test rejects the hypothesis of redundancy at the 1% level of significance.<sup>21</sup> The coefficients on the country dummy variables vary between 0.071 (for South Korea) and –0.022 (for New Zealand). The growth rate of world trade affects all countries in the same way, so this variable is similar to time period fixed effects. The coefficients on this variable and on the growth rate of real unit labour cost are both statistically significant and similar in magnitude to earlier findings for single countries (see Naastepad, 2006; Hartwig, 2013).

With the estimated coefficients it is possible to calculate  $C$ . Beforehand, it must be decided how to calibrate the ‘shares’ (export and import share, investment share, wage share) entering the model. Naastepad (2006) evaluates the shares at the sample mean. Stockhammer *et al.* (2009) report results for both the sample mean and the most up-to-date shares available. I will follow their lead. The sample mean shares will be calculated taking the unweighted average of the mean shares of the individual countries. The up-to-date shares will be calculated by averaging over the most recent shares available for any country.

Special attention must be paid to the export and import shares. The OECD area makes up a large portion of the world economy. Clearly, if the OECD countries were seen as a proxy for the global economy, exports and imports should be excluded from the model altogether. For one thing, if every country engages in wage moderation to the same extent, no country improves its competitiveness, and the trade flows remain unaltered. And even if this was not the case, global net exports are zero at all times and remain zero no matter how income distribution is shocked.

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<sup>21</sup> Cross-section random effects were rejected by the Hausman test for correlated random effects. This makes sense given that the sample of countries can hardly be regarded as a random draw from the full sample of OECD countries.

However, the OECD countries are not a good proxy for the world economy. According to the OECD's *Main Economic Indicators*, the share of OECD exports in world trade was 78.0% in 1970. It dropped to 62.8% in 2011. So even 40 years ago the OECD area did not represent the world economy, and it is becoming less representative by the minute.

If we contemplate a simultaneous increase in the wage share in all OECD countries, but not in the rest of the world, this would impair the OECD countries' competitiveness vis-à-vis the non-OECD countries. Exports of OECD countries to non-OECD countries would thus be dampened, but not the intra-OECD exports. The OECD's *International Trade by Commodity Statistics* database allows for calculating the shares of exports and imports which occur between OECD member states and between OECD member states and non-member states, respectively. On average over the years 1989-2011, OECD countries imported 26.6% of their imports from outside the OECD and exported 22.2% of their exports to destinations outside the OECD. These shares started rising around the turn of the millennium and stood at 36.2% and 28.9%, respectively, in 2011.

To capture the redistribution effects on trade between the OECD countries and the rest of the world, I will multiply the export share at sample mean by 0.222 – the mean degree of trade openness of the OECD area against the non-OECD area over the period for which data are available. The up-to-date export share will be multiplied by 0.289 – the degree of openness in 2011. The import shares will be calibrated accordingly, which means that the share at sample mean will be multiplied by 0.266 and the up-to-date share by 0.362.

Table 3 reports values for the remaining parameters and the effects of an increase in real wage growth in the OECD area by one percentage point on consumption growth, investment growth, export growth and the total effect. The signs on the partial demand effects are as expected, and the positive impact of redistribution towards labour on consumption growth is stronger than its negative impact on export growth. (The impact on investment growth is zero.) Altogether, demand growth in the OECD is wage-led on average. When calculated with the up-to-date shares as opposed to the sample mean shares, the positive impact of redistribution towards labour on consumption growth becomes weaker and the negative effect on export growth becomes stronger. The drop in the average wage share via its effect on  $\zeta$  and the growing importance of exports for total demand via its effect on  $\psi_e$  contribute to this. Still, however, demand growth remains (slightly) wage-led.

