A macroeconomic analysis of the effects of gender inequality, wages, and public social infrastructure: the case of the UK

Özlem Onaran*, Cem Oyvat**, Eurydice Fotopoulou***

forthcoming Feminist Economics

Acknowledgements: The support of the Economic and Social Research Council (ESRC) is gratefully acknowledged, via the Rebuilding Macroeconomics Network Plus grant. The authors are grateful for comments from Diane Elson, Sue Himmelweit, Jerome De Henau, İpek İlkkaracan, Elissa Braunstein, Stephanie Seguino, Engelbert Stockhammer, Ben Tippet and other participants of the Rebuilding Macroeconomics ESRC Social Science Festival on Women in Economics and the 2018 and 2019 Annual Conferences of IAFFE on earlier versions.

***Corresponding author:** University of Greenwich, Institute of Political Economy, Governance, Finance and Accountability, Old Royal Naval College, Park Row, Greenwich, London SE10 9LS**,** Email:o.onaran@gre.ac.uk

** University of Greenwich, c.oyvat@gre.ac.uk

***Goldsmiths University of London, e.fotopoulou@Gold.ac.uk

A macroeconomic analysis of the effects of gender inequality, wages, and public social infrastructure: the case of the UK

Abstract

The aim of this paper is to develop a model to analyze the macroeconomic effects of two dimensions of inequalities – gender inequality and functional income distribution- and public spending, in particular in social infrastructure, on output, productivity and hours of employment of men and women. We estimate the model econometrically using an IV-GMM estimator and time series data for the period of 1970-2016 for the UK. For the estimation of productivity, we use IV-GMM estimations based on panel data for 18 industries for the period of 1970-2015. We find that output in the UK is both gender equality-led and wage-led, and hence generally equality-led. Public social infrastructure investment has a high positive effect on both output and employment. Despite a strong positive effect on productivity, employment of both men and women increase in the medium run.

Keywords: gender wage gap, functional income distribution, social infrastructure, productivity, employment

JEL code: E1, E2, E62

1. Introduction

The aim of this paper is to develop a model to analyze the effects of multiple dimensions of inequalities, and fiscal policies on macroeconomic outcomes. The theoretical novelty is to integrate i) the impact of gender inequality, functional income distribution, and their interaction; ii) the impact of both wage and fiscal policies, focusing in particular on the effects of government spending in social infrastructure; iii) both the demand and supply-side effects; iv) the effect on both output and employment; and v) gendered behavioral differences, contributing to gendering macroeconomics.

We extend the theoretical models by Elissa Braunstein, Irene van Staveren and Daniele Tavani (2011) and Stephanie Seguino (2010, 2012), who incorporate both a demand and supply-side within structuralist, post-Keynesian/post-Kaleckian feminist theoretical models allowing for both positive and negative effects of gender equality. Post-Keynesian/post-Kaleckian demand-led macroeconomic models allow for both positive and negative effects of a fall in the labor share on aggregate demand (Bhaduri and Marglin, 1990; Naastepad and Storm, 2006/7; Hein and Vogel, 2008; Stockhammer, Onaran, and Ederer, 2009; Onaran and Galanis, 2014; Onaran and Obst, 2016). Extensions of these models integrate the impact of public spending and taxes (Mott and Slattery, 1994; You and Dutt, 1996, Blecker, 2002; Seguino, 2010, 2012; Palley, 2013; Commendatore, Panico, and Pinto, 2011; Allain, 2015; Tavani and Zamparelli, 2017a; Ko, 2018; Hein, 2018; Obst, Onaran, and Nikolaidi, 2019). Going beyond the short-run demand effects, a series of post-Keynesian models integrate the changes in productivity (Palley, 1996, 2013, 2014; Casetti, 2003; Stockhammer and Onaran, 2004; Dutt, 2006, 2010; Naastepad, 2006; Setterfield, 2006; Seguino, 2010, 2012; Hein and Tarassow, 2010; Tavani and Zamparelli, 2017b).

Elissa Braunstein, Rachid Bouhia, and Stephanie Seguino (2018) empirically analyze how care regimes, globalization and macroeconomic policies shape development trajectories using a principal component analysis. Another body of empirical research focusing on the demand effects of gender gaps, use input-output tables to analyze the impact of public spending in social care and education, and show their stronger effect on female and male employment compared to investment in physical infrastructure (Antonopoulos et al., 2010; Ilkkaracan et al., 2015; Ilkkaracan and Kim, 2018; De Henau et al., 2016). Antonopoulos et al. (2010) and Ilkkaracan et al. (2015) extend this analysis using micro household data to match the macro labor demand with personal characteristics of individuals. However, these studies are static, and do not take the medium-run productivity effects into account.

Pollitt et al (2017) use a demand-led post-Keynesian econometric model to simulate the impact of gender pay gaps on growth. In their analysis changes in income distribution have only supply-side effects and do not impact consumption and demand directly; similarly wages or government spending in social infrastructure does not affect productivity. Hannah Bargawi and Giovanni Cozzi (2017) use a global demand-led model without gendered variables to assess the impact of government expenditure in social infrastructure.

Neoclassical macroeconomic models do not analyze the gendered demand side effects and constraints, but rather focus on the supply-side effects of gender inequality and intra household bargaining on fertility, savings and the accumulation of human capital (Becker, Murphy, and Tamura, 1990; Benhabib, Rogerson, and Wright, 1991; Greenwood and Hercowitz, 1991; Doepke and Tertilt, 2016; Agenor and Agenor, 2014; Cavalcanti and Tavares, 2016; Heathcote, Storesletten, and Violante, 2017; Fukui, Nakamura, and Steinsson, 2019). Cross-country reduced form estimations of mainstream growth models focus on the supply-side effects of equality in education and labor force participation, via the direct and indirect/intergenerational effects on productivity, because women are assumed to spend more on children's education and health relative to men (Lundberg and Pollak, 1996; Phipps and Burton, 1998; Knowles, Lorgelly, and Owen, 2002; Morrison, Raju, and Sinha, 2007; Klasen and Lamanna 2009; Cuberes and Teignier, 2014). Reductions in labor market imperfections such as wage discrimination and occupational segregation are expected to stimulate growth. However, Stephanie Seguino (2017) highlights that most of these models do not account for the lack of labor demand matching the increases in female education and labor force participation.

Synthesizing these different strands, this paper aims at developing a novel gendered macroeconomic analysis building on post-Kaleckian feminist economics. We estimate the model econometrically using IV-GMM (instrumental variable- generalized method of moments) estimators and time series data for the period of 1970-2016 for the UK. For the medium-run estimation of productivity we use IV-GMM estimations based on panel data of 18 industries for the period of 1970-2015. The use of IV-GMM with an innovative set of instruments to control for endogeneity and the synthesis of time series and panel data econometrics to specify short-run and medium-run effects are methodological novelties of the paper. We nevertheless acknowledge that the endogeneity between wages, employment, demand and productivity is challenging and within these limitations our results indicate associations rather than strong causal links.

Finally, using the estimated parameters we analyze the effects of wages, the gender pay gap, and public spending in social infrastructure on output, employment of men and women, public debt, and productivity. The analysis of female and male employment and inequalities aims at broadening the scope of analysis beyond the narrow focus on GDP.

2. The model

We present a three-sector model: the social sector (health, social care, education, childcare, H); the rest of the market economy (N); and the unpaid care sectors. There are three types of factors of production: male labor, female labor, and capital. On the demand-side, we model behavioral equations determining consumption, private investment, exports, imports and government spending. On the supply-side, productivity in the rest of the economy changes in the medium run as an outcome of changes in wages, public and private expenditure and unpaid care. Hours of employment are determined by output and labor productivity and the distribution of employment between women and men depends on occupational segregation.

In the model hourly wage rates are determined exogenously by bargaining power and labor market institutions. Gender pay gap is determined exogenously by the relative bargaining power of women, social norms, occupational segregation, labor market institutions, and a set of personal characteristics (such as education) which are also affected by social norms.

Functional income distribution is determined endogenously, as the wage share of men and women and the profit share change when wages, output, employment and productivity change.

The model integrates gendered behavior, and the effects of social norms, which determine the distribution of unpaid domestic care between men and women, and job segregation (e.g. women's association with paid care work). A change in the gender pay gap or public spending in social vs. physical infrastructure have gendered short and medium-run impacts on employment and income.

Online Appendix 1 presents the list of variables and definitions.

Aggregate output (Y_t) is the sum of male and female wage bill ($WB_t^F \ and \ WB_t^M$), and profits (R_t).

$$Y_t = WB_t^M + WB_t^F + R_t \tag{1}$$

WB_t^F and WB_t^M are determined by female and male hourly wage rates and hours of employment in H and N ($w_t^{HF}, w_t^{HM}, w_t^{NF}, w_t^{NM}, E_t^{HF}, E_t^{HM}, ,E_t^{NF}, E_t^{NM}$respectively):

$$WB_t^F = w_t^{HF} E_t^{HF} + w_t^{NF} E_t^{NF} \tag{2}$$

$$WB_t^M = w_t^{HM} E_t^{HM} + w_t^{NM} E_t^{NM} \tag{3}$$

Working with hours rather than a headcount of employment is important for a gendered analysis to reflect the high share of women in part-time work.

The wages in both H and N are significantly larger for male workers in most countries, as in the UK (see Figure 1). Gender wage gaps (α_t) in H and N are

$$\alpha_t^N = \frac{w_t^{NM}}{w_t^{NF}} > 1, \quad \alpha_t^H = \frac{w_t^{HM}}{w_t^{HF}} > 1 \tag{4}$$

Output in the market economy (GDP, excluding unpaid activities) is

$$Y_t = C_t^N + C_t^H + I_t + G_t^H + G_t^C + I_t^G + X_t - M_t \tag{5}$$

where C_t^H denotes household social expenditure, C_t^N is consumption in N, I_t is private investment, G_t^H is the government's expenditures in health, social care, education and child care , G_t^C is the government's consumption expenditures, I_t^G is public physical infrastructure investment, X_t is exports and M_t is imports. In line with feminist economics emphasizing the importance of the government's social expenditures on productivity and the social fabric, we refer to G_t^H as public social infrastructure investment (Elson, 2017). G_t^H is a policy decision targeted as a share of Y_t (κ_t^H) and constitutes the social sector output (Y_t^H). The rest of the GDP is the market output in N (Y_t^N):

$$Y_t^H = G_t^H = \kappa_t^H Y_t \tag{6}$$

$$Y_t^N = Y_t - G_t^H = Y_t(1 - \kappa_t^H) \tag{7}$$

G_t^C and I_t^G are also determined by government as a share of $Y_t(\kappa_t^C, \kappa_t^G)$:

$$G_t^C = \kappa_t^C Y_t \tag{8}$$

$$I_t^G = \kappa_t^G Y_t \tag{9}$$

Hours of employment in H and economy (E_t^H, E_t^N) are determined by output and labor productivity in the relevant sectors.

E_t^N is output over labour productivity in N (T_t^N):

$$E_t^N = \frac{Y_t^N}{T_t^N} \tag{10}$$

The share of women in sector N (β_t^N) is exogenously determined by social norms determining occupational segregation, hence

$$E_t^{NF} = \frac{Y_t^N}{T_t^N}\beta_t^N \tag{11}$$

$$E_t^{NM} = \frac{Y_t^N}{T_t^N}(1 - \beta_t^N) \tag{12}$$

We assume that the wage bill of men and women in H constitutes G_t^H and H is non-profit. Any non-labor inputs used constitute part of G^C. Hence, G_t^H is

$$G_t^H = \kappa_t^H Y_t = \beta_t^H E_t^H w_t^{HF} + (1 - \beta_t^H) E_t^H w_t^{HM} \tag{13}$$

Based on the empirical data in Figure 1 below, we assume that $\beta_t^H > \beta_t^N$.

Figure 1

Using equations (11)-(13) and (4), E_t^H, E_t^{HF} and E_t^{HM} are

$$E_t^H = \frac{G_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \tag{14}$$

$$E_t^{HF} = \frac{\beta_t^H \kappa_t^H Y_t}{w_t^{FH}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \tag{15}$$

$$E_t^{HM} = \frac{(1-\beta_t^H)\kappa_t^H Y_t}{w_t^{FH}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \tag{16}$$

We model the per capita unpaid domestic care labor ($\frac{U_t}{N_t}$) within the households as

$$\log \frac{U_t}{N_t} = q_0 + q_G \log \frac{(G_t^H + C_t^H)}{N_t} \tag{17}$$

For a given demographic structure and population (N_t), which determines the exogenous care needs, (q_0), higher per capita government or household expenditures in H are expected to reduce the need for unpaid care ($q_G < 0$). We specify the equation in logs, since this effect might be non-linear, i.e. might be decreasing in absolute values as it gets increasingly difficult to substitute unpaid care at lower levels of unpaid care. The potential squeeze in unpaid care due to paid employment is excluded to simplify the model. The effect of $G_t^H$and C_t^H as determinants of employment only partially reflects this effect.

The profit income (R) is the operating surplus in N after wage payments:

$$R_t = Y_t^N - \ w_t^{NF} E_t^{NF} \ - w_t^{NM} \, E_t^{NM} \tag{18}$$

The profit share (π_t) is the share of R in N and depends on productivity in N:

$$\pi_t = \frac{Y_t^N - \ w_t^{NF} E_t^{NF} \ - w_t^{NM} \, E_t^{NM}}{Y_t^N} \tag{19}$$

On the demand-side household consumption is a function of after-tax female and male wage income and profits. Consumption in two types of goods and services produced in H and N depends on the differences in the marginal propensities to consume (MPC) out of female and male wage income and profits. Accounting for gendered income in the consumption function are novel features.

Consumption in N is

$$\begin{aligned} \log C_t^N = c_0 + c_R \log[R_t(1 - \ t_t^R)] \\ + c_F \log[(w_t^{NF} E_t^{NF} + w_t^{HF} E_t^{HF})(1 - \ t_t^W)] \\ + c_M \log[(w_t^{NM} E_t^{NM} + w_t^{HM} E_t^{HM})(1 - \ t_t^W)] \end{aligned} \tag{20}$$

where t_t^R is the implicit tax rate (ITR) on profits and $t_t^W$is ITR on wages. The MPC in N is different for male and female workers, reflecting the gender income gap as well as differences in behavior.

C_t^H is a function of after-tax profits, female and male wage income and G_t^H:

$$\log C_t^H = z_0 + z_R \log[R_t(1 - t_t^R)] + z_F \log[(w_t^{NF}E_t^{NF} + w_t^{HF}E_t^{HF})(1 - t_t^W)] + z_M \log[(w_t^{NM}E_t^{NM} + w_t^{HM}E_t^{HM})(1 - t_t^W)] \quad (21)$$

The MPC in H is different for profits, and male and female wage income. G_t^H is part of the wage bill in H and can increase C_t^H by providing wage income or decrease C_t^H by reducing the need for these expenditures. We assume that C_t^H is provided by the private sector in the market economy as part of the output in N.

An alternative specification, where relative prices in N and H also affect $C_t^H$and C_t^N is not presented, as empirical analysis shows that price elasticities are insignificant. C_t^H is likely to be very inelastic and is a very small part of household spending (3.6% in 2017). The aggregate price deflator is dominated by prices in N. Finally, as prices depend on unit labor costs, the effects of wages and their ratio to profits (and output) capture the price effects of higher wages as well. The exclusion of the insignificant explicit price elasticities in the model also helps to reduce the complexity in the analytical solution.

Private investment (I_t) is a function of the after-tax π_t, GDP, and public debt/GDP ($(D/Y)_t$):

$$logI_t = i_0 + i_1 \log Y_t + i_2 log\, [\pi_t(1 - t_t^R)] + i_3 \log \left(\frac{D}{Y}\right)_t \quad (22)$$

I_t is expected to increase as a result of higher demand ($i_1 > 0$), and higher after-tax π_t reflecting expected profitability and availability of internal funds ($i_2 > 0$). $(D/Y)_t$ captures the possible negative crowding-out effects of public debt on the interest rate and investment ($i_3 < 0$). However, there is also a potentially positive crowding-in effect in the medium-run, if productivity increases due to public spending, which in turn leads to higher π_t.

The public debt (D_t) is determined by the public debt in the previous period (D_{t-1}), the interest rate (r_{t-1}), plus the total government expenditures in *t*, minus the taxes collected on profits, wages, and consumption:

$$D_t = (1 + r_{t-1})\, D_{t-1} + G_t^H + G_t^C + I_t^G - t_t^W(WB_t^F + WB_t^M) - t_t^R R_t - t_t^C(C_t^N + C_t^H) \quad (23)$$

where t_t^C is the ITR on consumption.

Exports are a function of prices of exports relative to foreign prices and foreign income (Y_{world}) and the exchange rate (ε); imports are a function of Y^N and domestic prices relative to import prices. For simplicity we assume that marginal propensity to import in H is zero. The wage share is equivalent to the real unit labor cost, therefore when the profit share decreases (wage share increases), exports decrease and imports increase, and the magnitude of the effect depends on the pass through from the wage share to nominal unit labor costs and prices, and the price elasticity of exports and imports. . Hence, to simplify the model, exports and imports are reduced form functions of π:

$$logX_t = x_0 + x_1 logY_t^{World} + x_2 log\pi_t + x_3 log\varepsilon_t \tag{24}$$

$$logM_t = n_0 + n_1 logY_t^N + n_2 log\pi_t + n_3 log\varepsilon_t \tag{25}$$

Labor productivity is constant in the short-run (SR) and changes endogenously in the medium-run (MR) in N, as we assume technological change takes time. We assume productivity in H is constant, and simply equal to output per hour of employment in both SR and MR.[i] Labor productivity in N (T_t^N) is

$$\begin{aligned}\log T_t^N = t_0 + t_1 \log \frac{(G_{t-1}^H + C_{t-1}^H)}{N_{t-1}} + t_2 \log \frac{I_{t-1}^G}{N_{t-1}} \\ + t_3 \log Y_{t-1}^N + t_4 \log w_{t-1}^{NF} + t_5 \log(\alpha_{t-1}^N w_{t-1}^{NF}) + t_6 \log \frac{U_{t-1}}{N_{t-1}}\end{aligned} \tag{26}$$

In MR, $T_t^N$is likely to be positively affected by lagged values of per capita G^H, C^H, and $I^G (t_1, t_2 > 0)$. We also expect per capita unpaid care to affect T_t^N positively ($t_6 > 0$). Substituting equation (17) for $\frac{U}{N}$, we are able to model the effect indirectly via the effect of $G^H$and C^H.[ii] Higher output would also lead to higher productivity due to Verdoorn effect (Naastepad, 2006; Hein and Tarassow, 2010), as greater scale can lead to more efficient allocation of sources ($t_3 > 0$). Moreover, we expect that higher female and male wages in N lead to labor-saving technologies and increases productivity ($t_4,\ t_5 > 0$). This is also consistent with the efficiency wage theories. We expect these effects to be realized over a longer time period, defined as the medium run, which is a sufficiently long time period, e.g. five years or more. Using (17) and (26) we can further simplify productivity as in (27):

$$\begin{aligned}\log T_t^N = h_0 + h_1 \log \left(\frac{G_{t-1}^H + C_{t-1}^H}{N_{t-1}} \right) + h_2 \log \left(\frac{I_{t-1}^G}{N_{t-1}} \right) \\ + h_3 \log Y_{t-1}^N + h_4 \log w_{t-1}^{NF} + h_5 \log \alpha_{t-1}^N\end{aligned} \tag{27}$$

where $h_0 = t_0 + g_0 t_6$ and $h_1 = t_1 + g_G t_6$.

For simplicity we do not model the impact of G^H and unpaid care on labour supply, fertility, migration or the effects of changes in labor supply and unemployment on wages. Similarly, a rise in wages in H as an outcome of higher G^H is likely to lead to changes in occupational segregation and social norms. While these are interesting extensions, they are outside the scope of this paper.

3. The effects of increasing female wages in the rest of the economy

In this section, we first analyze the effects of closing the gender wage gap in the rest of the economy (N). This can be achieved via an upward convergence, i.e. female wages increasing faster than male wages or downward convergence, or with only female wages increasing. In this section, we focus on the latter.

We define two demand regimes in the short run as follows. Firstly, a *female wage-led* or *gender equality-led* regime in the short run is when a decreasing gender pay gap (due to a rise in female wages in N) leads to a higher aggregate output in the short run. Alternatively, if this leads to lower output in the short run, the demand regime is defined as *gender inequality-led* in the short run.

We expect rising female wages to have a positive partial impact on consumption in both sectors in the short run, since we expect the MPC out of female wages to be larger than that out of profits. This is based on previous aggregate macro-econometric estimations which find that MPC out of wages in the UK is higher than MPC out of profits (Hein and Vogel, 2008; Onaran and Galanis, 2014; Onaran and Obst, 2016; Obst et al., 2019).

Higher female wages in N is expected to have a partial negative impact on private investment for a constant output, because, it squeezes the profits share (π) in the short run. Moreover, as the composition of taxes collected on profits and wages affect the public debt/GDP, there is a further potentially small impact on private investment.

Finally, higher female wages in N and a falling profit share also imply an increasing real unit labor costs and have a partial negative effect on exports and a positive effect on imports in the short run.

The magnitudes of these positive and negative effects are elevated further through the multiplier effects.

In the medium run, a rise in female wages in N affect labor productivity and has further effects on output through changes in consumption in both sectors, private investment, export, imports, government expenditures and the consequent multiplier effects. Figure 2 summarizes the effects on productivity. As discussed above, we expect higher female wages in N to increase labor productivity. There are further lagged effects due to the changes in output in the previous period. If demand is female wage-led in the short run, higher female wages in N leads to higher labor productivity in the medium run due to the Verdoorn effects of higher output. Moreover, we expect increasing consumption in H, public social expenditures and other public expenditures to have positive effects on productivity. These effects via output work in the opposite direction if demand is gender inequality-led in the short run.

Figure 2

If the effect of female wages on labor productivity is positive, labor-saving technological change reduces labor demand and leads to a negative partial effect on both female and male employment in N in the medium run for a given output. Under these conditions, the medium-run partial effect of higher female wages in N on the profit share is also positive due to declining unit labor costs. However, if demand is gender inequality-led in the short run and the effect of output on productivity are sufficiently large, higher female wages in N could also have a negative medium-run partial impact on productivity and the profit share.

The effect of higher female wages in N on aggregate output in the medium run is ambiguous depending on its effect on productivity and the profit share. If demand is female wage-led in the short run, the medium-run effects on investment and net exports are more likely to be positive as the effects of higher wages on the profit share are partially offset, and public debt/GDP decreases. The medium-run partial effects on consumption depends on the changes in productivity, female and male employment and wage income and, profits.

The analytical solution of the model and further details of the comparative statistics are presented in the online Appendix 2. This can be used to check our simulation results for the UK and to replicate the empirical analysis using estimated parameters of another economy.

Table 1 summarizes different regimes in both the short and medium run. The size of the effect on consumption relative to investment and net exports determines the type of the growth regime. If the sum of the effects in short run and the next period is positive, we define this regime as *female wage-led or gender equality-led* in the medium run. If the total effect is negative, the regime is *gender inequality-led* in the medium run. As the impact of female wages in N on productivity and the profit share in the medium run is ambiguous, we cannot predict the effects on each component of demand in the medium run without knowing the size of these effects. E.g., an economy that is *female wage-led* in the short run could theoretically be *gender inequality-led* in the medium run, if higher wages lead to a significant shift to labor-saving techniques, which would substantially reduce employment and hence labor income.

With respect to the effects on employment, an increase in female wages in N increases female and male employment in both N and H in the short run, if the economy is female wage-led (see Figure 3). In the medium run employment is determined by changes in both output and productivity. Therefore, an economy that is female wage-led in the medium run could experience a decline in female and/or male employment if the medium-run impact of higher female wages on productivity in N more than offsets its positive effect on output.

