Inequality imperfect competition and their effect on fiscal policy, output and welfare

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Abstract

We use a New Keynesian model with imperfectly competitive goods markets and income inequality and study their impact on fiscal multipliers, output and welfare. Results show that imperfect competition has a positive effect on the government spending multiplier and a negative effect on tax multipliers. In addition, imperfect competition positively affects the balanced budget multiplier. Inequality positively affects the government spending multiplier but negatively affects the tax and balanced budget multipliers when poor workers are taxed, while the opposite is true when wealthy workers are taxed. Looking at the welfare effects of imperfect competition, we find that it positively affects the net welfare gains of both income groups as well as social welfare. In addition, greater numbers of poor workers reduce net welfare gains and social welfare when they are the ones taxed while the opposite is true when wealthy workers are taxed. Changes in workers' MPCs have an ambiguous effect on net welfare gains and social welfare when poor workers are taxed but a positive effect when wealthy workers are taxed. Therefore, our model proves that under imperfect competition and income inequality the maximum net increase in expenditure, output and social welfare comes when the government increases government spending and taxes wealthy workers.

(JEL classification codes: D31, D43, E12, E62, H3)

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1. Introduction

Macroeconomic theory, and specifically Keynesian economics, has long supported the idea that the marginal propensity to consume (MPC) is crucial for evaluating fiscal policy effectiveness, an idea first formulated by Keynes (1936) which is still included in standard macroeconomic textbooks (Blanchard and Johnson 2012; Mankiw 2014). The MPC of an individual is affected by his wealth and income with poorer people consuming a greater percentage of their income and vice versa. As a result, differences in wealth and income distribution, in other words income inequality, lead to significant variations in the MPC of different individuals and different sectors of society in an economy. All of the above imply that income inequality and the MPC have a significant impact on fiscal policy shocks.

However, for a number of years, authors did not incorporate income inequality and different MPCs in their analysis. Simple new Keynesian models (Hart, (1982); Dixon, (1987); Mankiw, (1987); Molana and Moutos, (1992); Torregrosa, (2003); Bénassy, (2001; 2005)) and even complex DSGE models (Bouakez and Rebei, (2007); Ercolani, (2007); Forni et al, (2010)) either assume that we have representative agents with no income and MPC differences, or do not use income inequality and the MPC in their analysis. Meanwhile, a number of researchers (Hazel and Thorat, (1998); Fiszbein and Schady, (2009); Evans and Popova, (2014)) studying the effects of redistributive spending under income inequality conclude that public spending can increase expenditure and output, while improving earning opportunities for the poor. These papers, although providing interesting insights about the role of government spending in the presence of income inequality, do not study the effects of income inequality on fiscal policy, expenditure, output and welfare nor do they provide a theoretical background to explain how income inequality and the MPC affect fiscal policy.

Recently, authors have developed models, where individual heterogeneity plays an important part in determining macroeconomic variables and policy outcomes. These models, known as HANK (Heterogeneous Agents New Keynesian Models) have proven that income inequality and MPC differences affect economic policy. Carroll et al (2014; 2016), Japelli and

Pistaferri (2014), and Anderson et al (2016) empirically confirm the negative relationship between income and the MPC and the considerable MPC variation between different income groups because of income inequality. These papers conclude that higher government spending targeted to the bottom income deciles and financed by taxing wealthier people can boost consumption much more than when the MPC is assumed to be the same for all households. Gornemann et al (2015) and Auclert (2017) evaluate the redistributive effects of monetary policy and conclude that income heterogeneity amplifies monetary policy shocks when households have different MPCs. Dosi et al (2010; 2013) analyze the effects of economic policy under different conditions characterizing the distribution of income between profits and wages. Their results indicate that when the profit mark-up is greater, higher doses of fiscal policy are needed to secure full employment and promote growth. Auclert and Rognlie (2018) examine how changes in income inequality, which result from idiosyncratic changes in labour demand, affect macroeconomic activity and conclude that permanent increases in income inequality, lead to recessions, which can be undone by fiscal policy.

In this paper, we re-examine the effect of income inequality and imperfect competition in the goods market on fiscal policy, output and welfare. The difference in our model is that income inequality is a result of wage differences rather than differences in the distribution of income between profit and wages (Dosi et al, (2010; 2013)), because as Piketty (2014; 2016) points out increasing wage differences are one of the main reasons for income inequality in many countries today. In addition, fiscal multipliers are not affected only by the income shares of profits and wages (Dosi et al, (2010; 2013)) or by labor demand shortages that lower wages alone (Auclert and Rognlie, (2018)); instead, it is both income inequality and firms' market power that affect the multiplier. In addition, profits in our model affect income and consumption, unlike Dosi et al (2010; 2013), where household income is composed entirely of wages. Furthermore, our paper investigates how income inequality and firms' market power can amplify tax policies and the net effect of fiscal policies by studying the tax and balanced budget multipliers, something not studied in the aforementioned literature. Our paper also examines the welfare effects of fiscal policies and how fiscal policies can be Pareto improving, by using the methodology of Adam (2004) for calculating the net welfare effects of economic policies and a social welfare function (Acemoglu and Robinson (2005)); to the best of our knowledge no other author has used these methods in similar papers.

We conduct our analysis using a New Keynesian macroeconomic model of an economy with imperfect competition in the goods market (Hart, (1982); Dixon, (1987); Mankiw, (1987); Molana and Moutos, (1992); Torregrosa, (2003); Bénassy, (2001; 2005)) but we expand it by adding skill heterogeneity (Auclert and Rognlie (2018)), resulting in income inequality and different MPCs. We then examine how income inequality and imperfect competition influence fiscal policy, output and welfare.

Results show that greater imperfect competition in the goods market increases the size of the government spending multiplier and the size of the balanced budget multiplier. As a result, an increase in government spending leads to a greater consumption and profits rise and in a greater increase in output (Hart, (1982); Dixon, (1987); Mankiw, (1987); Bénassy, (2001; 2005); Dosi et al, (2010; 2013)). Furthermore, imperfect competition negatively affects tax multipliers because as firms' market power increases taxes lead to a greater reduction of consumption, profits and output (Hart, (1982); Dixon, (1987); Mankiw, (1987); Bénassy, (2001; 2005)). Looking at the effect of inequality, we see that it positively affects the government spending multiplier by amplifying its positive effects on consumption (Carroll et al, (2014; 2016); Japelli and Pistaferri, (2014); Anderson et al, (2016)) and output (Gornemann et al, (2015); Auclert, (2017); Auclert and Rognlie, (2018)). In addition, higher inequality in the form of an increase in the number of *poor workers* or an increase in workers' MPC negatively affects the tax multiplier and the balanced budget multiplier when *poor workers* finance fiscal policy; when instead *wealthy workers* are taxed, inequality positively affects the tax and balanced budget multipliers. Therefore, our model indicates that under imperfect competition and inequality, the maximum net increase in expenditure and output comes when increased government spending is financed by taxing wealthier people. These findings are in line with Hazel and Thorat (1998), Fiszbein and Schady (2009) and Evans and Popova (2014) who show that government spending and progressive taxes increase consumption, profits and output and lead to a more efficient resource allocation. Carroll et al (2014; 2016), Japelli and Pistaferri (2014); Anderson et al (2016) also prove that inequality positively affects fiscal policy and consumption, when financed by wealthier taxpayers while Gornemann et al (2015), Auclert (2017) and Auclert and Ronglie (2018) find that inequality amplifies the positive effects of economic policy. Examining the effect of inequality on welfare, we find that greater imperfect competition increases social welfare and the net welfare gains of both income groups regardless of tax policies. In addition, higher numbers of poor workers negatively affect net welfare gains and social welfare when poor workers are taxed. If instead wealthy workers are taxed, net welfare gains of poor workers and social welfare are positively affected, while the opposite is true for the net welfare gains of wealthy workers. Changes in workers' MPCs have an ambiguous effect on net welfare gains and social welfare when poor workers are taxed but a positive effect when wealthy workers are taxed. Finally, the maximum increase in social welfare always comes when wealthy workers finance government spending as in Thorat (1998), Fiszbein and Schady (2009) and Evans and Popova (2014).

The rest of the paper is organized as follows. In section 2, we provide the model of our economy. Section 3 has an analysis of public spending schemes financed by taxing poor or wealthy workers and Section 4 analyses the welfare effects of fiscal policy. Section 5 provides an empirical assessment of our model and Section 6 concludes.

