Economic Growth and Income Inequality in Resource Countries: Theory and Evidence

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Theory and Evidence[*]

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Abstract

While much ink has been spilled over the study of income inequality and economic growth, little attention has been paid to investigate the interaction between these variables of interest in resource-dependent economies. The present paper develops a two-sector small open economy model including two groups of households (the rich and the poor). The mechanism is derived by two forces: 1) a composition of productivity growth with Learning by Doing (*LBD*) and capital accumulation with absorptive capacity constraints on the supply-side 2) a change in the relative demand of the non-traded to the traded goods on the demand-side. Applying a panel data approach for a sample database of 40 countries over the period 1975-2015, I evaluate the predictions of my theory. The main findings are fourfold. In response to a windfall income, first, the natural resource curse (i.e. the Dutch disease and Deindustrialization) appears. Second, income inequality rises if the non-traded sector is relatively capital-intensive while income inequality falls if the non-traded sector is relatively labor-intensive. Third, rising (falling) income inequality tends to deepen (moderate) the natural resource curse. Fourth, natural resource curse and income inequality change are relatively more intensive in a democratic country than in a non-democratic country.

Keywords: Windfall Income; Economic Growth; Income Inequality

JEL Classification: C33; O11; O13; O15.

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1 Introduction

Resource economies have usually failed to show better economic performance than those without (Frankel, 2010). In practice, these economies exhibit more slowly growth rates (Sachs and Warner, 1995) and higher levels of income inequality (Boyce and Ndikumana, 2012). The questions that have received most attention are how the windfall income can impress the economic growth and income inequality. However, surprisingly little attention has been paid to study the interaction between these variables of interest in resource-dependent economies. In other words, the persistence of high income inequality level in many resource economies makes the question of how the windfall income affects the economic performance through the channel of income inequality.

The useful starting point for this analysis could be to ask why often countries with resource wealth have tended to grow less rapidly than those without? A conventional response is the theory of the Dutch disease, the natural resource boom declines the competitiveness of the non-resource sectors through an increase in the real exchange rate and thus reduces the productivity level of the traded sector [1] (see. Corden and Neary (1982)) [2]. Two features of the Dutch disease literature that have been studied in isolation from each other are the productivity growth induced by Learning by Doing (LBD) mechanism (Sachs and Warner, 1995; Torvik, 2001) and capital accumulation with absorptive capacity constraint (Van der Ploeg and Venables, 2013). The essence of the core hypothesis, adverse effect of the resource dependence [3] on economic growth, is empirically supported by Sachs and Warner (1995); Rodriguez and Sachs (1999); Gylfason et al. (1999).

The second question received more attention in recent years is how the income inequality level responses to a resource boom. Bourguignon and Morrisson (1990) argue that the mineral resource endowment is one of the main determinants of income inequality in developing countries. According to Gylfason and Zoega (2002), resource dependence leads to both lower growth rate and higher inequality level. In a simple model, they demonstrate that education raising the return to work through a higher productivity level can simultaneously enhance equality and growth and thereby reduces the adverse effects of resource rent on these economies. In other words, investment in education may help the economic growth rate increase and inequality decrease. Goderis and Malone (2011) propose a two-sector growth model in which two kinds of labor, skilled and unskilled, under a learning by doing model (*LBD*) drive the economic growth. They suppose that the traded sector is relatively more skilled labor intensive than the non-traded sector. The main sources of a change in income inequality are the unequal distribution of the resource income and the factor reallocation across sectors. Their theoretical findings have been supported by a

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[1] The engine of the economy in the original Dutch disease model is the traded sector (Corden and Neary, 1982).

[2] The main idea surrounding the original theory rests on the following three-step reasoning. A natural resource boom, first, increases the value of the marginal product of labor in the natural resource sector and makes real wage rise. Accordingly, the labor force moves from both manufacturing and non-tradable sectors to the natural resource sector (i.e. so-called resource movement effect). Second, it raises the national income and so tends to increase the demand for the imported goods and the domestic absorption for both the traded and non-traded goods. Third, it appreciates the real exchange rate (the relative price of the non-traded to the traded goods) and thereby causes the relative demand of the non-traded to the traded goods to increase (Corden and Neary, 1982).