Figure 3

In the case of a simultaneous increase in both female and male wages in the rest of the economy, the direction of the partial effects on consumption, investment, exports, and imports are similar to those described above for the case of increasing female wages only; however, the absolute value of the magnitude of the partial effects is larger when both the male and female wage bill increase and there is a greater squeeze on the profit share. We define a demand regime as *wage-led* in the short run if the impact of a simultaneous increase in female and male wages in N on aggregate demand is positive. If the impact is negative, we define it as *profit-led* in the short run.

Table 2 summarizes the demand regimes in the short run. If an economy is both wage-led *and* female wage-led/gender equality-led, we define it as *equality-led demand regime* in the short run. Alternatively, the economy could be profit-led and gender inequality-led. However, an economy could also be wage-led and gender inequality-led or profit-led and gender equality-led in the short run at the same time depending on the MPC out of female and male wages and profits and the sensitivity of investment and net exports to unit labor costs.

Table 2

The effect of a simultaneous rise in female and male wages in N in the medium run again works mainly through the effect on productivity in N. The magnitude of the effect of a simultaneous rise in wages (i.e. an increase in both male and female wages) on productivity is expected to be larger than a closing of the gender pay gap due to only an increase in female wages. This is because higher male wages create additional incentives for labor-saving technological change. Similarly, the effects on consumption in both sectors, investment and net exports are also larger. Consequently, we expect the medium-run effect on aggregate output to be larger. We define an economy in which the sum of the short-run and medium-run effects of an increase in female and male wages in the rest of the economy on output is positive as *wage-led* in the medium run. The case in which the sum of the short-run and medium-run effects is negative is defined as *profit-led* in the medium run.

While the definition of short-run demand regimes is comparable to the previous literature based on Bhaduri and Marglin (1990), the medium-run effects combine both demand and supply-side effects, and therefore refers to the properties of the economy rather than just the demand regime. The effect of wages on productivity further complicate the picture in the medium run as the cumulative effect of wages on output and employment may move in the opposite direction as discussed in Servaas Storm and Ro Naastepad (2013). Ro Naastepad (2006) presents a two-by-two classification of growth regimes based on the nature of productivity regime and demand regime, both of which can be either wage-led or profit-led.

We define an economy that is both wage-led and female-wage-led in the medium run, as an *equality-led demand regime* in the medium run.

In summary, this section has presented the effects of closing the gender pay gap as well as simultaneously increasing both female and male wages in the rest of the economy on three macroeconomic variables: aggregate output and each component of aggregate demand; productivity; and employment of women and men in the short and medium run. We show that different growth regimes could exist in the short and medium run depending on the following parameters: the MPCs of the capitalists, female and male workers; the magnitudes of the sensitivity of investment and net exports to the profit share; and the effect of output and female and male wages on productivity in the rest of the economy.

4. The effects of public spending in social infrastructure

Next, we examine the effects of increasing public spending in social infrastructure. This spending can be used either to increase the wage rate of female or all employees in the social sector, or to hire more employees. We will analyze each of these mechanisms and their impact on reducing gender inequalities in employment.

We first analyze the case where public spending in social infrastructure as a share of GDP (κ^H) increases solely through new public employment in H (keeping wages constant). In the UK, the share of female employment in the social sector (H) is significantly larger than the share of female employment in the rest of the economy (N). Therefore, we expect that with this policy more female employment is generated in the short run in the public social sector.

The short-run effect of higher public social infrastructure investment (as a share of GDP, κ^H) on aggregate output depends on the effects on consumption in both sectors, private investment, public expenditures and the consequent multiplier effects. An increase in the public social infrastructure investment affects female and male employment in N and profit share only through the multiplier effects of changes in aggregate output in the short run; i.e. the partial (pre- multiplier) effects are zero.

An increase in public social infrastructure investment has a direct positive effect on aggregate output in the short run.

The generation of new employment in the public social sector stimulates consumption in both sectors in the short run. Higher public social infrastructure investment κ^H has a positive impact on private investment in the short run due to rising aggregate output. However, an increase in κ^H may partially crowd-out investment if public debt/GDP (*D/Y*) increases in the short run. This will occur if this leads to an increase in interest rates and investment is sensitive to interest rates. Higher κ^H has an ambiguous effect on *D/Y* as both debt and GDP increase. *D/Y* may fall if the effect on GDP is sufficiently large as the rise in GDP increases both the denominator and tax revenues.

These short-run effects are summarized in Figure 4.

Figure 4

Next, Figure 5 summarizes the effect of public social infrastructure investment on productivity in the medium run, which is expected to increase through both direct and indirect effects. The indirect effects are due to changes in aggregate output depending on whether the effects of public spending on output are positive or negative in the short run. If higher public social infrastructure investment stimulates aggregate output, it also leads to an increase in households' social expenditures and public physical infrastructure investment in the short run, which may also increase labor productivity in the medium run.

An increase in κ^H affects aggregate output in the medium run through changes in labor productivity and public debt/GDP as summarized in Figure 6. If higher public social infrastructure increases labor productivity in the medium run, its partial effect on female and male employment is negative in the medium run (for a constant output in the rest of the economy, prior to the multiplier effects), and the effect on the profit share is positive. This also affects consumption in both sectors, private investment, exports and imports in the medium run. If *D/Y* increases in the short run, these effects are further transmitted to the medium run, which may partially crowd-out private investment unless there is a sufficient increase in GDP and tax revenues to offset the increase in debt.

Figures 5-7

Regarding the employment effects, higher public social infrastructure directly generates female and male employment in the social sector in the short run. Furthermore, it is also likely to generate employment in the rest of the economy by increasing the GDP in the short run (see Figure 6). It is also expected to increase the labor productivity in the rest of the economy in the medium run. This however has a direct negative effect on employment in the rest of the economy and might lead to an increase or decrease in female or male employment depending on the magnitude of the effects on aggregate output in the medium run.

As discussed above, the second reason why public social spending could rise is due to an increase in both female and male wages in the social sector, with a constant gender gap. The effects of this change are very similar to the case above, where public social spending increases due to hiring new employees: for the same amount of increase in κ^H the wage bill in H will increase by the same amount. However, less employment will be created in the social sector in the short and medium run.

Finally, comparing the effects of a simultaneous rise in wages in the social sector with the effects of closing the gender wage gap (by increasing female wages with a constant male wage), the short-run effects of the latter on consumption in both sectors are smaller. However, since women constitute a larger part of employment in H, the difference between the effects of these two cases on consumption is smaller compared to the difference between the effects of a simultaneous increase in wages vs. closing the gender gap in N.

The analytical solution of the effects of a change in κ^H and further details of the comparative statistics are presented in the online Appendix 3.

5. Data, estimation methodology and results

The behavioral specifications are econometrically estimated using time series data for the UK. The data sources are in the online Appendix 1. The hourly wage and hours of work are calculated based on EUKLEMS database for the period of 1970-2015. The national accounts data is based on the Annual Macro Economic database of the European Commission (AMECO) and the OECD for the period of 1970-2016. The tax rates are based on Eurostat. The ratio of C^H to total consumption is based on ONS (2016a).

The stylized facts of our data are presented in the online Appendix 4 and Figure 1. Despite an improvement in gender equality since the early 1980s, the ratio of the hourly wage rate of men/women in H and N are still as high as 1.313 and 1.230 respectively in 2015. The share of women in hours worked in N is still as low as 40.6% and women constitute the majority of employment in H (75.2%) in 2015.

The share of wages in national income (labor compensation/GDP at factor cost, adjusted for self-employment) fell from its peak of 0.706 to 0.584 in 1996 and despite a recovery since then, it is 4%-point below its peak at 0.665 in 2016 (own calculations based on Ameco data).

There is no time series data dating back to 1970s for unpaid care work; however, there is time use survey data for selected years. In 2014 women carried out 69.3% of the unpaid care work in the UK (ONS, 2016b), which resembles the composition of paid care work.

All behavioral equations for consumption in H and N, investment, exports and imports are estimated using IV-GMM (instrumental variable- generalized method of moments) estimations in order to address endogeneity issues.[iii] The use of IV-GMM with an innovative set of instruments to address endogeneity is a methodological innovation of the paper, and is facilitated by the presence of gendered occupational segregation and pay gap ratios at sectoral level within the data set and the model, which provided stronger instruments for wage bill or profit share. Robert Blecker, Michael Cauvel, and Yun Kim (2020) present aggregate Kaleckian econometric estimations utilizing IV for the US and Michalis Nikiforos and Duncan Foley (2012) rely on lagged variables of the wage share as IV. We also present the OLS results for comparison, and while the signs of the coefficients are robust, they are not always statistically significant. Nevertheless, the overall direction of the simulation results discussed in section 6 below are very robust with respect to different estimators.

Endogeneity issues could also be tackled by using Vector Autoregression; however, this would require a large number of observations, and make it difficult to individually specify each behavioral equation and the interpretation of the results are less straightforward (Onaran and Obst, 2016).

Overall, we acknowledge that establishing a causal nexus between distribution and demand is challenging and can only be partially addressed in a time-series framework, given the strong endogeneity problems in the model and the possibility that the exclusion restrictions may fail for the specific instruments used. Given this limitation, our empirical work is an attempt at addressing this complex issue and we refrain from making strong causal statements and interpreted the estimations as associations in our discussion of the econometric estimation results.

Unit root tests suggest that all our variables are integrated of order one. We first estimate an ARDL (autoregressive distributed lag model) specification and find no cointegration and proceed with estimating the equations in first differences for consumption in H and N, investment, exports and imports. [iv]

The productivity in N is estimated using panel data of 18 industries based on EUKLEMS for the period of 1980-2015 by IV-GMM[v]. In order to reflect medium-term effects, a non-overlapping five years average of explanatory variables (starting from 1980) and of the dependent variable (starting from 1981) are used. The use of panel data helps to model the medium-run effects, which is difficult to detect using short time series. Sector level clustered standard errors are used. Different from equation (27) for the aggregate economy, the sector's own investment per hours of labor (I_{it}/E_{it}) is also included. This is because the industrial level value-added (Y_{it}) does not include industry's investment, while at the aggregate level Y^N includes investment.[vi] As an instrument for Y_{it} , I_{it}/E_{it}, sectoral gender pay gap, and female wage, we use the first lag of strike days as a ratio to employment, the sectoral value added in each sectors in the US and the EU (as the main trade partners of the UK), gender pay gap in the rest of the economy[vii] and 11 year lags (two 5 year periods) of Y_{it} , I_{it}/E_{it}, sectoral gender pay gap, and female wage. We don't use first differences, as unit root is less relevant with five-year period averages over a short period and the test results for the validity of the instruments for differences were poor. The synthesis of time series and panel data econometrics to specify short-run and medium-run effects is another methodological novelty of the paper.

5.1. Estimation results

Estimation results for social and other consumption (equations (20-21)) are in Table 3. Multiplying elasticities with consumption as a ratio to the relevant income category, we find that the MPC in N out of women's wage income (0.924) is larger than the MPC out of men's wage income (0.865), which in turn is larger than the MPC out of profits (0.193). MPC in H is also highest out of women's wage income (0.030), followed by MPC out of men's wage income (0.021), and the MPC in H out of profits is again the smallest (0.004). To the best of our knowledge, this is the first empirical comparison of the MPC out of female and male wages and profits. The results are consistent with other estimations showing that the MPC out of wages are higher than that out of profits (see Onaran and Galanis, 2014 for a review) as well as micro-level evidence that women tend to devote a larger share of their income on social expenditures like education and healthcare compared to men (Seguino and Floro, 2013; Stotsky, 2006; Morrison, Raju, and Sinha, 2007). However, we find that the overall propensity to save for women is not higher than men. This is at odds with the micro-evidence for developing counties, which suggest that the propensity to save is higher for women due to the higher uncertainty they face. The explanatory power of the estimations for C in H is rather low.

Table 3

Table 4 presents the estimation results for investment based on equation (22). After-tax π is significant and positively associated with investment. Investment is negatively associated with public debt/GDP, which reflects some negative crowding-out effects of public borrowing on investment. There is a strong significant effect of GDP on investment.

Table 4

Tables 5-6 present the estimation results for exports and imports based on equations 24-25. Y_{world} has a statistically significant positive impact on exports, and an increase in π is associated with higher international competitiveness. The increase in Y^N leads to a significant increase in imports. A higher π is associated with lower imports, again reflecting the impact of higher international competitiveness. Exchange rates are insignificant and are excluded.

Tables 5-6

The panel data estimation results for productivity in N based on equation (27) are in Table 7. The hourly wage rates in the sector and per capita public and private spending in the social sector are statistically significant and are associated with higher productivity in N. The high effect of public spending in H on productivity N provides supporting evidence that this spending serves the purpose of infrastructure investment. The value-added in the sector has a positive albeit insignificant coefficient. In the simulation analysis, we treat this coefficient as non-zero as the p-value of the t-statistic is less than 0.30[viii]. The effect of the sector's own investment per worker and per capita public physical infrastructure investment are statistically highly insignificant and are treated as zero in the simulations.

Table 7

6. Policy analysis

In this section we use the estimated parameters in Section 5 to simulate the effects of changes in wages, the gender pay gap, and public spending in social infrastructure. The simulations assume that the change takes place in the first period, and then the relevant variables (e.g. the wage rate) stay constant in the next period.

Table 8 shows the total (post-multiplier) effects of changes in wages and the gender pay gap. While overall the direction of the simulation results are very robust with respect to different estimators, it is in place here to note that the magnitude of the effects should be seen as indicative due to the limitations of the estimation methodology discussed in section five. The details of the calculations are in Appendices 2-3.[ix] The medium run (MR) effects are calculated as the sum of the effects in the short run (SR) and the period when productivity in N changes endogenously. In our theoretical model, the time period for different factors to affect productivity is an abstract matter, e.g. the impact of public investment in childcare may take longer than the impact of other types of government spending or higher wages. In the empirical estimations of productivity, the medium run is captured by using five-year averages. Hence, one limitation of our paper is that our estimations and simulations do not capture the very long-run effects of changing variables.[x]

Scenario (A) presents the effects of a 1% increase in both female and male hourly wage rate in the rest of the economy (N); (B) presents the effects of a 1% increase in only the female hourly wage rate while keeping male wages constant in N; i.e. closing the gender pay gap in N by 1%. In both cases, all components of demand except exports increase both in the SR and MR (except for private investment in the MR in B). The multiplier is 3.628.[xi] In (A), GDP increases by 0.213% in the SR and by 0.038% in the MR; hence the economy is wage-led, although the effect is small. The increase in GDP in the MR in all scenarios is smaller than in the SR because in the medium run the increase in productivity in N leads to a decline in employment in N. In (B), GDP increases by 0.086% in the SR and by 0.021% in the MR; hence the economy is gender equality-led, but the effects are even smaller than in the case when both wages increase. Hours of employment of both men and women increase in the SR in both (A) and (B), but decrease in the MR (by 0.641% in (A) and 0.049% in (B)) as the productivity increase in N in the MR (0.780% in (A) and 0.080% in (B)) is stronger than the increase in GDP.

Table 8

(C) presents the effects of a 1% increase in both the female and male hourly wage rate in the public social sector. (H)[xii] and (D) presents the effects of a 1% increase in only female wages in H while keeping male wages constant; i.e. closing the gender pay gap in H by 1%. Demand increases again in the SR and MR. Compared to (A), the total effects on GDP are higher for various reasons: the increase in C^H is higher because the effect on women's income is more substantial and the MPC in H out of female wages is higher compared to men. The increase in investment is higher because a rise in wages in the public social sector (H) does not squeeze profits. For this reason, exports do not fall in the SR, as a rise in productivity in N by 0.645% increases π. The multiplier is 3.651. In (C) GDP increases by 0.640% in the SR and 0.480% in the MR, and in (D) GDP increases by 0.436% in the SR and 0.328% in the MR. In both scenarios, female employment increases in both the SR and MR albeit by a small amount in the MR (0.019% and 0.013% respectively), but male employment increases only in the SR and decreases slightly in the MR (0.118% and 0.081% respectively) due to productivity gains in N.

(E) presents the effects of a 1% increase in all wages in both the social sector and the rest of the economy (N and H), which is the sum of the effects in (A) and (C). (F) presents an upward convergence scenario, i.e. a 2% increase in female wage rate and 1% increase in male wage rate in N and H, which is the sum of the effects in (A), (B), (C) and (D). An example of the latter scenario is to increase average wages via an increase in the minimum wage or collective bargaining coverage while at the same time enforcing equal pay legislation and aiming at higher rates of increases in occupations at the bottom end of the pay scale, where women constitute a large share of the workforce. In the upward convergence scenario (F), GDP increases by 1.374% in the SR and 0.867% in the MR, but both female and male employment decreases in the MR (by 0.573% and 0.959% respectively). Both female and male employment are wage-led and gender equality-led in the SR but not in the MR when wages increase in both sectors.

Public debt/GDP decreases in all scenarios, including (C)-(F), all of which include a direct increase in public social spending; e.g. in (F) public debt/GDP decreases by 0.686%-points in the SR and 0.394%-points in the MR.

The results in (A) are comparable to previous research which find that the UK is a wage-led economy, although these previous results are based on the impact of the profit share on aggregate output only (Bowles and Boyer, 1995; Stockhammer and Onaran, 2004; Naastepad and Storm, 2006/7; Hein and Vogel, 2008; Onaran and Galanis, 2014; Onaran and Obst, 2016; Obst, Onaran, Nikolaidi, 2019; Calvert Jump and Mendieta-Muñoz, 2017; Oyvat, Öztunalı, and Elgin, 2020). Based on our SR results for the rise in both wages in N, a 1%-point fall in π leads to 0.331% increase in GDP after the multiplier, which is comparable to the previous research for the UK.

We should note that given our estimated parameters, an increase in male wage rate only with a constant female wage rate, i.e. increasing gender inequality, would also have positive effects on output. In the short run in N the effect of an increase in only male wage rate would create larger positive effect on output (0.127%) compared to the effect of an increase in the female wage rate (as can be seen in the difference of the effect on Y in scenario (A) minus (B)). This is because of the high employment share of men in N as well as their high MPC in N that is only slightly lower than MPC for female workers in N. However, the positive impact of a 1% increase in male wage rate on GDP is smaller than the effect of a 1% increase in female wage rate in the medium run in N (0.017%) as well as both in the short run and medium run in H (0.204% and 0.152% respectively). The stronger impact of female wage rate in H is because of the high female share in H and therefore the substantial effect on the wage income when female wages are increased. To summarize, in a wage-led economy an increase in either male or female wage rate lead to higher output. Our definition of female wage-led growth is consistent with this finding as it is defined in relation to the positive effect on output of a rise in female wage rate with a constant male wage rate.

Table 9 shows the total (post-multiplier) effects of a 1%-point increase in public spending in social infrastructure as a share of GDP **(**G^H/GDP), i.e. hiring new employees with a constant wage in the social sector (H). With higher public social spending, GDP increases substantially in both the SR (5.947%) and MR (4.481%). A 1%-point increase in G^H/GDP increases productivity in the rest of the economy (N) by a substantial amount of 5.570% in the MR. This is mostly due to the strong direct positive impact of public social spending on productivity as well as the higher rate of increase in household consumption in the social sector, as more jobs are created for women in H which predominantly hires women.

Table 9

GDP and employment effects of public spending in social infrastructure are substantially higher than the effects of increasing wages. Despite productivity increases in the rest of the economy, both female and male total employment increases in the MR. However, the increase in women's employment is much stronger compared to men in the case of hiring new employees in the public social sector due to concentration of women in this sector. Women's employment increases by 9.273% in the SR and 3.373% in the MR while men's employment increases by 6.873% in the SR and only 0.063% in the MR.[xiii]

Comparing the effects of social infrastructure with physical infrastructure three findings are worth emphasis: 1) The effects of public investment in social infrastructure on output is higher than that of public investment in physical infrastructure both in the short and medium run.[xiv] 2) The effect on women's employment is much stronger compared to men's employment with social infrastructure due to gendered occupational/sectoral segregation in employment. 3) The effect on productivity in the rest of the economy is also substantially higher in the case of social infrastructure compared to physical infrastructure. This is both due to the strong direct positive impact of social infrastructure on productivity which is absent in the case of physical infrastructure in the UK, as well as higher increase in household consumption in the social sector with more social infrastructure investment, which creates more jobs for women with a higher MPC in H.

Our SR results are comparable to the input-output table based analysis in De Henau et al. (2016) for the UK suggesting that the positive impact of social infrastructure investment on male employment is substantial; however when the increase in productivity in the MR is included in our analysis, the effect on male employment is substantially smaller. The magnitudes of the effects are not comparable as De Henau et al. (2016) focus on only childcare and social care for social infrastructure.

Public debt/GDP decreases in both the SR and MR (by 0.790%-point). Even in the MR, increasing public spending in social infrastructure funds itself due to higher output and tax revenues even though tax rates remain constant. Private investment increases overall due to the positive demand and productivity effects and lower public debt/GDP.

7. Conclusion

This paper develops a gendered macroeconomic model to analyze the effects of changes in wages, gender pay gaps and public investment in social infrastructure on output, employment of women and men, productivity and public debt/GDP.

The results indicate that there is a significant interaction between gender and functional income inequality. Closing gender pay gaps with upward convergence leads to an increase in the wage share. Similarly, public spending affects inequalities as well by effecting employment and wage income.

Changes in inequalities have crucial effects on output, employment, productivity and government budget balances. We find that an upward convergence in wages, i.e. increasing wages by closing gender pay gaps in both the social sector and the rest of the economy, leads to higher output in both the short and the medium run. The UK is both gender equality-led and wage-led, and hence equality-led. However, the positive impact on productivity is stronger in the medium run than on output, which leads to a fall in employment of both men and women.

Public spending in education, childcare, health and social care has a high positive effect on productivity in the rest of the economy. The positive impact of public social infrastructure investment on both output and employment is very strong, and despite a strong positive effect on productivity, employment of both men and women increase in the medium run. Public debt/GDP falls as an outcome of this policy even with constant tax rates.

To summarize, achieving higher wages, gender equality and employment for both men and women at the same time would require a policy mix of upward convergence in wages and an increase in demand, e.g. via public investment in social infrastructure.

One caveat of using time series analysis to address the causal nexus between distribution and demand is the strong endogeneity between wages, employment and demand and our results should be regarded as indicative of associations which can guide further research.

References

Agenor, Pierre.R. and Agenor, Madina 2014. Infrastructure, women's time allocation, and economic development," Journal of Economics, 113:1-30

Allain, Olivier 2015. Tackling the instability of growth: a Kaleckian-Harrodian model with an autonomous expenditure component, Cambridge Journal of Economics, vol. 39, no. 1, 1351-1371

AMECO 2016. Annual macro-economic database of the European Commission, http://ec.europa.eu/economy_finance/ameco/user/serie/SelectSerie.cfm

Antonopoulos, Rania, Kijong Kim, Thomas Masterson and Ajit Zacharias. 2010. Investing in Care: A Strategy for Effective and Equitable Job Creation. Working Paper No.610. Levy Economics Institute.

Bargawi, Hannah. and Cozzi, Giovanni. 2017. Engendering Economic Recovery: Modeling Alternatives to Austerity in Europe, Feminist Economics, 23(4):225-24

Becker, Garry.S., Murphy, Kevin.M. and Tamura, Robert, 1990. Human capital, fertility, and economic growth. Journal of Political Economy 98 (5):12–37.

Benhabib, Jess, Rogerson, Richard and Wright, Randall, 1991. Homework in macroeconomics: Household production and aggregate fluctuations, Journal of Political economy, 99:1166–1187.

Bhaduri, Amit, and Stephen Marglin, 1990 Unemployment and the real wage: the economic basis for contesting political ideologies, Cambridge Journal of Economics, 14:375-93.

Blecker, Robert. 1989. International competition, Income Distribution and Economic Growth, Cambridge Journal of Economics, 13(3):395-412

Blecker, Robert 2002. Distribution, Demand, and Growth in Neo-Kaleckian Macro Models. in M. Setterfield (ed.). The Economics of Demand-Led Growth: Challenging the Supply-Side Vision of the Long Run. Cheltenham (UK) and Northampton (MA, USA): Edward Elgar.