2. The economy

The model we use is based on a simple new Keynesian model of imperfect competition (Hart (1982); Dixon (1987); Mankiw (1987); Molana and Moutos (1992); Bénassy(2001;2005); Torregrosa (2003)) but we enrich it with skill heterogeneity (Auclert and Rognlie (2018)), resulting in income inequality. We construct the simplest economic model possible in order to illustrate the main idea we want to present in this paper. Since our main objective is to examine how imperfect competition and income inequality affects fiscal policy, output and welfare, we refrain from using more complex general equilibrium models, which could alter but not invalidate our argument.

2.1 People

The economy is populated by a continuum of people indexed by $Z \in (0;1)$. A number λ of these people have no skill endowment and are *poor workers*, while the remaining $(Z-\lambda)$ people have high skill endowment due to education or work experience and are *wealthy workers*. We use income/wage rather than wealth differences because it is one of the main reasons for increasing inequality in most countries over the last 30 years (Piketty, (2014; 2016)). The majority of the economy's population consists of *poor workers*, so $\lambda > (Z-\lambda)$.

The time available to all people equals T and is divided between working hours (N) and leisure (L). However, as we mentioned *wealthy workers* are skilled and educated; for this reason, their labour productivity is bigger as in Auclert and Rognlie (2018). Therefore, the effective labour supply of a *wealthy worker* is $(N+\varepsilon_i)$ where $\varepsilon_i > 0$ is the higher productivity of *wealthy workers*. The labour supply of *poor workers* equals N. Wages are equal to the amount of labour supplied by each individual so *poor workers* have a wage equal to N and *wealthy workers* have a wage equal to $(N+\varepsilon_i)$.

People choose between two goods, consumption and leisure. Each individual maximizes a Cobb-Douglas utility function where he chooses between consumption (C_i) and leisure (L_i):

$$U_1 = a_1 \log C_1 + (1-a_1)\log L_1, \quad a_1 < 1 \qquad (1)$$

$$U_2 = a_2 \log C_2 + (1-a_2)\log L_2, \quad a_2 < 1 \qquad (2)$$

Where α_1 and α_2, are the MPC of each worker type. As we have seen in Carroll et al (2014; 2016), Japelli and Pistaferri (2014), and Anderson et al (2016), people with higher incomes use a smaller percentage of their income for consumption compared to those who have smaller incomes but use a greater percentage of their income for consumption; in other words, their MPC is smaller. For this reason, we assume that $\alpha_1 > \alpha_2$ which shows that *poor workers* use a greater percentage of their income for consumption, compared to *wealthy workers* who have bigger incomes but consume a smaller percentage of their income.

People own the economy's firms, receive all profits (Π) and pay a lump-sum tax (V_i). Each individual's budget constraint is therefore:

$$PCi = (T - L_i) + \frac{\Pi}{Z} - V_i \ ,$$

$$PCi + L_i = T + \frac{\Pi}{Z} - V_i \quad (3)$$

As mentioned before, α_1 and α_2, denote the share of income workers use for consumption. Using these indexes, we find the consumption function of every type of individual.

$$PC_1 = \alpha_1 (T + \frac{\Pi}{Z} - V_1) \quad (4)$$

$$PC_2 = \alpha_2 [(T + \varepsilon_i) + \frac{\Pi}{Z} - V_2] \quad (5)$$

Equations (4) and (5) are the consumption functions for each one of the two types of people in the economy and α_1, α_2 denote their MPCs. Note that in equation (5) the wage income of *wealthy workers* is higher by ε_i. However, their lower MPC mitigates the effect of greater incomes on consumption.

2.2 Firms

The goods market is characterized by imperfect competition (Hart, (1982); Dixon, (1987); Mankiw, (1987); Molana and Moutos, (1992); Bénassy,(2001; 2005); Torregrosa, (2003); Dosi et al, (2010; 2013)). More specifically, we have a number of M firms in the economy, and each firm produces quantity q of a single good using labour as their only input. The demand function for the whole industry equals:

$$Q = \frac{Y}{P} \quad (6)$$

Where Q is total output of the industry, P the price level and Y is the economy's expenditure.

The cost function of each firm is:

$$TC(q) = F + cq \quad (7)$$

Where $q = \frac{Q}{\mathrm{M}}$ is the output per firm. We assume, as in Hart (1982), Dixon (1987), Mankiw (1987), Molana and Moutos (1992), Torregrosa (2003), Bénassy (2001;2005) and Dosi et al (2010; 2013) that firms operate under imperfect competition and have market power. We calculate market power by using the Lerner Index (Lerner, (1934))

$$\mu = \frac{P - MC}{P} \quad (8),$$

where μ is the Lerner index, MC the marginal cost and P the price level.

Combining equations (6) and (8) and by differentiating equation (7) we get the following equation describing the demand function of the industry:

$$Q = \frac{(1-\mu)}{c} Y \quad (9)$$

We then calculate total profits for the whole industry which equal revenue minus the costs:

$$\Pi = PQ - MF - cQ \quad (10)$$

Using equations (6) and (9) and assuming for simplicity that fixed costs are equal to zero we express profits in terms of expenditure and the profit mark-up that firms have:

$$\Pi = \mu Y \quad (11)$$

Equation (11) shows that profits in the economy depend on expenditure.

2.3 Government

Government collects lump-sum taxes, in order to buy goods produced by the firms, which it uses as input to produce the public good using a simple production function: $G = f(q)$.

These goods cover all types of government ouput (healthcare, education, social security, infrastructure, production of goods such as energy, fuel, manufacturing and consumption goods by state owned firms and general services such as management and administration) which we group in an encompassing public good. The government budget constraint requires that spending equals revenue:

$$\lambda V_1 + (\mathrm{Z} - \lambda)V_2 = G \quad (12)$$

2.4 Total expenditure and output

Total output in the economy is equal to the sum of expenditure of the private sector i.e. *poor workers* and *wealthy workers* and government expenditure:

$$Y = \lambda PC_1 + (\mathrm{Z} - \lambda)PC_2 + G \quad (13)$$

Using equations (4) and (5) and the population percentages to substitute in equation (13) we find:

$$Y = \lambda a_1 (T + \frac{\Pi}{\mathrm{Z}} - V_1) + (\mathrm{Z} - \lambda)a_2[(T + \varepsilon_i) + \frac{\Pi}{\mathrm{Z}} - V_2] + G \quad (14)$$

Using equation (11) and rearranging terms we find an expression that also makes use of the Lerner index:

$$\begin{aligned} Y = {} & \frac{\lambda a_1 T}{1 - [\lambda a_1 + (\mathrm{Z} - \lambda)a_2]\mu} + \frac{(\mathrm{Z} - \lambda)a_2 (T + \varepsilon_i)}{1 - [\lambda a_1 + (\mathrm{Z} - \lambda)a_2]\mu} - \frac{\lambda a_1 V_1}{1 - [\lambda a_1 + (\mathrm{Z} - \lambda)a_2]\mu} \\ & - \frac{(\mathrm{Z} - \lambda)a_2 V_2}{1 - [\lambda a_1 + (\mathrm{Z} - \lambda)a_2]\mu} + \frac{G}{1 - [\lambda a_1 + (\mathrm{Z} - \lambda)a_2]\mu} \end{aligned} \quad (15)$$

Equation (15) shows that in our model output is affected by taxation (V_i), government spending (G) and imperfect competition in the goods market, which is represented by the Lerner index (μ), just like in other New-Keynesian models of imperfect competition (Hart, (1982); Dixon, (1987); Mankiw, (1987); Molana and Moutos, (1992); Bénassy, (2001;2005); Torregrosa, (2003); Dosi et al, (2010; 2013)). Private consumption also plays a role through the different MPCs (a_i) which are, as we noted before, a result of income differences (Carroll et al, (2014; 2016); Japelli and Pistaferri, (2014); Anderson et al, (2016)). However, when we allow for the existence of heterogeneous agents, we see that consumption and output is not affected by the MPC alone, but rather by income inequality($\lambda\alpha_1$ and $(Z-\lambda)\alpha_2$), which is the product of income distribution and the MPC.

3. Fiscal policy using different tax financing sources

In this section, we examine the impact of income inequality and imperfect competition on fiscal policy, and specifically on the size of fiscal multipliers. In addition, using the balanced budget multiplier we examine the effect of imperfect competition and income inequality on the net economic effect of fiscal policies.

