Inequality, Public Good Provision and the Composition of Trade

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Abstract

This paper investigates the effect of trade openness on the provision of productive public goods and shows that inequality plays an important role in this regard. The theoretical model suggests that the provision of productive public goods has differentiated effects in closed and open economies. In a closed economy, it decreases the price of the manufacturing commodity, whereas in a small open economy, it increases the firms' profits. Consequently, opening up the economy shifts the benefits of productive public spending from consumers to firms’ owners. If manufacturing income inequality is sufficiently small, the median voter earns a sufficiently high share of the firm’s profit and thus opening up the economy increases the provision of productive public goods. In this circumstance, the manufacturing export also increases via the increase in productivity of the firms.

JEL classification: D63; H41; O47; F43

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1 Introduction

The theoretical literature regarding the effects of trade openness on aggregate productivity is mainly focused on firm-level decisions. Trade is known to increase productivity by reallocating production factors to more productive firms (Melitz [2003]) or by encouraging firms to engage in innovation and R&D investments (e.g. Lileeva and Trefler [2010], Costantini and Melitz [2007] and Baldwin and Gu [2004]). However, to-date, little attention has been paid to how international trade affects aggregate productivity through its effect on the supply of productivity enhancing public goods. This is surprising since there is a (mostly empirical) literature that focuses on how trade affects

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the level and composition of public spending. The literature argues that under the “efficiency” hypothesis, market friendly activities and productive public spending such as education, securing property rights and R&D investment increases (Gemmell et al. [2008] and Garrett [2001]). This paper draws a connection between these two parts of literature by considering an economy with a set of homogeneous competitive firms in which the individuals—the firms’ owners—can decide about the optimal investment in productive public goods. The paper represents the circumstances under which opening up the economy leads to a higher (lower) productive public spending and hence to a raise (fall) in TFP. It turns out that one of the key factors in provision of productive public goods is inequality.

To investigate the effect of trade on productivity, I set up a static model of an economy with two goods, a manufacturing and an agricultural good. The goods are being produced in a competitive market where labor is the only production factor. The level of productive public goods in the economy directly affect the productivity of the manufacturing sector, whereas the productivity of the agricultural sector is unaffected. Each consumer provides one unit of labor and earn wage \( w \) which is identical in both sectors. However, the consumers are also the firms’ owners and their share of the firms’ profits may differ. I further assume that the individuals pay a proportional tax on their wage which is fully used to provide productive public goods. A raise in the level of productive public investment increases the productivity of the manufacturing sector and may change the individuals’ utility. Based on the median voter theorem, the model explores the equilibrium level of public good provision in both the closed and the open economies. One main result is that the provision of productive public goods in a closed economy leads to a decrease in the relative price of the manufacturing good which increases the consumer surplus. In a small open economy, where the price is determined in the international market, however, more investment in productive public goods increases the firms’ profits.

As the model predicts, the degree of inequality is a major determinant of the responses of the productive public spending and hence TFP to trade liberalization. By eliminating trade barriers, increasing the level of productive public spending leads to a rise in the firms’ profits instead of a fall in the price of the manufacturing good. Consequently, the benefits of the productive public spending shifts from the consumers to the firms owners and becomes more desirable for the individuals with a higher share of the firms’ profits. The more the revenue of the manufacturing sector is equally distributed, the share of the median voter becomes higher and therefore the equilibrium public investment increases. To put it briefly, if the median voter rule applies, inequality is good for
productive public spending in a closed economy and bad in an open economy.

A first glance at the data seems to support these results. Figure 1 shows the relationship between the provision of productive public goods, including education, health and defense expenditure, and the Gini coefficient of income distribution.\(^1\) The upward sloping fitted line details the relationship in relatively closed economies, in countries with an openness index below the median. The downward sloping fitted line is related to the countries with an openness index above the median, relatively open economies.\(^2\) For the low level of Gini index, the fitted values are higher in open economies compared to closed economies. However, if the Gini index is high, the estimated productive public spending is higher in closed economies.\(^3\)

![Figure 1: Inequality and productive public spending in countries with different levels of openness](image)

Furthermore, the model predicts that inequality also plays a role in determining trade patterns

\(^1\)Note that since the equilibrium results of the theoretical model is based on the median voter theorem, in the Figure and also in the regressions I only include countries with a certain level of democracy (polity index (Marshall and Jaggers [2013]) above zero).

\(^2\)The openness index, as will be explained in Appendix C.2, is the minus weighted mean applied tariff provided by the World Bank [2013]. In Figure 1, I have used the average in years (1995-2013) for all the countries that the Gini coefficient and productive public spending is available for them. Therefore it includes more countries compared to the regressions in Appendix C. However, the slopes of the fitted lines are approximately the same if I only use the observations that are included in the regressions. It is also the same if the mean of the openness index is used instead of the median to determine relatively closed and open economies.

\(^3\)Using the available datasets for a panel of 69 countries between 1995 and 2012 with different levels of trade restrictions, I investigate the relationship between inequality and the provision of productive public goods in Appendix C. The data shows a negative and significant relationship between the interaction of inequality and trade openness with productive public spending. The estimated coefficients suggest that inequality has a negative relationship with productive public spending—including education, health and defense—in relatively open economies and a positive relationship in relatively closed economies. These results are in line with the prediction of the theoretical model. The data also supports the negative relationship of inequality and the manufacturing export predicted by the model. However, to understand whether the significance of the estimated coefficients is due to causality or correlation, more cautious empirical work should be done.
through its effect on productive public spending. In a society where the income of the manufacturing sector is more evenly distributed, the productivity of the manufacturing sector is higher due to a higher level of productive public spending. This makes a comparative advantage for the manufacturing sector compared to the agricultural sector and causes a rise in the manufacturing export and consequently in the agricultural import. To the extent I am aware of, the effect of inequality on trade composition, is rarely discussed in the literature. As an example, Dalgin et al. [2004] classify the products into two groups, ”luxuries” and ”necessities” and show that imports of luxuries (necessities) increases (decreases) with the importing country inequality if the assumption of homothetic preferences is relaxed. Considering the manufacturing goods as luxuries and the agricultural goods as necessities, the prediction of Dalgin et al. [2004] is consistent with my model. However, I discuss this effect through the channel of public goods provision and concentrate on the optimal investment from the median voter perspective.

Empirical micro-level studies of trade and productivity mainly support a positive effect of trade liberalization on productivity (e.g., Lileeva and Trefler [2010], Aw et al. [2007] and Baldwin and Gu [2003]). In most of these empirical research and related theoretical models the role of inequality is poorly discussed. More recent studies however, explore the effect of credit constraints –which can be seen as a consequence of inequality– on trade in developing countries. In this regard, Foellmi and Oechslin [2012] explain that under asset inequality and credit market frictions trade liberalization may have a negative effect on productivity. With a focus on the effect of public good provision, I also show that trade liberalization leads to an increase in productivity only if the level of inequality is sufficiently small. Regarding public investment and inequality, most of the research concentrate on the effect of initial inequality in land ownership to be able to explain current differences in growth rates between different countries. Among them, a group of studies support the negative effect of inequality on the productivity enhancing public good provision, specifically growth enhancing educational policy (e.g., Galor et al. [2009] and Falkinger and Grossmann [2005]). Since capital distribution is the major cause of inequality in developed and also most developing countries in today’s world, this paper investigates the effect of inequality in the firm ownership or equivalently the capital distribution and shows that inequality is harmful for productivity under trade openness.

The paper also adds to the literature on the size and composition of public investment and trade. Garrett [2001] draws a distinction between different government policies regarding trade openness. As he explains, under the ”efficiency” hypothesis governments decrease their activism and invest only in market friendly activities, while the ”compensation” hypothesis argues that trade openness
may increase the governments’ incentives to compensate the losers from globalization which leads to more distributive policies. Based on the above division, Gemmell et al. [2008] reviewed the related papers and discussed the effect of globalization on the size and also on the structure of public expenditures. They point out that under the efficiency hypothesis, provision of productive public goods such as education, R&D, training and infrastructure may also increase. Many of the empirical papers, support the positive effect of globalization on the productivity enhancing public goods, specifically health and education, (e.g, Avelino et al. [2005], Alesina and Wacziarg [1998] and Kaufman and Segura-Ubiergo [2001]) while some others represent insignificant effect on the composition of government expenditure, (e.g., Dreher et al. [2008]). This paper claims that inequality may be able to explain this unambiguous effect of trade on productive public expenditure. The introduced model suggests that, if the median voter theorem holds, productivity enhancing public spending increases under trade liberalization only if the level of inequality is sufficiently small.

The rest of the paper is organized as follows; Section 2 introduces the assumptions on which the model is based, Section 3 derives the optimal level of productive public goods as a function of inequality in closed and open economies, compares the optimal decisions and explore the circumstances under which opening up the economy increases the productive public spending, Section 4 drives the condition under which the manufacturing export is positive and Section 5 briefly discusses two extensions of the model by relaxing two main assumptions. Conclusions are drawn in the final section.