Blecker, Robert, Cauvel, Michael, and Kim, Yun 2020. Systems Estimation of a Structural Model of Distribution and Demand in the US Economy, Working Papers PKWP2012, Post Keynesian Economics Society

Bowles, Samuel, and Boyer, Robert. 1995. Wages, aggregate demand, and employment in an open economy: an empirical investigation. In: G Epstein and H Gintis (eds): Macroeconomic policy after the conservative era. Studies in investment, saving and finance. Cambridge: University Press

Braunstein, Elissa, Irene van Staveren and Daniele Tavani 2011. Embedding Care and Unpaid Work in Macroeconomic Modelling: A Structuralist Approach. Feminist Economics 17(4):5–31.

Braunstein, Elissa, Rachid Bouhia, and Stephanie Seguino, 2018 Social Reproduction, Gender Equality and Economic Growth, forthcoming

Calvert Jump, Robert. and Mendieta-Muñoz, Ivan. 2017. Wage led aggregate demand in the United Kingdom. International Review of Applied Economics 31(5):565-584 .

Cassetti, Mario. 2003. Bargaining power, effective demand and technical progress: A Kaleckian model of growth. Cambridge Journal of Economics, 27(3):449–464.

Cavalcanti, Tiago, and Tavares, José. 2016. The output cost of gender discrimination: a model-based macroeconomics estimate. The Economic Journal, 126(590):109-134

Chinn, Menzie and Ito, Hiro. 2020. The Chinn-Ito Index. Available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm

Commendatore, Pasquale, Panico, Carlo, and Pinto, Antonio. 2011. The influence of different forms of government spending on distribution and growth, Metroeconomica, 62(1):1-23

Cuberes, David and Teignier, Marc, 2014. Gender inequality and economic growth: A critical review, Journal of International Development, 26(2):260-276.

De Henau, Jerome, Himmelweit, Susan, Łapniewska, Zofia and Perrons, Diane, 2016. Investing in the Care Economy: A gender analysis of employment stimulus in seven OECD countries. Report by the UK Women's Budget Group for the International Trade Union Confederation, Brussels.

Doepke, Matthias, and Tertilt, Michele 2016. Families in Macroeconomics, Handbook of Macroeconomics, Volume 2, eds. J. B. Taylor and Harald U., pp. 1789-1891, North HollandDutt, A.K. 2006. Aggregate demand, aggregate supply and economic growth. International Review of Applied Economics 20(3): 319–336.

Dutt, Amitava.K. 2010. Reconciling the growth of aggregate demand and aggregate supply, in Setterfield, M. (ed.), Handbook of Alternative Theories of Economic Growth, pp. 220–240. London: Edward Elgar.

Elson, Diane, 2017. A Gender-equitable Macroeconomic Framework for Europe, in Economics and Austerity in Europe: Gendered Impacts and Sustainable Alternatives, eds. Hannah Bargawi, Giovanni Cozzi, Susan Himmelweit, Routledge, pp.15-26

European Commission 2000. Structures of the taxation systems in the European Union 1970-1997, https://ec.europa.eu/taxation_customs/business/economic-analysis-taxation/taxation-trends-eu-union/taxation-trends-eu-union_en

EU KLEMS Growth and Productivity Accounts, releases 2009, 2012, 2018, http://www.euklems.net/

Fukui, Masao, Nakamura, Emi, and Steinsson, Jón. 2019. Women, Wealth Effects, and Slow Recoveries, NBER Working Paper No. 25311

Gechert, Sebastian. 2015. What fiscal policy is most effective? A meta-regression analysis, *Oxford Economic Papers*, vol. 67, no. 3, 553-580Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L. Violante 2017. The macroeconomics of the quiet revolution: understanding the implications of the rise in women's participation for economic growth and inequality, Research in Economics, 71:521–539.

Hein, Eckhard 2018. Autonomous government expenditure growth , deficits , debt , and distribution in a neo-Kaleckian growth model, Journal of Post Keynesian Economics. Taylor & Francis, 41(2): 316–338.

Hein, Eckhard and Vogel, Lena. 2008.Distribution and growth reconsidered – empirical results for six OECD countries, Cambridge Journal of Economics, 32: 479-511.

Hein, Eckhard and Artur Tarassow 2010. Distribution, Aggregate Demand and Productivity Growth—Theory and Empirical Results for Six OECD Countries based on a Post-Kaleckian Model. Cambridge Journal of Economics 34:727–754.

İlkkaracan, İpek, Kim, Kijong 2019. The employment generation impact of meeting SDG targets in early childhood care, education, health and long-term care in 45 countries, Geneva, ILO, forthcoming

İlkkaracan, İpek, Kim, Kijong. and Kaya, Tolga 2015. The Impact of Public Investment in Social Care Services on Employment, Gender Equality, and Poverty: The Turkish Case. Research Project Report, Istanbul Technical University Women's Studies Center in Science, Engineering and Technology and the Levy Economics Institute, in partnership with ILO and UNDP Turkey, and the UNDP and UN Women Regional Offices for Europe and Central Asia.

ILO. 2020. ILOSTAT database. Available at https://ilostat.ilo.org/data/

Klasen, Stephan, and Lamanna, Francesca 2009. The impact of gender inequality in education and employment on economic growth: new evidence for a panel of countries, Feminist Economics 15(3):91-132

Ko, Min-Chang 2018. Fiscal policy, government debt, and economic growth in the Kaleckian model of growth and distribution, Journal of Post Keynesian Economics, 1-17

Stephen Knowles, Paula,K. Lorgelly, P.Dorian Owen, 2002. Are educational gender gaps a brake on economic development? some cross-country empirical evidence, Oxford Economic Papers 54(1):118-49

Lundberg, Shelly and Pollak, Robert,A. 1996. Bargaining and distribution in marriage. Journal of Economic Perspectives, 10(4):139-158.

Morrison, Andrew, Raju, Dhushyanth, and Sinha, Nistha 2007. Gender equality, poverty and economic growth. Policy Research Working Paper 4349, The World Bank.

Mott, Tracy and Slattery, Edward 1994. Tax incidence and macroeconomic effects in a Kaleckian model when profits finance affects investment and prices may respond to taxes, Journal of Post Keynesian Economics, 16(3):391-409

Naastepad, Ro (C.W.M.) 2006. Technology, demand and distribution: a cumulative growth model with an application to the dutch productivity growth slowdown. Cambridge Journal of Economics 30:403–434.

Naastepad, Ro (C.W.M.) and Storm, Servaas. 2006. OECD demand regimes (1960-2000), Journal of Post Keynesian Economics, 29(2):211-246

Nikiforos, Michalis and Duncan Foley (2012). Distribution and capacity utilization: Conceptual issues and empirical evidence. Metroeconomica 63 (1), 200–229.

Office of National Statistics (ONS) 2016a, Consumption Trends, https://www.ons.gov.uk/economy/nationalaccounts/satelliteaccounts/timeseries/abjr/ukea

ONS, 2016b. Women shoulder the responsibility of 'unpaid work, https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/articles/womenshouldertheresponsibilityofunpaidwork/2016-11-10

Obst, Thomas, Onaran, Özlem, & Nikolaidi, Maria. 2019. A post-Kaleckian analysis of the effect of income distribution, public spending and taxes on demand, investment and budget balance: the case of Europe. Cambridge Journal of Economics, forthcoming

Onaran, Özlem, 2016. The role of gender equality in an equality-led sustainable development strategy, in Economics and Austerity in Europe: Gendered Impacts and Sustainable Alternatives, eds. Hannah Bargawi, Giovanni Cozzi, Susan Himmelweit, Routledge pp.40-56.

Onaran, Özlem, Boesch, Valerie. and Leibrecht, Markus. 2012. How does globalization affect the implicit tax rates on labor income, capital income, and consumption in the European Union? Economic Inquiry, 50(4): 880-904

Onaran, Özlem and Galanis, Giorgos. 2014. Income distribution and growth: a global model, Environment and Planning A 46(10):2489-2513

Onaran, Ö and Obst, Thomas, 2016. Wage-led growth in the EU15 Member States: the effects of income distribution on growth, investment, trade balance, and inflation", Cambridge Journal of Economics, 40(6):1517–1551

Onaran, Özlem, Engelbert Stockhammer, and Lucas Grafl 2011. The finance-dominated growth regime, distribution, and aggregate demand in the US, Cambridge Journal of Economics 35 (4):637-661.

Oyvat, Cem, Öztunalı, Ozan and Elgin, Ceyhun. 2020. Wage-led versus profit-led demand: a comprehensive empirical analysis. Metroeconomica. 71(3), 458-486.

Palley, Thomas,I., 1996. Aggregate demand in a reconstruction of growth theory, Review of Political Economy, 8:23–35.

Palley, Thomas,I. 2013. Cambridge and neo-Kaleckian growth and distribution theory: comparison with an application to fiscal policy, Review of Keynesian Economics, vol. 1, no. 1, 79-104

Palley, Thomas,I. 2014. A neo-Kaleckian-Goodwin model of capitalist economic growth: monopoly power, managerial pay, and labor market conflict, Cambridge Journal of Economics, 38 (6):1355 – 1372.

Phipps, Shelley,A., and Burton, Peter,S. 1998. What's mine is yours? The influence of male and female incomes on patterns of household expenditure. Economica, 65(260):599-613.

Pollitt, Hector, Sophie Billington, Katerina Mantouvalou, Jakub Caisl and Claudia Villosio 2017. Economic Benefits of Gender Equality in the European Union, European Institute for Gender Equality, Brussels.

Qazizada, Walid, Stockhammer, Engelbert, 2015. Government spending multipliers in contraction and expansion, *International Review of Applied Economics* 29, 2: 238-258

Seguino, Stephanie. 2010. Gender, Distribution, and Balance of Payments Constrained Growth in Developing Countries. Review of Political Economy 22(3):373–404.

Seguino, Stephanie. 2012. Macroeconomics, Human Development, and Distribution. Journal of Human Development and Capabilities: A Multi-Disciplinary Journal for People-Centered Development 13(1):59–81.

Seguino, Stephanie. 2017. Engendering Macroeconomic Theory and Policy, The World Bank Report 121781, Washington, D.C.

Seguino, Stephanie, and Floro, Maria, Sergy. 2003. Does gender have any effect on aggregate saving? An empirical analysis. International Review of Applied Economics, 17(2):147-166.

Setterfield, Mark. 2006. Thirlwall's law and Palley's pitfalls: a reconsideration, in Arestis, P., McCombie, J., and Vickerman, R. (eds), Growth and Economic Development: Essays in Honour of A.P. Thirlwall, Cheltenham, UK & Northampton, MA, Edward Elgar.

Stockhammer, Engelbert, Onaran, Özlem, and Ederer, Stefan. 2009 Functional income distribution and aggregate demand in the Euro area, Cambridge Journal of Economics, 33 (1):139-159.

Stockhammer, Engelbert, and Özlem Onaran 2004. Accumulation, distribution and employment: a structural VAR approach to a Kaleckian macro-model, Structural Change and Economic Dynamics, 15:421-47.

Stockhammer, Engelbert, Qazizada, Walid, Gechert, Sebastian. (2019) 'Demand effects of fiscal policy since 2008', *Review of Keynesian Economics* 7, 1: 57-74 Storm, Servaas and Naastepad, Ro (C.W.M.) 2013. "Wage-led and profit-led supply: wages, productivity and investment", in eds. Marc Lavoie and Engelbert Stockhammer, Wage-led Growth: an Equitable Strategy for Economic Recovery, pp. 100-124, Palgrave Macmillan, Basingstoke.

Stotsky, Janet,G. 2006. Gender and its relevance to macroeconomic policy: A survey. IMF Working Paper. WP/06/233, IMF

Tavani, Daniele. and Zamparelli, Luca 2017a. Government spending composition, aggregate demand, growth, and distribution, Review of Keynesian Economics, 5(2):239-258

Tavani, Daniele. and Zamparelli, Luca 2017b. Endogenous technical change in alternative theories of growth and distribution, Journal of Economic Surveys 31(5):1272–1303

You, Jong-Il and Dutt, Amitava,K. 1996. Government debt, income distribution and growth, Cambridge Journal of Economics, 20(1):335–351.

Table 1: The regimes and their conditions in the case of an increase in female wages in N with a declining gender wage gap

Case	**Growth Regime**	**Condition**
Rising (declining) female wages increase (reduce) aggregate output in the short run	Female wage-led/gender equality-led in the short run	|Impact of w_t^{NF} on total consumption| > |Impact of w_t^{NF} on investment + net exports|
Rising (declining) female wages reduce (increase) aggregate output in the short run	Gender inequality-led in the short run	|Impact of w_t^{NF} on total consumption| < |Impact of w_t^{NF} on investment + net exports|
Rising (declining) female wages increase (reduce) aggregate output in the medium run	Female wage-led/gender equality-led in the medium run	Ambiguous due to effects on labor productivity
Rising (declining) female wages reduce (increase) aggregate output in the medium run	Gender inequality-led in the medium run	Ambiguous due to effects on labor productivity

Table 2: The demand regimes in the short run

	Wage-led in the short run	**Profit-led in the short run**
Female wage-led/ gender equality-led in the short run	|Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on total consumption| > |Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on investment + net exports| & |Impact of w_t^{NF} on total consumption| > |Impact of w_t^{NF} on investment + net exports|	|Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on investment + net exports| > |Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on total consumption| > |Impact of w_t^{NF} on total consumption| > |Impact of w_t^{NF} on investment + net exports|
Gender inequality-led in the short run	|Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on total consumption| > |Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on investment + net exports| > |Impact of w_t^{NF} on investment + net exports > |Impact of w_t^{NF} on total consumption|	|Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on total consumption| < |Impact of w_t^{NF} & w_t^{NM} (constant α_t^N) on investment + net exports| & |Impact of w_t^{NF} on total consumption| < |Impact of w_t^{NF} on investment + net exports|

Table 3: IV-GMM and OLS estimation results for consumption in N and H

	GMM-IV				*OLS*			
Dependent variable	$\Delta \log C^N_t$		$\Delta \log C^H_t$		$\Delta \log C^N_t$		$\Delta \log C^H_t$	
Variable	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Constant	0.008	0.000	0.007	0.014	0.008	0.018	0.011	0.049
$\Delta \log(R_t(1-t^R_t))$	0.081	0.000	0.040	0.064	0.107	0.000	0.030	0.479
$\Delta \log(WB^F_t(1-t^W_t))$	0.277	0.000	0.204	0.003	0.254	0.001	0.209	0.136
$\Delta \log(WB^M_t(1-t^W_t))$	0.441	0.000	0.243	0.060	0.443	0.000	0.126	0.611
R^2	0.697		0.083		0.710		0.096	
Kleibergen-Paap rk Wald F statistic for weak identification	28.06		28.06		-		-	
Hansen J overidentification test (p-value)	0.315		0.203		-		-	
Durbin-Wu-Hausman test for endogeneity (p-value)	0.012		0.977		-		-	
Sample	1973-2015		1973-2015		1973-2015		1973-2015	

Notes: Robust standard errors used. Stock-Yogo weak ID critical test values for GMM-IVs are 19.94 for a 10% maximal IV size, 10.70 for a 15% maximal IV size, 5.91 for a 20% maximal IV size, and 4.24 for 25% maximal IV size. We use contemporaneous, one-year and two-year lagged differences of $\log \alpha^N$,$\log \alpha^H$, $\log t^R$, $\log t^W$, $\log \beta^N$, $\log \beta^H$, $\log Y^W$, logarithm of strike days as a ratio to employment as instruments for all independent variables.

Table 4: IV-GMM and OLS estimation results for private investment

	GMM-IV		*OLS*	
Dependent variable	$\Delta \log I_t$		$\Delta \log I_t$	
Variable	Coeff.	p-value	Coeff.	p-value
Constant	-0.028	0.000	-0.026	0.007
$\Delta \log(\pi_t(1-t^R_t))$	0.192	0.000	0.172	0.110
$\Delta \log Y_t$	2.379	0.000	2.264	0.000
$\Delta \log(D/Y)_t$	-0.217	0.000	-0.140	0.152
R^2	0.663		0.675	
Kleibergen-Paap rk Wald F statistic for weak identification	8.68		-	
Hansen J overidentification test (p-value)	0.359		-	
Durbin-Wu-Hausman test for endogeneity (p-value)	0.692		-	
Sample	1974-2016		1974-2016	

Notes: Robust standard errors used. Stock-Yogo weak ID critical test values for GMM-IVs are 20.31 for a 10% maximal IV size, 10.78 for a 15% maximal IV size, 5.87 for a 20% maximal IV size, and 4.16 for 25% maximal IV size. We use contemporaneous, one-year and two-year lagged differences of $\log \alpha^N$, $\log t^R$, $\log t^W$, $\log \beta^N$, $\log \kappa^H$, $\log Y^W$, logarithm of strike days as a ratio to employment and 1-3 year lagged differences of log*(D/Y)* as instruments for all independent variables.

Table 5: IV-GMM and OLS estimation results for exports

	GMM-IV		*OLS*	
Dependent variable	$\Delta logX_t$		$\Delta logX_t$	
Variable	Coeff.	p-value	Coeff.	p-value
Constant	-0.025	0.008	-0.018	0.108
$\Delta log(\pi_t)$	0.230	0.018	0.127	0.301
$\Delta logY^{World}_t$	2.167	0.000	1.930	0.000
R^2	0.503		0.473	
Kleibergen-Paap rk Wald F statistic for weak identification	26.94		-	
Hansen J overidentification test (p-value)	0.434		-	
Durbin-Wu-Hausman test for endogeneity (p-value)	0.6204		-	

Notes: Robust standard errors used. Stock-Yogo weak ID critical test values for GMM-IVs are 20.25 for a 10% maximal IV size bias, 11.39 for a 15% maximal IV size bias, 6.69 for a 20% maximal IV size bias, and 4.99 for 25% maximal IV size bias. We use one-year and two-year lagged differences of $\log \kappa^H$, $\log Y^N$, logarithm of strike days as a ratio to employment and Chinn-Ito capital account openness index as instruments for $\Delta log(\pi_t)$.

Table 6: IV-GMM and OLS estimation results for imports

	GMM-IV		*OLS*	
Dependent variable	$\Delta logM_t$		$\Delta logM_t$	
Variable	Coeff.	p-value	Coeff.	p-value
Constant	0.001	0.751	0.008	0.238
$\Delta log(\pi_t)$	-0.307	0.001	-0.227	0.074
$\Delta logY^N_t$	1.836	0.000	1.643	0.000
R^2	0.627		0.622	
Kleibergen-Paap rk Wald F statistic for weak identification	11.98		-	
Hansen J overidentification test (p-value)	0.295		-	
Durbin-Wu-Hausman test for endogeneity (p-value)	0.692		-	
Sample	1973-2016		1973-2016	

Notes: Robust standard errors used. Stock-Yogo weak ID critical test values for GMM-IVs are 20.33 for a 10% maximal IV size bias, 11.00 for a 15% maximal IV size bias, 6.14 for a 20% maximal IV size bias, and 4.43 for 25% maximal IV size bias. We use contemporaneous, one-year and two-year lagged differences of $\log \alpha^N$, , $\log \beta^N$, $\log \kappa^H$, $\log Y^W$, logarithm of strike days as a ratio to employment and Chinn-Ito capital account openness index as instruments for all independent variables.

Table 7: IV-GMM estimation results for labor productivity in N

	GMM-IV		*OLS*	
Dependent variable	$\log T_{it}$		$\log T_{it}$	
Variable	Coeff.	p-value	Coeff.	p-value
$\log Y_{i(t-1)}$	0.141	0.297	0.253	0.005
$\log I_{i(t-1)}/E_{i(t-1)}$	-0.025	0.806	-0.104	0.091
$\log w^F_{i(t-1)}$	0.650	0.000	0.603	0.000
$\log \alpha_{i(t-1)}$	0.622	0.000	0.553	0.000
$\log(G^H_{t-1}+C^H_{t-1})/N_{t-1}$	0.402	0.014	0.487	0.002
$\log(I^G_{t-1})/N_{t-1}$	-0.069	0.336	-0.126	0.014
R-squared	0.913		0.917	
Kleibergen-Paap rk Wald F statistic for weak identification	7.509		-	
Hansen J overidentification test (p-value)	0.146		-	
Durbin-Wu-Hausman test for endogeneity (p-value)	0.217		-	
Number of observations	126		126	
Number of sectors	18		18	
Sample	1981-2015		1981-2015	

Notes: Both regressions include yearly fixed effects. The time indicator t refers to five-year non-overlapping average of explanatory variables starting from 1980 and of the dependent variable starting from 1981. One year lags of $\log Y_i$, $\log I_i/E_i$, $\log w^F_i$, $\log \alpha_i$ are instrumented by one year lags of strike days as a a ratio to employment for six broad sectors, logarithms of sectoral value added in each 18 sectors in the US, logarithms of sectoral value added in each 18 sectors in the EU-12, logarithms of α^N for the UK; 11 year lags of $\log Y_i$, $\log I_i/E_i$, $\log w^F_i$, $\log \alpha_i$.

Table 8: The total (post-multiplier) effects of changes in wages and gender pay gap on the components of aggregate demand (as a ratio to GDP), GDP, employment and public debt/GDP

	%-point change in consumption in N /GDP	%-point change in consumption in H /GDP	%-point change in private investment /GDP	%-point change in exports /GDP	%-point change in imports in N /GDP	%-point change in public social infrastructure investment /GDP	%-point change in government current expenditure /GDP	%-point change in public physical infrastructure investment /GDP	% change in GDP	% change in total employment	% change in female employment	% change in male employment	%-point change in public debt /GDP
	$\Delta C^N/Y$	$\Delta C^H/Y$	$\Delta I/Y$	$\Delta X/Y$	$\Delta M/Y$	$\Delta G^H/Y$	$\Delta G^C/Y$	$\Delta I^G/Y$	$\Delta Y/Y$	$\Delta E/E$	$\Delta E^F/E^F$	$\Delta E^M/E^M$	$\Delta D/Y$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)(i)	(10)	(11)	(12)	(13)
A. The effects of a 1% increase in female and male wages in N													
SR (ii)	0.400	0.011	0.040	-0.084	0.209	0.026	0.022	0.006	0.213	0.224	0.230	0.219	-0.156
MR (ii)	0.081	0.000	0.008	-0.018	0.042	0.005	0.004	0.001	0.038	-0.641	-0.564	-0.704	-0.075
B. Closing gender pay gap in N by 1%: the effects of a 1% increase in only female wages in N (1% decline in α^{N})													
SR	0.137	0.004	0.021	-0.025	0.072	0.010	0.009	0.003	0.086	0.091	0.093	0.089	-0.061
MR	0.080	0.003	-0.003	-0.023	0.041	0.003	0.002	0.001	0.021	-0.049	-0.040	-0.055	-0.037
C. The effects of a 1% increase in female and male wages in H													
SR	0.336	0.050	0.249	0.000	0.239	0.160	0.065	0.019	0.640	0.673	0.691	0.660	-0.257
MR	0.064	0.041	0.212	0.054	0.094	0.140	0.049	0.014	0.480	-0.057	0.019	-0.118	-0.163
D. Closing gender pay gap in H by 1%: the effects of a 1% increase in only female wages in H (1% decline in α^{H})													
SR	0.229	0.036	0.170	0.000	0.164	0.107	0.044	0.013	0.436	0.459	0.471	0.449	-0.212
MR	0.044	0.030	0.145	0.037	0.065	0.094	0.033	0.010	0.328	-0.040	0.013	-0.081	-0.118
E: The effects of a 1% increase in female and male wages in both N and H (iii)													
SR	0.736	0.061	0.289	-0.084	0.447	0.186	0.087	0.025	0.852	0.898	0.921	0.879	-0.413
MR	0.145	0.041	0.221	0.036	0.136	0.145	0.053	0.016	0.519	-0.699	-0.545	-0.822	-0.239
F. Upward convergence: The effects of a 2% increase in female wages and 1% increase in male wages in both N and H (closing gender pay gaps by 1%; 1% decline in α^H (i) and α^N (iv))													
SR	1.101	0.102	0.479	-0.109	0.683	0.303	0.140	0.041	1.374	1.447	1.485	1.417	-0.686
MR	0.269	0.074	0.363	0.049	0.243	0.241	0.088	0.026	0.867	-0.787	-0.573	-0.959	-0.394

Notes :(i) Column (9)=(1)+(2)+(3)+(4)-(5)+(6)+(7)+(8). In each column, the effects in Appendices 2-3 are multiplied by the wage rate in the relevant sector and divided by Y.