First, consider an increase in government spending, financed by lump-sum taxes:

$$\frac{dY}{dG} = \frac{1}{1-[\lambda a_1 + (Z-\lambda)a_2]\mu} \geq 1 \quad (16)$$

This result is similar to the government spending multiplier seen in most textbooks (Blanchard and Johnson, (2012); Mankiw, (2014)). As expected, higher government spending increases expenditure and output, and greater imperfect competition positively affects this result. The intuition behind the result is simple: Increases in government spending raise consumption and profits, which in turn raise expenditure and output in the economy even further in the way the textbook Keynesian public spending multiplier works. In the limiting case where the goods market is perfectly competitive $(\mu = 0)$, this process ends after the initial increase in government spending and the multiplier is unity $\left(\frac{dY}{dG} = 1\right)$. Therefore, imperfect competition in the goods market is crucial in our analysis because it increases the size of the government spending multiplier, making it greater than unity $\left(\frac{dY}{dG} > 1 \forall, \mu > 0\right)$. Consequently, as firms' market power becomes greater, an increase in government spending is more productive, leading to a greater increase in consumption and profits, and resulting in a much greater increase in expenditure and output as in Hart (1982), Dixon (1987), Mankiw (1987) and Bénassy (2001; 2005) who find a positive relationship between imperfect competition and government spending with government spending multipliers that are greater than unity. Dosi et al (2010; 2013) also finds that larger income shares for profits make government spending more effective. However, as we can see in our model, even when firms have no market power $(\mu = 0)$ and profits are essentially zero, government spending can still be effective, although the multiplier will be equal to unity $\left(\frac{dY}{dG} = 1\right)$ unlike Dosi et al (2010; 2013) where profit mark-up is necessary for government spending to be effective.

In order to examine how income inequality affects government spending multipliers, we differentiate equation (17) with respect to either λ, α_1 or α_2:

$$\frac{d\left(\frac{dY}{dG}\right)}{d\lambda} = \frac{(\alpha_1 - \alpha_2)\mu}{\{1 - [\lambda a_1 + (Z - \lambda)a_2]\mu\}^2} > 0 \quad (17)$$

$$\frac{d\left(\frac{dY}{dG}\right)}{d\alpha_1} = \frac{\lambda\mu}{\{1 - [\lambda a_1 + (Z - \lambda)a_2]\mu\}^2} > 0 \quad (18)$$

$$\frac{d\left(\frac{dY}{dG}\right)}{d\alpha_2} = -\frac{(Z - \lambda)\mu}{\{1 - [\lambda a_1 + (Z - \lambda)a_2]\mu\}^2} < 0 \quad (19)$$

Equation (17) gives us the effect of an increase in the number of *poor workers* and equations (18) and (19) give us the result of a rise in the MPC of *poor workers* and *wealthy workers* respectively. The result of equation (17) is easy to explain: When λ increases, the number of *poor workers* who have lower incomes but a higher MPC of α_1 increases and the number of *wealthy workers* who have higher incomes but a smaller MPC of α_2 decrease. The aggregate consumption of *poor workers* is greater than the aggregate consumption of *wealthy workers* because they individually consume more than *wealthy workers* (since $\alpha_1 > \alpha_2$) and because they constitute a larger segment of the population (since $\lambda > (Z - \lambda)$). Consequently, the more unequal an economy, the bigger $(\lambda\alpha_1 + (Z - \lambda)\alpha_2)$ becomes, making the denominator of equation (17) smaller and the government spending multiplier bigger. As a result higher government spending increases expenditure and output much more in unequal economies, where the majority of the population consists of low-skill, low-income workers when compared to economies that are more egalitarian. The intuition is similar in equation (18). *Poor workers* have a high MPC so they are likely to spend nearly every penny they have on consumption; therefore, when their MPC increases the consumption of each *poor worker* as well as their aggregate consumption increases leading to the same result as in equation (17). The negative result in equation (19) is puzzling at first; it can however be explained by the fact that individuals of above average wealth have an MPC which is close to zero, and essentially static – in the short term at least – as seen in the relevant literature ((Carroll et al, (2014; 2016); Japelli and Pistaferri, (2014); Anderson et al, (2016)). As a result, when their income decreases, their MPC rises but this increase is very small meaning that *wealthy workers* actually reduce their consumption – in absolute terms - when their incomes fall.

The important finding of this analysis is that income inequality positively affects government spending multipliers. As in ordinary Keynesian models, the MPC has a positive effect on the size of the multiplier, but in the case of heterogeneous agents, it is the product of the number of people belonging to each income group and their MPCs – in other words income inequality – that affects fiscal multipliers. As a result the bigger income inequality is, the bigger the multiplier of government spending becomes; meaning that increases in government spending lead to a greater increase in expenditure and output the bigger income inequality is. These results are in line with Carroll et al (2014; 2016), Japelli and Pistaferri (2014), Anderson et al (2016) and Auclert and Rognlie (2018) about the role of the MPC and income inequality on fiscal policy. Furthermore, Hazel and Thorat (1998), Fiszbein and Schady (2009) and Evans and Popova (2014) also prove that government spending which takes into account inequality increases productivity and output, reduces poverty and allocates resources more efficiently. Finally, our results are similar to those of Gornemann et al (2015) and Auclert (2017) who find that income heterogeneity amplifies monetary policy shocks when households have different MPCs. We present our findings in the following proposition:

Proposisiton 1: *An increase in income inequality, in the form of an increase in the number of poor workers or an increase of their MPC positively affects government spending multipliers. An increase in the MPC of wealthy workers, which implies a decrease in inequality, negatively affects government spending multipliers*.

Based on this proposition, in highly unequal economies where $\lambda\alpha_1 > (\mathrm{Z}-\lambda)\alpha_2$, the aggregate consumption of *poor workers* is much bigger than that of *wealthy workers*, because they individually consume more than *wealthy workers* do and because they constitute a much larger segment of the population. Consequently, increases in government spending increase expenditure and output much more in unequal economies, where the majority of the population consists of *poor workers*. This result is possible because income inequality makes government spending more productive, leading to greater profitability and a greater increase in consumption, resulting in a much greater increase in expenditure and output.

Next, we calculate tax multipliers when *poor workers* and *wealthy workers* are taxed respectively:

$$\frac{dY}{dV_1} = \frac{-\lambda a_1}{1-[\lambda a_1 + (\mathrm{Z}-\lambda)a_2]\mu} < 0 \quad (20)$$

$$\frac{dY}{dV_2} = \frac{-(\mathrm{Z}-\lambda)a_2}{1-[\lambda a_1 + (\mathrm{Z}-\lambda)a_2]\mu} < 0 \quad (21)$$

Equations (20) and (21) are similar to tax multipliers in most macroeconomics textbooks (Blanchard and Johnson, (2012); Mankiw, (2014)). Increased taxation, lowers expenditure and output and this effect becomes greater the more market power firms have. Again, the multiplier works through the channel of profits (Hart, (1982); Dixon, (1987); Mankiw, (1987)): Tax hikes lower consumption and profits, which reduces expenditure and output.

We then differentiate equations (20) and (21) with respect to λ, α_1 and α_2, first for the case of taxes paid by *poor workers* and then for the case of taxes paid by *wealthy workers*:

$$\frac{d\left(\frac{dY}{dV_1}\right)}{d\lambda} = -a_1 \frac{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu + \lambda(a_1 - a_2)\mu\}}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (22)$$

$$\frac{d\left(\frac{dY}{dV_1}\right)}{da_1} = -\frac{\{\lambda[1 - Za_2\mu - \lambda a_2\mu]\}}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (23)$$

$$\frac{d\left(\frac{dY}{dV_1}\right)}{da_2} = -\frac{(Z-\lambda)\lambda a_1\mu}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (24)$$

$$\frac{d\left(\frac{dY}{dV_2}\right)}{d\lambda} = -a_2 \frac{\{-1+[\lambda a_1 + (Z-\lambda)a_2]\mu + (Z-\lambda)(a_1 - a_2)\mu\}}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} > 0 \quad (25)$$

$$\frac{d\left(\frac{dY}{dV_2}\right)}{da_1} = -\frac{a_2\lambda\mu(Z-\lambda)}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (26)$$

$$\frac{d\left(\frac{dY}{dV_2}\right)}{da_2} = \frac{(Z-\lambda)(\lambda a_1\mu - 1)}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (27)$$

Equations (22) to (24) show us the effect of an increase in the number of *poor workers* and of the MPCs on the tax multipliers, when *poor workers* are taxed and equations (25) to (27) give us the same results when *wealthy workers* are taxed. As we can see, greater numbers of *poor workers* and higher MPCs for both worker types increase the negative effect of taxation on expenditure and output. The only exception is equation (25) where we examine the effect of an increase in the number of *poor workers* on tax multipliers when *wealthy workers* are taxed, but this result can be easily explained: When *wealthy workers* become fewer, the negative effect that taxing these workers has on expenditure and output becomes smaller.