2 Assumptions

2.1 Preferences and policy variables

Consider an economy in which there are only two goods, a manufacturing good and an agricultural good. The economy is populated by continuum one of individuals, indexed by $i$. Preferences are given by

$$u_i = \beta \ln y_i + \ln x_i$$

(1)

where $y_i$ and $x_i$ are, respectively, the quantity of the manufacturing and agricultural good consumed by individual $i$. The parameter $\beta > 1$ gives the weight of the manufacturing good in the utility function. The individuals have two sources of income. First, each individual provides one unit of labor and earns wage $w$. Second, the individuals are the owners of the firms and earn a fraction $\theta_i^m$ of the firms’ profits as the manufacturing income. Assuming different levels of $\theta_i^m$ in the model allows
us to see the effects of public goods on different individuals. It also enables us to see the effects of inequality on public good provision. Moreover, I assume that the individuals pay a proportional income tax that is only imposed on their wage, $\tau w$, and is fully used to provide productive public goods. Imposing tax on only the wage and not the manufacturing income, is a simplifying assumption that enables us to derive explicitly the optimal decisions. In section 5.2 however, by simulating the model, I show that the general results of the paper remain unchanged if the tax is imposed on the whole income instead.\footnote{Increase in the provision of productive public goods under trade liberalization for low levels of inequality is even stronger in this case.}

The price of the agricultural good is normalized to one. Therefore the individuals’ budget constraint can be written as

$$py_i + x_i = (1 - \tau)w + \theta_i^* \pi^M$$  \hspace{1cm} (2)

where $p$ is the price of the manufacturing good in terms of the agricultural good. Maximizing the individual’s utility function subject to the budget constraint leads to the following individual demand functions:

$$y_i = \frac{\beta ((1 - \tau)w + \theta_i^* \pi^M)}{1 + \beta}$$  \hspace{1cm} (3)

$$x_i = \frac{1}{1 + \beta} [(1 - \tau)w + \theta_i^* \pi^M]$$  \hspace{1cm} (4)

Since the number of individuals in the economy is normalized to one, the aggregate demand functions can be written as

$$y^d = \int y_idi = \int \frac{\beta ((1 - \tau)w + \theta_i^* \pi^M)}{p(1 + \beta)} di = \frac{\beta ((1 - \tau)w + \pi^M)}{p(1 + \beta)}$$  \hspace{1cm} (5)

$$x^d = \int x_idi = \int \frac{((1 - \tau)w + \theta_i^* \pi^M)}{1 + \beta} di = \frac{((1 - \tau)w + \pi^M)}{1 + \beta}$$  \hspace{1cm} (6)

I assume that the tax rate is determined in a majority voting system. As a result, based on the median voter theorem, the equilibrium tax rate is the one preferred by the median voter. I further assume that the full tax revenues are used to finance the productive public goods. The provision of productive public goods is a concave function of the tax revenue:

$$(\tau w)^{\frac{1}{\gamma}} = G$$  \hspace{1cm} (7)

where $\gamma > 1$. Therefore, the initial units of tax revenue increases productive public spending by a
larger amount.

2.2 The agricultural sector

The agricultural good is being produced in a competitive market with a linear technology that uses labor as the only input factor.

\[ x_j = zl_j \]  

(8)

where \( z \) is the productivity of the agricultural sector which is exogenous and \( l_j \) is the labor used by firm \( j \) to produce \( x_j \). The price of the agricultural good is normalized to one. Thus, the profit can be written as below.

\[ \pi^A_j = zl_j - wl_j \]

Based on the above profit function, three cases may happen.

\[
\begin{align*}
(x_j, l_j) &= (0, 0), & \text{if } z < w \\
(0, 0) &< (x_j, l_j) < (\infty, \infty), & \text{if } z = w \\
(x_j, l_j) &= (\infty, \infty), & \text{if } z > w
\end{align*}
\]  

(9)

Due to labor scarcity, the third case can not be observed in the equilibrium. Moreover, there is always a positive demand for the agricultural good. As a result, the first case is also impossible for a closed economy in equilibrium since the supply of the agricultural good can not be zero while the demand is positive. However, in an open economy, positive demand and zero supply is possible due to the agricultural import. In this circumstance, when there is no international labor mobility, all the individuals supply their labors in the manufacturing sector. The equilibrium wage equalize demand and supply of the labor within the manufacturing sector while labor supply is equal to one. Consequently, the domestic supply of the agricultural goods is zero. From now on, I focus on the second case and assume that we have production in both sectors, \( w^{eq} = z \). The agricultural profit is thus zero. In section 5.1, I also explore the circumstances under which \( w^{eq} > z \) and thus, the demand for the agricultural good is provided via the agricultural import. The main results of the paper, specifically more productive public spending in open economies with lower inequality, still holds if \( w^{eq} > z \).
2.3 The manufacturing sector

There is a continuum one of the homogeneous firms in the industry that produce the manufacturing good. Firms are price takers and have access to a technology that uses labor as an input factor. Moreover, firms’ productivity is affected by the level of public goods.

\[ y_j = \alpha^{-1} AG^{1-\alpha} l_j^{\alpha} \]  

(10)

where \( 0 < \alpha < 1 \) and \( G \) is the level of productive public goods, such as health, education and defense.\(^5\)

Based on the above production function, the firm’s output is an increasing concave function with respect to the level of productive public goods available in the economy. The firm maximization problem can be written as

\[ \max_{l_j} \{ pA_{\alpha}^{-1} l_j^{\alpha} G^{1-\alpha} - \alpha l_j \} \]

By solving the firm maximization problem we have:

\[ l_j = \left( \frac{pA}{\alpha} \right)^{\frac{1}{1-\alpha}} G \]  

(11)

Substituting the optimal investment decision into the production and the profit functions leads to the optimal level of the production and profit respectively (see the proof in Appendix A.1).

\[ y_j = \frac{G}{\alpha} \left( \frac{p}{w} \right)^{\frac{\alpha}{1-\alpha}} A^{\frac{1}{1-\alpha}} \]  

(12)

\[ \pi_j = \frac{1 - \alpha}{\alpha} G(pA)^{\frac{1}{1-\alpha}} \left( \frac{1}{w} \right)^{\frac{\alpha}{1-\alpha}} \]  

(13)

Since the number of the firms in the economy is normalized to one, the aggregate supply function can be written as follows:

\[ y^{s} = \int y_j d_j = \frac{G}{\alpha} \left( \frac{p}{w} \right)^{\frac{\alpha}{1-\alpha}} A^{\frac{1}{1-\alpha}} \]  

(14)

3 Analysis

I now investigate the optimal level of public goods in the economy from different agents’ perspective. First, I derive the equilibrium tax rate, and hence the productive public investment, in a closed

\(^5\)Using the IMF functional classification, Kneller et al. [1999] classify general public services, education, health, housing, defense, transport and communication as the productive public expenditures. Social security and welfare expenditures and expenditures on recreation are classified as unproductive expenditures.
economy, where the market price is determined endogenously. I then move on to an open economy where the price equals to an exogenous world market price. Note that in all the sections except section 5.1, it is assumed that the wage is determined in the agricultural sector, $w^{eq} = z$.

### 3.1 Closed economy

The equilibrium market price of the manufacturing good can be derived by equating supply and demand (see proof in Appendix A.2).

$$p^{eq} = \left(\frac{\alpha \beta ((1 - \tau)z + \pi)}{G(1 + \beta)}\right)^{1 - \alpha} A^{-1} z^\alpha$$

(15)

As the above equation shows, the equilibrium price is decreasing in $G$ since the firms operate more efficiently if the level of public goods is higher. By substituting the equilibrium price into the profit function we can find the firms’ profit in the equilibrium (see the proof in Appendix A.2). Note that in this step, $G$ and $\tau$ are independent and tax is not imposed yet to increase $G$.

$$\pi^M = \frac{\beta(1 - \alpha)}{1 + \alpha \beta} (1 - \tau)z$$

(16)

**Lemma 3.1.** In a closed economy the equilibrium price, $p^{eq}$, is decreasing in the level of public goods, $G$, while the equilibrium profit, $\pi$, is unaffected.

The increase in $G$ raises the productivity of the manufacturing sector and hence, the firms operate more efficiently. However, due to Cobb-Douglas preferences and production, the increase in the efficiency of the firms only lowers the equilibrium price while the profit is unaffected. 6

Based on the equilibrium price derived above, I now proceed to find the equilibrium $(\tau, G)$. In order to do so, I need to find the indirect utility function. The equilibrium level of consumptions can be written as follows (see the proof in Appendix A.2):

$$y_i = \left(\frac{\beta}{1 + \beta}\right)^\alpha \left(\frac{G}{\alpha}\right)^{1-\alpha} A^{\alpha} \left(\frac{(1 - \tau)z + \theta^i \pi^M}{((1 - \tau)z + \pi^M)^{1-\alpha}}\right)^{\alpha}$$

$$x_i = \frac{((1 - \tau)z + \theta^i \pi^M)}{1 + \beta}$$

6If instead, the quasilinear utility function $(\frac{\beta}{1 - \tau} y_i + x_i) \sigma_i$ with $\sigma > 1$ is used, $\pi$ turns out to be increasing in $G$. 9
By substituting $\pi^M$ from equation (16) into the above equations, we have

$$y_i = A(\beta(1-\tau))^{\alpha}\left(G^{\alpha}^{1-\alpha}\left(\frac{1}{1+\beta}\right)(1+\alpha\beta)^{1-\alpha}[1+\theta_i^{\pi} \frac{\beta(1-\alpha)}{1+\alpha\beta}]\right)$$

(17)

$$x_i = \frac{(1-\tau)z}{1+\beta} [1+\theta_i^{\pi} \frac{\beta(1-\alpha)}{1+\alpha\beta}]$$

(18)

The indirect utility function can be derived by substituting equations (17)-(18) into equation (1). I now assume that the whole tax income is used to provide public goods and hence substitute $G$ from equation (7).

$$v_i = F_1 + \frac{\beta}{\gamma}(1-\alpha)\ln\tau + (1+\alpha\beta)\ln(1-\tau) + (1+\beta)\ln(1+\theta_i^{\pi} \frac{\beta(1-\alpha)}{1+\alpha\beta})$$

(19)

where $F_1 = \alpha\beta\ln\beta - (1+\beta)\ln(1+\beta) - \beta(1-\alpha)\ln\alpha + \beta(1-\alpha)\ln(1+\alpha\beta) + \beta\ln A + (1+\frac{\beta(1-\alpha)}{-\tau})\ln z$.

Equation (19) shows that the indirect utility function is increasing in $A$. Higher $A$ is associated with higher productivity and hence lower price in the manufacturing sector which increases the utility of the consumers. Not surprisingly, a rise in $\theta_i^{\pi}$ and $z$ also increases the indirect utility via increasing disposable income. However, the effect of $\tau$ and therefore $G$ is ambiguous. On the one hand, higher level of tax is used to provide more public goods which decreases the price and enables the consumers to consume more. But on the other hand, it decreases disposable income and therefore reduces consumption.

Maximizing the indirect utility function shows that the equilibrium tax decision in this closed economy is the same for all the individuals. Furthermore, it is decreasing in $\gamma$ and $\alpha$.