(ii) SR: short-run. MR: medium-run, defined as the cumulative of the effects in the short-run and the period when productivity changes.

(iii) Sum of the effects in simulations (A) and (C)

(iv) Sum of the effects in simulations (A), (B), (C) and (D)

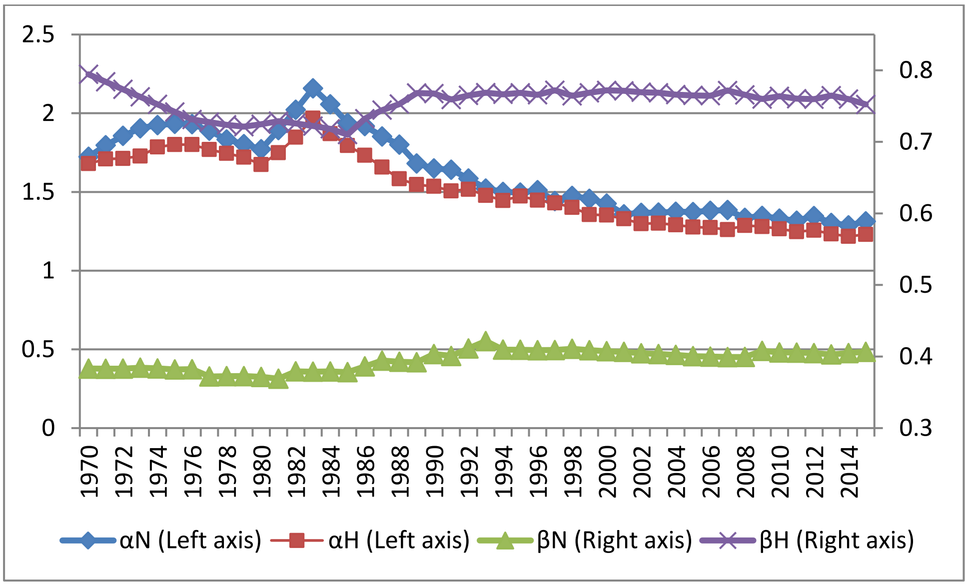
Table 9: The total (post-multiplier) effects of changes in public spending in social infrastructure as a share of GDP (κ^H) on the components of aggregate demand (as a ratio to GDP), GDP, employment and public debt/GDP

	%-point change in consumption in N /GDP	%-point change in consumption in H /GDP	%-point change in private investment /GDP	%-point change in exports /GDP	%-point change in imports in N /GDP	%-point change in public social infrastructure investment /GDP	%-point change in government current expenditure /GDP	%-point change in public physical infrastructure investment /GDP	% change in GDP	% change in total employment	% change in female employment	% change in male employment	%-point change in public debt /GDP
	$\Delta C^N/Y$	$\Delta C^H/Y$	$\Delta I/Y$	$\Delta X/Y$	$\Delta M/Y$	$\Delta G^H/Y$	$\Delta G^C/Y$	$\Delta I^G/Y$	$\Delta Y/Y$	$\Delta E/E$	$\Delta E^F/E^F$	$\Delta E^M/E^M$	$\Delta D/Y$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)[(i)]	(10)	(11)	(12)	(13)
SR (ii)	3.168	0.087	2.288	0.000	2.101	1.722	0.605	0.178	5.947	7.941	9.273	6.873	-2.478
MR (ii)	0.779	0.006	1.911	0.466	0.816	1.544	0.456	0.134	4.481	1.536	3.373	0.063	-0.790

Notes: (i) Column (9)=(1)+(2)+(3)+(4)-(5)+(6)+(7)+(8). In each column, the effects in Appendix 3 are divided by Y.

(ii) SR: short run. MR: medium-run, defined as the cumulative of the effects in the short-run and the period when productivity in N changes endogenously.

Figure 1: The ratio of hourly wage rate of men/women (α) and share of women in hours worked (β) in the social sector (H) and the rest of the economy (N) in the UK



Source: Own calculations based on EU KLEMS database

Figure 2: The effects of female wages in N on labor productivity in the medium run

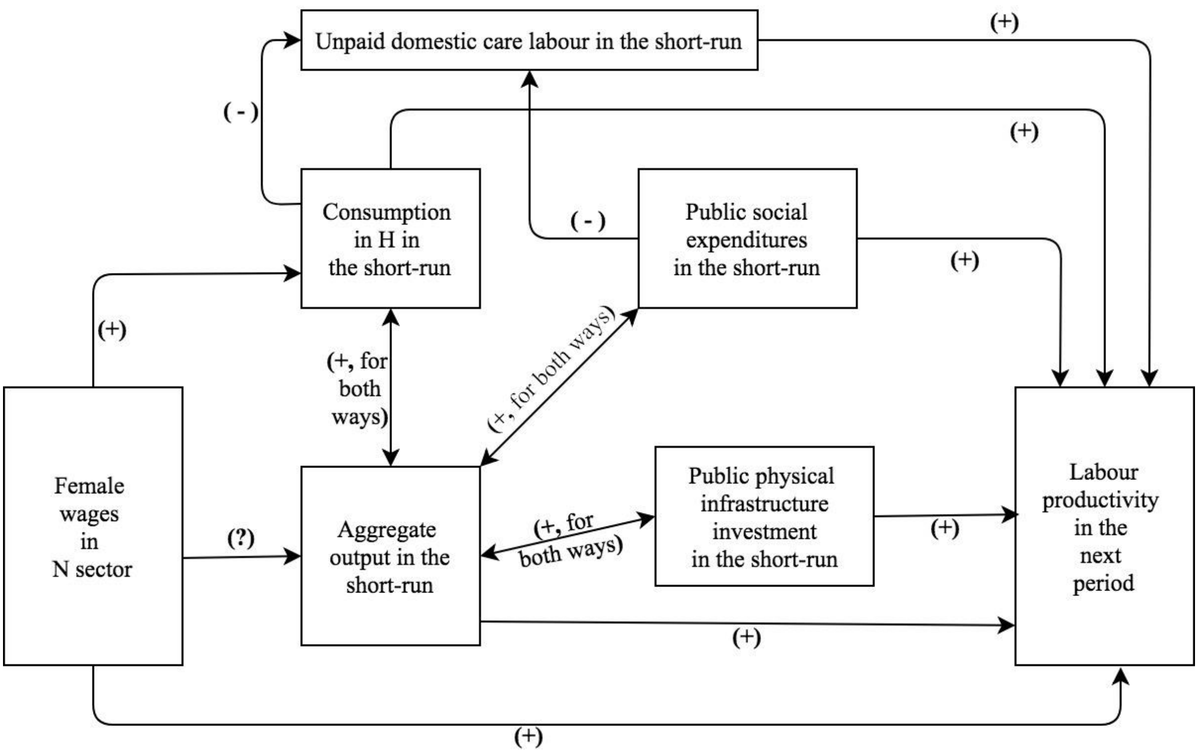


Figure 3: The effects of an increase in female wages in N on total employment in the short run and in the medium run

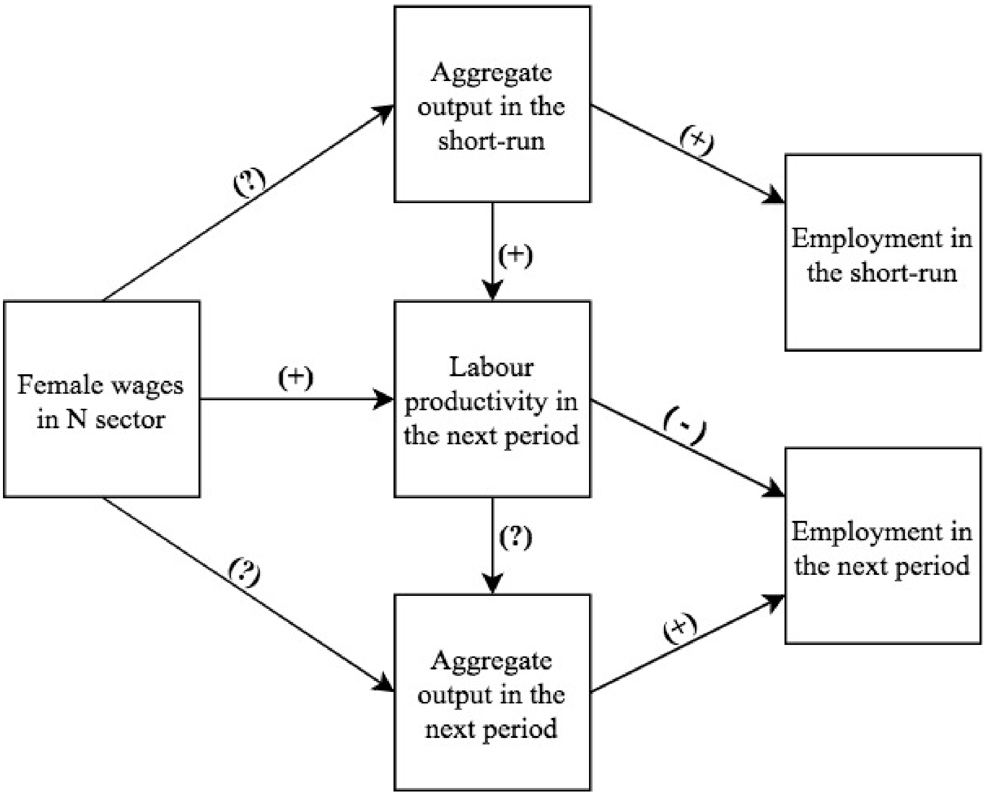
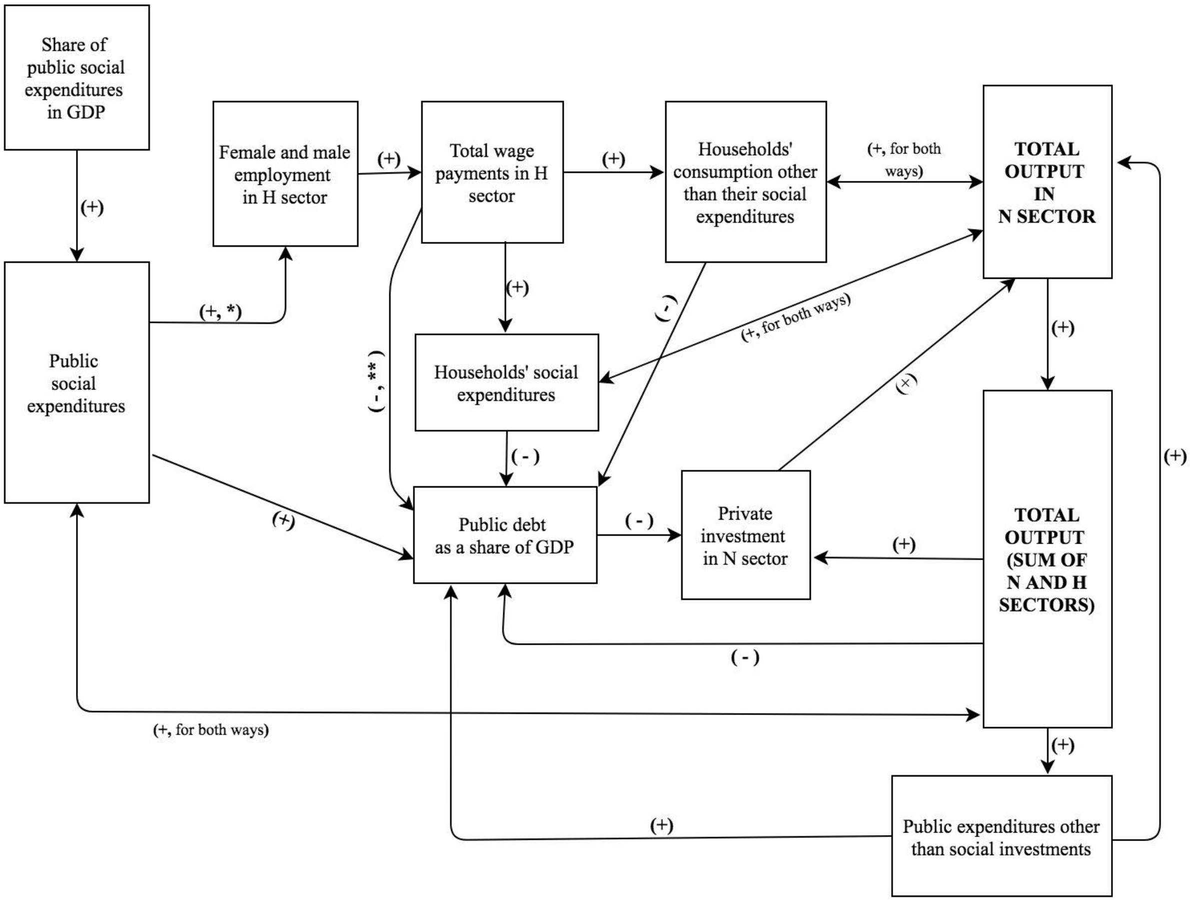


Figure 4: The effects of an increase in public social infrastructure investment on total output in the short run



* Based on Figure 1, the positive partial impact of public social expenditures is expected to be relatively larger for female employment compared to the partial impact from expenditures in N sector.
** The impact of total wage payments in H sector is through its impact on wage taxes.

Figure 5: The effects of an increase in public social infrastructure investment on labor productivity in the medium run

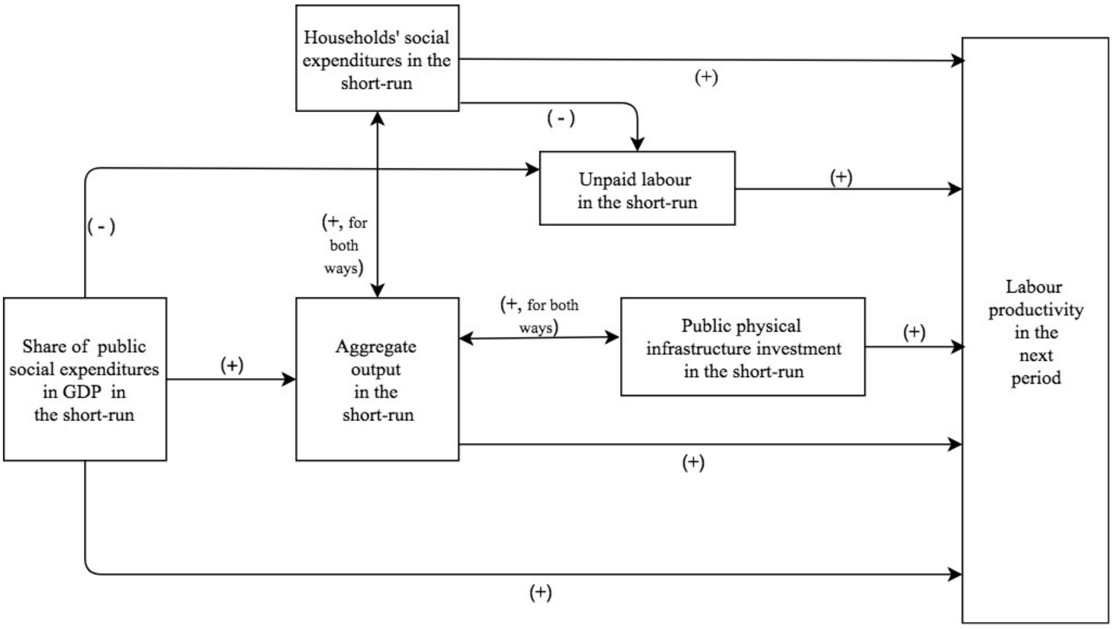


Figure 6: The effects of an increase in public social infrastructure investment on total output in the medium run

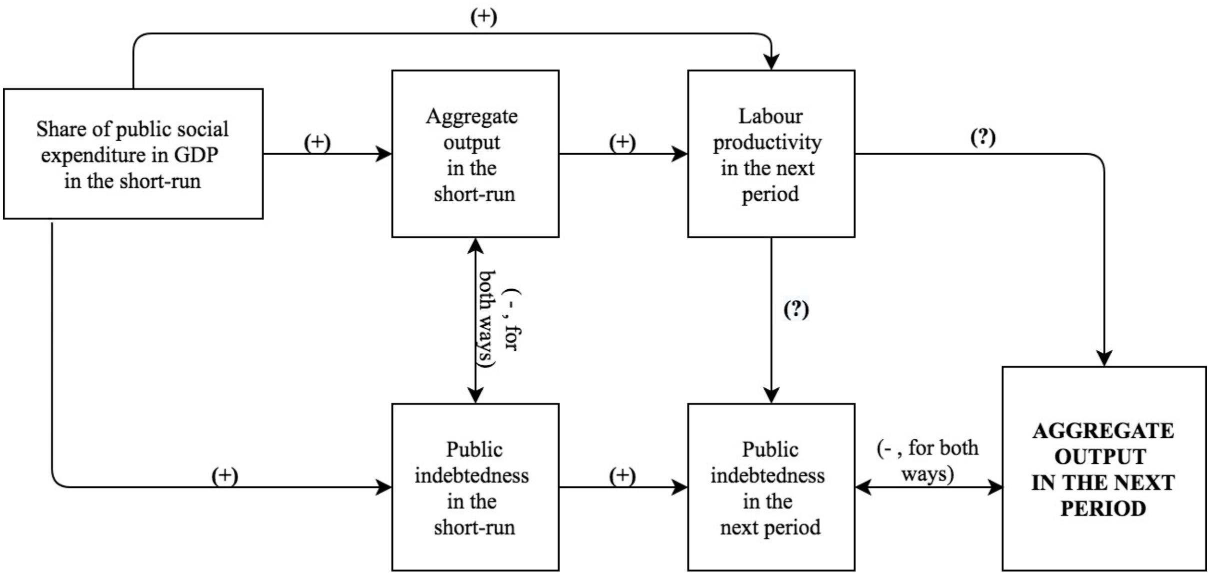
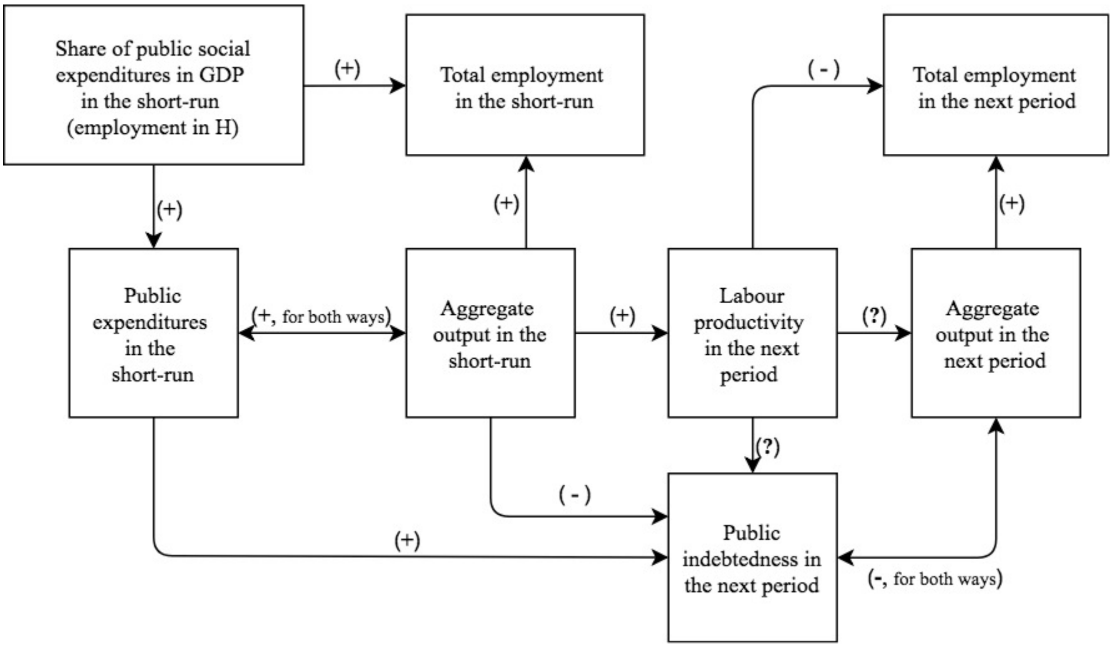


Figure 7: The effects of public social infrastructure investment on total employment in the short run and in the medium run



Online Appendix 1: Variables and data sources

Symbol	Variable name	Source	Time
Y	Aggregate output, GDP (real), in billions	AMECO	1970-2016
WB	Total wage bill, labour compensation adjusted for the labour income of the self-employed (real), in billions	AMECO, own calculations	1970-2015
WB^F	Total wage bill for female workers (real, adjusted labour compensation), in billions	Own calculations based on data from AMECO and EUKLEMS (1)	1970-2015
WB^M	Total wage bill for male workers (real, adjusted labour compensation), in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
E^H	Total employment in the public social sector (total hours worked by persons engaged in education and health & social work categories of the industrial classification of EUKLEMS), in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
E^N	Total employment in the rest of the economy, in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
E^{HF}	Hours of Employment of women in the public social sector, in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
E^{HM}	Hours of Employment of men in the public social sector, in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
E^{NF}	Hours of Employment of women in the rest of the economy, in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
E^{NM}	Hours of Employment of men in the rest of the economy, in billions	Own calculations based on data from AMECO and EUKLEMS	1970-2015
w^{HF}	Average female hourly wage rate in the public social sector (real)	Own calculations based on data from AMECO and EUKLEMS	1970-2015
w^{HM}	Average male hourly wage rate in the social sector (real)	Own calculations based on data from AMECO and EUKLEMS	1970-2015
w^{NF}	Average female hourly wage rate in the rest of the economy (real)	Own calculations based on data from AMECO and EUKLEMS	1970-2015
w^{NM}	Average male hourly wage rate in the rest of the economy (real)	Own calculations based on data from AMECO and EUKLEMS	1970-2015
α^H	Ratio between male and female wages in the public social sector	Own calculations based on data from EUKLEMS	1970-2015
α^N	Ratio between male and female wages in the rest of the economy	Own calculations based on data from EUKLEMS	1970-2015
C^H	Households' private social expenditures (real), in billions	Own calculations based on data from Office of National Statistics (ONS) (2016a) and AMECO (2)	1970-2016
C^N	Private consumption of goods and services in the rest of the economy (real), in billions	Own calculations based on data from Office of National Statistics (ONS) (2016) and AMECO (2)	1970-2016
I	Private investment (real), in billions	AMECO, own calculations	1970-2016
G^C	Government's consumption expenditures (real), in billions	Own calculations based on data from OECD National Accounts and AMECO	1970-2016
I^G	Public investments other than investments in the social sector (real), in billions	AMECO, own calculations	1970-2016
G^H	Government's social infrastructure expenditures (real), in billions	Own calculations based on data from OECD National Accounts and AMECO	1970-2016
M	Imports (real), in billions	AMECO	1970-2016
X	Exports (real), in billions	AMECO	1970-2016
Y^H	Total expenditure in the social sector (real), in billions	G^H	1970-2016
Y^N	Total expenditure in the rest of the economy (real), in billions	$Y-Y^H$	1970-2016
κ^H	Share of government spending on the social sector in total output	G^H/Y	1970-2016
κ^C	Share of government's consumption expenditures in total output	G^C/Y	1970-2016
κ^G	total output	I^G/Y	1970-2016
T^N	Productivity in the rest of the economy (real)	Y^N/E^N	1970-2015
β^N	Share of women employed in the rest of the economy	Own calculations based on data from EUKLEMS	1970-2015
β^H	Share of women employed in the public social sector	Own calculations based on data from EUKLEMS	1970-2015

…Online Appendix 1 cotinued: Variables and data sources

U	Unpaid domestic care labour	ONS 2016b	2014
R	Gross operating surplus (real), in billions	AMECO, own calculations	1970-2016
π	Profit share in the rest of the economy (R/Y^N)	AMECO, own calculations	1970-2016
t^W	Implicit tax rate on labour, %	Euoprean Commission, Eurostat and Onaran et al. (2012)	1970-2016
t^R	Implicit tax rate on capital income, %	Own calculations based on Euoprean Commission, Eurostat and Onaran et al. (2012)	1970-2016
t^C	Implicit tax rate on consumption, %	Euoprean Commission, Eurostat and Onaran et al. (2012)	1970-2016
D/Y	General government consolidated debt/Y	AMECO, own calculations	1970-2016
ε	Real exchange rate	World Bank World Development Indicators	1970-2016
Y^{World}	Rest of the world income	Own calculations based on World Bank World Development Indicators	1970-2016
N	Population	World Bank World Development Indicators	1970-2016
	strike days as a a ratio to employment	Own calculations based on ILO (2020)	1970-2017
	Capital account openness index	Chinn-Ito (2020)	1970-2018

Notes: (1) The data in 2018 release is linked back with data in 2012 and 2009 releases. (2) The ONS data for the composition of C starts in 1985; for the years before 1985 we assumed C^H/C to be constant.