Our results prove that income inequality has a negative impact on tax multipliers by making the adverse effect of taxation bigger, leading to a greater reduction in consumption, greater profits loss and in a much greater reduction in output. On the other hand, inequality, in the form of an increase in the number of *poor workers*, has a positive effect on tax multipliers when *wealthy workers* are taxed as the adverse effects of taxes on consumption, profits, expenditure and output decrease along with the number of *wealthy workers*. These results are similar to Carroll et al (2014; 2016), Japelli and Pistaferri (2014), Anderson et al (2016), as well as Hazel and Thorat (1998), Fiszbein and Schady (2009) and Evans and Popova (2014) who find that progressive taxation has smaller negative effects on resource allocation, expenditure and output. Based on our results, we form the following proposition:

Proposition 2: *In an economy with income inequality, increases in the MPC of each worker type increase (in absolute terms) the tax multipliers regardless of the type of worker that pays the increased taxes. In addition, increases in the number of poor workers increase (in absolute terms) the size of the tax multiplier when poor workers pay the increased taxes, but decrease (in absolute terms) the size of the tax multiplier when wealthy workers pay the increased taxes.*

As we have seen in Proposition 1, in unequal economies where $\lambda\alpha_1 > (Z-\lambda)\alpha_2$, the aggregate consumption of *poor workers* is bigger compared to the consumption of *wealthy workers*, because they individually consume more than wealthier people do (since $\alpha_1 > \alpha_2$) and because they are a much larger segment of the population (since $\lambda > (Z-\lambda)$). Consequently, tax hikes lower expenditure and output more in unequal economies, where most of the population consists of *poor workers*, compared to more egalitarian economies.

Finally, we calculate the balanced budget multiplier, when *poor workers* and *wealthy workers* respectively finance the increase in government spending by subtracting equation (20) from equation (16) and equation (21) from equation (16):

$$\frac{dY}{dG_{G=V_1}} = \frac{(1-\lambda\alpha_1)}{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu} > 0 \quad (28)$$

$$\frac{dY}{dG_{G=V_2}} = \frac{[1-(\mathrm{Z}-\lambda)\alpha_2]}{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu} > 0 \quad (29)$$

Equations (28) and (29) give us the balanced budget multiplier for each tax type. As we can see, when imperfect competition rises, an increase in government spending becomes more productive, leading to a greater increase in consumption and profits, which results in a much greater net increase of expenditure and output. These findings verify that imperfect competition in the goods market increases the size of the balanced budget multiplier (Hart, (1982); Dixon, (1987); Mankiw, (1987); Bénassy, (2001; 2005)). As in the case of the government spending multiplier our results are similar to Dosi et al (2010; 2013) where larger income shares for profits (i.e. greater firms' market power) makes government spending more effective. However, as in the case of the government spending multiplier, when firms have no market power $(\mu = 0)$, government spending is still effective, unlike Dosi et al (2010; 2013) where profit mark-up is necessary for government spending to be effective.

When it comes to income inequality, we find that that since $\lambda\alpha_1 > (\mathrm{Z}-\lambda)\alpha_2$, the maximum net increase in expenditure and output comes when the government increases government spending and taxes *wealthy workers*, as the positive effects of government spending on expenditure and output will be much greater compared to the case where *poor workers* are taxed $\left(\frac{dY}{dG_{G=V_2}} > \frac{dY}{dG_{G=V_1}}\right)$. The logic behind this idea is the one analyzed before: In an economy where the majority of the population consists of *poor workers*, taxing these workers has a greater adverse effect due to that group's greater MPC and because they are a bigger part of the population. Therefore, economies achieve the maximum net increase in expenditure and output by raising government spending and taxing *wealthy workers*, who have a smaller MPC and constitute a smaller part of the population. These results are in line with Carroll et al (2014; 2016), Japelli and Pistaferri (2014) and Anderson et al (2016) who find that government spending is more effective when financed by wealthy households. Similarly, Hazel and Thorat (1998), Fiszbein and Schady (2009) and Evans and Popova (2014) prove that higher government spending financed by progressive taxes is more productive, resulting in a greater profits and consumption rise, and in a more efficient resource allocation. Similarly, Gornemann et al (2015), Auclert (2017) and Auclert and Ronglie (2018) posit that inequality positively affects expansionary economic policy.

We then calculate how the number of *poor workers* and the MPC affect the balanced budget multiplier:

$$\frac{d\left(\dfrac{dY}{dG_{G=V_1}}\right)}{d\lambda} = \frac{-a_1\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\} - (1-\lambda\alpha_1)[(a_1-a_2)\mu]}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (30)$$

$$\frac{d\left(\dfrac{dY}{dG_{G=V_1}}\right)}{da_1} = \frac{-\lambda}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}} + \frac{\lambda\mu(1-\lambda\alpha_1)}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} < 0 \quad (31)$$

$$\frac{d\left(\dfrac{dY}{dG_{G=V_1}}\right)}{d\alpha_2} = \frac{-(1-\lambda\alpha_1)[-(Z-\lambda)\mu]}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} > 0 \quad (32)$$

$$\frac{d\left(\dfrac{dY}{dG_{G=V_2}}\right)}{d\lambda} = \frac{a_2\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\} - (1-(Z-\lambda)\alpha_2)[-(a_1-a_2)\mu]}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} > 0 \quad (33)$$

$$\frac{d\left(\dfrac{dY}{dG_{G=V_2}}\right)}{d\alpha_1} = \frac{(1-(Z-\lambda)\alpha_2)[\lambda\mu]}{\{1-[\lambda a_1 + (Z-\lambda)a_2]\mu\}^2} > 0 \quad (34)$$

$$\frac{d\left(\frac{dY}{dG_{G=V_2}}\right)}{d\alpha_2}=\frac{\lambda\{1-[\lambda a_1+(Z-\lambda)a_2]\mu\}-(1-(Z-\lambda)\alpha_2)[-(Z-\lambda)\mu]}{\{1-[\lambda a_1+(Z-\lambda)a_2]\mu\}^2}>0 \quad (35)$$

The results of Equations (28) to (35) lead to a number of results, which we formally present in the following proposition:

Proposition 3: *In an economy with income inequality and imperfect competition in the goods market, the following statements are true:*

- *Imperfect competition has a positive effect on the size of the balanced budget multiplier; as a result when this variable becomes greater, increased government spending becomes more productive, leading to a greater consumption and profits rise, and resulting in a much greater net increase in expenditure and output.*
- *The maximum net increase in expenditure and output comes when the government increases government spending and taxes the minority of wealthy workers.*
- *A rise in the number of poor workers reduces the net increase in expenditure and output that increased government spending causes when the government taxes poor workers but positively affects the net increase in expenditure and output that increased government spending causes when the government taxes wealthy workers.*
- *A rise in the wealthy workers' MPC positively affects the net increase of expenditure and output caused by increased government spending regardless of which income group finances this spending.*
- *A rise in poor workers' MPC positively affects the net increase of expenditure and output caused by increased government spending when wealthy worker finance this spending but negatively affects it when poor workers finance it.*

To sum up, our model shows that imperfect competition has a positive effect on government spending multipliers, making them greater than unity $\left(\frac{dY}{dG} > 1, \forall \mu > 0\right)$, a negative effect on tax multipliers $\left(\frac{dY}{dV_i} < 0, \forall \mu > 0\right)$ and a positive effect on the balanced budget multiplier $\left(\frac{dY}{dG_{G=V_i}} > 0, \forall \mu > 0\right)$ because greater imperfect competition increases the size of fiscal multipliers. As a result, higher government spending (taxation) leads to a greater rise (reduction) in profits and consumption, resulting in a greater increase (decrease) in output. Income inequality also has a positive effect on government spending and a negative effect on tax multipliers. Furthermore, the balanced budget multiplier is positive regardless of which income group is taxed and the maximum net increase in expenditure and output comes when increased government spending is financed by taxing *wealthy workers* $\left(\frac{dY}{dG_{G=V_1}} > \frac{dY}{dG_{G=V_2}} > 0\right)$.

4. Welfare analysis

In the previous section, we have seen that income inequality and imperfect competition in the goods market positively affect the size of fiscal multipliers and the net increase of expenditure and output in the economy. However, we also need to examine if a government's fiscal policy can improve the welfare of the people in the economy. For this reason, we examine the welfare gains or losses of fiscal policy using the methodology of Adam (2004) and the social welfare function of Acemoglu and Robinson (2005).