**Proposition 3.2.** The equilibrium tax level, equivalently equilibrium level of public goods provision, in the closed economy is independent of $\theta_i^{\pi}$ of the median voter and decreasing in $\gamma$ and $\alpha$.

$$\tau^{opt} = \frac{\beta(1-\alpha)}{\gamma(1+\alpha\beta) + \beta(1-\alpha)}$$

*Proof. Appendix B.1*

The intuition behind the reduction of $\tau$ and therefore $G$ by raises in $\gamma$ and $\alpha$ is quite clear. If $\gamma$ is higher, the provision of public goods is more costly. Moreover, higher $\alpha$ means lower impact of public goods on production and thus less effective public goods. Hence, under both conditions, the optimal provision would be lower. The independence of the optimal decision from $\theta_i^{\pi}$, however, is due to the fact that the proportional income tax is levied only on the wage. Based on this assumption, the
manufacturing income, \( \pi \) in equation (16), indirectly decreases by the ratio \((1 - \tau)\). As a result, the whole income –left hand side of equation (2)– decreases by the same ratio \((1 - \tau)\). Since disposable income and the price decreases similarly for all the individuals, the equilibrium \((\tau, G)\) would be the same irrespective of \(\theta_i^\pi\). If instead, the proportional income tax is imposed on total income, \(\pi\) is more decreasing in \(\tau\) and hence, disposable income decreases more for the individuals with higher share of the firm’s profit. Section 5.2 shows that in this circumstance, the equilibrium tax rate decreases with \(\theta_i^\pi\).

### 3.2 Open economy

In this section, we consider a small open economy in which the relative price of the manufacturing good is equal to the international level, \(p^f\). Since the price is determined exogenously, the firm’s profit in the manufacturing sector and the domestic demand can be written as in equations (13) and (3), respectively, where \(p\) is substituted by \(p^f\).

\[
\pi^M = \left(1 - \frac{\alpha}{\alpha}\right) G \left(p^f A \right)^{\frac{1}{1-\alpha}} \left(\frac{1}{z^{\frac{1}{\alpha}}} \right) \tau^{\frac{\alpha}{1-\alpha}} \tag{20}
\]

\[
y_i = \frac{\beta}{1 + \beta} \left[ (1 - \tau) z + \theta_i \pi^M \right] \tag{21}
\]

As we can see above, unlike the profit in the closed economy (see equation (16)), the firms’ profit in the open economy is an increasing function of \(G\) and does not depend on \(\tau\). Note that in this step, \(G\) and \(\tau\) are independent and tax is not imposed yet to increase \(G\).

**Lemma 3.3.** The equilibrium profit in a small open economy is increasing in the level of public goods, \(G\).

As explained before, productive public spending increases the productivity and thus the efficiency of the firms. In a small open economy, higher efficiency of the firms increases the profit since the price is determined in the international market and is unaffected by the domestic firms.

By substituting \(\pi^M\) into the equations (21) and (4), we have

\[
y_i = \frac{\beta}{1 + \beta} \left[ (1 - \tau) z + \theta_i \pi^M \right] \tag{21}
\]

\[
x_i = \frac{1}{1 + \beta} \left[ (1 - \tau) z + \theta_i \pi^M \right] \tag{4}
\]

The above equations show the equilibrium levels of the manufacturing and the agricultural goods.
consumption. By combining these two equations with the individuals’ utility function, we can drive the indirect utility function in this small open economy (see the proof in Appendix A.3). I now impose the assumption that the tax is fully used to provide public goods and thus substitute $G$ from equation (7).

$$v_i = F_2 + (1 + \beta) \ln[(1 - \tau)z + \theta_i^\tau \left(\frac{1 - \alpha}{\alpha}\right)(\tau z)\frac{1}{\gamma}(p/A)^{1/\alpha}(1/z)^{1/\alpha}]$$

(22)

where $F_2 = \beta \ln \beta - (1 + \beta) \ln(1 + \beta) - \beta \ln p^f$. Not surprisingly, the indirect utility function is increasing in $\theta_i^\tau$. However, as is the case in the closed economy, the effect of public goods on the indirect utility is ambiguous. On the one hand, providing public goods increases the profit and therefore the manufacturing income. On the other hand, however, the taxes imposed to provide public goods decreases the net wage. It can be shown that the equilibrium tax level is increasing in $\theta_i^\tau$ where $\theta_i^\tau$ is the median voter’s share of the firms profit. As a result, provision of public goods is more interesting for those who earn higher income in the manufacturing sector.

**Proposition 3.4.** The equilibrium tax level, equivalently equilibrium level of public goods provision, in the open economy is increasing in $\theta_i^{\pi}$ of the median voter and $p^f$ and decreasing in $z$.

$$\tau^{opt} = \left[\theta_i^\tau (p^f A)^{1/\alpha} \left(\frac{1 - \alpha}{\gamma}\right)^{\frac{1}{1 - \alpha}} (1/z)^{\frac{1}{\gamma - 1}}\right]$$

Proof. Appendix B.2

The equilibrium tax and hence the amount of public goods are increasing in world market price, $p^f$. This is the case, because, as equation (20) shows, the rise in the firms’ profit by a rise in the level of productive public goods is higher if the international price is higher. Equivalently, productive public investment is more profitable if international price is higher. The equilibrium tax rate is also increasing in $\theta_i^\tau$. Accordingly, those with higher share of the firms’ profit are more interested in providing public goods. This happens since the firm’s profit is increasing in $G$ while the relative price of the manufacturing good is unaffected. Furthermore, the equilibrium tax rate is decreasing in $z$. To get the intuition, note that a rise in the tax rate affect the indirect utility through two channels. One is the negative effect due to a decrease in the disposable income. The other is the positive effect due to an increase in the firm’s profit. A higher $z$, consequently a higher wage, intensifies the negative effect of increasing $\tau$ on the individuals’ utility and hence decreases the equilibrium tax rat.
3.3 Closed and open economy comparison

One important issue is to understand whether trade liberalization increases the provision of public goods. In a small open economy with price taker firms, public goods provision increases the firms’ profit while the price of the manufacturing good is determined in the international market. However, in a similar closed economy, the provision of public goods decreases the price of the manufacturing good and has no effect on the firms’ profit. It can be shown that there is a threshold price, $p^*$ such that for the international prices higher than this threshold, the provision of public goods in the open economy is higher than the closed economy.

Proposition 3.5. The provision of public goods under trade liberalization increases if $p^I > p^*$, where $p^*$ is decreasing in $\theta_i^\pi$ and $A$ and increasing in $z$.

$$p^* = \frac{1}{A} \left( \frac{z^{\alpha+\gamma-1/\gamma}(\frac{2\alpha}{\beta})^{1-\alpha}}{(1-\alpha)^{1-\alpha}} \right) \left[ \frac{1}{\gamma}(1 + \alpha \beta) + (1 - \alpha) \right]^{(\gamma - 1)(1 - \alpha)}/\gamma$$

Proof. Appendix B.3

The threshold is decreasing in $\theta_i^\pi$ where the individual $i$ is the median voter. The intuition is that if the individual $i$ earns a higher share of the firms’ profit, her disposable income increases more with the provision of public goods under trade liberalization and hence productive public spending is more desirable for her. Accordingly, for the lower international price of the manufacturing good, the level of public goods in the open economy is still higher than the closed economy. Higher $A$ has also a similar effect since it intensifies the positive effect of public goods provision on the firms’ profit and thus disposable income. Moreover, as explained in Proposition 3.4., productive public spending in the open economy decreases with $z$. Consequently, for higher $z$, the international price should also be higher to motivate public spending. An interesting consequence of the above proposition is that we can relate the provision of public goods under trade liberalization to the level of inequality. Based on the median voter theorem, the optimal decision is the one which is the most preferred by the median voter. Assuming that the manufacturing income is the main source of inequality, a richer median voter, a more equally distributed manufacturing income, leads to a higher $\tau$ and hence a higher $G$ as the optimal choice in an open economy.
4 Export and Import relationship with the provision of public goods

Provision of public goods increases the firms’ profit and encourages the firms owners to produce more. Under these circumstances, the excess supply of the manufacturing good will be exported to the foreign market. Exporting the manufacturing good would be compensated with importing the agricultural good. In this section I discuss the condition under which the export of the manufacturing good is positive and explore the composition of trade through the channel of public good provision.

In each sector, the excess supply with respect to the domestic demand can be defined as the level of export.

\[ EX^y = y^s - y^d \]

\[ EX^x = z(1 - l^m) - \tau w - x^d \]

where \( l^m \) is the labor used in the manufacturing sector and is determined by the manufacturing firms. The rest of the individuals, \((1 - l^m)\), supply their labors in the agricultural sector and hence \( z(1 - l^m) \) is the supply of the agricultural good. The agricultural demand is the summation of the households’ consumption, \( x^d \), and the tax collected by the government, \( \tau w \). As assumed before, I focus on the second case of equation (9) where \( w^{eq} = z \) and hence, in what follows, \( w \) is substituted with \( z \).

Lemma 4.1. The export of the manufacturing good is an increasing function of \( \tau \) and therefore \( G \).

\[ EX^y = \frac{\beta}{(1 + \beta)} z \left[ (\tau z) \frac{1}{\gamma} (\frac{p^f A}{z}) \frac{1}{\alpha} \frac{1 + \alpha \beta}{\alpha \beta} \right] \]

Proof. Appendix B.4

Lemma 4.2. The export of the agricultural good is a decreasing function of \( \tau \) and therefore \( G \).

\[ EX^x = \frac{\beta}{(1 + \beta)} z \left[ (1 - \tau) - (\tau z) \frac{1}{\gamma} (\frac{p^f A}{z}) \frac{1}{\alpha} \frac{1 + \alpha \beta}{\alpha \beta} \right] \]

Proof. Appendix B.5

The intuition behind Lemmas 4.1. and 4.2. is that productivity of the manufacturing sector increases as the provision of public goods increases. This makes a comparative advantage for the
manufacturing sector compared to the agricultural sector and hence raises the manufacturing export, equivalently the agricultural import.

By substituting \( \tau \) from Proposition 3.4 into the above equations we can find a threshold price such that for the international prices above the threshold, the manufacturing good is exported to the international market.

**Proposition 4.3.** The export (Import) of the manufacturing (agricultural) good is positive if \( p^f > p^{**} \) and negative if \( p^f < p^{**} \).

\[
p^{**} = \frac{1}{A} \left[ \frac{\alpha - \gamma}{\gamma} - \frac{(1+\alpha \beta)}{\alpha \beta} \left( \frac{1}{1+\alpha \beta} + \theta_i^\pi \left( \frac{1 - \alpha}{\alpha \gamma} \right)^2 \right) \right]
\]

\( p^{**} \) is decreasing in \( \theta_i^\pi \) and \( A \) and increasing in \( z \).