Definitions

Ψ_{tt}^{NF}	Short-run impact of simultaneous increase in female and male wages in N on total output
d_{tt}^{F}	Partial effect of simultaneous increase in female and male wages N on public debt/GDP in the short-run
$\Psi_{t(t-1)}^{NF}$	Impact of simultaneous increase in female and male wages in N on total output in the next period
$d_{t(t-1)}^{F}$	Partial effect of simultaneous increase in female and male wages in N on public debt/GDP in the next period
$\Psi_{tt}^{N\alpha}$	Short-run impact of increase in female wages (decline in gender wage gap) in N on total output
d_{tt}^{α}	Partial effect of female wages (decline in gender wage gap) in N on public debt/GDP in the short-run
$\Psi_{t(t-1)}^{N\alpha}$	Impact of increase in female wages (decline in gender wage gap) in N in the next period
$d_{t(t-1)}^{\alpha}$	Partial effect of increase in female wages (decline in gender wage gap) in N on public debt/GDP in the next period
Ψ_{tt}^{k}	Short-run impact of rising share of social expenditures in GDP on total output
d_{tt}^{k}	Partial effect of rising share of social expenditures in GDP on public debt/GDP in the short-run
$\Psi_{t(t-1)}^{k}$	Impact of rising share of social expenditures in GDP on total output in the next period
$d_{t(t-1)}^{k}$	Partial effect increase rising share of social expenditures on public debt/GDP in the next period
Ψ_{tt}^{H}	Short-run impact of increase in female wages (decline in gender wage gap) in H on total output
d_{tt}^{H}	Partial effect of increase in female wages (decline in gender wage gap) in H on public debt/GDP in the short-run
$\Psi_{t(t-1)}^{H}$	Impact of increase in female wages (decline in gender wage gap) in H in the next period
$d_{t(t-1)}^{H}$	Partial effect increase in female wages (decline in gender wage gap) in H on public debt/GDP in the next period

Online Appendix 2: The effects of wages and gender pay gap

A2.1 The effects of a change in female and male wages in N

In this section, we examine the short-run and medium run effects of a simultaneous change in female and male wages in N on aggregate output, employment and public debt as a ratio to GDP.

A2.1.1 The short-run effect of a change in female and male wages in N on aggregate output

The short-run effect of a simultaneous change in female and male wages in N on aggregate output is the sum of its impact on consumption in N and H, private investment, exports, imports multiplied by the multiplier $(1/(1-\varphi_{NF}))$ as below:

$$\Psi_{tt}^{NF} = \frac{dY_t}{dw_t^{NF}} = \frac{\left|\frac{\partial C_t^N}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} + \left|\frac{\partial C_t^H}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} + \left|\frac{\partial I_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} + \left|\frac{\partial X_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} - \left|\frac{\partial M_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N}}{1-\varphi_{NF}} \tag{A2.1}$$

where φ_{NF} is

$$\varphi_{NF} = \left|\frac{\partial C_t^N}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \left|\frac{\partial C_t^H}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \left|\frac{\partial I_t}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \left|\frac{\partial X_t}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} - \left|\frac{\partial M_t}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \kappa_t^H + \kappa_t^C + \kappa_t^G \tag{A2.2}$$

And will be analysed in more detail in A2.1.5 below. Note that the bars around each derivative indicate the partial derivative, holding the variables at the bottom right hand side constant.

To derive the effects on the components of GDP, we first show that the partial short-run effects of a simultaneous change in female and male wages on female and male employment in N and H are zero.

$$\left|\frac{\partial E_t^{NF}}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = e_{Ft}^{NF} = 0 \tag{A2.3}$$

$$\left|\frac{\partial E_t^{NM}}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = e_{Ft}^{NM} = 0 \tag{A2.4}$$

$$\left|\frac{\partial E_t^{HF}}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = e_{Ft}^{HF} = 0 \tag{A2.5}$$

$$\left|\frac{\partial E_t^{HM}}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = e_{Ft}^{HM} = 0 \tag{A2.6}$$

For a constant aggregate output, the partial impact of female and male wages in N on consumption in N and H is

$$\left|\frac{\partial C_t^N}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = C_t^N\left(c_F\frac{E_t^{NF}}{WB_t^F} + c_M\frac{\alpha_t^N(E_t^{NM})}{WB_t^M} - c_R\frac{E_t^{NF} + \alpha_t^N E_t^{NM}}{R_t}\right) \tag{A2.7}$$

$$\left|\frac{\partial C_t^H}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = C_t^H\left(z_F\frac{E_t^{NF}}{WB_t^F} + z_M\frac{\alpha_t^N(E_t^{NM})}{WB_t^M} - z_R\frac{E_t^{NF} + \alpha_t^N E_t^{NM}}{R_t}\right) \tag{A2.8}$$

The effect on investment is due to the effects of wages in N on the profit share and public debt/GDP as shown in detail below:

$$\left|\frac{\partial I_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = I_t\left(i_2\frac{\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N}}{\pi_t} + i_3\frac{d_{tt}^F}{\left(\frac{D}{Y}\right)_t}\right) \tag{A2.9}$$

where

$$\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = -\frac{(\alpha_t^N - \alpha_t^N\beta_t^N + \beta_t^N)}{T_t^N} < 0 \tag{A2.10}$$

and

$$d_{tt}^F = \left|\frac{\partial\left(\frac{D}{Y}\right)_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = \frac{1}{Y_t}\left((t_t^R - t_t^W)(E_t^{NF} + \alpha_t^N E_t^{NM}) - t_t^C\left(\left|\frac{\partial C_t^N}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} + \left|\frac{\partial C_t^H}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N}\right)\right) \tag{A2.11}$$

A simultaneous increase in female and male wages in N increases exports and decreases imports as shown below:

$$\left|\frac{\partial X_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = X_t\left(x_2\frac{\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N}}{\pi_t}\right) < 0 \tag{A2.12}$$

$$\left|\frac{\partial M_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N} = M_t\left(n_2\frac{\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t,\alpha_t^N}}{\pi_t}\right) > 0 \tag{A2.13}$$

A2.1.2 The effect of a change in female and male wages in N on aggregate output in the medium run

For a constant aggregate output, the effect of an increase in female and male wages in N on aggregate output in the medium run is through the effects on consumption in N and H, private investment and net exports as shown below:

$$\Psi_{t(t-1)}^{NF} = \frac{dY_t}{dw_{t-1}^{NF}} = \frac{\left|\frac{\partial C_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} + \left|\frac{\partial I_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} + \left|\frac{\partial X_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} - \left|\frac{\partial M_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N}}{1-\varphi_{NF}} \tag{A2.14}$$

To calculate these partial derivatives, we need the partial effects of a change in female and male wages in N on female and male employment in N and H, which are

$$\left|\frac{\partial E_t^{NF}}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = e_{F(t-1)}^{NF} = -\beta_t^N\frac{(1-\kappa_t^H)Y_t}{(T_t^N)^2}\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} \tag{A2.15}$$

$$\left|\frac{\partial E_t^{NM}}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = e_{F(t-1)}^{NM} = -(1-\beta_t^N)\frac{(1-\kappa_t^H)Y_t}{(T_t^N)^2}\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} \tag{A2.16}$$

$$\left|\frac{\partial E_t^{HF}}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = e_{F(t-1)}^{HF} = 0 \tag{A2.17}$$

$$\left|\frac{\partial E_t^{HM}}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = e_{F(t-1)}^{HM} = 0 \tag{A2.18}$$

where the effect on labor productivity is

$$\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = T_t^N \left(h_1 \frac{\left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} + \kappa_{t-1}^H \Psi_{(t-1)(t-1)}^F}{C_{t-1}^H + G_{t-1}^H} + (h_2 + h_3)\frac{\Psi_{(t-1)(t-1)}^F}{Y_{t-1}} + \frac{h_4}{w_{t-1}^{NF}} \right) \tag{A2.19}$$

where

$$\Psi_{(t-1)(t-1)}^F = \frac{dY_{t-1}}{dw_{t-1}^{NF}} \tag{A2.20}$$

The effect of an increase in female and male wages in N on consumption in H in the previous period is

$$\left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = \left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{NF}}\right|_{Y_t,Y_{t-1},\alpha_{t-1}^N} + \left|\frac{\partial C_{t-1}^H}{\partial Y_{t-1}}\right|_{Y_t,\alpha_{t-1}^N} \Psi_{(t-1)(t-1)}^F \tag{A2.21}$$

For a constant aggregate income, the impact of female and male wages in N on consumption in N and H in the medium run are shown by equations (A2.22) and (A2.23) respectively.

$$\left|\frac{\partial C_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = C_t^N \left(c_F \frac{\left(e_{F(t-1)}^{NF} w_t^{NF}\right)}{WB_t^F} + c_M \frac{\alpha_t^N \left(e_{F(t-1)}^{NM} w_t^{NF}\right)}{WB_t^M} - c_R \frac{\left(e_{F(t-1)}^{NM}\alpha_t^N + e_{F(t-1)}^{NF}\right) w_t^{NF}}{R_t} \right) \tag{A2.22}$$

$$\left|\frac{\partial C_t^H}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = C_t^H \left(z_F \frac{\left(e_{F(t-1)}^{NF} w_t^{NF}\right)}{WB_t^F} + z_M \frac{\alpha_t^N \left(e_{F(t-1)}^{NM} w_t^{NF}\right)}{WB_t^M} - z_R \frac{\left(e_{F(t-1)}^{NM}\alpha_t^N + e_{F(t-1)}^{NF}\right) w_t^{NF}}{R_t} \right) \tag{A2.23}$$

The impact of wages on private investment is shown below:

$$\left|\frac{\partial I_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = I_t\left(i_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N}}{\pi_t} + i_3\frac{d_{t(t-1)}^F}{\left(\frac{D}{Y}\right)_t}\right) \tag{A2.24}$$

where

$$\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = \left(\frac{(\alpha_t^N - \alpha_t^N\beta_t^N + \beta_t^N)(w_t^{NF})}{(T_t^N)^2}\right)\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} \tag{A2.25}$$

The partial effect of a change in female and male wages in N on public debt/GDP in the medium run is

$$\begin{aligned} d_{t(t-1)}^F &= \left|\frac{\partial\left(\frac{D}{Y}\right)_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = \left|\frac{\partial D_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N}\frac{1}{Y_t} \\ &= \left(\left|\frac{\partial D_{t-1}}{\partial w_{t-1}^{NF}}\right|_{\alpha_{t-1}^N}(1+r_{t-1}) - t_t^W\left(e_{F(t-1)}^{NM}\alpha_t^N + e_{F(t-1)}^{NF}\right)w_t^{NF}\right. \\ &\quad + t_t^R\left(e_{F(t-1)}^{NM}\alpha_t^N + e_{F(t-1)}^{NF}\right)w_t^{NF} \\ &\quad \left. - t_t^C\left(\left|\frac{\partial C_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N}\right)\right)\frac{1}{Y_t} \end{aligned} \tag{A2.26}$$

where

$$\left|\frac{\partial D_{t-1}}{\partial w_{t-1}^{NF}}\right|_{\alpha_{t-1}^N} = Y_{t-1}\left|\frac{d\left(\frac{D}{Y}\right)_{t-1}}{dw_{t-1}^{NF}}\right|_{\alpha_t^N} + \Psi_{(t-1)(t-1)}^F\frac{D_{t-1}}{Y_{t-1}} \tag{A2.27}$$

The effects of female and male wages in N on exports and imports in the medium run are shown in (A2.28) and (A2.29) respectively.

$$\left|\frac{\partial X_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = X_t\left(x_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N}}{\pi_t}\right) \tag{A2.28}$$

$$\left|\frac{\partial M_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N} = M_t\left(n_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t,\alpha_{t-1}^N}}{\pi_t}\right) \tag{A2.29}$$

A2.1.3 The effect of a change in female and male wages on employment

The short-run total effect of a change in female and male wages in N (including partial effects and effects due to changes in aggregate output) on female, male and total employment are

$$\left|\frac{dE_t^F}{dw_t^{NF}}\right|_{\alpha_t^N} = \beta_t^N \frac{(1-\kappa_t^H)}{T_t^N} \Psi_{tt}^{NF} + \frac{\beta_t^H \kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \Psi_{tt}^{NF} \tag{A2.30}$$

$$\left|\frac{dE_t^M}{dw_t^{NF}}\right|_{\alpha_t^N} = (1-\beta_t^N) \frac{(1-\kappa_t^H)}{T_t^N} \Psi_{tt}^{NF} + \frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \Psi_{tt}^{NF} \tag{A2.31}$$

$$\left|\frac{dE_t}{dw_t^{NF}}\right|_{\alpha_t^N} = \left(\frac{(1-\kappa_t^H)}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)}\right) \Psi_{tt}^{NF} \tag{A2.32}$$

The total effects of an increase in female and male wages in N on female, male and total employment in the medium run are

$$\begin{aligned}\left|\frac{dE_t^F}{dw_{t-1}^{NF}}\right|_{\alpha_{t-1}^N} &= e_{F(t-1)}^{NF} + \beta_t^N \frac{(1-\kappa_t^H)}{T_t^N} \Psi_{t(t-1)}^{NF} \\ &+ \frac{\beta_t^H \kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \Psi_{t(t-1)}^{NF}\end{aligned} \tag{A2.33}$$

$$\begin{aligned}\left|\frac{dE_t^M}{dw_{t-1}^{NF}}\right|_{\alpha_{t-1}^N} &= e_{F(t-1)}^{NM} + (1-\beta_t^N) \frac{(1-\kappa_t^H)}{T_t^N} \Psi_{t(t-1)}^{NF} \\ &+ \frac{(1-\beta_t^H)\kappa_t^H}{w_t^{NF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \Psi_{t(t-1)}^{NF}\end{aligned} \tag{A2.34}$$

$$\begin{aligned}\left|\frac{dE_t}{dw_{t-1}^{NF}}\right|_{\alpha_{t-1}^N} &= e_{F(t-1)}^{NF} + e_{F(t-1)}^{NM} \\ &+ \left(\frac{(1-\kappa_t^H)}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)}\right) \Psi_{t(t-1)}^{NF}\end{aligned} \tag{A2.35}$$

A2.1.4 The effect of a change in female and male wages on public debt

The total short-run and medium-run effects on public debt to GDP ratio are shown in (A2.36) and (A2.37):

$$\left|\frac{d\left(\frac{D}{Y}\right)_t}{dw_t^{NF}}\right|_{\alpha_t^N} = d_{tt}^{WF} + d_{tt}^{Y}\Psi_{tt}^{NF} \tag{A2.36}$$

$$\left|\frac{d\left(\frac{D}{Y}\right)_t}{dw_{(t-1)}^{NF}}\right|_{\alpha_{t-1}^N} = d_{t(t-1)}^{WF} + d_{tt}^{Y}\Psi_{t(t-1)}^{NF} \tag{A2.37}$$

A2.1.5 Income multiplier

The income multiplier used in (A2.2) and (A2.14) is

$$Income\ multiplier = \frac{1}{1-\varphi_{NF}} \tag{A2.38}$$

where φ_{NF} is

$$\begin{aligned}\varphi_{NF} = {} & \left|\frac{\partial C_t^N}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \left|\frac{\partial C_t^H}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \left|\frac{\partial I_t}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \left|\frac{\partial X_t}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} \\ & - \left|\frac{\partial M_t}{\partial Y_t}\right|_{w_t^{NF},\alpha_t^N} + \kappa_t^H + \kappa_t^C + \kappa_t^G\end{aligned} \tag{A2.39}$$

To calculate the multiplier, we first derive the effect of output on employment, which we then use to derive the effect of output on the components of demand.

$$\frac{\partial E_t^{NF}}{\partial Y_t} = e_{Yt}^{NF} = \beta_t^N\ \frac{(1-\kappa_t^H)}{T_t^N} > 0 \tag{A2.40}$$

$$\frac{\partial E_t^{NM}}{\partial Y_t} = e_{Yt}^{NM} = (1-\beta_t^N)\ \frac{(1-\kappa_t^H)}{T_t^N} > 0 \tag{A2.41}$$

$$\frac{\partial E_t^{HF}}{\partial Y_t} = e_{Yt}^{HF} = \frac{\beta_t^H\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)} > 0 \tag{A2.42}$$

$$\frac{\partial E_t^{HM}}{\partial Y_t} = e_{Yt}^{HM} = \frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)} > 0 \tag{A2.43}$$

Next, the effects of output on consumption in N and H are

$$\begin{aligned}\frac{\partial C_t^N}{\partial Y_t} = C_t^N \Bigg(& c_F\frac{(e_{Yt}^{NF}w_t^{NF} + e_{Yt}^{HF}w_t^{HF})}{WB_t^F} + c_M\frac{(e_{Yt}^{NM}w_t^{NF}\alpha_t^N + e_{Yt}^{HM}w_t^{HF}\alpha_t^H)}{WB_t^M} \\ & + c_R\frac{(1-\kappa_t^H) - \alpha_t^N w_t^{NF}e_{Yt}^{NM} - w_t^{NF}e_{Yt}^{NF}}{R_t}\Bigg)\end{aligned} \tag{A2.44}$$

$$\frac{\partial C_t^H}{\partial Y_t} = C_t^H \left(z_F \frac{(e_{Yt}^{NF} w_t^{NF} + e_{Yt}^{HF} w_t^{HF})}{WB_t^F} + z_M \frac{(e_{Yt}^{NM} w_t^{NF} \alpha_t^N + e_{Yt}^{HM} w_t^{HF} \alpha_t^H)}{WB_t^M} + z_R \frac{(1-\kappa_t^H) - \alpha_t^N w_t^{NF} e_{Yt}^{NM} - w_t^{NF} e_{Yt}^{NF}}{R_t} \right) \tag{A2.45}$$

The effect of aggregate output on private investment is

$$\frac{\partial I_t}{\partial Y_t} = I_t \left(i_1 \frac{1}{Y_t} + i_2 \frac{\frac{\partial \pi_t}{\partial Y_t}}{\pi_t} + i_3 \frac{\left(\frac{\partial \left(\frac{D}{Y}\right)_t}{\partial Y_t} \right)}{\frac{D_t}{Y_t}} \right) \tag{A2.46}$$

where the impact on the profit share is zero.

$$\frac{\partial \pi_t}{\partial Y_t} = 0 \tag{A2.47}$$

The effect of aggregate output on public debt/GDP is shown in (A2.48):

$$d_{tt}^Y = \frac{\partial \left(\frac{D}{Y}\right)_t}{\partial Y_t} = \frac{\frac{\partial D_t}{\partial Y_t} Y_t - D_t}{{Y_t}^2} = \frac{\partial D_t}{\partial Y_t} \frac{1}{Y_t} - \frac{D_t}{{Y_t}^2} \tag{A2.48}$$

$$d_{tt}^Y = \frac{\partial \left(\frac{D}{Y}\right)_t}{\partial Y_t} = \left((\kappa_t^H + \kappa_t^C + \kappa_t^G) - t_t^R(1-\kappa_t^H) - (t_t^W - t_t^R) w_t^{NF} (e_{Yt}^{NF} + \alpha_t^N e_{Yt}^{NM}) - t_t^W (e_{Yt}^{HF} + \alpha_t^H e_{Yt}^{HM}) - t_t^C \left(\frac{\partial C_t^N}{\partial Y_t} + \frac{\partial C_t^H}{\partial Y_t} \right) - \frac{D_t}{Y_t} \right) \frac{1}{Y_t} \tag{A2.48'}$$

Finally, output doesn't affect exports and has a positive impact on imports as shown below:

$$\frac{\partial X_t}{\partial Y_t} = X_t \left(x_2 \frac{\partial \pi_t}{\partial Y_t} \right) = 0 \tag{A2.49}$$

$$\frac{\partial M_t}{\partial Y_t} = M_t \left(\frac{n_1}{Y_t} + n_2 \left(\frac{\partial \pi_t}{\partial Y_t} \right) \right) = \frac{M_t n_1}{Y_t} > 0 \tag{A2.50}$$

A2.2 The effects of a change in gender wage gap in N

In this section, we derive the short-run and medium-run effects of an increase in female wages in N (with constant male wages) on aggregate output, employment and public debt/GDP.