<Insert Table 3>

## 4.2 Adding the Productivity Regime

Table 4 reports the results from the estimation of the productivity regime equation (Equation 10). Productivity is defined as real gross value added per person employed. In principle, a per-hour based productivity measure would be preferable. However, labour productivity per hour is available for only 23 OECD countries and for a shorter time period than the employment based measure. Using the latter allows me to estimate the productivity regime equation for the same set of countries and time period as the demand regime equations.<sup>22</sup> The real wage is consequently also defined per-person and not per-hour.<sup>23</sup>

As was noted above, the Durbin-Wu-Hausman test for endogeneity cannot be run with panel data. Previous findings for single countries (see Naastepad, 2006; Hartwig, 2013) as well as common sense indicate however that there is simultaneity between GDP and productivity in Equation 10. Therefore, the equation is estimated with Pooled Two-stage Least Squares and with an AR(1) specification.<sup>24</sup> The explanatory variables are significant with the expected signs. The estimate for the parameter  $\beta_2$ , which is a measure for wage-induced technological progress (see Naastepad, 2006), equals 0.114. Since this is far below 1, the ‘paradoxical result’ (Schütz, 2012) that an expansive wage policy induces so much productivity growth that the profit share rises is not an issue.

*<Insert Table 4>*

With the estimates for  $\beta_1$  and  $\beta_2$  we can now calculate the total impact of wage policy on output and productivity growth, taking into account the interactions between the demand and productivity regimes. From Equations 12 and 13 it follows that

$$\frac{d\hat{x}^*}{d\hat{w}} = \left[ \frac{(1 - \beta_2)C}{1 + \beta_1 C} \right] \quad (18)$$

$$\frac{d\hat{\lambda}^*}{d\hat{w}} = \left[ \frac{\beta_2 + \beta_1 C}{1 + \beta_1 C} \right] \quad (19)$$

Table 5 reports the results for Equations 18 and 19, distinguishing between the two variants of  $C$  (calibrated on mean vs. up-to-date shares). Taking account of the interactions

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<sup>22</sup> I also estimated Equation 10 using the hour-based productivity measure. The coefficients on  $\hat{x}$  and  $\hat{w}$  are also significant at the 1% level, albeit a bit smaller.

<sup>23</sup> The real wage is defined as nominal wage income deflated by the GDP deflator and divided by the number of persons employed.

<sup>24</sup> See Fair (1984, pp. 210-214) for details of this procedure. As in Hartwig (2013),  $\hat{w}$ ,  $\hat{z}$ ,  $\hat{z}_{-1}$ ,  $u$  and  $u_{-1}$  (see Table 1) are used as instruments. The lagged dependent variable and lagged regressors are automatically added to the instrument list.



between the demand and productivity regimes does not alter the conclusion from Section 4.1: short-term GDP growth in the OECD is wage-led on average. The productivity regime, is also wage-led. Real wage growth has a direct positive effect on productivity growth (the wage-induced technological progress) and an indirect positive effect that stems from real wage growth increasing demand growth (since the demand regime is wage-led), which in turn raises productivity growth through the Verdoorn channel.

*<Insert Table 5>*

### **4.3 Robustness Analysis: Splitting the Estimation Period**

In panels covering more than four decades, structural breaks might be an issue. To test the robustness of my results, I will therefore split the observation period in two halves and redo the estimations. To be able to do this is another advantage of the panel-econometric approach adopted here. In single-country regressions, the small number of degrees of freedom normally precludes dropping observations.

I will choose the year 1990 as breakpoint not only because it marks the middle of the observation period but also because it marks the fall of the ‘Iron Curtain’. This event has arguably facilitated the advent of “pro-capital redistribution policies” in the 1990s, as Onaran and Galanis (2012, p. 8) have suggested. If a structural break in the distribution regime occurred around 1990 this might have changed the demand and productivity regimes in OECD countries as well.

Table 6 reports the results of the parameter estimations for the two sub-samples. Obviously, the coefficients do not vary much between the two sub-samples and between the sub-samples and the full sample. There is a slight decrease in the propensity to save out of wages over time and an increase in the propensity to save out of profits (Equation 15). This means that the stimulus to consumption demand from income redistribution towards labour has become stronger in the more recent period. No impact of redistribution on investment demand is found both for the full sample and the sub-samples (Equation 16). The accelerator was weakest in the first sub-sample and significant only at the 10% level. The impact of world trade growth on export growth is becoming stronger while the impact of real unit labour cost growth remains stable (Equation 17). Also in the equation for the productivity regime (Equation 10) the coefficients are stable. The coefficient measuring wage-induced technological progress is insignificant in the first sub-sample. It is close-to-significant, however (Prob. = 0.124). Given the measurement problems with macroeconomic data there may have been an impact of real wage growth on productivity growth in that period also.