**Proof.** Appendix B.6

If the individual \( i \), the median voter, earns a higher share of the firm’s profit, \( \theta_i^\pi \), her disposable income increases more with the provision of public goods. Thus, she prefers higher level of public spending which leads to more production in the manufacturing sector. In these circumstances, the threshold price decreases since for each \( p^f \) the supply of the manufacturing good is higher. As in section 3.3, we can relate the trade patterns to inequality. Based on the above proposition, the export (import) of the manufacturing (agricultural) good is higher if the level of inequality is lower, equivalently \( \theta_i^\pi \) of the median voter is higher. The threshold price also decreases with \( A \) since the production process is more efficient for higher \( A \) which increases the supply of the manufacturing good.

5 Extensions of the model

In this section I demonstrate that relaxing two simplifying assumptions of the paper leads to the same and even stronger effect of inequality on productive public spending.

5.1 A small open economy with a low agricultural productivity

As discussed in section 2.2, the first case of equation (9) is possible in an open economy where \( z \), the exogenous productivity of the manufacturing sector, is sufficiently small. In this circumstance, obtaining a non-negative profit in the agricultural sector is impossible and the agricultural production
is zero. The positive demand for the agricultural good is thus provided via import. Subsequently, all the individuals supply their labors in the manufacturing sector. The equilibrium wage equalize the manufacturing demand for labor, equation (11), with total labor supply in the economy, which is equal to one.

\[ l^d = l^s \]

\[ \left( \frac{p^f A}{w} \right) ^{\frac{1}{1-\alpha}} G = 1 \]

\[ w = p^f AG^{1-\alpha} \tag{23} \]

Using equation(13), the firms’ profit can be written as follows.

\[ \pi^e = \frac{1 - \alpha}{\alpha} p^f AG^{1-\alpha} \tag{24} \]

Moreover, the level of public goods in the economy, \( G \), is a function of tax revenue and hence wage. Using equations (7) and (23) together, we can drive public good provision as a function of tax rate and exogenous variables.

\[ G = (\tau p^f A)^{\frac{1}{\gamma + \alpha - 1}} \tag{25} \]

Based on the new equations for \( w \) and \( \pi \), demand for the agricultural and manufacturing goods is derived.

\[ y_i = \frac{\beta}{1 + \beta} \left[ (1 - \tau) p^f AG^{1-\alpha} + \theta_i \left( \frac{1}{\alpha} \right) p^f AG^{1-\alpha} \right] \]

\[ x_i = \frac{1}{1 + \beta} \left[ (1 - \tau) p^f AG^{1-\alpha} + \theta_i \left( \frac{1}{\alpha} \right) p^f AG^{1-\alpha} \right] \]

Substituting \( G \) from equation (25) into the above equations and combining them with equation (1) leads to the following indirect utility function.

\[ v_i = F_3 + \frac{(1 + \beta)(1 - \alpha)}{\gamma + \alpha - 1} \ln \tau + (1 + \beta) \ln (1 - \tau + \theta_i \frac{1 - \alpha}{\alpha}) \tag{26} \]

By maximizing the indirect utility function with respect to \( \tau \) we can now derive the optimal tax choice of individual \( i \).

**Proposition 5.1.** The equilibrium tax level, equivalently equilibrium level of public goods provision,
in an open economy with \( w > z \) is increasing in \( \theta^* \) of the median voter and decreasing in \( \alpha \).

\[
\tau^{opt} = \frac{1 - \alpha}{\gamma} \left( 1 + \theta^*_i \frac{1 - \alpha}{\alpha} \right)
\]

As in Proposition 3.4., if the median voter theorem holds, the equilibrium tax rate and hence public good provision is increasing in \( \theta^* \) of the median voter. However, it is no more increasing in \( p^f \). The intuition is that a rise in price affect the profit and wage with a same ratio. Accordingly, the cost and benefit of income ratio tax, decrease in disposable income due to decrease in net wage and increase in disposable income due to increase in profit, are affected similarly and hence the optimal tax remains unchanged. The above proposition and proposition 3.4. show that in an open economy, individuals with higher manufacturing income prefer more public spending. Accordingly, if the median voter rule applies, lower inequality leads to more provision of productive public goods. This result holds irrespective of agricultural productivity level, \( z \).

To find the condition under which we drop to the first case of equation (9), note that if \( z \leq w|_{m=1} \), production in the agricultural sector is zero and wage is determined in the manufacturing sector. The threshold, \( w|_{m=1} \), is the equilibrium wage when all the labors are employed in the manufacturing sector. It can be derived as a function of \( \tau \) and exogenous variables by substituting equation (25) in equation (23).

\[
w|_{m=1} = \tau^\frac{1-\alpha}{\gamma} \left( \frac{p^f A}{\gamma+\alpha-1} \right)
\]

Using the equilibrium tax rate from Proposition 3.4., I derive a threshold, \( z^* \), such that for \( z > z^* \) the first case of equation (9) holds and \( w^{eq} = z \). However, for \( z \leq z^* \), there is no employment and hence no production in the agricultural sector and wage is determined in the manufacturing sector.

**Proposition 5.2.** The production in both sectors is positive and \( w^{eq} = z \), if \( z > z^* \).

\[
z^* = \left( \frac{\theta^*_i (1 - \alpha)}{\gamma \alpha} \right)^{\frac{1-\alpha}{\gamma+\alpha-1}} \left( p^f A \right)^{\frac{\gamma}{\gamma+\alpha-1}}
\]

Consequently, the equilibrium tax rate in the economy is as in Proposition 3.4..
increases which leads to a higher threshold and decreases the possibility of positive production in the agricultural sector. In fact, the economy becomes a net agricultural importer if the manufacturing productivity is high enough so that the wage determined under full employment in the manufacturing sector cannot be paid by the agricultural sector.

5.2 Income ratio tax imposition on the total income (Simulation results)

So far, I assumed that the proportional income tax is only imposed on the wage. If instead, it is imposed on total income, the individual’s budget constraint can be written as follows.

\[ py_i + x_i = (1 - \tau)(w + \theta M \pi M) \tag{27} \]

Under this assumption, the equilibrium \((\tau, G)\) can not be derived explicitly. In this section, I show the simulation results for the relationship between the equilibrium tax rate and inequality, \(\theta \pi\), in the closed and open economies.

![Figure 2: The optimal tax as a function of \(\theta \pi\) in a closed economy. \(\alpha = 0.3, \beta = 2, \gamma = 3, p^f A = 100\) and \(M = 10000\).](image-url)
5.2.1 Closed economy

By equating the supply and the demand for the manufacturing product, we can drive its equilibrium price in a closed economy.

\[ p^{eq} = \left[ \frac{\alpha \beta (1-\tau)(w + \pi)}{(1+\beta)G} \right]^{1-\alpha} w^{\alpha} A^{-1} \] (28)

Substituting the equilibrium price into the equation (10) leads to the equilibrium profit of the firms.

\[ \pi^{eq} = \frac{\beta(1-\alpha)(1-\tau)}{1+\alpha \beta + \beta \tau - \alpha \beta \tau} w \] (29)

Equations 28 and 29 show that Lemma 3.1. still holds. The equilibrium price is decreasing in \( G \) while the profit is unaffected. To find the equilibrium tax rate I maximize the indirect utility function.

\[ v_i = F_4 + (1 + \beta \alpha) \ln(1-\tau) + \beta(1-\alpha) \gamma \ln(\tau) + (1 + \beta)(\beta - \alpha \beta - \beta \tau + \alpha \beta \tau)(\theta_i^{\pi} - 1) \]
\[ - (\alpha \beta + \beta(1-\alpha) \gamma + 1) \ln(1 + \alpha \beta + \beta \tau - \alpha \beta \tau) \] (30)

where \( F_3 = f(\alpha, \beta, \gamma, A, M) \). Figure 1 shows that, for the given set of parameters, the equilibrium tax rate in a closed economy, \( \tau_c \), is decreasing in the individual’s share from the firms’ profit, \( \theta_i^{\pi} \).

This happens because a rise in \( \tau \) and hence \( G \), on the one hand, increases the efficiency of the firms and decreases the equilibrium price of the manufacturing good, which increases the consumers surplus. On the other hand, a higher \( \tau \), in addition to a direct decrease in the manufacturing income, indirectly decline it via the decrease in the disposable income of the consumers. As a result, a raise in \( \tau \) is more harmful for the individuals with higher share from the firms profit. This leads to a decreasing \( \tau_c \) with respect to \( \theta_i^{\pi} \).

5.2.2 Open economy

In an open economy the equilibrium price is determined in the international market. Therefore, the profit is the same as equation (19) and Lemma 3.3. holds. The indirect utility function, however, changes since the individuals B.C. is different.

\[ v_i = F_4 + (1 + \beta) \ln(1-\tau) + (1 + \beta) \ln \left( w + \theta_i^{\pi} \left( \frac{1-\alpha}{\alpha} \right) G(p^f A) \right) \frac{1}{1-\alpha} \left( \frac{1}{w} \right)^{\frac{\alpha}{1-\alpha}} \] (31)
Figure 3: The optimal tax as a function of $\theta^*$ in an open economy. 
$\alpha = 0.3$, $\beta = 2$, $\gamma = 3$, $p^fA = 100$ and $M = 10000$.

where $F_4 = f(\beta, p^f)$. Figure 2 shows, as in Section 2.2, the equilibrium tax rate in an open economy
is increasing in $\theta^*$.\textsuperscript{7} The intuition is straightforward: the profit of the manufacturing sector increases
as the level of productive public spending increases. However, the manufacturing price is unaffected
since it is determined in the international market. Accordingly, the imposition of tax and hence the
provision of public goods is more desirable for the individuals with a higher share from the firm’s
profit.

As discussed above, a more equally distributed manufacturing income, higher $\theta^*$, increases the
amount of productive public goods in an open economy while decreases it in a closed economy.
Consequently, as in section 3.3, the difference between the equilibrium tax rate in the open and
closed economies, is increasing in $\theta^*$. If inequality is sufficiently small $-\theta^*$ is sufficiently high– the
provision of productive public goods is higher in open compare to the closed economy (Figure 3).