A2.2.1 The short-run effect of closing the gender pay gap with rising female wages in N on aggregate output

As the male wages in N are constant, the rising female wages will reduce the gender pay gap in N in the following way:

$$\frac{d\alpha_t^N}{dw_t^{NF}} = -\frac{\alpha_t^N}{w_t^{NF}} \tag{A2.51}$$

Higher female wages in N influence aggregate output in the short run through the effects on the components of GDP as shown in equation (A2.52):

$$\Psi_{tt}^{\alpha} = \frac{dY_t}{dw_t^{NF}} = \frac{\left|\frac{\partial C_t^N}{\partial w_t^{NF}}\right|_{Y_t} + \left|\frac{\partial C_t^H}{\partial w_t^{NF}}\right|_{Y_t} + \left|\frac{\partial I_t}{\partial w_t^{NF}}\right|_{Y_t} + \left|\frac{\partial X_t}{\partial w_t^{NF}}\right|_{Y_t} - \left|\frac{\partial M_t}{\partial w_t^{NF}}\right|_{Y_t}}{1-\varphi_{NF}} \tag{A2.52}$$

To derive the impact of closing gender pay gap in N on the components of GDP, we first show that the partial effect of female wages in N on employment is zero for a constant output.

$$\left|\frac{\partial E_t^{NF}}{\partial w_t^{NF}}\right|_{Y_t} = e_{\alpha t}^{NF} = 0 \tag{A2.53}$$

$$\left|\frac{\partial E_t^{NM}}{\partial w_t^{NF}}\right|_{Y_t} = e_{\alpha t}^{NM} = 0 \tag{A2.54}$$

$$\left|\frac{\partial E_t^{HF}}{\partial w_t^{NF}}\right|_{Y_t} = e_{\alpha t}^{HF} = 0 \tag{A2.55}$$

$$\left|\frac{\partial E_t^{HM}}{\partial w_t^{NF}}\right|_{Y_t} = e_{\alpha t}^{HM} = 0 \tag{A2.56}$$

Next, we derive the effects of female wages in N on consumption N and H as in (A2.57) and (A2.58) respectively.

$$\left|\frac{\partial C_t^N}{\partial w_t^{NF}}\right|_{Y_t} = C_t^N\left(c_F\frac{E_t^{NF}}{WB_t^F} - c_R\frac{E_t^{NF}}{R_t}\right) \tag{A2.57}$$

$$\left|\frac{\partial C_t^H}{\partial w_t^{NF}}\right|_{Y_t} = C_t^H\left(z_F\,\frac{E_t^{NF}}{WB_t^F} - z_R\,\frac{E_t^{NF}}{R_t}\right) \tag{A2.58}$$

The impact of closing the gender wage gap in N on private investment is shown in (A2.59).

$$\left|\frac{\partial I_t}{\partial w_t^{NF}}\right|_{Y_t} = I_t\left(i_2\,\frac{\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t}}{\pi_t} + i_3\,\frac{d_{tt}^{\alpha}}{\left(\frac{D}{Y}\right)_t}\right) \tag{A2.59}$$

For a constant output, female wages in N has a negative effect on profit share.

$$\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t} = -\,\frac{\beta_t^N}{T_t^N} < 0 \tag{A2.60}$$

For a constant output, the effect of female wages in N on public debt/GDP is

$$d_{tt}^{\alpha} = \left|\frac{\partial\left(\frac{D}{Y}\right)_t}{\partial w_t^{NF}}\right|_{Y_t} = \frac{1}{Y_t}\left((t_t^R - t_t^W)(E_t^{NF}) - t_t^C\left(\left|\frac{\partial C_t^N}{\partial w_t^{NF}}\right|_{Y_t} + \left|\frac{\partial C_t^H}{\partial w_t^{NF}}\right|_{Y_t}\right)\right) \tag{A2.61}$$

Finally, the partial short-run effect of higher female wages in N on exports is negative and on imports is positive.

$$\left|\frac{\partial X_t}{\partial w_t^{NF}}\right|_{Y_t} = X_t\left(x_2\,\frac{\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t}}{\pi_t}\right) < 0 \tag{A2.62}$$

$$\left|\frac{\partial M_t}{\partial w_t^{NF}}\right|_{Y_t} = M_t\left(n_2\,\frac{\left|\frac{\partial \pi_t}{\partial w_t^{NF}}\right|_{Y_t}}{\pi_t}\right) > 0 \tag{A2.63}$$

A2.2.2 The effect of closing the gender pay gap with rising female wages in N on aggregate output in the medium run

As the male wages in N are constant, the rising female wages will reduce the gender pay gap in N in previous period as in equation (A2.64).

$$\frac{d\alpha_{t-1}^{N}}{dw_{t-1}^{NF}} = -\frac{\alpha_{t-1}^{N}}{w_{t-1}^{NF}} \tag{A2.64}$$

We show the medium-run impact of rising female wages in N on aggregate output in (A2.65).

$$\Psi_{t(t-1)}^{\alpha} = \frac{dY_t}{dw_{t-1}^{NF}} = \frac{\left|\frac{\partial C_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{NF}}\right|_{Y_t} + \left|\frac{\partial I_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} + \left|\frac{\partial X_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} - \left|\frac{\partial M_t}{\partial w_{t-1}^{NF}}\right|_{Y_t}}{1-\varphi_{NF}} \tag{A2.65}$$

For a constant aggregate output, the effect of closing the gender pay gap in N on female and male employment in N and H in the medium run is shown in (A2.66)-(A2.69).

$$\left|\frac{\partial E_t^{NF}}{\partial w_{t-1}^{NF}}\right|_{Y_t} = e_{\alpha(t-1)}^{NF} = -\beta_t^N \frac{(1-\kappa_t^H)Y_t}{(T_t^N)^2}\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t} \tag{A2.66}$$

$$\left|\frac{\partial E_t^{NM}}{\partial w_{t-1}^{NF}}\right|_{Y_t} = e_{\alpha(t-1)}^{NM} = -(1-\beta_t^N) \frac{(1-\kappa_t^H)Y_t}{(T_t^N)^2}\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t} \tag{A2.67}$$

$$\left|\frac{\partial E_t^{HF}}{\partial w_{t-1}^{NF}}\right|_{Y_t} = e_{\alpha(t-1)}^{HF} = 0 \tag{A2.68}$$

$$\left|\frac{\partial E_t^{HM}}{\partial w_{t-1}^{NF}}\right|_{Y_t} = e_{\alpha(t-1)}^{HM} = 0 \tag{A2.69}$$

We derive the medium-run effect of higher female N wages on labor productivity in equation (A2.70).

$$\left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t} = T_t^N \left(h_1 \frac{\left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{NF}}\right|_{Y_t} + \kappa_{t-1}^H \Psi_{(t-1)(t-1)}^{\alpha}}{C_{t-1}^H + G_{t-1}^H} + (h_2+h_3)\frac{\Psi_{(t-1)(t-1)}^{\alpha}}{Y_{t-1}} + \frac{(h_4-h_5)}{w_{t-1}^{NF}} \right) \tag{A2.70}$$

where

$$\Psi^{\alpha}_{(t-1)(t-1)} = \frac{dY_{t-1}}{dw^{NF}_{t-1}} \tag{A2.71}$$

The total impact of closing gender wage gap on consumption in H in the previous period is

$$\begin{aligned}\left|\frac{\partial C^{H}_{t-1}}{\partial w^{NF}_{t-1}}\right|_{Y_t} &= \left|\frac{\partial C^{H}_{t-1}}{\partial w^{NF}_{t-1}}\right|_{Y_t,Y_{t-1}} + \left|\frac{\partial C^{H}_{t-1}}{\partial Y_{t-1}}\right|_{Y_t}\left|\frac{\partial Y_{t-1}}{\partial w^{NF}_{t-1}}\right|_{Y_t} \\ &= \left|\frac{\partial C^{H}_{t-1}}{\partial w^{NF}_{t-1}}\right|_{Y_t,Y_{t-1}} + \left|\frac{\partial C^{H}_{t-1}}{\partial Y_{t-1}}\right|_{Y_t}\Psi^{\alpha}_{(t-1)(t-1)}\end{aligned} \tag{A2.72}$$

We derive the medium-run impact of higher female N wages for a constant aggregate output on consumption in N in (A2.73) and consumption in H in (A2.74).

$$\begin{aligned}\left|\frac{\partial C^{N}_{t}}{\partial w^{NF}_{t-1}}\right|_{Y_t} = C^{N}_{t}\Bigg(c_F\frac{\left(e^{NF}_{\alpha(t-1)}w^{NF}_{t}\right)}{WB^{F}_{t}} + c_M\frac{\alpha^{N}_{t}\left(e^{NM}_{\alpha(t-1)}w^{NF}_{t}\right)}{WB^{M}_{t}} \\ - c_R\frac{\left(e^{NM}_{\alpha(t-1)}\alpha^{N}_{t} + e^{NF}_{\alpha(t-1)}\right)w^{NF}_{t}}{R_t}\Bigg)\end{aligned} \tag{A2.73}$$

..

$$\begin{aligned}\left|\frac{\partial C^{H}_{t}}{\partial w^{NF}_{t-1}}\right|_{Y_t} = C^{H}_{t}\Bigg(z_F\frac{\left(e^{NF}_{\alpha(t-1)}w^{NF}_{t}\right)}{WB^{F}_{t}} + z_M\frac{\alpha^{N}_{t}\left(e^{NM}_{\alpha(t-1)}w^{NF}_{t}\right)}{WB^{M}_{t}} \\ - z_R\frac{\left(e^{NM}_{\alpha(t-1)}\alpha^{N}_{t} + e^{NF}_{\alpha(t-1)}\right)w^{NF}_{t}}{R_t}\Bigg)\end{aligned} \tag{A2.74}$$

(A2.75) below shows the partial impact of higher female wages in N on private investment.

$$\left|\frac{\partial I_t}{\partial w^{NF}_{t-1}}\right|_{Y_t} = I_t\left(i_2\frac{\left|\frac{\partial \pi_t}{\partial w^{NF}_{t-1}}\right|_{Y_t}}{\pi_t} + i_3\frac{d^{\alpha}_{t(t-1)}}{\left(\frac{D}{Y}\right)_t}\right) \tag{A2.75}$$

where the partial impact of higher female wages in N on the profit share is

$$\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} = \left(\frac{\beta_t^N w_{t-1}^{NF}}{(T_t^N)^2}\right) \left|\frac{\partial T_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t} \tag{A2.76}$$

Higher female wages in N affect public debt/GDP as shown below in the medium run:

$$\begin{aligned} d_{t(t-1)}^F = \left|\frac{\partial \left(\frac{D}{Y}\right)_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} &= \left|\frac{\partial D_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} \frac{1}{Y_t} \\ &= \left(\frac{\partial D_{t-1}}{\partial w_{t-1}^{NF}}(1+r_{t-1}) - t_t^W\left(e_{\alpha(t-1)}^{NM}\alpha_t^N + e_{\alpha(t-1)}^{NF}\right)w_t^{NF} \right. \\ &\quad + t_t^R\left(e_{\alpha(t-1)}^{NM}\alpha_t^N + e_{\alpha(t-1)}^{NF}\right)w_t^{NF} \\ &\quad \left. - t_t^C\left(\left|\frac{\partial C_t^N}{\partial w_{t-1}^{NF}}\right|_{Y_t} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{NF}}\right|_{Y_t}\right)\right)\frac{1}{Y_t} \end{aligned} \tag{A2.77}$$

where

$$\frac{\partial D_{t-1}}{\partial w_{t-1}^{NF}} = Y_{t-1}\frac{d\left(\frac{D}{Y}\right)_{t-1}}{dw_{t-1}^{NF}} + \Psi_{(t-1)(t-1)}^{\alpha}\frac{D_{t-1}}{Y_{t-1}} \tag{A2.78}$$

Finally, the medium-run impact of female wages on exports is shown in (A2.79) and on imports is shown in (A2.80).

$$\left|\frac{\partial X_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} = X_t\left(x_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t}}{\pi_t}\right) \tag{A2.79}$$

$$\left|\frac{\partial M_t}{\partial w_{t-1}^{NF}}\right|_{Y_t} = M_t\left(n_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{NF}}\right|_{Y_t}}{\pi_t}\right) \tag{A2.80}$$

A2.2.3 The effect of closing the gender pay gap with rising female wages in N on employment

We derive the short-run effect of closing the gender pay gap in N on female, male and total employment in equations (A2.81)-(A2.83).

$$\frac{dE_t^F}{dw_t^{NF}} = \beta_t^N\frac{(1-\kappa_t^H)}{T_t^N}\Psi_{tt}^{\alpha} + \frac{\beta_t^H\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\Psi_{tt}^{\alpha} \tag{A2.81}$$

$$\frac{dE_t^M}{dw_t^{NF}} = (1-\beta_t^N)\frac{(1-\kappa_t^H)}{T_t^N}\Psi_{tt}^{\alpha} + \frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\Psi_{tt}^{\alpha} \tag{A2.82}$$

$$\frac{dE_t}{dw_t^{NF}} = \left(\frac{(1-\kappa_t^H)}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)}\right)\Psi_{tt}^{\alpha} \tag{A2.83}$$

The total effect of higher female wages in N on female, male and total employment in the medium run is

$$\frac{dE_t^F}{dw_{t-1}^{NF}} = e_{\alpha(t-1)}^{NF} + \beta_t^N \frac{(1-\kappa_t^H)}{T_t^N}\Psi_{t(t-1)}^{\alpha} + \frac{\beta_t^H \kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)}\Psi_{t(t-1)}^{\alpha} \tag{A2.84}$$

$$\begin{aligned}\frac{dE_t^M}{dw_{t-1}^{NF}} &= e_{\alpha(t-1)}^{NM} + (1-\beta_t^N)\frac{(1-\kappa_t^H)}{T_t^N}\Psi_{t(t-1)}^{\alpha} \\ &\quad + \frac{(1-\beta_t^H)\kappa_t^H}{w_t^{NF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)}\Psi_{t(t-1)}^{\alpha}\end{aligned} \tag{A2.85}$$

$$\frac{dE_t}{dw_{t-1}^{NF}} = e_{\alpha(t-1)}^{NF} + e_{\alpha(t-1)}^{NM} + \left(\frac{(1-\kappa_t^H)}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)}\right)\Psi_{t(t-1)}^{\alpha} \tag{A2.86}$$

A2.2.4 The effect of closing the gender pay gap with rising female wages in N on public debt

The short-run and medium-run total effect of gender pay gap in N on D/Y are shown in (A2.87) and (A2.88) respectively.

$$\frac{d\left(\frac{D}{Y}\right)_t}{dw_t^{NF}} = d_{tt}^{\alpha} + d_{tt}^{Y}\Psi_{tt}^{\alpha} \tag{A2.87}$$

$$\frac{d\left(\frac{D}{Y}\right)_t}{dw_{(t-1)}^{NF}} = d_{t(t-1)}^{\alpha} + d_{tt}^{Y}\Psi_{t(t-1)}^{\alpha} \tag{A2.88}$$

Online Appendix 3

A3.1 The effects of public social infrastructure investment

In this section, we analyse the case where social expenditure increase solely through new public sector employment in the social sector rather than rising wages in this sector ($w_t^{HM} = w_t^{HM*}, w_t^{HF} = w_t^{HF*}$).

A3.1.1 The short-run effect of a change in public social infrastructure investment/GDP on aggregate output

The impact of public social infrastructure investment/GDP (κ^H) on aggregate output in the short run is through changes in output in N (Y^N) and its direct impact on aggregate output as shown below:

$$\Psi_{tt}^k = \frac{dY_t}{d\kappa_t^H} = \frac{dY_t}{dY_t^N}\frac{dY_t^N}{d\kappa_t^H} + \left|\frac{dY_t}{d\kappa_t^H}\right|_{Y_t^N}$$
$$= \left(\frac{\left|\frac{\partial C_t^N}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial I_t}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial X_t}{\partial \kappa_t^H}\right|_{Y_t^N} - \left|\frac{\partial M_t}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial G_t^C}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial I_t^G}{\partial \kappa_t^H}\right|_{Y_t^N}}{1-\varphi_k} + Y_t\right) \tag{A3.1}$$
$$* \ \frac{1}{(1-\kappa_t^H)}$$

where $\frac{dY_t^N}{d\kappa_t^H}$ is

$$\frac{dY_t^N}{d\kappa_t^H} = \frac{\left|\frac{\partial C_t^N}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial I_t}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial X_t}{\partial \kappa_t^H}\right|_{Y_t^N} - \left|\frac{\partial M_t}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial G_t^C}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial I_t^G}{\partial \kappa_t^H}\right|_{Y_t^N}}{1-\varphi_k} \tag{A3.2}$$

and φ_k is

$$\varphi_k = \left|\frac{\partial C_t^N}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial C_t^H}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial I_t}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial X_t}{\partial Y_t^N}\right|_{\kappa_t^H} - \left|\frac{\partial M_t}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial G_t^C}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial I_t^G}{\partial Y_t^N}\right|_{\kappa_t^H} \tag{A3.3}$$

φ_k is analysed in detail in A3.1.5 below.

To derive the effects on the components of demand, (A3.4)-(A3.7) show the short-run partial impact on female and male employment in N and H for a constant output in N.

$$e_{kt}^{HF} = \left|\frac{\partial E_t^{HF}}{\partial \kappa_t^H}\right|_{Y_t^N} = \frac{\beta_t^H Y_t^N}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\ \frac{1}{(1-\kappa_t^H)^2} > 0 \tag{A3.4}$$

$$e_{kt}^{HM} = \left|\frac{\partial E_t^{HM}}{\partial \kappa_t^H}\right|_{Y_t^N} = \frac{(1-\beta_t^H)Y_t^N}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \; \frac{1}{(1-\kappa_t^H)^2} > 0 \tag{A3.5}$$

$$e_{kt}^{NF} = \left|\frac{\partial E_t^{NF}}{\partial \kappa_t^H}\right|_{Y_t^N} = 0 \tag{A3.6}$$

$$e_{kt}^{NM} = \left|\frac{\partial E_t^{NM}}{\partial \kappa_t^H}\right|_{Y_t^N} = 0 \tag{A3.7}$$

For a constant output in N, public social infrastructure investment/GDP doesn't have an impact on the profit share.

$$\left|\frac{\partial \pi_t}{\partial \kappa_t^H}\right|_{Y_t^N} = 0 \tag{A3.8}$$

The short-run impact of public social infrastructure investment on consumption in N and H are shown in (A3.9) and (A3.10) respectively.

$$\left|\frac{\partial C_t^N}{\partial \kappa_t^H}\right|_{Y_t^N} = C_t^N \left(c_F \frac{e_{kt}^{HF} w_t^{HF}}{WB_t^F} + c_M \frac{e_{kt}^{HM} w_t^{HF} \alpha_t^H}{WB_t^M} \right) \tag{A3.9}$$

$$\left|\frac{\partial C_t^H}{\partial \kappa_t^H}\right|_{Y_t^N} = C_t^H \left(z_F \frac{e_{kt}^{HF} w_t^{HF}}{WB_t^F} + z_M \frac{e_{kt}^{HM} w_t^{HF} \alpha_t^H}{WB_t^M} \right) \tag{A3.10}$$

The short-run impact of public social infrastructure investment on private investment is

$$\left|\frac{\partial I_t}{\partial \kappa_t^H}\right|_{Y_t^N} = I_t \left(i_1 \frac{1}{1-\kappa_t^H} + i_3 \frac{d_{tt}^k}{\left(\frac{D}{Y}\right)_t} \right) \tag{A3.11}$$

where

$$d_{tt}^k = \left|\frac{\partial (D/Y)_t}{\partial \kappa_t^H}\right|_{Y_t^N} = \left|\frac{\partial D_t}{\partial \kappa_t^H}\right|_{Y_t^N} \frac{1}{Y_t^N} - \frac{1}{(1-\kappa_t^H)} \frac{D_t}{Y_t} \tag{A3.12}$$

The partial short-run effect of public social infrastructure investment on public debt is shown in (A3.13).

$$\begin{aligned} \left|\frac{\partial D_t}{\partial \kappa_t^H}\right|_{Y_t^N} = {} & \frac{Y_t(1+\kappa_t^C + \kappa_t^G)}{(1-\kappa_t^H)} - t_t^w w_t^{HF} (\alpha_t^H e_{kt}^{HM} + e_{kt}^{HF}) \\ & - t_t^C \left(\left|\frac{\partial C_t^N}{\partial \kappa_t^H}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial \kappa_t^H}\right|_{Y_t^N} \right) \end{aligned} \tag{A3.13}$$

Moreover, for a constant output in N, the impact of κ^H on exports and imports is zero.

$$\left|\frac{\partial X_t}{\partial \kappa_t^H}\right|_{Y_t^N} = 0 \tag{A3.14}$$

$$\left|\frac{\partial M_t}{\partial \kappa_t^H}\right|_{Y_t^N} = 0 \tag{A3.15}$$

Finally, the short-run partial impact of public social infrastructure investment/GDP on the components of government expenditures is positive and shown below:

$$\left|\frac{\partial G_t^H}{\partial \kappa_t^H}\right|_{Y_t^N} = \frac{Y_t^N}{(1-\kappa_t^H)^2} > 0 \tag{A3.16}$$

$$\left|\frac{\partial G_t^C}{\partial \kappa_t^H}\right|_{Y_t^N} = \frac{\kappa_t^C Y_t^N}{(1-\kappa_t^H)^2} > 0 \tag{A3.17}$$

$$\left|\frac{\partial I_t^G}{\partial \kappa_t^H}\right|_{Y_t^N} = \frac{\kappa_t^G Y_t^N}{(1-\kappa_t^H)^2} > 0 \tag{A3.18}$$

A3.1.2 The effect of a change in public social infrastructure investment/GDP on aggregate output in the medium run

The effect of a change in public social infrastructure investment/GDP on aggregate output in the medium run is shown in (A3.19).

$$\begin{aligned}\Psi_{t(t-1)}^k = \frac{dY_t}{d\kappa_{t-1}^H} &= \frac{dY_t}{dY_t^N}\frac{dY_t^N}{d\kappa_{t-1}^H} \\ &= \frac{\left|\frac{\partial C_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial I_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial X_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} - \left|\frac{\partial M_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{(1-\varphi_k)(1-\kappa_t^H)} \\ &+ \frac{\left|\frac{\partial G_t^C}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial I_t^G}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{(1-\varphi_k)(1-\kappa_t^H)}\end{aligned} \tag{A3.19}$$

where

$$\begin{aligned}\frac{dY_t^N}{d\kappa_{t-1}^H} = &\frac{\left|\frac{\partial C_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial I_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial X_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} - \left|\frac{\partial M_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{(1-\varphi_k)} \\ &+ \frac{\left|\frac{\partial G_t^C}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial I_t^G}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{(1-\varphi_k)}\end{aligned} \tag{A3.20}$$

We derive the effect of public social infrastructure investment/GDP on labor productivity below.

$$\left|\frac{\partial T_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = T_t^N \left(h_1 \frac{\left|\frac{\partial C_{t-1}^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \kappa_{t-1}^H \Psi_{(t-1)(t-1)}^k + Y_{t-1}}{C_{t-1}^H + G_{t-1}^H} + h_2 \frac{\Psi_{(t-1)(t-1)}^k \kappa_{t-1}^G + Y_{t-1}}{I_{t-1}^G} + h_3 \left(\frac{\Psi_{(t-1)(t-1)}^k}{Y_{t-1}} - \frac{1}{(1-\kappa_{t-1}^H)} \right) \right) \tag{A3.21}$$

where $\left|\frac{\partial C_{t-1}^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}$ is

$$\left|\frac{\partial C_{t-1}^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = \left|\frac{\partial C_{t-1}^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, Y_{t-1}^N} + \left|\frac{\partial C_{t-1}^H}{\partial Y_{t-1}^N}\right|_{Y_t^N} \left|\frac{\partial Y_{t-1}^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} \tag{A3.22}$$

For a constant output in N, the partial impact of an increase in public social infrastructure investment/GDP on female and male employment in N and H are shown in (A3.23)-(A3.26).

$$e_{k(t-1)}^{NF} = \left|\frac{\partial E_t^{NF}}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = -\frac{\beta_t^N Y_t^N}{(T_t^N)^2} \left|\frac{\partial T_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} \tag{A3.23}$$

$$e_{k(t-1)}^{NM} = \left|\frac{\partial E_t^{NM}}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = -\frac{(1-\beta_t^N) Y_t^N}{(T_t^N)^2} \left|\frac{\partial T_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} \tag{A3.24}$$

$$e_{k(t-1)}^{HF} = 0 \tag{A3.25}$$

$$e_{k(t-1)}^{HM} = 0 \tag{A3.26}$$

The impact of an increase in κ^H on the profit share is through the effects on labor productivity as shown below:

$$\left|\frac{\partial \pi_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = \left(\frac{(\alpha_t^N - \alpha_t^N \beta_t^N + \beta_t^N) w_t^{NF}}{(T_t^N)^2} \right) \left|\frac{\partial T_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} \tag{A3.27}$$

For a constant output in N, the medium-run effect of an increase in κ^H on consumption in N and H are shown in (A3.28) and (A3.29).

$$\left|\frac{\partial C_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = C_t^N\left(c_F\frac{e_{k(t-1)}^{NF}w_t^{NF}}{WB_t^F} + c_M\frac{e_{k(t-1)}^{NM}w_t^{NF}\alpha_t^N}{WB_t^M} - c_R\frac{\left(e_{k(t-1)}^{NM}\alpha_t^N + e_{k(t-1)}^{NF}\right)w_t^{NF}}{R_t}\right) \tag{A3.28}$$

$$\left|\frac{\partial C_t^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = C_t^H\left(z_F\frac{e_{k(t-1)}^{NF}w_t^{NF}}{WB_t^F} + z_M\frac{e_{k(t-1)}^{NM}w_t^{NF}\alpha_t^N}{WB_t^M} - z_R\frac{\left(e_{k(t-1)}^{NM}\alpha_t^N + e_{k(t-1)}^{NF}\right)w_t^{NF}}{R_t}\right) \tag{A3.29}$$

The medium-run impact of κ^H on private investment is

$$\left|\frac{\partial I_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = I_t\left(i_2\frac{\left|\frac{\partial \pi_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{\pi_t} + i_3\frac{d_{t(t-1)}^k}{\left(\frac{D}{Y}\right)_t}\right) \tag{A3.30}$$

where

$$d_{t(t-1)}^k = \left|\frac{\partial (D/Y)_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = \left|\frac{\partial D_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}\frac{1}{Y_t} = \left(\frac{\partial D_{t-1}}{\partial \kappa_{t-1}^H}(1+r_{t-1}) - t_t^W\left(e_{k(t-1)}^{NM}\alpha_t^N + e_{k(t-1)}^{NF}\right)w_t^{NF} + t_t^R\left(e_{k(t-1)}^{NM}\alpha_t^N + e_{k(t-1)}^{NF}\right)w_t^{NF} - t_t^C\left(\left|\frac{\partial C_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}\right)\right)\frac{1}{Y_t} \tag{A3.31}$$