*<Insert Table 6>*

An interesting question is how the change in the propensities to save – which increases the stimulus to (consumption) demand from income redistribution towards labour – and the increasing weight of the demand for exports – which works in the other direction – interact. To answer this I calibrate the model on the parameters estimated for the 1990-2011 sub-period and on the up-to-date shares and up-to-date degree of trade openness of the OECD area. Table 7 shows that, as expected, the demand and productivity regimes become more wage-led compared with the case for which the parameters were estimated over the 1970-2011 period (Tables 3 and 5). On average, an increase in real wage growth by one percentage point stimulates output growth by 0.1 percentage points and productivity growth by 0.15 percentage points.

*<Insert Table 7>*

## **5 Conclusion**

This paper is the first to test the Bhaduri-Marglin model with panel data. Pooling cross-sectional and time-series data allows for obtaining more reliable estimates for the model parameters by widening the dataset. For instance, the parameter estimates in this paper rely on up to 1091 observations against a maximum of 62 (see Hartwig, 2013) in the earlier single-country literature. This is a big improvement.

This said, my results are in line with the earlier literature. Naastepad and Storm (2006-7), for instance, who estimate the same model specification that is used in this paper with data for eight individual OECD countries over the period 1960-2000, find an average impact of a one percentage point increase in real wage growth on demand growth of 0.08 percentage points. This happens to be the median of the range of my estimates for  $C$  (see Table 3). The demand regime in the average OECD country is thus (slightly) wage-led. Also, the productivity regime is found to be wage-led. This conforms to Hein and Tarassow's (2010) finding for the period from the early/mid 1980s to 2007.<sup>25</sup>

When we go beyond the OECD area and think in terms of the global economy, we can conclude that the global effects of a positive wage shock in the OECD area are even more expansionary than Table 3 suggests. The reasoning is as follows. The exports of the OECD area are negatively affected by an assumed expansionary wage shock only because it was assumed that the non-OECD area experiences no such shock. That is why the competitiveness

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<sup>25</sup> Against their own expectation, Hein and Tarassow (2010) find profit-led productivity regimes in four OECD countries for the period from 1960 to the early/mid 1980s.

of OECD countries is impaired at all by the shock. As a consequence, they lose market shares to non-OECD countries. To put it differently, each drag to the OECD area's exports is counterbalanced by a commensurate stimulus to the exports of the non-OECD area. Therefore, Table 3 understates the global effect. Given that the world's net exports are always zero we have to disregard trade and concentrate on domestic demand when we want to determine the global effects of an assumed global shock to redistribution.<sup>26</sup> My finding is that domestic demand growth in the OECD area is wage-led. The global effect hence hinges on whether domestic demand growth in developing and emerging countries is also wage-led. While to determine this is beyond the scope of this study, it poses an interesting subject for future empirical research.<sup>27</sup>

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<sup>26</sup> Onaran and Galanis (2012, p. 8) suggest that “neoliberal policies have been implemented simultaneously in many developed and developing countries in the post-1980s period”.

<sup>27</sup> Based on single-country regressions Onaran and Galanis (2012) find wage-led domestic demand regimes in all four non-OECD countries (Argentina, China, India and South Africa) they include.

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## **Appendix: Data sources**

The source for all (except Swiss) data is the OECD's website ([www.oecd-ilibrary.org](http://www.oecd-ilibrary.org)), more specifically the databases *OECD National Accounts Statistics* (nominal and real data for GDP and the demand-side components), *Main Economic Indicators* (data for international trade, labour input and labour costs), *Employment and Labour Market Statistics* (data for population and unemployment), and *International Trade by Commodity Statistics* (data on the trade openness of the OECD area). All data were extracted in November 2012.

Part of the data for Switzerland has been found to be inconsistent in the OECD databases. (For instance, labour productivity data are not equal to the ratio of real gross value added and employment data, as they should be.) Data for Switzerland have therefore been extracted from the databases of KOF Swiss Economic Institute. These are the same data that were used in Hartwig (2013). See there for the sources.