In order to make a complete evaluation of the welfare effects of fiscal policy, we need to examine both the income benefits of higher government spending and the income losses of higher taxes. Government spending in our model does not affect utility directly. However, since utility increases if the budget constraint of the individual increases and since people in our model receive all the profits and wages, using the balanced budget multiplier will be sufficient for examining the welfare effects of higher government spending on utility (Mankiw, (1987); Torregrosa, (2003)). We then use the methodology of Adam (2004) in order to calculate the welfare losses caused by taxes. We first derive the indirect utility functions for the representative *poor worker* and *wealthy worker* respectively using equations (1) (2) (4) and (5):

$$\upsilon_1(P, w_1) = a_1^{a_1}(1-a_1)^{(1-a_1)} \frac{\left[T + \frac{\mu Y}{Z} - V_1\right]}{P^{a_1}} \quad (36)$$

$$\upsilon_2(P, w_2) = a_2^{a_2}(1-a_2)^{(1-a_2)} \frac{\left[(T+\varepsilon_i) + \frac{\mu Y}{Z} - V_2\right]}{P^{a_2}} \quad (37)$$

Where $w_1 = T + \Pi - V_1, w_2 = (T+\varepsilon_i) + \Pi - V_2$ is the total wealth of poor and wealthy workers respectively. Equations (36) and (37) give us the indirect utility function of *poor workers* and *wealthy workers* respectively. Using these results, we calculate the social welfare function following Acemoglu and Robinson (2005):

$$\upsilon = \lambda \upsilon_1 + (Z - \lambda)\upsilon_2 \quad (38)$$

We then calculate the welfare losses of each income group when we impose them a lump-sum tax:

$$\frac{d\upsilon}{dV_1} = -\lambda \frac{a_1^{a_1}(1-a_1)^{(1-a_1)}\left[1 + \frac{\mu \frac{\partial Y}{\partial V_1}}{Z}\right]}{P^{a_1}} < 0 \quad (39)$$

$$\frac{d\upsilon}{dV_2} = -(Z-\lambda) \frac{a_2^{a_2}(1-a_2)^{(1-a_2)}\left[1 + \frac{\mu \frac{\partial Y}{\partial V_2}}{Z}\right]}{P^{a_2}} < 0 \quad (40)$$

Equations (39) and (40) give us the welfare losses for *poor workers* and *wealthy workers* respectively when a lump-sum tax is imposed on them.

Having already seen in Section 3 how changes in income inequality affect the net increase in expenditure and output (and hence income) caused by an increase in government spending, we will now examine how changes in income inequality affect the welfare losses of *poor workers* and *wealthy workers*. We do so by differentiating equations (39) and (40), same as before:

$$\frac{d\left(\frac{d\upsilon}{dV_1}\right)}{d\lambda} = -\frac{a_1^{a_1}(1-a_1)^{(1-a_1)}}{P^{a_1}} < 0 \quad (41)$$

$$\frac{d\left(\frac{d\upsilon}{dV_2}\right)}{d\lambda} = \frac{a_2^{a_2}(1-a_2)^{(1-a_2)}}{P^{a_2}} > 0 \quad (42)$$

$$\frac{d\left(\frac{d\upsilon}{dV_1}\right)}{da_1} = \frac{\lambda(a_1-1)a_1^{a_1}\left[\ln(a_1)-\ln(1-a_1)-\ln(P)\right]}{P^{a_1}(1-a_1)^{a_1}} \quad (43)$$

$$\frac{d\left(\frac{d\upsilon}{dV_2}\right)}{da_2} = \frac{(Z-\lambda)(a_2-1)a_2^{a_2}\left[\ln(a_2)-\ln(1-a_2)-\ln(P)\right]}{P^{a_2}(1-a_2)^{a_2}} \quad (44)$$

Equations (41) and (44) show that when the number of *poor workers* increases, social welfare losses become greater when *poor workers* are taxed, but decrease when *wealthy workers* pay the taxes. Increases in the MPC have an ambiguous effect on welfare losses in the economy as the outcome depends critically on the size of the MPC and the price level of the economy.

What is important for the evaluation of fiscal policy is to see if it can be Pareto improving. Following Adam (2004), we examine if the gains from increased government spending are greater than the cost of taxes necessary to finance them by comparing the net increase in expenditure and output caused by a tax-financed rise in government spending, with the welfare losses of the income group that pays the taxes:

$$d\upsilon_{V=V_1}=\lambda\left(\frac{(1-\lambda\alpha_1)}{\mathrm{Z}\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}-\frac{a_1^{a_1}(1-a_1)^{(1-a_1)}}{P^{a_1}}\right)+(\mathrm{Z}-\lambda)\frac{(1-\lambda\alpha_1)}{\mathrm{Z}\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}} \quad (45)$$

$$d\upsilon_{V=V_2}=\lambda\frac{[1-(\mathrm{Z}-\lambda)\alpha_2]}{\mathrm{Z}\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}+(\mathrm{Z}-\lambda)\left(\frac{[1-(\mathrm{Z}-\lambda)\alpha_2]}{\mathrm{Z}\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}-\frac{a_2^{a_2}(1-a_2)^{(1-a_2)}}{P^{a_2}}\right) \quad (46)$$

Equation (45) gives us the welfare effect that an increase in government spending has when *poor workers* finance this increase, while equation (46) gives us the same result when *wealthy workers* finance the increase in government spending. As we can see, increased government spending positively affects social welfare but this effect is diminished because the increase in taxes needed to finance this rise in government spending lowers income, consumption and utility for the people who pay the taxes. Fiscal policy in this model can be Pareto improving if the term inside the parentheses in equations (45) and (46), which is the net social welfare gains of the tax-paying segment of the population, is greater than or equal to zero[1]. If this is the case then the welfare of the tax paying segment of the population increases or remains unchanged, which means that the government's fiscal policy leads to a Pareto improvement. We summarize the logic behind this result using the following proposition:

Proposition 4: *In an economy with income inequality and imperfect competition in the goods market, fiscal policy is Pareto improving if the income gains which taxpayers have when expenditure and output increases due to higher government spending are greater than or equal to the income losses they have because of the taxes they pay to fund government spending.*

[1] An increase in government spending is **always** welfare improving for the income group that does **not** pay taxes; therefore terms outside the parentheses are **always positive**:
$\frac{(1-\lambda\alpha_1)}{\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}>(\mathrm{Z}-\lambda)\frac{(1-\lambda\alpha_1)}{\mathrm{Z}\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}>0$ and $\frac{[1-(\mathrm{Z}-\lambda)\alpha_2]}{\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}>\lambda\frac{[1-(\mathrm{Z}-\lambda)\alpha_2]}{\mathrm{Z}\{1-(\lambda\alpha_1+(\mathrm{Z}-\lambda)\alpha_2)\mu\}}>0$

As we have seen in Section 3, increased government spending financed by taxing *wealthy workers* is more productive, which leads to a greater rise of profits and consumption, resulting in the maximum net increase in expenditure and output $\left(\frac{[1-(Z-\lambda)\alpha_2]}{\{1-(\lambda\alpha_1+(Z-\lambda)\alpha_2)\mu\}} > \frac{(1-\lambda\alpha_1)}{\{1-(\lambda\alpha_1+(Z-\lambda)\alpha_2)\mu\}} \right)$. This result shows us that the positive effects of increased government spending on social welfare are in fact greater when *wealthy workers* are taxed. However, as we have seen in this Section increased government spending also incurs a welfare cost, due to increased taxes. Therefore, in order to find which type of fiscal policy is optimal not just in achieving the maximum net increase in expenditure and output but also in achieving the maximum increase in social welfare we must compare equation (45) with equation (46). If $dW_{V=V_1} < dW_{V=V_2}$ then the optimal policy in terms of social welfare is an increase in government spending financed by taxing *wealthy workers*; if instead $dW_{V=V_1} > dW_{V=V_2}$ then the opposite is true. By rearranging terms and simplifying, we find the necessary condition under which the maximum increase in social welfare occurs when increased government spending is financed through taxation of *wealthy workers*:

$$(Z-\lambda)\frac{a_2^{a_2}(1-a_2)^{(1-a_2)}}{P^{a_2}} \leq \frac{[1-(Z-\lambda)\alpha_2]-(1-\lambda\alpha_1)}{\{1-(\lambda\alpha_1+(Z-\lambda)\alpha_2)\mu\}} + \lambda\frac{a_1^{a_1}(1-a_1)^{(1-a_1)}}{P^{a_1}} \quad (47)$$

Similarly, we also find the same condition for the case in when it is optimal in terms of welfare for *poor workers* to finance increased government spending:

$$\lambda\frac{a_1^{a_1}(1-a_1)^{(1-a_1)}}{P^{a_1}} \leq \frac{(1-\lambda\alpha_1)-[1-(Z-\lambda)\alpha_2]}{\{1-(\lambda\alpha_1+(Z-\lambda)\alpha_2)\mu\}} + (Z-\lambda)\frac{a_2^{a_2}(1-a_2)^{(1-a_2)}}{P^{a_2}} \quad (48)$$