We show the impact of public social infrastructure investment/GDP on public debt in the previous period below:

$$\frac{\partial D_{t-1}}{\partial \kappa_{t-1}^H} = Y_{t-1}\frac{d\left(\frac{D}{Y}\right)_{t-1}}{d\kappa_{t-1}^H} + \Psi_{(t-1)(t-1)}^k\frac{D_{t-1}}{Y_{t-1}} \tag{A3.32}$$

The partial medium-run effect of public social infrastructure investment/GDP on exports and imports is through the effects on the profit share as shown in (A3.33) and (A3.34).

$$\left|\frac{\partial X_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = X_t\left(x_2\frac{\left|\frac{\partial \pi_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{\pi_t}\right) \tag{A3.33}$$

$$\left|\frac{\partial M_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = M_t\left(n_2\frac{\left|\frac{\partial \pi_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N}}{\pi_t}\right) \tag{A3.34}$$

Finally, for a constant output in N, the impact of public social infrastructure investment/GDP on G^C and I^G are zero.

$$\left|\frac{\partial G_t^C}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = 0 \tag{A3.35}$$

$$\left|\frac{\partial I_t^G}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} = 0 \tag{A3.36}$$

A3.1.3 The effect of a change in public social infrastructure investment/GDP on employment

We show the short-run impact of public social infrastructure investment/GDP on female, male and total employment in equations (A3.37)-(A3.39) below.

$$\frac{dE_t^F}{d\kappa_t^H} = \left(\beta_t^N\frac{(1-\kappa_t^H)}{T_t^N} + \beta_t^H\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{tt}^k + \frac{\beta_t^H Y_t^N}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)(1-\kappa_t^H)^2} \tag{A3.37}$$

$$\frac{dE_t^M}{d\kappa_t^H} = \left((1-\beta_t^N)\frac{(1-\kappa_t^H)}{T_t^N} + (1-\beta_t^H)\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{tt}^k + \frac{(1-\beta_t^H)Y_t^N}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)(1-\kappa_t^H)^2} \tag{A3.38}$$

$$\frac{dE_t}{d\kappa_t^H} = \left(\frac{1-\kappa_t^H}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{tt}^k + \frac{Y_t^N}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)(1-\kappa_t^H)^2} \tag{A3.39}$$

The medium-run effect of on female, male and total employment are

$$\frac{dE_t^F}{d\kappa_{t-1}^H} = e_{k(t-1)}^{NF} + \frac{\beta_t^N}{T_t^N}\frac{dY_{t-1}^N}{d\kappa_{t-1}^H} + \left(\frac{\beta_t^H\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^k \tag{A3.40}$$

$$\frac{dE_t^M}{d\kappa_{t-1}^H} = e_{k(t-1)}^{NM} + \frac{(1-\beta_t^N)}{T_t^N}\frac{dY_{t-1}^N}{d\kappa_{t-1}^H} + \left(\frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^k \tag{A3.41}$$

$$\frac{dE_t}{d\kappa_{t-1}^H} = e_{k(t-1)}^{NF} + e_{k(t-1)}^{NM} + \frac{1}{T_t^N}\frac{dY_{t-1}^N}{d\kappa_{t-1}^H} + \left(\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^k \tag{A3.42}$$

A3.1.4 The effect of a change in public social infrastructure investment/GDP on public debt

We derive the total short-run effect of public social infrastructure investment/GDP on public debt/GDP as below:

$$\frac{d\left(\frac{D}{Y}\right)_t}{d\kappa_t^H} = d_{tt}^k + \frac{\partial\left(\frac{D}{Y}\right)_t}{\partial Y_t^N}\frac{\partial Y_t^N}{\partial \kappa_t^H} \tag{A3.43}$$

The medium-run impact of public social infrastructure investment/GDP on public debt/GDP is shown in (A3.44).

$$\frac{d\left(\frac{D}{Y}\right)_t}{d\kappa_{t-1}^H} = d_{t(t-1)}^k + \frac{\partial\left(\frac{D}{Y}\right)_t}{\partial Y_t^N}\frac{\partial Y_t^N}{\partial \kappa_{t-1}^H} \tag{A3.44}$$

A3.1.5 Multiplier (with respect to Y^N)

φ_k term in the multiplier is derived in (A3.45) below.

$$\varphi_k = \left|\frac{\partial C_t^N}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial C_t^H}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial I_t}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial X_t}{\partial Y_t^N}\right|_{\kappa_t^H} - \left|\frac{\partial M_t}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial G_t^C}{\partial Y_t^N}\right|_{\kappa_t^H} + \left|\frac{\partial I_t^G}{\partial Y_t^N}\right|_{\kappa_t^H} \tag{A3.45}$$

We first derive the impact of output in N on employment in equations (A3.46)-(A3.49).

$$\frac{\partial E_t^{NF}}{\partial Y_t^N} = e_{YNt}^{NF} = \frac{\beta_t^N}{T_t^N} > 0 \tag{A3.46}$$

$$\frac{\partial E_t^{NM}}{\partial Y_t^N} = e_{YNt}^{NM} = \frac{(1-\beta_t^N)}{T_t^N} > 0 \tag{A3.47}$$

$$\frac{\partial E_t^{HF}}{\partial Y_t^N} = e_{YNt}^{HF} = \frac{\beta_t^H \kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)(1-\kappa_t^H)} > 0 \tag{A3.48}$$

$$\frac{\partial E_t^{HM}}{\partial Y_t^N} = e_{YNt}^{HM} = \frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)(1-\kappa_t^H)} > 0 \tag{A3.49}$$

We derive the effect of output in N on consumption in N and H in (A3.50) and (A3.51) respectively.

$$\frac{\partial C_t^N}{\partial Y_t^N} = C_t^N \left(c_F \frac{w_t^{NF} e_{YNt}^{NF} + w_t^{HF} e_{YNt}^{HF}}{WB_t^F} + c_M \frac{w_t^{NF} \alpha_t^N e_{YNt}^{NM} + w_t^{HF} \alpha_t^H e_{YNt}^{HM}}{WB_t^M} + c_R \frac{1 - \alpha_t^N w_t^{NF} e_{YNt}^{NM} - w_t^{NF} e_{YNt}^{NF}}{R_t} \right) \tag{A3.50}$$

$$\frac{\partial C_t^H}{\partial Y_t^N} = C_t^H \left(z_F \frac{w_t^{NF} e_{YNt}^{NF} + w_t^{HF} e_{YNt}^{HF}}{WB_t^F} + z_M \frac{w_t^{NF} \alpha_t^N e_{YNt}^{NM} + w_t^{HF} \alpha_t^H e_{YNt}^{HM}}{WB_t^M} + z_R \frac{1 - \alpha_t^N w_t^{NF} e_{YNt}^{NM} - w_t^{NF} e_{YNt}^{NF}}{R_t} \right) \tag{A3.51}$$

We derive the effect of output in N on private investment below.

$$\frac{\partial I_t}{\partial Y_t^N} = I_t \left(i_1 \frac{1}{Y_t^N} + i_3 \frac{\left(\frac{\partial \left(\frac{D}{Y}\right)_t}{\partial Y_t^N} \right)}{\frac{D_t}{Y_t}} \right) \tag{A3.52}$$

The impact of output in N on public debt to GDP ratio is shown in (A3.53) below.

$$\frac{\partial \left(\frac{D}{Y}\right)_t}{\partial Y_t^N} = \frac{\frac{\partial D_t}{\partial Y_t^N} Y_t - \frac{D_t}{1 - \kappa_t^H}}{{Y_t}^2} = \frac{\partial D_t}{\partial Y_t^N} \frac{1}{Y_t} - \frac{D_t}{{Y_t}^2 (1 - \kappa_t^H)} \tag{A3.53}$$

$$\frac{\partial \left(\frac{D}{Y}\right)_t}{\partial Y_t^N} = \left(\frac{\kappa_t^H + \kappa_t^C + \kappa_t^G}{1 - \kappa_t^H} - t_t^R - (t_t^W - t_t^R) w_t^{NF} (e_{YNt}^{NF} + \alpha_t^N e_{YNt}^{NM}) - t_t^W w_t^{HF} (e_{YNt}^{HF} + \alpha_t^H e_{YNt}^{HM}) - t_t^C \left(\frac{\partial C_t^N}{\partial Y_t} + \frac{\partial C_t^H}{\partial Y_t} \right) - \frac{D_t}{Y_t (1 - \kappa_t^H)} \right) \frac{1}{Y_t} \tag{A3.53'}$$

Finally, we derive the effect of output in N on exports and imports in (A3.54) and (A3.55) respectively.

$$\frac{\partial X_t}{\partial Y_t^N} = X_t \left(x_2 \frac{\partial \pi_t}{\partial Y_t} \right) = 0 \tag{A3.54}$$

$$\frac{\partial M_t}{\partial Y_t^N} = M_t\left(\frac{n_1}{Y_t^N} + n_2\left(\frac{\partial \pi_t}{\partial Y_t}\right)\right) = \frac{M_t n_1}{Y_t^N} > 0 \qquad \text{(A3.55)}$$

A3.2 The effects of a change in female and male wages in H

In this section, we examine the impact of public social expenditures through a simultaneous increase in female and male wages in H.

A3.2.1 The short-run effect of in a change in female and male wages in H on aggregate output

The impact of rising wages in H on public social expenditures/GDP is

$$\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \frac{(E_t^{HF} + \alpha_t^H E_t^{HM})(1-\kappa_t^H)}{Y_t} \tag{A3.56}$$

The short-run effect of rising wages in H on total output is

$$\Psi_{tt}^H = \frac{dY_t}{dw_t^{HF}} = \frac{dY_t}{dY_t^N}\frac{dY_t^N}{dw_t^{HF}} + \left|\frac{dY_t}{dw_t^{HF}}\right|_{Y_t^N}$$
$$= \left(\frac{\left|\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial I_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial X_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} - \left|\frac{\partial M_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H}}{(1-\varphi_k)} \right.$$
$$\left. + \frac{\left|\frac{\partial G_t^C}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial I_t^G}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H}}{(1-\varphi_k)} + Y_t\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} \right) * \frac{1}{(1-\kappa_t^H)} \tag{A3.57}$$

where

$$\frac{dY_t^N}{dw_t^{HF}}$$
$$= \frac{\left|\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial I_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial X_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} - \left|\frac{\partial M_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H}}{(1-\varphi_k)}$$
$$+ \frac{\left|\frac{\partial G_t^C}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left|\frac{\partial I_t^G}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H}}{(1-\varphi_k)} \tag{A3.58}$$

φ_k is derived in (A3.59).

$$\varphi_k = \left|\frac{\partial C_t^N}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial C_t^H}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial I_t}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial X_t}{\partial Y_t^N}\right|_{w_t^{HF}} - \left|\frac{\partial M_t}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial G_t^C}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial I_t^G}{\partial Y_t^N}\right|_{w_t^{HF}} \tag{A3.59}$$

The partial effects of wages in H on employment and the profit share are zero.

$$\left.\frac{\partial E_t^{HF}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \left.\frac{\partial E_t^{HM}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \left.\frac{\partial E_t^{NF}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \left.\frac{\partial E_t^{NM}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = 0 \tag{A3.60}$$

$$\left.\frac{\partial \pi_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = 0 \tag{A3.61}$$

For a constant output in N, the effect of a change in female and male wages in H on consumption in N and H are as below.

$$\left.\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = C_t^N\left(c_F\frac{E_t^{HF}}{WB_t^F} + c_M\frac{E_t^{HM}\alpha_t^H}{WB_t^M}\right) \tag{A3.62}$$

$$\left.\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = C_t^H\left(z_F\frac{E_t^{HF}}{WB_t^F} + z_M\frac{E_t^{HM}\alpha_t^H}{WB_t^M}\right) \tag{A3.63}$$

We derive the short-run effect of a simultaneous increase in female and male wages in H on investment in (A3.64).

$$\left.\frac{\partial I_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = I_t\left(i_1\frac{1}{1-\kappa_t^H}\left.\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + i_3\frac{d_{tt}^{WH}}{\left(\frac{D}{Y}\right)_t}\right) \tag{A3.64}$$

where

$$d_{tt}^{WH} = \left.\frac{\partial (D/Y)_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \left.\frac{\partial D_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H}\frac{1}{Y_t^N} - \frac{1}{(1-\kappa_t^H)}\frac{D_t}{Y_t}\left.\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} \tag{A3.65}$$

and

$$\begin{aligned}\left.\frac{\partial D_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} &= \frac{Y_t(1+\kappa_t^C+\kappa_t^G)}{(1-\kappa_t^H)}\left.\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} - t_t^w(\alpha_t^H E_t^{HM} + E_t^{HF}) \\ &\quad - t_t^C\left(\left.\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} + \left.\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H}\right)\end{aligned} \tag{A3.66}$$

For a constant output in N, the partial effects of female and male wages in H on X and M are zero in the short run.

$$\left.\frac{\partial X_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = 0 \tag{A3.67}$$

$$\left.\frac{\partial M_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = 0 \tag{A3.68}$$

An increase in female and male wages in H has a positive partial effect on types of government spending as below.

$$\left|\frac{\partial G_t^C}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \frac{\kappa_t^C Y_t^N}{(1-\kappa_t^H)^2}\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} > 0 \tag{A3.69}$$

$$\left|\frac{\partial I_t^G}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \frac{\kappa_t^G Y_t^N}{(1-\kappa_t^H)^2}\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} > 0 \tag{A3.70}$$

$$\left|\frac{\partial G_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} = \frac{Y_t^N}{(1-\kappa_t^H)^2}\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H,\alpha_t^H} > 0 \tag{A3.71}$$

A3.2.2 The effect of in a change in female and male wages in H on aggregate output in the medium run

The medium-run impact of a change in female and male wages in H on aggregate output is through its effect on output in N as shown below:

$$\begin{aligned}\Psi_{t(t-1)}^H &= \frac{dY_t}{dw_{t-1}^{HF}} = \frac{dY_t}{dY_t^N}\frac{dY_t^N}{dw_{t-1}^{HF}} \\ &= \frac{\left|\frac{\partial C_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial I_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial X_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} - \left|\frac{\partial M_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{(1-\varphi_k)(1-\kappa_t^H)} \\ &+ \frac{\left|\frac{\partial G_t^C}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial I_t^G}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{(1-\varphi_k)(1-\kappa_t^H)}\end{aligned} \tag{A3.72}$$

where

$$\begin{aligned}\left|\frac{dY_t^N}{dw_{t-1}^{HF}}\right|_{E_t^H,\alpha_t^H} &= \frac{\left|\frac{\partial C_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial I_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial X_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} - \left|\frac{\partial M_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{(1-\varphi_k)} \\ &+ \frac{\left|\frac{\partial G_t^C}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial I_t^G}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{(1-\varphi_k)}\end{aligned} \tag{A3.73}$$

The rising wage in H also increases the public social expenditures/GDP in the previous period by the following amount:

$$\frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}} = \frac{E_{t-1}^{HF} + \alpha_{t-1}^H E_{t-1}^{HM} + w_{t-1}^{HF}\left(e_{Y(t-1)}^{HF} + e_{Y(t-1)}^{HM}\alpha_{t-1}^H\right)}{\frac{Y_{t-1}}{(1-\kappa_t^H)} + \Psi_{(t-1)(t-1)}^H \kappa_{t-1}^H} \tag{A3.74}$$

We derive the impact of rising wages in H on labor productivity in (A3.75) below.

$$\left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = T_t^N \left(h_1 \frac{\left|\frac{\partial C_{t-1}^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N} + \kappa_{t-1}^H \Psi_{(t-1)(t-1)}^H + Y_{t-1} \frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}}}{C_{t-1}^H + G_{t-1}^H} + h_2 \frac{\Psi_{(t-1)(t-1)}^H \kappa_{t-1}^G + Y_{t-1} \frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}}}{I_{t-1}^G} + h_3 \left(\frac{\Psi_{(t-1)(t-1)}^H}{Y_{t-1}} - \frac{1}{(1-\kappa_{t-1}^H)} \frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}} \right) \right) \quad \text{(A3.75)}$$

where

$$\left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = \left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, Y_{t-1}^N} + \left|\frac{\partial C_{t-1}^H}{\partial Y_{t-1}^N}\right|_{Y_t^N} \left|\frac{\partial Y_{t-1}^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} \quad \text{(A3.76)}$$

We derive the medium-run partial effect of rising female and male wages in H on employment in equations (A3.77)-(A3.80) below.

$$e_{H(t-1)}^{NF} = \left|\frac{\partial E_t^{NF}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = -\frac{\beta_t^N Y_t^N}{(T_t^N)^2} \left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} \quad \text{(A3.77)}$$

$$e_{H(t-1)}^{NM} = \left|\frac{\partial E_t^{NM}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = -\frac{(1-\beta_t^N) Y_t^N}{(T_t^N)^2} \left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} \quad \text{(A3.78)}$$

$$e_{H(t-1)}^{HF} = \left|\frac{\partial E_t^{HF}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = 0 \quad \text{(A3.79)}$$

$$e_{H(t-1)}^{HM} = \left|\frac{\partial E_t^{HM}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = 0 \quad \text{(A3.80)}$$

The effect of female and male wages in H on the profit share is through the effects on labor productivity in the medium run.

$$\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = \left(\frac{(\alpha_t^N - \alpha_t^N \beta_t^N + \beta_t^N) w_t^{NF}}{(T_t^N)^2} \right) \left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} \quad \text{(A3.81)}$$

We derive the partial effect of female and male wages in H on consumption in N and H below.

$$\left|\frac{\partial C_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = C_t^N\left(c_F\frac{e_{H(t-1)}^{NF}w_t^{NF}}{WB_t^F} + c_M\frac{e_{H(t-1)}^{NM}w_t^{NF}\alpha_t^N}{WB_t^M} - c_R\frac{\left(e_{H(t-1)}^{NM}\alpha_t^N + e_{H(t-1)}^{NF}\right)w_t^{NF}}{R_t}\right) \tag{A3.82}$$

$$\left|\frac{\partial C_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = C_t^H\left(z_F\frac{e_{H(t-1)}^{NF}w_t^{NF}}{WB_t^F} + z_M\frac{e_{H(t-1)}^{NM}w_t^{NF}\alpha_t^N}{WB_t^M} - z_R\frac{\left(e_{H(t-1)}^{NM}\alpha_t^N + e_{H(t-1)}^{NF}\right)w_t^{NF}}{R_t}\right) \tag{A3.83}$$

Higher wages in H influence private investment through the effects on the profit share and public debt/GDP as below:

$$\left|\frac{\partial I_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = I_t\left(i_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{\pi_t} + i_3\frac{d_{t(t-1)}^H}{\left(\frac{D}{Y}\right)_t}\right) \tag{A3.84}$$

where

$$d_{t(t-1)}^H = \left|\frac{\partial (D/Y)_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = \left|\frac{\partial D_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}\frac{1}{Y_t} = \left(\frac{\partial D_{t-1}}{\partial w_{t-1}^{HF}}(1+r_{t-1}) - t_t^W\left(e_{H(t-1)}^{NM}\alpha_t^N + e_{H(t-1)}^{NF}\right)w_t^{NF} + t_t^R\left(e_{H(t-1)}^{NM}\alpha_t^N + e_{H(t-1)}^{NF}\right)w_t^{NF} - t_t^C\left(\left|\frac{\partial C_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}\right)\right)\frac{1}{Y_t} \tag{A3.85}$$

The impact of wages in H on the previous period’s public debt/GDP is

$$\frac{\partial D_{t-1}}{\partial w_{t-1}^{HF}} = Y_{t-1}\frac{d\left(\frac{D}{Y}\right)_{t-1}}{dw_{t-1}^{HF}} + \Psi_{(t-1)(t-1)}^H\frac{D_{t-1}}{Y_{t-1}} \tag{A3.86}$$

Wages in H influence exports and imports in the medium run through the effects on the profit share as below:

$$\cdot\left|\frac{\partial X_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = X_t\left(x_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{\pi_t}\right) \tag{A3.87}$$

$$\left|\frac{\partial M_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = M_t\left(n_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N}}{\pi_t}\right) \tag{A3.88}$$

Finally, for a constant output in N, higher wages in H has zero effect on government's physical investments and government's consumption expenditures.

$$\left|\frac{\partial G_t^C}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = 0 \tag{A3.89}$$

$$\left|\frac{\partial I_t^G}{\partial w_{t-1}^{HF}}\right|_{Y_t^N} = 0 \tag{A3.90}$$

A3.2.3 The effect of in a change in female and male wages on employment

The short-run effect of higher wages in H on female, male and total employment is through the effects on aggregate output as shown in (A3.91)-(A3.93) below:

$$\frac{dE_t^F}{dw_t^{HF}} = \left(\beta_t^N\frac{(1-\kappa_t^H)}{T_t^N} + \beta_t^H\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{tt}^H \tag{A3.91}$$

$$\frac{dE_t^M}{dw_t^{HF}} = \left((1-\beta_t^N)\frac{(1-\kappa_t^H)}{T_t^N} + (1-\beta_t^H)\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{tt}^H \tag{A3.92}$$

$$\frac{dE_t}{d\kappa_t^H} = \left(\frac{1-\kappa_t^H}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{tt}^H \tag{A3.93}$$

We derive the medium-run effect of higher wages in H on employment in (A3.94)-(A3.96) below:

$$\frac{dE_t^F}{dw_{t-1}^{HF}} = e_{H(t-1)}^{NF} + \beta_t^N\frac{1}{T_t^N}\left|\frac{dY_t^N}{dw_{t-1}^{HF}}\right|_{E_t^H,\alpha_t^H} + \left(\frac{\beta_t^H\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^H \tag{A3.94}$$

$$\frac{dE_t^M}{dw_{t-1}^{HF}} = e_{H(t-1)}^{NM} + (1-\beta_t^N)\frac{1}{T_t^N}\left|\frac{dY_t^N}{dw_{t-1}^{HF}}\right|_{E_t^H,\alpha_t^H} + \left(\frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H+\alpha_t^H-\beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^H \tag{A3.95}$$

$$\frac{dE_t}{dw_{t-1}^{HF}} = e_{H(t-1)}^{NF} + e_{H(t-1)}^{NM} + \frac{1}{T_t^N} \left| \frac{dY_t^N}{dw_{t-1}^{HF}} \right|_{E_t^H, \alpha_t^H} + \left(\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)} \right) \Psi_{t(t-1)}^H \tag{A3.96}$$

A3.2.4 The effect of a change in female and male wages in H on public debt

We show the short-run and medium-run impact of an increase in female and male wages in H on public debt/GDP in (A3.97) and (A3.98) respectively.

$$\frac{d\left(\frac{D}{Y}\right)_t}{dw_t^{HF}} = d_{tt}^H + \frac{\partial\left(\frac{D}{Y}\right)_t}{\partial Y_t^N} \left| \frac{dY_t^N}{dw_{t-1}^{HF}} \right|_{E_t^H, \alpha_t^H} \tag{A3.97}$$

$$\frac{d\left(\frac{D}{Y}\right)_t}{dw_t^{HF}} = d_{t(t-1)}^H + \frac{\partial\left(\frac{D}{Y}\right)_t}{\partial Y_t^N} \left| \frac{dY_t^N}{dw_{t-1}^{HF}} \right|_{E_{t-1}^H, \alpha_t^H} \tag{A3.98}$$

A3.3 The effects of a change in the gender wage gap in H

A3.3.1 The short-run effect of a change in gender wage gap in H on aggregate output