\textsuperscript{7}Note that, the utility value and its slope goes to negative infinity as the tax rate approaches 1. Moreover, the limit
of $\frac{\partial v}{\partial \tau}$ goes to positive infinity when $\tau$ approaches zero from the right. The utility function is continuous in $\tau\in[0, 1]$ and
it can be shown that for natural numbers of $\gamma \geq 2$, $\frac{\partial^2 v}{\partial \tau^2}$ is negative. These conditions imply that equation 2 has
a unique maximum in $[0, 1]$.
Figure 4: The difference of the productive public good provision in the open and the closed economy with respect to \( \vartheta^* \).

\( \alpha = 0.3, \beta = 2, \gamma = 3, p^f A = 100 \) and \( M = 10000 \).

6 Conclusion

This paper explores the effect of trade liberalization on aggregate productivity by highlighting the role of income inequality. Unlike most of the studies in this respect, which focus on the firms’ behavior, I investigate the effect of trade openness on the provision of productive public goods. I consider an economy with a set of homogeneous competitive firms where the productivity of the manufacturing sector is an increasing function of productive public goods, financed by a proportional income tax on wage. In a closed economy, productive public spending is more desirable for the consumers since it decreases the price of the manufacturing good. In a small open economy, where the price is determined in the international market, however, productive public spending is more interesting for the firms owners. The median voter theorem implies that a more equal distribution of the manufacturing income, and as a result, higher share of the firms’ profit for the median voter increases productive public spending in an open economy while may decrease it in a closed economy.

The key implication of this model is that inequality-reducing policy is an essential prerequisite to trade liberalization. In fact, opening up an economy with a democratic regime increases productivity
enhancing expenditures only if the level of inequality is sufficiently small so that the median voter is highly benefited from the rise in the manufacturing income. This may explain why some empirical research support the negative effect of trade openness on productive public spending while some others not. Consequently, the efficiency of the manufacturing sector and hence manufacturing export is more in an economy with more equally distributed income. Under trade liberalization, an economy with high inequality becomes a net importer of manufacturing commodities with a low equilibrium wage level.

The main results of the model remains the same or even stronger if two simplifying assumptions are relaxed. First, having a positive or no production in the agricultural sector leads to similar effect of inequality on productive public spending. Second, imposing tax on total income instead of wage strengthen the effect of inequality on productive public spending under trade liberalization. Moreover, a fundamental assumption in the paper is that the median voter theorem applies. If instead, only one group of the individuals, the rich elite, decide about the provision of public goods, the effect of inequality is quite different. In this circumstance, the higher is the inequality, the richer is the elite and thus the more is the provision of public goods in a small open economy.
References


World Bank (18 dec. 2013). World development indicators.
A Mathematical appendix

A.1 Firms’ decision

By substituting the optimal decision into the production function, equation (10), we have

\[ y_j = \frac{A}{\alpha}G^{1-\alpha}[(\frac{pA}{w})^{\frac{1}{1-\alpha}}]^{\alpha} \]

\[ = AG_{\alpha}(\frac{pA}{w})^{\frac{\alpha}{1-\alpha}} \]

\[ = G_{\alpha}(\frac{p}{w})^{\frac{\alpha}{1-\alpha}}(A)^{\frac{1}{1-\alpha}} \]

We also can drive the profit function by substituting the optimal investment decision into the profit function.

\[ \pi_j = pA_{\alpha}G^{1-\alpha}[(\frac{pA}{w})^{\frac{1}{1-\alpha}}]^{\alpha} - w(\frac{pA}{w})^{\frac{1}{1-\alpha}}G \]

\[ = \frac{1}{\alpha}(pA)^{\frac{1}{1-\alpha}}(\frac{1}{w})^{\frac{\alpha}{1-\alpha}}G - (pA)^{\frac{1}{1-\alpha}}(\frac{1}{w})^{\frac{\alpha}{1-\alpha}}G \]

\[ = (\frac{1}{\alpha} - 1)(pA)^{\frac{1}{1-\alpha}}(\frac{1}{w})^{\frac{\alpha}{1-\alpha}}G \]

\[ = G(pA)^{\frac{1}{1-\alpha}}(\frac{1}{w})^{\frac{\alpha}{1-\alpha}}(\frac{1 - \alpha}{\alpha}) \]

In order to drive the equilibrium price for the manufacturing good we equate supply and demand.

\[ y^s = y^d \]

\[ \frac{G}{\alpha}(\frac{p}{w})^{\frac{\alpha}{1-\alpha}}A^{\frac{1}{1-\alpha}} = \frac{\beta((1 - \tau)w + \pi)}{p(1 + \beta)} \]

\[ p^{eq} = \frac{\alpha\beta((1 - \tau)w + \pi)w^{\alpha}}{(1 + \beta)GA^{\frac{1}{1-\alpha}}} \]

\[ p^{eq} = \left[ \frac{\alpha\beta((1 - \tau)w + \pi)}{(1 + \beta)G} \right]^{1-\alpha}A^{-1}w^{\alpha} \]

By substituting the equilibrium price in equation (13), The equilibrium profit can be written as below.

\[ \pi^M = G\left[ \frac{\alpha\beta((1 - \tau)w + \pi)}{(1 + \beta)G} \right]^{1-\alpha}A^{-1}w^{\alpha}A^{\frac{1}{1-\alpha}}(\frac{1}{w})^{\frac{\alpha}{1-\alpha}}(\frac{1 - \alpha}{\alpha}) \]

\[ = G\left[ \frac{\alpha\beta((1 - \tau)w + \pi)}{(1 + \beta)G} \right](\frac{1 - \alpha}{\alpha}) \]

25
\[
\frac{(1 - \alpha)\beta((1 - \tau)w + \pi)}{(1 + \beta)}
\]

\[
\rightarrow (1 + \beta)\pi = (1 - \alpha)\beta((1 - \tau)w + \pi)
\]

\[(1 + \beta - \beta + \alpha\beta)\pi = \beta(1 - \alpha)(1 - \tau)w \]

\[
\pi = \frac{\beta(1 - \alpha)(1 - \tau)w}{1 + \alpha\beta}
\]

A.2 Closed economy

By substituting the equilibrium price in equation (3) we have

\[
y_i = \frac{\beta((1 - \tau)w + \theta_i^\pi p^M)}{p(1 + \beta)}
\]

\[
= \frac{\beta((1 - \tau)w + \theta_i^\pi p^M)}{\left(\frac{\alpha\beta((1 - \tau)w + \pi)}{(1 + \beta)}\right)^{1-\alpha} A^{-1} \omega^\alpha (1 + \beta)}
\]

\[
= \left(\frac{\beta}{1 + \beta}\right)^\alpha \left(\frac{G}{\alpha}\right)^{1-\alpha} \frac{A((1 - \tau)w + \theta_i^\pi p^M)}{\omega^\alpha ((1 - \tau)w + \pi M)^{1-\alpha}}
\]

We substitute \(\pi\) from equation (16) in \(y_i\) and \(x_i\),

\[
y_i = \left(\frac{\beta}{1 + \beta}\right)^\alpha \left(\frac{G}{\alpha}\right)^{1-\alpha} \frac{A((1 - \tau)w + \theta_i^\pi p)}{\omega^\alpha ((1 - \tau)w + \pi)^{1-\alpha}}
\]

\[
= \left(\frac{\beta}{1 + \beta}\right)^\alpha \left(\frac{G}{\alpha}\right)^{1-\alpha} \frac{A((1 - \tau)w + \theta_i^\pi p)}{\omega^\alpha ((1 + \beta)(1 - \tau)w)^{1-\alpha}}
\]

\[
= \frac{\beta^\alpha A}{((1 - \tau)w)^{1-\alpha}} \left(\frac{1}{1 + \beta}\right)(1 + \alpha\beta)^{-\alpha}(1 - \tau)w + \theta_i^\pi (1 - \tau)w \beta(1 - \alpha)
\]

\[
= A(\beta(1 - \tau))^\alpha \left(\frac{1}{1 + \beta}\right)(1 + \alpha\beta)^{-\alpha}[1 + \theta_i^\pi \beta(1 - \alpha)]
\]

Similarly for \(x_i\) we have

\[
x_i = \frac{((1 - \tau)w + \theta_i^\pi p)}{1 + \beta}
\]

\[
= \frac{1}{1 + \beta}((1 - \tau)w + \theta_i^\pi (1 - \tau)w \beta(1 - \alpha))
\]

\[
= \frac{(1 - \tau)w}{1 + \beta}[1 + \theta_i^\pi \beta(1 - \alpha)]
\]
We combine equation (1) with the above equations to drive the indirect utility function.

\[ u_i = \beta \ln y_i + \ln x_i \]

\[
= \beta \ln \left( A(\beta(1-\tau))^\alpha \left( \frac{G}{\alpha} \right)^{1-\alpha} \left( \frac{1}{1 + \alpha \beta} \right) (1 + \alpha \beta)^{1-\alpha} [1 + \theta_i^p \beta(1-\alpha)] \right) + \ln \left( \frac{(1-\tau)w}{1 + \beta} \left[ 1 + \theta_i^p \beta(1-\alpha) \right] \right) \\
= \beta \ln \beta + \beta \ln A + \beta \alpha \ln(1-\tau) + \beta(1-\alpha) \ln G - (1-\alpha) \ln \alpha - \beta \ln(1+\beta) + \beta(1-\alpha) \ln(1+\alpha \beta) \\
+ \beta \ln \left[ 1 + \theta_i^p \frac{\beta(1-\alpha)}{1 + \alpha \beta} \right] + \ln \left[ 1 + \theta_i^p \frac{\beta(1-\alpha)}{1 + \alpha \beta} \right] - \ln(1+\beta) + \ln(1-\tau) + \ln w \\
= -(1+\beta) \ln(1+\beta) + \alpha \beta \ln \beta - \beta(1-\alpha) \ln \alpha + \beta(1-\alpha) \ln(1+\alpha \beta) \\
+ \beta \ln A + \beta(1-\alpha) \ln(\tau w)^{\frac{1}{\gamma}} + \ln w + (1+\alpha \beta) \ln(1-\tau) + (1+\beta) \ln[1 + \theta_i^p \frac{\beta(1-\alpha)}{1 + \alpha \beta}] \\
= F + \frac{\beta}{\gamma} (1-\alpha) \ln \tau + (1+\alpha \beta) \ln(1-\tau) + (1+\beta) \ln[1 + \theta_i^p \frac{\beta(1-\alpha)}{1 + \alpha \beta}] \\
\]

where \( G \) is substituted with \( (\tau w)^{\frac{1}{\gamma}} \) and \( F_1 = \alpha \beta \ln \beta - (1+\beta) \ln(1+\beta) - \beta(1-\alpha) \ln \alpha + \beta(1-\alpha) \ln(1+\alpha \beta) + \beta \ln A + (1 + \frac{\beta(1-\alpha)}{\gamma}) \ln w \).