Ccomparing equations (47) and (48) we find that fiscal policy achieves the maximum increase in social welfare when taxing *wealthy workers* if the welfare losses due to higher taxes are smaller than the welfare losses when *poor workers* are taxed; or in other words if the gains in social welfare from higher government spending when taxing *wealthy workers* are greater than the welfare gains from higher government spending when *poor workers* are taxed (and vice versa):

$$(Z-\lambda)\frac{a_2^{a_2}\left(1-a_2\right)^{(1-a_2)}}{P^{a_2}} < \lambda\frac{a_1^{a_1}\left(1-a_1\right)^{(1-a_1)}}{P^{a_1}} \quad (49)$$

$$\lambda\frac{a_1^{a_1}\left(1-a_1\right)^{(1-a_1)}}{P^{a_1}} < (Z-\lambda)\frac{a_2^{a_2}\left(1-a_2\right)^{(1-a_2)}}{P^{a_2}} \quad (50)$$

Our results are formally presented in the following Proposition:

Proposition 5: *In an economy with income inequality and imperfect competition in the goods market, fiscal policy leads to the maximum increase in social welfare when the welfare losses (net welfare gains) associated with increased taxation (government spending) are smaller (greater) than the welfare losses (net welfare gains) associated with all other possible spending – taxing schemes, which the government can use.*

5. Numerical solution

In this section, we provide a quantitative assessment of the output and welfare results of fiscal policy under different key parameters, namely the Lerner index (μ), the number of *poor workers* (λ) and the MPCs of *poor workers* and *wealthy workers* (α_1, α_2). We use different MPCs taken from Carroll et al (2014; 2016), Japelli and Pistaferri, (2014) and Anderson et al (2016) in order to obtain better and more robust results.

There are four Tables presented below. Tables 1-2 give us the effect of an increase in firms' market power under constant numbers of *poor workers* and *wealthy workers*. Tables 3-4 give us the effect of an increase in the number of *poor workers* when firms' market power remains the same. Column 2 gives us the government spending multiplier, Columns 3 and 4 the tax multiplier when *poor workers* and *wealthy workers* are taxed and Columns 5 and 6 the balanced budget multiplier when *poor workers* and *wealthy workers* are taxed respectively. Columns 7 to 9 show us the effects of fiscal policy on the welfare of *poor workers* and *wealthy workers* and on social welfare when *poor workers* finance government spending and Columns 10 to 12 give us the same results when *wealthy workers* are taxed.

[Table 1 here]

[Table 2 here]

In Tables 1 and 2, we see that imperfect competition (μ) positively affects the size of the government spending multiplier making it greater than unity, except for the case where $\mu = 0$ and $\frac{\partial Y}{\partial G} = 1$. Similarly, imperfect competition has a negative, although quantitatively smaller, effect on tax multipliers making the balanced budget multiplier always positive. The impact of imperfect competition on the balanced budget multiplier remains the same when using different values of the MPCs; however, the effect of the MPC on the size of the multiplier is ambiguous because higher MPCs positively affect both government spending and tax multipliers. More specifically, when *poor workers* are taxed, and for $0 \leq \mu \leq 0.9$ the maximum net increase in expenditure and output comes when $\{\alpha_1 = 0.2, \alpha_2 = 0.07\}$ and only for $\mu = 1$ does the maximum net increase in expenditure and output come when $\{\alpha_1 = 0.72, \alpha_2 = 0.12\}$. When instead *wealthy workers* are taxed higher MPCs have a positive effect on the net increase in expenditure and output the only exception being when $0 \leq \mu \leq 0.1$. In addition, the balanced budget multiplier is always bigger when *wealthy workers* are taxed, being greater than unity in all cases except for $0 \leq \mu \leq 0.1$. These findings prove that greater imperfect competition makes higher government spending more productive, leading to a greater rise in profits, and consumption which results in a greater rise in output; additionally the maximum net increase in expenditure and output comes when increased government spending is financed by taxing *wealthy workers*.

The impact of imperfect competition on the net welfare gains of both income groups and on social welfare is also positive; however, the effect of the MPC on these variables depends on firms' market power and the size of each income group, particularly when *poor workers* are taxed. In this case, the maximum net welfare gains of this income group vary greatly. More specifically, for $0 \leq \mu \leq 0.4$ the maximum net welfare gains for *poor workers* come when $\{\alpha_1 = 0.2, \alpha_2 = 0.07\}$; for higher values the effect is negative. For $0.5 \leq \mu \leq 0.9$ the maximum net welfare gains for *poor workers* come when $\{\alpha_1 = 0.45, \alpha_2 = 0.05\}$. Only when $\mu = 1$ do the maximum net welfare gains for *poor workers* come when $\{\alpha_1 = 0.72, \alpha_2 = 0.12\}$. Looking at the net welfare gains of *wealthy workers* we find that when $0 \leq \mu \leq 0.8$ the effect of the MPC is actually negative, and that the maximum net welfare gains come when $\{\alpha_1 = 0.06, \alpha_2 = 0.04\}$; when $\mu = 0.9$ and $\mu = 1$, the maximum net gains in welfare come when $\{\alpha_1 = 0.45, \alpha_2 = 0.05\}$ and $\{\alpha_1 = 0.72, \alpha_2 = 0.12\}$ respectively. Similarly, when $0 \leq \mu \leq 0.8$ the maximum increase in social welfare comes when $\{\alpha_1 = 0.2, \alpha_2 = 0.07\}$; when $\mu = 0.9$ the maximum net gains in welfare come when $\{\alpha_1 = 0.45, \alpha_2 = 0.05\}$ and when $\mu = 1$ the maximum net gains in welfare come when $\{\alpha_1 = 0.72, \alpha_2 = 0.12\}$. In the case where *wealthy workers* are taxed the effect of the MPC on net welfare gains and on social welfare is positive, the only exception being the negative impact of the MPC on the net welfare gains of *poor workers* for $\mu = 0$ with the maximum net welfare gains coming when $\{\alpha_1 = 0.06, \alpha_2 = 0.04\}$. Maximum net welfare gains for *wealthy workers* and maximum values in social welfare come when $\{\alpha_1 = 0.72, \alpha_2 = 0.12\}$ meaning that for these variables the MPC has a positive impact. Furthermore, regardless of differences in imperfect competition and the MPC, when we compare Columns 9 and 12 we find that the maximum increase in social welfare always comes when the government taxes *wealthy workers*.

[Table 3 here]

[Table 4 here]

Tables 3 and 4 give us the result of a change in the number of *poor workers* under constant imperfect competition. An increase in the number of *poor workers* has, as expected, a positive effect on government spending multiplier with the multiplier always being greater than unity. When it comes to tax multipliers, the result is negative when *poor workers* are taxed but positive when *wealthy workers* pay the taxes. Looking at the balanced budget multiplier we find a positive effect when *wealthy workers* pay taxes, with multipliers that are greater than unity and a negative effect when the government taxes *poor workers*.

We then evaluate the effect that the number of *poor workers* has on the net welfare gains of each worker type and to social welfare. When *poor workers* are taxed, we find that the net welfare gains of each income group as well as social welfare depend critically upon the combination of different MPCs and the number of *poor workers*. For $0.5 \leq \lambda \leq 0.6$ the maximum net gains for poor workers come when $\{\alpha_1 = 0.45, \alpha_2 = 0.05\}$ while for higher values of λ the maximum net gains for poor workers come when $\{\alpha_1 = 0.2, \alpha_2 = 0.07\}$. Looking at the case of *wealthy workers* the MPC seems to have a negative effect on this group's welfare, as the maximum net gains in welfare come when $\{\alpha_1 = 0.06, \alpha_2 = 0.04\}$. When it comes to social welfare, the maximum gains come when $\{\alpha_1 = 0.2, \alpha_2 = 0.07\}$. When instead *wealthy workers* are taxed the MPC seems to have a positive effect on the net welfare gains of both income groups and on social welfare. Finally the maximum increase in social welfare always comes when *wealthy workers* are taxed and the MPC is $\{\alpha_1 = 0.72, \alpha_2 = 0.12\}$.

To sum up, our empirical results seem to verify the main findings of our model. Our results are also very similar to the findings of the relevant literature about the role of imperfect competition on fiscal policy effectiveness (Hart, (1982); Dixon, (1987); Mankiw, (1987); Bénassy, (2001; 2005); Dosi et al, (2010; 2013)) and the effect that changes in income inequality –either in the form of changes in the number of *poor workers* and *wealthy workers* or in the form of changes in the MPC- have on fiscal multipliers(Carroll et al, (2014; 2016), Japelli and Pistaferri, (2014); Anderson et al, (2016); Gornemann et al, (2015); Auclert, (2017); Auclert and Ronglie, (2018)) and on the welfare effects of fiscal policy ((Thorat, (1998); Fiszbein and Schady, (2009); Evans and Popova, (2014)).