The impact of rising social expenditures through closing the gender wage gap in H, i.e. increasing female wages with a constant male wage on public social expenditures/GDP is

$$\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H} = \frac{E_t^{HF}(1-\kappa_t^H)}{Y_t} \tag{A3.99}$$

$$\begin{aligned}\Psi_{tt}^{\alpha H} &= \frac{dY_t}{dw_t^{HF}} = \frac{dY_t}{dY_t^N}\frac{dY_t^N}{dw_t^{HF}} + \left|\frac{dY_t}{dw_t^{HF}}\right|_{Y_t^N} \\ &= \left(\frac{\left|\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial I_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial X_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} - \left|\frac{\partial M_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H}}{(1-\varphi_k)}\right. \\ &\quad \left. + \frac{\left|\frac{\partial G_t^C}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial I_t^G}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H}}{(1-\varphi_k)} + \left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H} Y_t\right) * \frac{1}{(1-\kappa_t^H)}\end{aligned} \tag{A3.100}$$

where

$$\begin{aligned}\frac{dY_t^N}{dw_t^{HF}} &= \frac{\left|\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial I_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial X_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} - \left|\frac{\partial M_t}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H}}{(1-\varphi_k)} \\ &\quad + \frac{\left|\frac{\partial G_t^C}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} + \left|\frac{\partial I_t^G}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H}}{(1-\varphi_k)}\end{aligned} \tag{A3.101}$$

φ_k is shown in (A3.102).

$$\begin{aligned}\varphi_k &= \left|\frac{\partial C_t^N}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial C_t^H}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial I_t}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial X_t}{\partial Y_t^N}\right|_{w_t^{HF}} - \left|\frac{\partial M_t}{\partial Y_t^N}\right|_{w_t^{HF}} + \left|\frac{\partial G_t^C}{\partial Y_t^N}\right|_{w_t^{HF}} \\ &\quad + \left|\frac{\partial I_t^G}{\partial Y_t^N}\right|_{w_t^{HF}}\end{aligned} \tag{A3.102}$$

The partial effects on female and male employment in N and H are zero.

$$\left|\frac{\partial E_t^{HF}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = \left|\frac{\partial E_t^{HM}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = \left|\frac{\partial E_t^{NF}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = \left|\frac{\partial E_t^{NM}}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = 0 \tag{A3.103}$$

The partial effect of a change in gender wage gap in H on the profit share is also zero.

$$\left|\frac{\partial \pi_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = 0 \tag{A3.104}$$

For a constant output in N, the effect of higher female wages in H is positive in the short run.

$$\left|\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = C_t^N \left(c_F \frac{E_t^{HF}}{WB_t^F}\right) > 0 \tag{A3.105}$$

$$\left|\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = C_t^H \left(z_F \frac{E_t^{HF}}{WB_t^F}\right) > 0 \tag{A3.106}$$

The partial effect of higher female wages in H in the short run is shown in (A3.107) as below:

$$\left|\frac{\partial I_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = I_t \left(i_1 \frac{1}{1-\kappa_t^H} \left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N, E_t^H} + i_3 \frac{d_{tt}^{\alpha H}}{\left(\frac{D}{Y}\right)_t} \right) \tag{A3.107}$$

where

$$d_{tt}^{\alpha H} = \left|\frac{\partial (D/Y)_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = \left|\frac{\partial D_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} \frac{1}{Y_t^N} - \frac{1}{(1-\kappa_t^H)} \frac{D_t}{Y_t} \left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N, E_t^H} \tag{A3.108}$$

For a constant output in N, the short-run impact of higher female wages in H on the public debt is

$$\begin{aligned} \left|\frac{\partial D_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = {} & \frac{Y_t(1+\kappa_t^C+\kappa_t^G)}{(1-\kappa_t^H)} \left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N, E_t^H} - t_t^w (E_t^{HF}) \\ & - t_t^C \left(\left|\frac{\partial C_t^N}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} + \left|\frac{\partial C_t^H}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} \right) \end{aligned} \tag{A3.109}$$

For a constant output in N, the short-run effect of female wages in H on exports and imports are zero.

$$\left|\frac{\partial X_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = 0 \tag{A3.110}$$

$$\left|\frac{\partial M_t}{\partial w_t^{HF}}\right|_{Y_t^N, E_t^H} = 0 \tag{A3.111}$$

Finally, the partial effects of closing the gender pay gap in H on the components of government expenditures are positive in the short run.

$$\left|\frac{\partial G_t^H}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = \frac{Y_t^N}{(1-\kappa_t^H)^2}\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H} > 0 \qquad \text{(A3.112)}$$

$$\left|\frac{\partial G_t^C}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = \frac{\kappa_t^C Y_t^N}{(1-\kappa_t^H)^2}\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H} > 0 \qquad \text{(A3.113)}$$

$$\left|\frac{\partial I_t^G}{\partial w_t^{HF}}\right|_{Y_t^N,E_t^H} = \frac{\kappa_t^G Y_t^N}{(1-\kappa_t^H)^2}\left|\frac{d\kappa_t^H}{dw_t^{HF}}\right|_{Y_t^N,E_t^H} > 0 \qquad \text{(A3.114)}$$

A3.3.2 The effect of in a change in the gender wage gap in H on aggregate output in the medium run

Closing the gender wage gap in H with increasing female wages in H also increases the public social expenditures/GDP in the previous period by the following amount:

$$\frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}} = \frac{E_{t-1}^{HF} + w_{t-1}^{HF}\left(e_{Y(t-1)}^{HF} + e_{Y(t-1)}^{HM}\alpha_{t-1}^H\right)}{\frac{Y_{t-1}}{(1-\kappa_t^H)} + \Psi_{(t-1)(t-1)}^{\alpha H}\kappa_{t-1}^H} \qquad \text{(A3.115)}$$

and

$$\frac{d\alpha_{t-1}^H}{dw_{t-1}^{HF}} = -\frac{\alpha_{t-1}^H}{w_{t-1}^{HF}} \qquad \text{(A3.116)}$$

The medium-run impact of closing the gender wage gap in H on aggregate output is shown in (A3.117) below:

$$\begin{aligned}\Psi_{t(t-1)}^{\alpha H} &= \frac{dY_t}{dw_{t-1}^{HF}} = \frac{dY_t}{dY_t^N}\frac{dY_t^N}{dw_{t-1}^{HF}} \\ &= \frac{\left|\frac{\partial C_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H} + \left|\frac{\partial C_t^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H} + \left|\frac{\partial I_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H} + \left|\frac{\partial X_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H} - \left|\frac{\partial M_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H}}{(1-\varphi_k)(1-\kappa_t^H)} \\ &+ \frac{\left|\frac{\partial G_t^C}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H} + \left|\frac{\partial I_t^G}{\partial \kappa_{t-1}^H}\right|_{Y_t^N,E_{t-1}^H}}{(1-\varphi_k)(1-\kappa_t^H)}\end{aligned} \qquad \text{(A3.117)}$$

where

$$\frac{dY_t^N}{dw_{t-1}^{HF}} = \frac{\left|\frac{\partial C_t^N}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H} + \left|\frac{\partial C_t^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H} + \left|\frac{\partial I_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H} + \left|\frac{\partial X_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H} - \left|\frac{\partial M_t}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H}}{(1-\varphi_k)} + \frac{\left|\frac{\partial G_t^C}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H} + \left|\frac{\partial I_t^G}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H}}{(1-\varphi_k)} \tag{A3.118}$$

The impact of higher female wages in H affects labor productivity in the medium run as below:

$$\left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = T_t^N \left(h_1 \frac{\left|\frac{\partial C_{t-1}^H}{\partial \kappa_{t-1}^H}\right|_{Y_t^N, E_{t-1}^H} + \kappa_{t-1}^H \Psi_{(t-1)(t-1)}^{\alpha H} + Y_{t-1} \frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}}}{C_{t-1}^H + G_{t-1}^H} + h_2 \frac{\Psi_{(t-1)(t-1)}^{\alpha H} \kappa_{t-1}^G + Y_{t-1} \frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}}}{I_{t-1}^G} + h_3 \left(\frac{\Psi_{(t-1)(t-1)}^{\alpha H}}{Y_{t-1}} - \frac{1}{(1-\kappa_{t-1}^H)} \frac{d\kappa_{t-1}^H}{dw_{t-1}^{HF}} \right) \right) \tag{A3.120}$$

where the impact of higher female wages in H on consumption in H in the previous period is

$$\left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = \left|\frac{\partial C_{t-1}^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H, Y_{t-1}^N} + \left|\frac{\partial C_{t-1}^H}{\partial Y_{t-1}^N}\right|_{Y_t^N, E_{t-1}^H} \left|\frac{\partial Y_{t-1}^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} \tag{A3.121}$$

For a constant output in N, an increase in the female wages in H has a partial impact on female and male employment in N through labor productivity and does not have an impact on female and male employment in H.

$$e_{\alpha H(t-1)}^{NF} = \left|\frac{\partial E_t^{NF}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = -\frac{\beta_t^N Y_t^N}{(T_t^N)^2} \left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} \tag{A3.122}$$

$$e_{\alpha H(t-1)}^{NM} = \left|\frac{\partial E_t^{NM}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = -\frac{(1-\beta_t^N) Y_t^N}{(T_t^N)^2} \left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} \tag{A3.123}$$

$$e_{\alpha H(t-1)}^{HF} = \left|\frac{\partial E_t^{HF}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = 0 \tag{A3.124}$$

$$e_{\alpha H(t-1)}^{HM} = \left|\frac{\partial E_t^{HM}}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = 0 \tag{A3.125}$$

The partial impact of closing the gender wage gap in H is through changes in labor productivity in the medium run as shown below:

$$\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = \left(\frac{(\alpha_t^N - \alpha_t^N \beta_t^N + \beta_t^N) w_t^{NF}}{(T_t^N)^2}\right) \left|\frac{\partial T_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} \tag{A3.126}$$

For a constant output in N, the partial effect of closing the gender wage gap in H on consumption in N and H is through the effects on the female and male wage bill in the medium run as shown below:

$$\begin{aligned}\left|\frac{\partial C_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = C_t^N \Bigg(& c_F \frac{e_{\alpha H(t-1)}^{NF} w_t^{NF}}{WB_t^F} + c_M \frac{e_{\alpha H(t-1)}^{NM} w_t^{NF} \alpha_t^N}{WB_t^M} \\ & - c_R \frac{\left(e_{\alpha H(t-1)}^{NM} \alpha_t^N + e_{\alpha H(t-1)}^{NF}\right) w_t^{NF}}{R_t} \Bigg)\end{aligned} \tag{A3.127}$$

$$\begin{aligned}\left|\frac{\partial C_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = C_t^H \Bigg(& z_F \frac{e_{\alpha H(t-1)}^{NF} w_t^{NF}}{WB_t^F} + z_M \frac{e_{\alpha H(t-1)}^{NM} w_t^{NF} \alpha_t^N}{WB_t^M} \\ & - z_R \frac{\left(e_{\alpha H(t-1)}^{NM} \alpha_t^N + e_{\alpha H(t-1)}^{NF}\right) w_t^{NF}}{R_t} \Bigg)\end{aligned} \tag{A3.128}$$

The partial effect of female wages in H on private investment is through the effects on the profit share and public debt/GDP in the medium run.

$$\left|\frac{\partial I_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = I_t \left(i_2 \frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H}}{\pi_t} + i_3 \frac{d_{t(t-1)}^{\alpha H}}{\left(\frac{D}{Y}\right)_t} \right) \tag{A3.129}$$

(A3.130) shows the medium-run partial impact on the public debt/GDP.

$$d_{t(t-1)}^{\alpha H} = \left|\frac{\partial (D/Y)_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = \left|\frac{\partial D_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} \frac{1}{Y_t}$$

$$= \left(\frac{\partial D_{t-1}}{\partial w_{t-1}^{HF}}(1 + r_{t-1}) - t_t^W\left(e_{\alpha H(t-1)}^{NM}\alpha_t^N + e_{\alpha H(t-1)}^{NF}\right)w_t^{NF} + t_t^R\left(e_{\alpha H(t-1)}^{NM}\alpha_t^N + e_{\alpha H(t-1)}^{NF}\right)w_t^{NF} - t_t^C\left(\left|\frac{\partial C_t^N}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} + \left|\frac{\partial C_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H}\right)\right)\frac{1}{Y_t} \tag{A3.130}$$

where

$$\frac{\partial D_{t-1}}{\partial w_{t-1}^{HF}} = Y_{t-1}\frac{d\left(\frac{D}{Y}\right)_{t-1}}{dw_{t-1}^{HF}} + \Psi_{(t-1)(t-1)}^{\alpha H}\frac{D_{t-1}}{Y_{t-1}} \tag{A3.131}$$

For a constant output in N, the effects of higher female wages in H on exports and imports are through the effects on the profit share in the medium run.

$$\left|\frac{\partial X_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = X_t\left(x_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H}}{\pi_t}\right) \tag{A3.132}$$

$$\left|\frac{\partial M_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = M_t\left(n_2\frac{\left|\frac{\partial \pi_t}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H}}{\pi_t}\right) \tag{A3.133}$$

Finally, for a constant output in N, the medium-run partial effect of change in female wages in H on the components of government spending is zero.

$$\left|\frac{\partial G_t^H}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = 0 \tag{A3.134}$$

$$\left|\frac{\partial G_t^C}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = 0 \tag{A3.135}$$

$$\left|\frac{\partial I_t^G}{\partial w_{t-1}^{HF}}\right|_{Y_t^N, E_{t-1}^H} = 0 \tag{A3.136}$$

A3.3.3 The effect of a change in the gender wage gap in H on employment

In the short run, the total effect of a change in the gender wage gap in H on female and male employment is through the effects on aggregate output.

$$\frac{dE_t^F}{dw_t^{HF}} = \left(\beta_t^N\frac{(1 - \kappa_t^H)}{T_t^N} + \beta_t^H\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\right)\Psi_{tt}^{\alpha H} \tag{A3.137}$$

$$\frac{dE_t^M}{dw_t^{HF}} = \left((1-\beta_t^N)\frac{(1-\kappa_t^H)}{T_t^N} + (1-\beta_t^H)\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\right)\Psi_{tt}^{\alpha H} \quad \text{(A3.138)}$$

The effect of higher female wages in H on employment is the sum of $\frac{dE_t^F}{dw_t^{HF}}$ and $\frac{dE_t^M}{dw_t^{HF}}$ as shown below:

$$\frac{dE_t}{dw_t^{HF}} = \left(\frac{1-\kappa_t^H}{T_t^N} + \frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\right)\Psi_{tt}^{\alpha H} \quad \text{(A3.139)}$$

The impact of higher female wages in H on female, male and total employment in the medium run is shown in equations (A3.140), (A3.141) and (A3.142) respectively.

$$\frac{dE_t^F}{dw_{t-1}^{HF}} = e_{\alpha H(t-1)}^{NF} + \beta_t^N \frac{1}{T_t^N}\frac{dY_t^N}{dw_{t-1}^{HF}}\left(\frac{\beta_t^H\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^{\alpha H} \quad \text{(A3.140)}$$

$$\begin{aligned}\frac{dE_t^M}{dw_{t-1}^{HF}} = e_{\alpha H(t-1)}^{NM} + (1-\beta_t^N)\frac{1}{T_t^N}\frac{dY_t^N}{dw_{t-1}^{HF}} \\ + \left(\frac{(1-\beta_t^H)\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^{\alpha H}\end{aligned} \quad \text{(A3.141)}$$

$$\begin{aligned}\frac{dE_t}{dw_{t-1}^{HF}} = e_{\alpha H(t-1)}^{NF} + e_{\alpha H(t-1)}^{NM} + \frac{1}{T_t^N}\frac{dY_t^N}{dw_{t-1}^{HF}} \\ + \left(\frac{\kappa_t^H}{w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H\alpha_t^H)}\right)\Psi_{t(t-1)}^{\alpha H}\end{aligned} \quad \text{(A3.142)}$$

A3.3.4 The effect of a change in the gender wage gap in H on public debt

The short-run and medium-run impact of a change in the gender wage gap in H on public debt/GDP are shown in equations (A3.143) and (A3.144).

$$\frac{d\left(\frac{D}{Y}\right)_t}{dw_t^{HF}} = d_{tt}^{\alpha H} + \frac{\partial\left(\frac{D}{Y}\right)_t}{\partial Y_t^N}\left|\frac{dY_t^N}{dw_{t-1}^{HF}}\right|_{E_t^H} \quad \text{(A3.143)}$$

$$\frac{d\left(\frac{D}{Y}\right)_t}{dw_t^{HF}} = d_{t(t-1)}^{\alpha H} + \frac{\partial\left(\frac{D}{Y}\right)_t}{\partial Y_t^N}\left|\frac{dY_t^N}{dw_{t-1}^{HF}}\right|_{E_{t-1}^H} \quad \text{(A3.144)}$$

Online Appendix 4. Stylised facts of the data

	Mean	Std. Dev.	Observations
Y	1161.194	359.168	47
WB^F	273.802	121.957	46
WB^M	465.495	115.115	46
E^H	7.171	1.764	46
E^N	44.793	1.408	46
E^{HF}	5.426	1.385	46
E^{HM}	1.745	0.399	46
E^{NF}	17.697	0.783	46
E^{NM}	27.096	1.088	46
w^{HF}	13.143	4.217	46
w^{HM}	20.321	3.626	46
w^{NF}	11.017	4.144	46
w^{NM}	15.874	3.825	46
α^H	1.621	0.256	46
α^N	1.519	0.222	46
C^H	29.913	9.006	47
C^N	684.148	254.500	47
I	174.792	47.024	47
G^C	110.120	11.600	47
I^G	32.162	9.919	47
G^H	142.017	48.692	47
M	276.036	167.121	47
X	265.690	143.665	47
Y^N	1019.177	311.513	47
κ^H	0.122	0.008	47
κ^C	0.102	0.025	47
κ^G	0.030	0.013	47
T^N	22.473	6.613	46
β^N	0.755	0.020	46
β^H	0.395	0.014	46
R	412.358	121.270	47
π	0.406	0.026	47
t^W	25.102	1.433	47
t^R	29.881	5.084	47
t^{PW}	1.286	0.426	47
t^C	18.494	1.405	47
D/Y	0.516	0.171	47
Y^{World}	41700000000000	16700000000000	47

Endnotes

[i] Productivity in H is $w_t^{HF}(\beta_t^H + \alpha_t^H - \beta_t^H \alpha_t^H)$.

[ii] This simplification is also imposed by the unavailability of time series data for $\frac{U}{N}$.

[iii] In the estimations for C^N and C^H, we use contemporaneous, one-year and two-year lagged differences of $\log \alpha^N$, $\log \alpha^H$, $\log t^R$, $\log t^W$, $\log \beta^N$, $\log \beta^H$, $\log Y^W$, logarithm of strike days as a ratio to employment as instruments for all independent variables. In investment estimations we use contemporaneous, one-year and two-year lagged differences of $\log \alpha^N$, $\log t^R$, $\log t^W$, $\log \beta^N$, $\log \kappa^H$, $\log Y^W$, logarithm of strike days as a ratio to employment and 1-3 year lagged differences of log*(D/Y)* as instruments for all independent variables. In export estimations we use one-year and two-year lagged differences of $\log \kappa^H$, $\log Y^N$, logarithm of strike days as a ratio to employment and Chinn-Ito capital account openness index as instruments for $\Delta\log(\pi_t)$. In import equation, we use contemporaneous, one-year and two-year lagged differences of $\log \alpha^N$, $\log \beta^N$, $\log \kappa^H$, $\log Y^W$, logarithm of strike days as a ratio to employment and Chinn-Ito capital account openness index as instruments for all independent variables. The choice of instruments is based on tests for satisfying exogeneity and relevance conditions based on tests for weak identification, overidentification and endogeneity, reported at the end of the estimation tables. Kleibergen-Paap rk Wald F values in regressions for C^N, C^H, X are greater than Stock-Yogo values for a 10% maximal IV size bias; and for M and I they are respectively larger than Stock-Yogo values for 15% maximal IV size bias and 20% maximal IV size bias, which show that the selected instruments are strong. To test for robustness, we estimated 3SLS/ Seemingly Unrelated Regressions (SUR)-IV regressions in which consumption in N, consumption in H, investment, exports and imports are estimated in a system; however the equations fail rank condition for identification, hence the system is not identified. As an alternative we considered GMM-3SLS regressions; however the number of parameters exceeded the number of observations. We preferred not to use SUR without instruments, as this does not address the endogeneity and reverse causality issues.

[iv] Engle Granger and ARDL Bounds tests show that there is no cointegration in any of the regressions, therefore we did not proceed with Error Correction Model (ECM) and Autoregressive Distributed Lag (ARDL).

[v] The last year is determined by data availability. Electricity, gas and water; construction; public administration and defense, compulsory social security; agriculture, forestry and fishing and mining and quarrying (as well as education and health and social work) are excluded due to the

complications in measuring productivity in these sectors. The results are rather robust to the inclusion of these sectors. The results are also robust to excluding the post-2008 crisis period.

[vi] The use of 5-year sum (average) serves as a proxy for capital stock in terms of both private and public human and physical capital.

[vii] The strike days as a ratio to employment reflects the bargaining power of workers and serves as an instrument for female wages. Due to lack of long-term comparable data, we use strike days/employment for three broad sectors (manufacturing, market services, non-market services). The gender pay gap for the whole N sector reflects the changes in the gender norms in the UK and serves as a good instrument for sectoral gender pay gaps. The sectoral value added in the US and the EU-12 are expected to influence the sectoral value added and investment in the UK as they reflect the growth of markets for these sectors in the UK`s two major trade partners.

[viii] We follow this methodology because in our simulations we do not prefer to treat our variables that have intuitively expected signs and are statistically insignificant (at 10%) as zero. The problems of dismissing the effects coming through variables that are statistically insignificant at commonly accepted levels are discussed in Ziliak and McCloskey (2004; 2008).

[ix] Wherever required, the elasticities in the estimations in Tables 3-7 are converted to marginal effects using the averages of the relevant variables for the estimation period.

[x] In the theoretical model, the medium run is not an econometric concept related to data or time lags, What distinguishes the medium run from the short run is the change in productivity which triggers further effects on employment, total wage bill, the profit share and thereby consumption, investment, exports, and imports. See Appendix A2.1.2, A2.2.2, A3.1.2, A3.2.2, and A3.3.2 for the calculations.

[xi] The multiplier shows the increase in Y as a ratio to an increase in demand, in this case due to a rise in the wage rates in N and is equal to $(1/(1-\varphi_{NF}))$, where φ_{NF} is calculated as in Equations A2.2 in the online appendix. This is on the high end of the estimates of multipliers compared with the estimations by Thomas Obst, Ozlem Onaran and Maria Nikolaidi (2019) using a Post-Kaleckian model with government without gendered effects, who report multipliers in the range of 1.13 and 4.84. The high multiplier value in our case is particularly driven by the high elasticity of investment to output (i_1 in Equation 22 estimated in Table 4). There is also evidence that demand-led models deliver higher estimates (Gechert, 2015). See also Walid Qazizada and Engelbert Stockhammer, (2015) and Engelbert Stockhammer, Walid Qazizada and Sebastian Gechert (2019) for high multiplier during down-turns. Nevertheless,

we note that our estimates should be used to interpret the direction of the effects and the magnitudes of the effects are indicative.

[xii] The increase in hourly real wage rate in N and H in GBP is comparable. A 1% increase in female wages in H and N are £0.18 and £0.17 respectively, and a 1% increase in male wages in H and N are £0.24 and £0.21 respectively in 2015.

[xiii] A 1%-point increase in G^H/GDP is a rather substantial increase given that as of 2016 G^H/GDP in the UK is 0.13. This partly explains the high magnitude of the effects. The other reason is the high multiplier implied by the estimated elasticities, in particular output elasticity of investment, as discussed above. In terms of aggregate employment effects being positive despite a high productivity increase, it is worth noting that estimated productivity increase figure refers to the rest of the economy not the aggregate economy and the social sector is a very labor intensive sector.

[xiv] With higher public physical investment, GDP increases in the SR by 3.399% and MR by 2.933%. Detailed results available upon request and are not reported here due to space limitations.