### A.3 Open economy

Substituting the equilibrium level of consumptions in the open economy into in the individuals’ utility function leads to following result.

\[
v_i = \beta \ln \left( (1-\tau)w + p^f (\frac{1}{\alpha}) \frac{\beta(1-\alpha)}{1 + \alpha \beta} \right) + \ln \left( (1-\tau)w + p^f (\frac{1}{\alpha}) \frac{\beta(1-\alpha)}{1 + \alpha} \right) \\
= \beta \ln \beta + \beta \ln((1-\tau)w + p^f (\frac{1}{\alpha}) \frac{\beta(1-\alpha)}{1 + \alpha \beta}) - \beta \ln p^f - \beta \ln(1+\beta) \\
+ \ln((1-\tau)w + p^f (\frac{1}{\alpha}) \frac{\beta(1-\alpha)}{1 + \alpha}) - \ln(1+\beta) \\
= F_2 + (1+\beta) \ln((1-\tau)w + p^f (\frac{1}{\alpha}) \frac{\beta(1-\alpha)}{1 + \alpha}) 
\]

where \( G \) is substituted with \( (\tau w)^{\frac{1}{\gamma}} \) and \( F_2 = \beta \ln \beta - (1+\beta) \ln(1+\beta) - \beta \ln p^f \).

### B The proofs of Lemmas and Propositions

#### B.1 Proposition 2.2.

\[
\frac{\partial v_i}{\partial \tau} = \frac{\beta(1-\alpha)}{\gamma \tau} - \frac{1 + \alpha \beta}{1 - \tau} 
\]
In order to find the optimal tax rate we should solve $\frac{\partial v_i}{\partial \tau} = 0$.

$$\frac{\partial v_i}{\partial \tau} = 0$$

$$\frac{\beta(1 - \alpha)(1 - \tau)}{\gamma} - (1 + \alpha \beta) \tau = 0$$

$$\tau = \frac{\beta(1 - \alpha)}{\gamma(1 + \alpha \beta) + \beta(1 - \alpha)}$$

B.2 Proposition 2.4.

$$\frac{\partial^2 v_i}{\partial \tau^2} = \frac{1 - \gamma}{\gamma} \frac{1}{\tau} \frac{1}{\gamma} - 2 \theta^\tau \gamma w \gamma (p^f A)^{\frac{1}{\alpha}} (\frac{1}{w})^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\alpha}) \frac{1}{\gamma} \frac{1}{\gamma} - 1$$

$$\text{Denominator} - \left( - w + \theta^\tau (p^f A)^{\frac{1}{\alpha}} (\frac{1}{w})^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\alpha}) \frac{1}{\gamma} \frac{1}{\gamma} - 1 \right) \text{Numerator}$$

$$\frac{\partial^2 v_i}{\partial \tau^2} = \frac{1 - \gamma}{\gamma} \frac{1}{\tau} \frac{1}{\gamma} - 2 \theta^\tau \gamma w \gamma (p^f A)^{\frac{1}{\alpha}} (\frac{1}{w})^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\alpha}) \frac{1}{\gamma} \frac{1}{\gamma} - 1$$

$$\text{Denominator} - \left( - w + \theta^\tau (p^f A)^{\frac{1}{\alpha}} (\frac{1}{w})^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\alpha}) \frac{1}{\gamma} \frac{1}{\gamma} - 1 \right) \text{Numerator}^2$$

$$\frac{\partial^2 v_i}{\partial \tau^2} < 0$$

In order to find the optimal tax rate we should solve $\frac{\partial v_i}{\partial \tau} = 0$.

$$\frac{\partial v_i}{\partial \tau} = 0$$

$$- w + \theta^\tau (p^f A)^{\frac{1}{\alpha}} (\frac{1}{w})^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\alpha}) \frac{1}{\gamma} \frac{1}{\gamma} - 1 = 0$$

$$\tau^{1 - \gamma} = \frac{w}{\theta^\tau (p^f A)^{\frac{1}{\alpha}} (\frac{1}{w})^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\alpha}) \frac{1}{\gamma}}$$

$$\tau = \left[ \theta^\tau (p^f A)^{\frac{1}{\alpha}} (\frac{1 - \alpha}{\gamma \alpha}) \right]^{\frac{1}{\gamma} \frac{1}{\gamma} - 1} w^{\frac{1 - \alpha}{\gamma \alpha} (\frac{1}{\gamma} - 1)}$$

B.3 Proposition 2.5.

The provision of public goods in the open economy is higher than the closed economy if $\tau^{\text{open}} > \tau^{\text{closed}}$ or $\frac{\tau^{\text{open}}}{\tau^{\text{closed}}} > 1$.

$$\frac{\tau^{\text{open}}}{\tau^{\text{closed}}} > 1$$
\[
\left[ \theta^* \left( p^f A \right)^{\frac{1}{1-\alpha}} \left( \frac{\gamma}{\rho} \right)^{\frac{\gamma-1}{\beta(1-\alpha)}} \right] > 1
\]

\[
(p^f A)^{\gamma} > \frac{1 + \frac{1-\alpha}{\gamma}}{\beta(1-\alpha)} \left( \frac{\gamma}{\alpha} \right)^{\gamma-1}
\]

\[
p^f > \frac{1}{A} \left( \frac{w \left( \frac{\alpha}{\beta} \right)^{rac{1-\alpha}{\gamma}} (1 + \alpha \beta)}{(1-\alpha)^{\frac{1-\alpha}{\gamma}} [\frac{1}{2} (1 + \alpha \beta) + (1 - \alpha)]^{\gamma(1-\alpha)}} \right)
\]

**B.4 Lemma 3.1.**

\[
EX^y = y^s - y^d
\]

\[
= \frac{G \left( p^f A \right)^{\frac{1}{1-\alpha}} 1}{\alpha w^{\frac{1}{1-\alpha}}} A^{\frac{1}{1-\alpha}} - \frac{\beta \left( (1 - \tau) w + \pi \right)}{p^f (1 + \beta)}
\]

\[
= \frac{G \left( p^f A \right)^{\frac{1}{1-\alpha}} 1}{\alpha w^{\frac{1}{1-\alpha}}} A^{\frac{1}{1-\alpha}} - \frac{\beta \left( (1 - \tau) w + \pi \right)}{p^f (1 + \beta)}
\]

\[
= \frac{\beta}{(1 + \beta) p^f} \left( \tau w \right)^{\frac{1}{\gamma}} \left( \frac{p^f A}{w} \right)^{\frac{1}{1-\alpha}} \left[ 1 + \alpha \beta \right] - (1 - \tau)
\]

where \( G \) is substituted with \( (\tau w)^{\frac{1}{\gamma}} \).

**B.5 Lemma 3.2.**

\[
EX^x = z(1 - l^m) - \tau w - x^d
\]

The equilibrium wage is equal to the productivity in the agricultural sector, \( z \) can be substituted with \( w \). Labor demand in the manufacturing sector, \( l^m \), is given in equation (11).

\[
EX^x = w(1 - \left( \frac{p^f A}{w} \right)^{\frac{1}{1-\alpha}}) - \frac{(1 - \tau) w + \pi}{1 + \beta}
\]

\[
= w - \left( \frac{1}{w} \right)^{\frac{1}{1-\alpha}} (p^f A)^{\frac{1}{1-\alpha}} G - \tau w - \frac{(1 - \tau) w}{1 + \beta} - \frac{1-\alpha}{\alpha} G (p^f A)^{\frac{1}{1-\alpha}} \left( \frac{1}{w} \right)^{\frac{1}{1-\alpha}}
\]

\[
= (1 - \tau) w \left( \frac{1}{1 + \beta} \right) G (p^f A)^{\frac{1}{1-\alpha}} \left[ \frac{1 + \alpha \beta}{\alpha(1 + \beta)} \right]
\]

29
In this section, first, I investigate whether the relationship between inequality and productive public same

By substituting \( \tau \)

\[
EX^p > 0 \text{ if } \quad (\tau w)^{1 - \alpha} \left( \frac{p^f A}{w} \right)^{\frac{1}{\gamma}} \frac{1 + \alpha \beta}{\alpha \beta} - (1 - \tau) > 0
\]

\[
(\tau w)^{1 - \alpha} \left( \frac{p^f A}{w} \right)^{\frac{1}{\gamma}} \frac{1 + \alpha \beta}{\alpha \beta} + \tau > 1
\]

By substituting \( \tau \) from Proposition 3.4, we have

\[
[\theta_i^p (p^f A)^{\frac{1}{\gamma}} \left( \frac{1 - \alpha}{\gamma \alpha} \right)]^{\frac{1}{\gamma - 1}} \left( \frac{1 - \alpha}{\gamma \alpha} \right)^{\frac{1}{\gamma - 1}} \left( \frac{p^f A}{w} \right)^{\frac{1}{\gamma - 1}} \frac{1 + \alpha \beta}{\alpha \beta} + [\theta_i^p (p^f A)^{\frac{1}{\gamma}} \left( \frac{1 - \alpha}{\gamma \alpha} \right)]^{\frac{1}{\gamma - 1}} w^{\frac{1 - \alpha - \gamma}{\gamma}} > 1
\]

\[
(p^f A)^{\frac{1 - \alpha - \gamma}{\gamma}} w^{\frac{1 - \alpha - \gamma}{\gamma}} \left[ (\theta_i^p (1 - \alpha)^{\gamma} \left( \frac{1 + \alpha \beta}{\alpha \beta} \right) + \theta_i^p (1 - \alpha)^{\frac{1}{\gamma - 1}} \right] > 1
\]

\[
(p^f A)^{\frac{1 - \alpha - \gamma}{\gamma}} w^{\frac{1 - \alpha - \gamma}{\gamma}} \left( \theta_i^p (1 - \alpha)^{\gamma} \left( \frac{1 + \alpha \beta}{\alpha \beta} \right) + \theta_i^p (1 - \alpha)^{\frac{1}{\gamma - 1}} \right] > 1
\]

\[
p^f A > \frac{(p_f^\gamma (1 - \alpha)^{\frac{1}{\gamma}} \alpha^{1 - \alpha} w^{\frac{a + \gamma - 1}{\gamma}}}{\left[ (1 + \alpha \beta)^{\frac{1}{\gamma}} \theta_i^p (1 - \alpha)^{\frac{1}{\gamma - 1}} \right]}
\]

\[
p^f > \frac{1}{A} \left[ \theta_i^p \left( \frac{1 - \alpha}{\gamma \alpha} \right)^{\frac{1 - \alpha - \gamma}{\gamma}} w^{\frac{a + \gamma - 1}{\gamma}} \left[ (1 + \alpha \beta)^{\frac{1}{\gamma}} + \theta_i^p (1 - \alpha)^{\frac{1}{\gamma - 1}} \right] \right]
\]

Calculating \( p^{**} \) such that for \( p^f > p^{**} \), the agricultural good is imported, \( EX^p < 0 \), leads to the same \( p^{**} \).