6. Conclusion

This paper investigates the effect of imperfect competition and income inequality on fiscal policy, output and welfare using a New Keynesian model of imperfect competition in the goods market (Hart, (1982); Dixon, (1987); Mankiw, (1987); Bénassy, (2001; 2005) with income inequality due to skill/wage differences (Auclert and Ronglie, (2018)). Our results prove that imperfect competition positively affects the government spending and balanced budget multipliers meaning that greater imperfect competition increases government spending productivity, leading to a greater increase in profits, consumption and output; similarly, imperfect competition negatively affects taxes (Hart, (1982); Dixon, (1987); Mankiw, (1987); Bénassy, (2001; 2005); Dosi et al, (2010; 2013)). Income inequality, also positively affects government spending multipliers, as the consumption of *poor workers* is greater than the consumption of *wealthy workers* implying that government spending is more productive when most of the population consists of *poor workers*. Similarly, inequality negatively affects tax multipliers. Furthermore, when examining the balanced budget multiplier we find that it is always positive regardless of which income group is taxed, and that income inequality has a negative impact on the net effect of fiscal policies when *poor workers* pay the taxes. When, instead, *wealthy workers* are taxed, then income inequality positively affects the net effect of fiscal policies; consequently, the maximum net increase in expenditure and output comes when governments finance higher government spending by taxing *wealthy workers* (Hazel and Thorat, (1998); Fiszbein and Schady, (2009); Evans and Popova, (2014)). Our findings are also similar to Carroll et al (2014; 2016), Japelli and Pistaferri (2014); Anderson et al (2016), as well as Gornemann et al (2015), Auclert (2017) and Auclert and Ronglie (2018). Looking at social welfare, we find that imperfect competition, positively affects the net welfare gains of both income groups and social welfare. In addition, greater numbers of *poor workers* reduce net welfare gains and social welfare when *poor workers* are taxed while the opposite is true when *wealthy workers* are taxed. Higher MPCs have an ambiguous effect on net welfare gains and social welfare when *poor workers* are taxed but a positive effect when *wealthy workers* are taxed. Therefore, our model proves that under imperfect competition and income inequality the maximum net increase in expenditure and output and the maximum increase in social welfare comes when the government increases government spending and taxes *wealthy workers* ((Thorat, (1998); Fiszbein and Schady, (2009); Evans and Popova, (2014)).

This model could be extended in several directions. First, we can alter our model by allowing government spending to affect utility and output in the economy directly. In addition, a more complete analysis of the labor market and the idiosyncrasies leading to income inequality and different types of taxes such as labor or profit taxation can be examined. Finally, our model could become dynamic in order to study the effects of fiscal policy in the long run as well as incorporate savings and investment.

7. Appendix

Table 1: Effect of change in imperfect competition under different MPCs.

Panel a: $\alpha_1 = 0.72 \quad \alpha_2 = 0.12 \quad \lambda = 0.6 \quad (1-\lambda) = 0.4$

μ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V=V_1)$	$d\upsilon_2$ $(V=V_1)$	$d\upsilon_1 + d\upsilon_2$ $(V=V_1)$	$d\upsilon_1$ $(V=V_2)$	$d\upsilon_2$ $(V=V_2)$	$d\upsilon_1 + d\upsilon_2$ $(V=V_2)$
0	1.000	-0.432	-0.048	0.568	0.952	0.009	0.227	0.236	0.571	0.104	0.675
0.1	1.050	-0.454	-0.050	0.597	1.000	0.026	0.239	0.265	0.600	0.123	0.723
0.2	1.106	-0.478	-0.053	0.628	1.053	0.045	0.251	0.297	0.632	0.144	0.776
0.3	1.168	-0.505	-0.056	0.664	1.112	0.067	0.265	0.332	0.667	0.168	0.835
0.4	1.238	-0.535	-0.059	0.703	1.178	0.090	0.281	0.371	0.707	0.194	0.901
0.5	1.316	-0.568	-0.063	0.747	1.253	0.117	0.299	0.416	0.758	0.224	0.975
0.6	1.404	-0.607	-0.067	0.798	1.337	0.147	0.319	0.466	0.802	0.258	1.060
0.7	1.506	-0.651	-0.072	0.855	1.434	0.182	0.342	0.524	0.860	0.296	1.157
0.8	1.623	-0.701	-0.078	0.922	1.545	0.222	0.369	0.590	0.927	0.341	1.268
0.9	1.761	-0.761	-0.085	1.000	1.676	0.268	0.400	0.668	1.006	0.393	1.399
1	1.923	-0.831	-0.092	1.092	1.831	0.324	0.437	0.761	1.098	0.455	1.544

Panel b: $\alpha_1 = 0.45 \quad \alpha_2 = 0.05 \quad \lambda = 0.6 \quad (1-\lambda) = 0.4$

μ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V=V_1)$	$d\upsilon_2$ $(V=V_1)$	$d\upsilon_1 + d\upsilon_2$ $(V=V_1)$	$d\upsilon_1$ $(V=V_2)$	$d\upsilon_2$ $(V=V_2)$	$d\upsilon_1 + d\upsilon_2$ $(V=V_2)$
0	1.000	-0.270	-0.020	0.730	0.980	0.136	0.292	0.428	0.588	0.064	0.652
0.1	1.030	-0.278	-0.021	0.752	1.009	0.150	0.301	0.450	0.606	0.076	0.681
0.2	1.062	-0.287	-0.021	0.775	1.040	0.163	0.310	0.473	0.624	0.088	0.712
0.3	1.095	-0.296	-0.022	0.800	1.073	0.178	0.320	0.498	0.644	0.101	0.745
0.4	1.131	-0.305	-0.023	0.826	1.109	0.194	0.330	0.524	0.665	0.115	0.781
0.5	1.170	-0.316	-0.023	0.854	1.146	0.211	0.342	0.552	0.688	0.131	0.818
0.6	1.211	-0.327	-0.024	0.884	1.186	0.229	0.354	0.582	0.712	0.147	0.858
0.7	1.255	-0.339	-0.025	0.916	1.230	0.248	0.366	0.614	0.738	0.164	0.902
0.8	1.302	-0.352	-0.026	0.951	1.276	0.269	0.380	0.649	0.766	0.182	0.948
0.9	1.353	-0.365	-0.027	0.988	1.326	0.291	0.395	0.686	0.796	0.202	0.998
1	1.408	-0.380	-0.028	1.028	1.380	0.315	0.411	0.727	0.828	0.224	1.052

Table 2: Effect of change in imperfect competition under different MPCs.

μ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V=V_1)$	$d\upsilon_2$ $(V=V_1)$	$d\upsilon_1+d\upsilon_2$ $(V=V_1)$	$d\upsilon_1$ $(V=V_2)$	$d\upsilon_2$ $(V=V_2)$	$d\upsilon_1+d\upsilon_2$ $(V=V_2)$
Panel a: $\alpha_1=0.20$ $\alpha_2=0.07$ $\lambda=0.6$ $(1-\lambda)=0.4$											
0	1.000	-0.120	-0.028	0.880	0.972	0.164	0.352	0.516	0.583	0.078	0.662
0.1	1.015	-0.122	-0.028	0.893	0.987	0.172	0.357	0.529	0.592	0.084	0.676
0.2	1.031	-0.124	-0.029	0.907	1.002	0.180	0.363	0.543	0.601	0.090	0.691
0.3	1.046	-0.126	-0.029	0.921	1.017	0.189	0.368	0.557	0.610	0.096	0.707
0.4	1.063	-0.128	-0.030	0.935	1.033	0.197	0.374	0.572	0.620	0.103	0.723
0.5	1.080	-0.130	-0.030	0.950	1.050	0.206	0.380	0.587	0.630	0.109	0.739
0.6	1.097	-0.132	-0.031	0.966	1.067	0.216	0.386	0.602	0.640	0.116	0.756
0.7	1.116	-0.134	-0.031	0.982	1.084	0.225	0.393	0.618	0.651	0.123	0.774
0.8	1.134	-0.136	-0.032	0.998	1.103	0.235	0.399	0.634	0.662	0.131	0.792
0.9	1.154	-0.138	-0.032	1.015	1.121	0.245	0.406	0.651	0.673	0.138	0.811
1	1.174	-0.141	-0.033	1.033	1.141	0.256	0.413	0.669	0.685	0.146	0.830
Panel b: $\alpha_1=0.06$ $\alpha_2=0.04$ $\lambda=0.6$ $(1-\lambda)=0.4$											
0	1.000	-0.036	-0.016	0.964	0.984	0.100	0.386	0.486	0.590	0.055	0.645
0.1	1.005	-0.036	-0.016	0.969	0.989	0.103	0.388	0.491	0.593	0.057	0.650
0.2	1.011	-0.036	-0.016	0.974	0.994	0.106	0.390	0.496	0.597	0.060	0.657
0.3	1.016	-0.037	-0.016	0.979	1.000	0.109	0.392	0.501	0.600	0.062	0.662
0.4	1.021	-0.037	-0.016	0.984	1.005	0.113	0.394	0.507	0.603	0.064	0.667
0.5	1.027	-0.037	-0.016	0.990	1.010	0.116	0.396	0.512	0.606	0.066	0.672
0.6	1.032	-0.037	-0.017	0.995	1.016	0.119	0.398	0.517	0.609	0.068	0.677
0.7	1.038	-0.037	-0.017	1.000	1.021	0.122	0.400	0.522	0.613	0.070	0.683
0.8	1.043	-0.038	-0.017	1.006	1.027	0.125	0.402	0.527	0.616	0.073	0.689
0.9	1.049	-0.038	-0.017	1.011	1.032	0.129	0.405	0.534	0.619	0.075	0.694
1	1.055	-0.038	-0.017	1.017	1.038	0.132	0.407	0.540	0.623	0.077	0.700