**Table 1:** Glossary

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<b><u>Variables</u></b>		
x: Demand (GDP)	c: Private consumption	i: Gross fixed investment
e: Exports of goods and services	m: Imports of goods and services	w: Real wage
$\lambda$ : Labour productivity	v: Wage share in GDP	$\pi$ : Profit share in GDP
z: Volume of world trade	$\zeta$ : Import share in GDP	$\chi$ : Export share in GDP
v: Investment share in GDP	$\mu^{-1}$ : Keynesian multiplier	u: Rate of unemployment
$\hat{p}$ : Growth rate of real unit labour cost (RULC), equals $\left[ \hat{w} - \hat{\lambda} \right]$	$\Psi_i$ : $v/\mu$	$\xi$ : $v/\mu$
	$\Psi_e$ : $\chi/\mu$	$\theta$ : $v/\pi$
<b><u>Parameters</u></b>		
$\sigma_w$ : Propensity to save out of wages	$\sigma_\pi$ : Propensity to save out of profits	$\phi_1$ : Profit elasticity of investment
$\phi_2$ : Accelerator	$\varepsilon_0$ : World trade elasticity of exports	$\varepsilon_1$ : RULC elasticity of exports
$\beta_1$ : Verdoorn parameter	$\beta_2$ : Parameter measuring wage-induced technological progress	C: Real wage elasticity of demand

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**Table 2:** Regression results for the demand regime

	(15)	(16)	(17)
	$\sigma$	$\hat{l}$	$\hat{e}$
Const.		0.021*** (8.108)	0.005* (1.875)
$\sigma_w$	0.202*** (9.110)		
$\pi_{-1}$	0.115** (2.351)		
$\hat{\pi}_{-1}$		-0.005 (-1.174)	
$\hat{x}$		0.180*** (3.936)	
$\hat{z}$			0.911*** (21.509)
$\hat{v}$			-0.396*** (-6.034)
$AR(1)$	0.882*** (35.411)	0.308*** (5.279)	
Adj. $R^2$	0.934	0.228	0.503
SE	0.016	0.024	0.047
D.W.	1.868	2.072	1.651
Obs.	1075	1047	1091
Period	1970-2011	1970-2011	1970-2011

*Notes:* The estimation method is pooled Least Squares. Cross-section fixed effects (not shown) are added in each equation. Numbers in parentheses below the coefficients are  $t$ -statistics adjusted for heteroskedasticity (White cross-section standard errors and covariance). Equations 15 and 16 are estimated allowing for an AR(1) process in the error term. \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels respectively. SE = standard error. D.W. = Durbin-Watson statistic. The symbols are defined in Table 1.

**Table 3:** Parameter values

Coefficients	$\sigma_w$	$\sigma_\pi$	$\phi_1$	$\phi_2$	$\varepsilon_0$	$\varepsilon_1$
	0.202	0.317	0.000	0.180	0.911	-0.396
Other parameters	$\mu^{-1}$	$\xi$	$\psi_e$	$\psi_i$	$\theta$	
At mean shares	2.903	1.908	0.252	0.667	1.917	
At up-to-date shares	2.332	1.440	0.364	0.456	1.615	
Effects of an increase in real wage growth by one percentage point on						
	Consumption growth $\frac{[\xi(\sigma_\pi - \sigma_w)]}{[1 - \psi_i \phi_2]}$	Investment growth $\frac{-[\psi_i \phi_1 \theta]}{[1 - \psi_i \phi_2]}$	Export growth $\frac{[\psi_e \varepsilon_1]}{[1 - \psi_i \phi_2]}$	Total effect $C$		
At mean shares	0.250	0.000	-0.113	0.136		
At up-to-date shares	0.181	0.000	-0.157	0.024		



**Table 4:** Regression results for the productivity regime

	(10)
	$\hat{\lambda}$
Const.	0.004** (2.084)
$\hat{x}$	0.478*** (7.534)
$\hat{w}$	0.114*** (3.456)
$AR(1)$	0.333*** (5.107)
Adj. $R^2$	0.623
SE	0.013
D.W.	1.940
Instrument rank	39
Obs.	932
Period	1970-2011

*Notes:* Equation 10 is estimated with Pooled Two-stage Least Squares allowing for an AR(1) process in the error term.  $\hat{w}$ ,  $\hat{z}$ ,  $\hat{z}_{-1}$ ,  $u$  and  $u_{-1}$  are used as instruments. The lagged dependent variable and lagged regressors are automatically added to the instrument list. Cross-section fixed effects (not shown) are added. Numbers in parentheses below the coefficients are  $t$ -statistics adjusted for heteroskedasticity (White cross-section standard errors and covariance). \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels respectively. SE = standard error. D.W. = Durbin-Watson statistic. The symbols are defined in Table 1.