C  Empirical Evidence

In this section, first, I investigate whether the relationship between inequality and productive public good provision, predicted in Proposition 3.5., can be observed in a panel of 69 countries between 1995 to 2012. Then, I examine the relationship between inequality and the manufacturing export to check whether data is consistent with Proposition 4.3.,
As discussed in Section 3, the model predicts that inequality has a negative effect on the provision of productive public goods in a small open economy. However, in a closed economy, inequality has no effect on the level of productive public goods if the proportional income tax is only imposed on wage. Releasing this assumption, as shown in Section 5.2, makes the disposable income and therefore the profit more decreasing in the tax. The decrease in disposable income is higher for those with higher share of the firms’ profit. This leads to positive effect of inequality on productive public spending in a closed economy. Accordingly, the effect of inequality differs for open and closed economies.

### C.1 Empirical Strategy

The empirical strategy proceeds in two steps. First, I explore the relationship between inequality and the provision of public goods. Second, I examine the relationship between inequality and the manufacturing export. In the first step, the following fixed-effect regression model is estimated.

\[
y_{it} = \alpha_0 + \alpha_1 \text{Inequality}_{it} + \alpha_2 \text{Openness}_{it} + \alpha_3 \text{Inequality}_{it} \times \text{Openness}_{it} + \beta X_{it} + u_i + u_t + \epsilon_{it} \tag{32}
\]

The dependent variable, \(y_{it}\), is the provision of productive public goods –education, health and defense– in year \(t\) and country \(i\). On the right hand side, \(X_{it}\) is a vector of control variables which are commonly used in the empirical studies regarding the effect of trade on government size and expenditure (e.g. Kaufman and Segura-Ubiergo [2001]). It includes per capita income, population, the share of old population, inflation, the government revenue as a percentage of GDP and the real exchange rate. Furthermore, in the theoretical model, the wage is equal to the exogenous agricultural productivity if production in both sectors is positive. Consequently, the model predicts a negative effect of agricultural productivity and thus wage on productive public spending. I also control for the share of agricultural land in total land to capture the effect of agricultural endowment as a measure of exogenous agricultural productivity. The country and year fixed effects, \(u_i\) and \(u_t\), are also included in the equation. The aim of this regression is to examine whether inequality has a different relationship with productive public spending in closed and open economies. Consequently, the coefficient of interest is \(\alpha_3\) which –based on the model– I expect to be negative and significant. A negative \(\alpha_3\) means that the effect of openness on the provision of public goods is more positive if inequality is lower. It also means that inequality is more harmful for providing public goods in more open economies.

In the second step, I test whether the data supports the negative relationship between inequal-
ity and manufacturing export that is suggested by Section 4.3. The model predicts that more
equal distribution of the manufacturing income increases the productivity and hence export in the
manufacturing sector. To see the effect of inequality on export composition, I apply a fixed-effect
regression.

\[ y_{it} = \alpha_0 + \alpha_1 \text{pro.pub}_{it} + \alpha_2 \text{Inequality}_{it} + \alpha_3 \text{Inequality}_{it} \times \text{Openness}_{it} + \alpha_4 \text{Openness}_{it} + \beta X_{it} + u_i + u_t + \epsilon_{it} \] (33)

where the dependent variable, \( y_{it} \), is the percentage of manufacturing in total merchandise export in
year \( t \) and country \( i \). The variable \( \text{pro.pub}_{it} \) is the productive public spending –education, health and
defense– in year \( t \) and country \( i \). The vector of control variables, \( X_{it} \), includes per capita income,
growth, inflation, exchange rate, the ratio of average affected tariff rate applied for manufacturing
to that of primary products, the share of agricultural land in total land area, the share of old and
the share of urban in total population. I control for growth since manufacturing export may be
higher in countries with higher growth rates due to higher levels of productivity. The share of old
and urban population may also affect the share of employment in manufacturing sector and hence
manufacturing export. Inflation and exchange rate are included in the set of control variables to
capture the effect of international prices predicted in the model. I also control for the share of
agricultural land in total land area to capture the effect of agricultural endowment, since countries
with higher agricultural endowment have intrinsic advantage in agricultural production. Finally,
I control for the ratio of average affected tariff rate applied for manufacturing to that of primary
products as an index for trade barriers in manufacturing compare to other sectors. The model
predicts a positive and significant coefficient for productive public spending, \( \alpha_1 \). Hence, I first run
the regression, restricting \( \alpha_2 = 0 \), to see the relationship between productive public spending and
manufacturing export. Then I restrict \( \alpha_1 = 0 \) and estimate \( \alpha_2 \) and \( \alpha_3 \). The model suggests that,
in a small open economy, inequality decreases productive public spending and hence manufacturing
export. Therefore, I expect \( \alpha_1 \) to be positive and \( \alpha_3 \) to be negative and significant.

C.2 Data

I use an unbalanced panel of 69 countries from 1995 to 2012. This panel includes all the countries
and the years for which the required data is available. Summary statistics for all the variables appear
in Table 1.
### Table 1: Summary statistics

<table>
<thead>
<tr>
<th></th>
<th>count</th>
<th>mean</th>
<th>sd</th>
<th>min</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td>healthexp(% GDP)</td>
<td>465</td>
<td>5.023406</td>
<td>2.010532</td>
<td>.85344</td>
<td>10.27049</td>
</tr>
<tr>
<td>eduxep(% GDP)</td>
<td>465</td>
<td>4.872817</td>
<td>1.388981</td>
<td>1.55</td>
<td>9.11</td>
</tr>
<tr>
<td>defexp(% GDP)</td>
<td>465</td>
<td>1.753634</td>
<td>.9356557</td>
<td>.16</td>
<td>9.16</td>
</tr>
<tr>
<td>agriland(% total land area)</td>
<td>465</td>
<td>44.26282</td>
<td>19.03374</td>
<td>3.31</td>
<td>85.46</td>
</tr>
<tr>
<td>lngdppc(current US$ per capita)</td>
<td>465</td>
<td>9.125058</td>
<td>1.299467</td>
<td>5.517292</td>
<td>11.46363</td>
</tr>
<tr>
<td>gini</td>
<td>465</td>
<td>35.85013</td>
<td>10.49066</td>
<td>20</td>
<td>69.17</td>
</tr>
<tr>
<td>exchange</td>
<td>349</td>
<td>100.7977</td>
<td>11.65474</td>
<td>62.3</td>
<td>139.65</td>
</tr>
<tr>
<td>oldpop(% total population)</td>
<td>465</td>
<td>12.5594</td>
<td>4.878609</td>
<td>2.56</td>
<td>20.81</td>
</tr>
<tr>
<td>population</td>
<td>465</td>
<td>3.13e+07</td>
<td>6.57e+07</td>
<td>231860</td>
<td>1.13e+09</td>
</tr>
<tr>
<td>urban(% total population)</td>
<td>465</td>
<td>68.43925</td>
<td>14.87365</td>
<td>15.04</td>
<td>97.46</td>
</tr>
<tr>
<td>minustariff</td>
<td>465</td>
<td>-4.053871</td>
<td>3.559945</td>
<td>-26.72</td>
<td>0</td>
</tr>
<tr>
<td>gorev(% GDP)</td>
<td>408</td>
<td>30.90181</td>
<td>9.870431</td>
<td>10.15</td>
<td>90.46</td>
</tr>
<tr>
<td>gdpdef(inflation)</td>
<td>465</td>
<td>5.381914</td>
<td>7.979377</td>
<td>-23.85</td>
<td>93.52</td>
</tr>
<tr>
<td>polity</td>
<td>456</td>
<td>8.785088</td>
<td>1.687015</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>lnpro.pub(current US$ per capita)</td>
<td>465</td>
<td>6.936682</td>
<td>1.517686</td>
<td>2.856943</td>
<td>9.567588</td>
</tr>
<tr>
<td>manuexp(% merchandise export)</td>
<td>462</td>
<td>62.82647</td>
<td>23.79653</td>
<td>5.26</td>
<td>97.5</td>
</tr>
</tbody>
</table>

**Productive Public Spending.**– The dependent variable in the first regression equation is the productive public spending. Public education and military (defense) expenditures are provided by the World Bank as a percentage of GDP. Total health expenditure and the share of public health expenditure in total is also available in the World Bank datasets. I use these variables to derive public health expenditure as a percentage of GDP. Then I compute the overall expenditures on education, health and defense as the productive public spending as a percentage of GDP. Using the GDP per capita, I compute the value of productive public spending per capita in current US$. I investigate the effect of inequality on both, the logarithmic form of this value \( \text{lnpro.pub} \) and productive public spending as a percentage of GDP \( \text{pro.pub} \). Note that IMF also provides annual data for the government expenses by function. However, using the IMF datasets, the number of observations in the regression equations decreases from 408 to less than 200.

**Inequality.**– The model explores the effect of inequality in the distribution of manufacturing income. However, to the extent that I am aware of, there is no dataset regarding inequality based on different sources of income available for all the countries. Hence, as an inequality measurement, I use the Gini coefficient by the World Bank and update it by the Eurostat [2014] dataset. While interpreting the results, I implicitly assume that the Gini coefficient shows inequality in the distribution of the manufacturing income. In other words, as in the model, I assume that the unequal distribution of the agricultural income is not an important source of inequality.