Table 3: Effect of change in the number of poor workers under different MPCs

Panel a: $\alpha_1 = 0.72 \quad \alpha_2 = 0.12 \quad \mu = 0.5$

λ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V = V_1)$	$d\upsilon_2$ $(V = V_1)$	$d\upsilon_1 + d\upsilon_2$ $(V = V_1)$	$d\upsilon_1$ $(V = V_2)$	$d\upsilon_2$ $(V = V_2)$	$d\upsilon_1 + d\upsilon_2$ $(V = V_2)$
0.5	1.266	-0.456	-0.076	0.810	1.190	0.129	0.405	0.534	0.595	0.249	0.843
0.55	1.290	-0.511	-0.070	0.779	1.221	0.125	0.351	0.475	0.671	0.238	0.909
0.6	1.316	-0.568	-0.063	0.747	1.253	0.117	0.299	0.416	0.752	0.224	0.975
0.65	1.342	-0.628	-0.056	0.714	1.286	0.105	0.250	0.355	0.836	0.208	1.043
0.7	1.370	-0.690	-0.049	0.679	1.321	0.089	0.204	0.293	0.924	0.188	1.113
0.75	1.399	-0.755	-0.042	0.643	1.357	0.068	0.161	0.229	1.017	0.166	1.183
0.8	1.429	-0.823	-0.034	0.606	1.394	0.042	0.121	0.164	1.115	0.140	1.256
0.85	1.460	-0.893	-0.026	0.566	1.434	0.012	0.085	0.097	1.219	0.111	1.330
0.9	1.493	-0.967	-0.018	0.525	1.475	-0.025	0.053	0.028	1.327	0.078	1.405
0.95	1.527	-1.044	-0.009	0.482	1.518	-0.067	0.024	-0.043	1.442	0.041	1.483
1	1.563	-1.125	0.000	0.438	1.563	-0.115	0.000	-0.115	1.563	0.000	1.563

$\alpha_1 = 0.45 \quad \alpha_2 = 0.05 \quad \mu = 0.5$

λ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V = V_1)$	$d\upsilon_2$ $(V = V_1)$	$d\upsilon_1 + d\upsilon_2$ $(V = V_1)$	$d\upsilon_1$ $(V = V_2)$	$d\upsilon_2$ $(V = V_2)$	$d\upsilon_1 + d\upsilon_2$ $(V = V_2)$
0.5	1.143	-0.257	-0.029	0.886	1.114	0.192	0.443	0.634	0.557	0.147	0.704
0.55	1.156	-0.286	-0.026	0.870	1.130	0.202	0.391	0.594	0.622	0.140	0.761
0.6	1.170	-0.316	-0.023	0.854	1.146	0.211	0.342	0.552	0.688	0.131	0.818
0.65	1.183	-0.346	-0.021	0.837	1.163	0.218	0.293	0.511	0.756	0.120	0.876
0.7	1.198	-0.377	-0.018	0.820	1.180	0.222	0.246	0.469	0.826	0.108	0.934
0.75	1.212	-0.409	-0.015	0.803	1.197	0.225	0.201	0.426	0.898	0.094	0.992
0.8	1.227	-0.442	-0.012	0.785	1.215	0.226	0.157	0.383	0.972	0.079	1.051
0.85	1.242	-0.475	-0.009	0.767	1.233	0.225	0.115	0.340	1.048	0.062	1.110
0.9	1.258	-0.509	-0.006	0.748	1.252	0.221	0.075	0.296	1.126	0.043	1.170
0.95	1.274	-0.545	-0.003	0.729	1.271	0.215	0.036	0.252	1.207	0.023	1.230
1	1.290	-0.581	0.000	0.710	1.290	0.207	0.000	0.207	1.290	0.000	1.290

Table 4: Effect of change in the number of poor workers under different MPCs

Panel a: $\alpha_1 = 0.20 \quad \alpha_2 = 0.07 \quad \mu = 0.5$

λ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V=V_1)$	$d\upsilon_2$ $(V=V_1)$	$d\upsilon_1+d\upsilon_2$ $(V=V_1)$	$d\upsilon_1$ $(V=V_2)$	$d\upsilon_2$ $(V=V_2)$	$d\upsilon_1+d\upsilon_2$ $(V=V_2)$
0.5	1.072	-0.107	-0.038	0.965	1.035	0.179	0.483	0.662	0.517	0.129	0.647
0.55	1.076	-0.118	-0.034	0.958	1.042	0.193	0.431	0.624	0.573	0.120	0.693
0.6	1.080	-0.130	-0.030	0.950	1.050	0.206	0.380	0.587	0.630	0.109	0.739
0.65	1.084	-0.141	-0.027	0.943	1.057	0.219	0.330	0.549	0.687	0.098	0.786
0.7	1.088	-0.152	-0.023	0.935	1.065	0.230	0.281	0.511	0.745	0.087	0.832
0.75	1.091	-0.164	-0.019	0.928	1.072	0.241	0.232	0.473	0.804	0.074	0.878
0.8	1.095	-0.175	-0.015	0.920	1.080	0.251	0.184	0.435	0.864	0.061	0.925
0.85	1.099	-0.187	-0.012	0.912	1.088	0.260	0.137	0.397	0.925	0.047	0.971
0.9	1.103	-0.199	-0.008	0.905	1.095	0.268	0.090	0.359	0.986	0.032	1.018
0.95	1.107	-0.210	-0.004	0.897	1.103	0.276	0.045	0.321	1.048	0.016	1.064
1	1.111	-0.222	0.000	0.889	1.111	0.283	0.000	0.283	1.111	0.000	1.111

Panel b: $\alpha_1 = 0.06 \quad \alpha_2 = 0.04 \quad \mu = 0.5$

λ	$\frac{\partial Y}{\partial G}$	$\frac{\partial Y}{\partial V_1}$	$\frac{\partial Y}{\partial V_2}$	$\frac{\partial Y}{\partial G_{G=V_1}}$	$\frac{\partial Y}{\partial G_{G=V_2}}$	$d\upsilon_1$ $(V=V_1)$	$d\upsilon_2$ $(V=V_1)$	$d\upsilon_1+d\upsilon_2$ $(V=V_1)$	$d\upsilon_1$ $(V=V_2)$	$d\upsilon_2$ $(V=V_2)$	$d\upsilon_1+d\upsilon_2$ $(V=V_2)$
0.5	1.026	-0.031	-0.021	0.995	1.005	0.099	0.497	0.596	0.503	0.080	0.583
0.55	1.026	-0.034	-0.018	0.992	1.008	0.107	0.447	0.554	0.554	0.073	0.627
0.6	1.027	-0.037	-0.016	0.990	1.010	0.116	0.396	0.512	0.606	0.066	0.673
0.65	1.027	-0.040	-0.014	0.987	1.013	0.124	0.346	0.469	0.658	0.059	0.717
0.7	1.028	-0.043	-0.012	0.985	1.015	0.131	0.295	0.427	0.711	0.051	0.762
0.75	1.028	-0.046	-0.010	0.982	1.018	0.139	0.246	0.384	0.763	0.043	0.807
0.8	1.029	-0.049	-0.008	0.979	1.021	0.146	0.196	0.342	0.816	0.035	0.851
0.85	1.029	-0.052	-0.006	0.977	1.023	0.153	0.147	0.299	0.870	0.027	0.896
0.9	1.030	-0.056	-0.004	0.974	1.026	0.160	0.097	0.257	0.923	0.018	0.941
0.95	1.030	-0.059	-0.002	0.972	1.028	0.166	0.049	0.215	0.977	0.009	0.986
1	1.031	-0.062	0.000	0.969	1.031	0.172	0.000	0.172	1.031	0.000	1.031

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