**Table 5:** Effects of an increase in real wage growth by one percentage point on output growth and productivity growth, taking account of interactions between the demand and productivity regimes

	(5) Output growth	(6) Productivity growth
<i>C</i> at mean shares	0.113	0.168
<i>C</i> at up-to-date shares	0.021	0.124

**Table 6:** Regression results for sub-samples

	(15)		(16)		(17)		(10)	
	$\sigma$		$\hat{t}$		$\hat{e}$		$\hat{\lambda}$	
	1970-1990	1990-2011	1970-1990	1990-2011	1970-1990	1990-2011	1970-1990	1990-2011
Const.			0.029*** (6.806)	0.016*** (4.923)	0.006* (1.680)	0.006** (2.580)	0.004 (1.375)	0.003 (1.565)
$\sigma_w$	0.211*** (9.256)	0.177*** (6.261)						
$\pi_{-1}$	0.096* (1.662)	0.180*** (2.605)						
$\hat{\pi}_{-1}$			-0.005 (-1.115)	-0.017 (-0.573)				
$\hat{x}$			0.149* (1.697)	0.191** (2.509)				
$\hat{z}$					0.837*** (13.907)	0.927*** (22.847)		
$\hat{v}$					-0.404*** (-4.296)	-0.416*** (-4.304)		
$\hat{x}$							0.497*** (4.607)	0.474*** (5.883)
$\hat{w}$							0.106 (1.542)	0.098*** (2.565)
$AR(1)$	0.792*** (11.682)	0.800*** (17.078)	0.359*** (4.897)	0.140* (1.916)			0.127 (1.605)	0.379*** (3.939)
Adj. $R^2$	0.897	0.956	0.277	0.165	0.320	0.624	0.598	0.644
SE	0.018	0.014	0.025	0.023	0.052	0.042	0.014	0.013
D.W.	1.937	1.802	2.124	2.004	1.612	1.71	1.944	1.943
Cross-sections	24	31	24	31	24	31	21	31
Obs.	462	637	441	630	483	632	350	603

Notes: For Equations 15-17, the estimation method is pooled Least Squares. Equations 15 and 16 are estimated allowing for an AR(1) process in the error term. Equation 10 is estimated with Pooled Two-stage Least Squares allowing for an AR(1) process in the error term.  $\hat{w}$ ,  $\hat{z}$ ,  $\hat{z}_{-1}$ ,  $u$  and  $u_{-1}$  are used as instruments. The lagged dependent variable and lagged regressors are automatically added to the instrument list. Cross-section fixed effects (not shown) are added in each equation. Numbers in parentheses below the coefficients are  $t$ -statistics adjusted for heteroskedasticity (White cross-section standard errors and covariance). \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels respectively. SE = standard error. D.W. = Durbin-Watson statistic. The symbols are defined in Table 1.

**Table 7:** Effects of an increase in real wage growth by one percentage point on demand growth and productivity growth when the model is calibrated on parameters estimated for the 1990-2011 sub-period and on up-to-date shares and the up-to-date degree of trade openness of the OECD area

Consumption growth	Investment growth	Export growth	Demand growth	Output growth*	Productivity growth
$\frac{[\xi(\sigma_\pi - \sigma_w)]}{[1 - \psi_i \phi_2]}$	$\frac{-[\psi_i \phi_1 \theta]}{[1 - \psi_i \phi_2]}$	$\frac{[\psi_e \varepsilon_1]}{[1 - \psi_i \phi_2]}$	$C$	$\left[ \frac{(1 - \beta_2)C}{1 + \beta_1 C} \right]$	$\left[ \frac{\beta_2 + \beta_1 C}{1 + \beta_1 C} \right]$
0.284	0.000	-0.166	0.119	0.102	0.146

\* Taking account of interactions between the demand and productivity regimes.