33
Openness.– The weighted mean applied tariff is provided by the World Bank. It is defined as "the average of effectively applied rates weighted by the product import shares corresponding to each partner country." Specific rates are also converted to their ad-valorem equivalent rates and included in the index where possible. As a result, we can say that it reflects import barriers to a good extent. Assuming balanced trade, export and import move together. Thus, it can also be a good measure for trade barriers. Looi Kee et al. [2009] also provide a clearly defined trade restrictiveness index based on trade theory. As explained by the World Bank, The overall trade restrictiveness index, first developed in Looi Kee et al. [2009], "is a more sophisticated way to calculate the weighted average tariff of a given country, with the weights reflect the composition of import volume and import demand elasticities of each imported product." However, to the best of my knowledge, it is only available for 2009. Therefore, I use minus weighted mean tariff as an openness index. In the whole dataset, the range of this variable goes from −254.58 to 0 with mean −7.6 and median −5.09. However, observations included in the regressions range from −26.72 to 0 since including other variables drops out a large number of observations.

Manufacturing Export.– As the dependent variable in the second regression equation, I use the percentage of manufactures in total merchandise export, manuexp. This variable is also provided by the World Bank Group and explained to include "commodities in SITC sections 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods), excluding division 68 (non-ferrous metals)."

Control Variables.– The vector of control variables includes annual GDP growth rate (growth), log GDP per capita (lngdppc), government revenue as a percentage of GDP (govrev), inflation measured by the annual growth rate of the GDP implicit deflator (gdpdef(inflation)), real effective exchange rate (exchange), total population (population), the share of old (oldpop) and urban (urban) in total population and the share of agricultural land in total land area (agriland). These variables are all available in the World Bank datasets. Moreover, in the second regression equation, I control for an extra variable (manuexpbar). This variable is the ratio of the weighted mean applied tariff of the manufactured to that of primary products. I use it as an index of the trade barriers in the manufacturing sector compare to the other sectors.

C.3 Results

The first four columns of Table 2 reports the estimated parameters from the first regression equation. In columns (1), (2), (3) and (5), the dependent variable is the logarithmic form of productive public
### Table 2: Inequality and productive public spending under trade liberalization

<table>
<thead>
<tr>
<th></th>
<th>Fixed effect regression</th>
<th>Pooled regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lnpro.pub</td>
<td>pro.pub</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gini</td>
<td>-0.0130*</td>
<td>-0.00794***</td>
</tr>
<tr>
<td></td>
<td>(-1.83)</td>
<td>(-2.58)</td>
</tr>
<tr>
<td>minustariff</td>
<td>0.139***</td>
<td>0.111***</td>
</tr>
<tr>
<td></td>
<td>(4.10)</td>
<td>(6.74)</td>
</tr>
<tr>
<td>gini*minustariff</td>
<td>-0.00274***</td>
<td>-0.00196***</td>
</tr>
<tr>
<td></td>
<td>(-4.08)</td>
<td>(-5.96)</td>
</tr>
<tr>
<td>agriland</td>
<td>-0.00265</td>
<td>-0.000155</td>
</tr>
<tr>
<td></td>
<td>(-1.35)</td>
<td>(-0.07)</td>
</tr>
<tr>
<td>population</td>
<td>3.65e-09</td>
<td>1.12e-08*</td>
</tr>
<tr>
<td></td>
<td>(1.32)</td>
<td>(1.87)</td>
</tr>
<tr>
<td>oldpop</td>
<td>0.00173</td>
<td>0.0221</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(1.63)</td>
</tr>
<tr>
<td>gdpdef(inflation)</td>
<td>0.00123</td>
<td>0.000897</td>
</tr>
<tr>
<td></td>
<td>(1.13)</td>
<td>(0.68)</td>
</tr>
<tr>
<td>lngdppc</td>
<td>1.095***</td>
<td>1.179***</td>
</tr>
<tr>
<td></td>
<td>(36.62)</td>
<td>(17.29)</td>
</tr>
<tr>
<td>govrev</td>
<td>0.00483***</td>
<td>0.00356***</td>
</tr>
<tr>
<td></td>
<td>(3.57)</td>
<td>(2.56)</td>
</tr>
<tr>
<td>exchange</td>
<td>-0.0000224</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.02)</td>
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</tr>
<tr>
<td>_cons</td>
<td>8.284***</td>
<td>-2.962***</td>
</tr>
<tr>
<td></td>
<td>(26.22)</td>
<td>(-7.90)</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>480</td>
<td>408</td>
</tr>
</tbody>
</table>

Statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In column (4) however, the dependent variable is the productive public spending as a percentage of GDP. In column (5), I drop out the country and year fixed effects and run a simple OLS regression. As shown in the table, the estimated coefficient of $gini \times minustariff$, the interaction of inequality and openness, is significant and negative in all cases. This result is consistent with the prediction of the theoretical model. Inequality decreases the productive public spending in more open economies. In the first column, I drop out all the control variables. As the model predicts, the estimated coefficients of $gini \times minustariff$ remains negative and significant. In addition, consistent with the theoretical model, the effect of inequality differs for open and closed economies. The estimated coefficient of $gini$ and $gini \times minustariff$ in column 2 are $-0.00794$ and $-0.00196$ respectively. Based on these estimated coefficients, inequality is associated with an increase in productive public spending if the average weighted tariff is greater than 4.051, if the economy is

---

8 The coefficients of interest remain significant with the same sign if the values are considered in constant 2005 U.S.$$ instead.
relatively closed, and a decrease otherwise. In other words, one standard deviation increases in gini index is associated with 5.5 percent standard deviation decrease in logged productive public spending for completely open economies with no tariff. However, it is associated with 30.7 percent increase for relatively closed economies with weighted average tariff rate equal to 26.72. Note that the estimation approach explore correlation but not causality. Therefore, the real effect of inequality can be upward or downward biased due to possible reverse causality. Nevertheless, the significant negative coefficient of the interaction of inequality and openness shows that the sign of correlation between inequality and productive public spending is different in open and closed economies, which is in line with our expectation. The model suggests that higher international prices may increase the provision of productive public goods. In column (3), besides the inflation, I also add the real effective exchange rate to the regression equation to control for the effect of international prices. Although the number of observations decreases, the estimated coefficient of $gini \times minustariff$ remains significant.

In Table 3, I use different areas of public spending—education, health and defense as a percentage of GDP— as the dependent variable in equation 1. The included control variables are as in column (2) of Table 2. Except for the defense expenditure in a pooled regression, column 6, the coefficient of interest, $gini \times minustariff$, is negative as we expect. However it is not significant in the first two columns. These results show that the theoretical model’s prediction fits better to the total productive public spending compare to the different functions of it. This may happen due to unobserved shocks that affect each area of public spending within a period in a country. For example, the prevalence of a contagious disease in a period of time may increase the share of health and therefore decrease the share of education in total government expenditure.

Table 3: Inequality and different forms of productive public spending

<table>
<thead>
<tr>
<th></th>
<th>Fixed effect regression</th>
<th>Pooled regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>edexp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gini</td>
<td>-0.00659</td>
<td>-0.0332***</td>
</tr>
<tr>
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<td>(-0.49)</td>
<td>(-2.33)</td>
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<tr>
<td>minustariff</td>
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</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(0.52)</td>
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<tr>
<td>gini*minustariff</td>
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<tr>
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<td>(-0.82)</td>
<td>(-1.48)</td>
</tr>
<tr>
<td>N</td>
<td>421</td>
<td>564</td>
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</table>

$t$ statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Table 4: Inequality and manufacturing export

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
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<td>lnpro.pub</td>
<td>8.059***</td>
<td>8.478***</td>
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<td>(2.70)</td>
<td>(2.97)</td>
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</tr>
<tr>
<td>pro.pub</td>
<td>0.519*</td>
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<td>(1.75)</td>
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<td>-0.0655***</td>
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</tr>
<tr>
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<td>3.292***</td>
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<tr>
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<td>(-1.46)</td>
<td>(-1.26)</td>
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<tr>
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<td>(1.93)</td>
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<td>(0.47)</td>
<td>(0.39)</td>
<td>(0.34)</td>
</tr>
<tr>
<td>agriland</td>
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<td>-3.558</td>
<td>0.227</td>
<td>0.860</td>
<td>6.179**</td>
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<td></td>
<td>(-2.27)</td>
<td>(-0.80)</td>
<td>(0.14)</td>
<td>(0.56)</td>
<td>(2.06)</td>
</tr>
<tr>
<td>manuexpbar</td>
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<td>0.787</td>
<td>-0.607</td>
<td>-0.390</td>
<td>0.488</td>
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<td></td>
<td>(-1.36)</td>
<td>(1.41)</td>
<td>(-1.51)</td>
<td>(-0.91)</td>
<td>(0.89)</td>
</tr>
<tr>
<td>exchange</td>
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<tr>
<td></td>
<td>(-0.20)</td>
<td></td>
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<tr>
<td>cons</td>
<td>102.5***</td>
<td>72.62**</td>
<td>73.44**</td>
<td>91.86***</td>
<td>44.10</td>
</tr>
<tr>
<td></td>
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<td>(2.25)</td>
<td>(2.49)</td>
<td>(3.08)</td>
<td>(1.43)</td>
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</table>

$t$ statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 reports the estimated coefficients from the second regression equation. The dependent variable is the percentage of manufactures in total merchandise export. In columns (1) to (3), I investigate the relationship between productive public spending and the share of manufactures in total merchandise export. The productive public spending is considered in logarithmic form and the value is measured in current U.S.$ per capita in columns (1) and (2). In column (3) it is considered as a percentage of GPD. In all cases, the estimated coefficient of the productive public spending is positive and significant. These results are consistent with the prediction of the theoretical model. The model suggests that productive public spending increases the aggregate productivity of the manufacturing sector and hence raises the manufacturing export. Moreover, in small open economies, the model predicts a negative effect of inequality in manufacturing export. Inequality decreases the provision of productive public goods. A fall in the level of productive public spending decreases
the productivity of the firms and hence manufacturing export. In line with our expectations, the estimated coefficient of the interaction of inequality and openness, columns (4) and (5), is negative and significant. Based on the estimated coefficients in column (4), $-0.0335$ for the interaction of inequality and openness and $-0.582$ for inequality, we can say that lower levels of inequality is associated with higher share of manufacturing export if the average tariff rate is less than 17.37. Accordingly, as predicted by the theoretical model, more equal distribution of income increase the share of manufacturing export in a small open economy. In columns (2) and (5) I also control for the real effective exchange to capture the effect of the international prices predicted by the model. Although the numbers of observation decrease, the coefficient of interest remains significant.