[3] Two different criteria are usually used to assess the economies depended on the natural resource: "resource dependence" referring to the value of resource as a share of GDP or total national wealth and "resource abundance" referring to per capita value of the stock of natural resource wealth. The literature has voided this misconception that resource abundance should be interpreted as a rule that resource-rich countries are doomed to failure (Frankel, 2010). For example, comparing Sierra Leone and Botswana as two diamond-rich countries show that Botswana has expanded at an average rate of 7 % over the recent 20 years, while the growth rate of Sierra Leone has dropped 37 % between 1971 and 1989 (Humphreys et al., 2007). Moreover, the recent empirical studies across a comprehensive sample of countries indicate that natural resource abundance plays a positive role in economic performance (see. Brunnschweiler and Bulte (2008); Alexeev and Conrad (2009); Esfahani et al. (2013); Cavalcanti et al. (2011)).

panel data approach for a dataset including 90 countries over the period 1965-1999. They show that income inequality falls in the short run immediately after a resource boom and then rises steadily over time until the initial impact of the resource boom disappears. In this vein, the impacts of oil rent on income inequality has also been investigated by Mallaye et al. (2015). They study a dynamic panel data model for a dataset including 40 developing countries over the period 1996-2008. The findings reveal that there is a non-linear (U-shaped) relationship between oil rent and inequality. More precisely, oil rent declines inequality in the short run, while over time this effect is erased as the oil revenue increases. Although the literature has deepened our understanding of the impact of natural resource rent on economic growth and income inequality, the mechanisms of how these variables interact seem to be ambiguous. It may be because of that the literature related to resource economies has usually analyzed the variables of interest in isolation from each other. A useful starting point to peruse this issue is to shed light on the causality between those two variables. More precisely, does income inequality impresses the growth rate or is the causality reversed? There are two fundamental approaches to disentangle the issue. The first one tries to figure out how rising of inequality level may hinder the economic growth. The empirical evidences for this case are inconclusive. For instance, Persson and Tabellini (1994); Alesina and Rodrik (1994); Castelló and Doménech (2002); Easterly (2007) and Assa (2012) all suggest that income inequality has a negative impact on growth rate, while Perotti (1996); Li and Zou (1998); Forbes (2000) and Naguib (2015) show that an increase in income inequality accelerates the rate of economic growth. In contrast, Banerjee and Duflo (2003); Grijalva (2011) find a monotonic relationship between these variables [4] and Barro (2000, 2008) argue that a higher level of income inequality decelerates growth rate in developing countries while it accelerates growth rate in developed countries.

On the contrary, the second approach refers to the *Kuznets hypothesis* which links the Gini index, a proxy for income inequality, and the average income level of an economy. The hypothesis claims that income inequality must rise in the first stage of the development process to motivate the rich to save a greater share of their income [5] and thereby causes the capital accumulation to expand. Rising income inequality is originated from the sectoral reallocation of factor inputs (i.e. labor and capital), commonly known as structural transformation or structural change (Kuznets, 1973; Herrendorf et al., 2013*a*). Given the fact that agricultural sector has the lowest productivity level, the reallocation of factor inputs leads to a gradual shrink in the share of agricultural sector, corresponding to an expansion in the share of manufacturing and industry sectors. Consequently, these sweeping changes in the relative share of sectors tend to rise income inequality, within an economy, to consolidate the development process. But in the following stages while the market forces become widespread the total income tends to be distributed evenly and so income inequality falls (Kuznets, 1955). A large number of empirical studies have examined the existence of the Kuznets curve. While some of which, such as Barro (2000, 2008) validate the hypothesis, some others (e.g.Deininger and Squire (1998); Frazer (2006)) reject it.

One reason for inconsistent evidence of the relationship between income inequality and economic growth is that both variables of interest are endogenous so that their comovement impresses the underlying economic forces to which they are both responding (Turnovsky, 2011). Therefore, as Lundberg and Squire (2003) suggest, both economic growth and income inequality may need to be simultaneously studied since their relationship seems to be associative rather than causal (Ehrlich and Kim, 2007). In other words, to study the interaction of income inequality and economic growth, we must develop a general setup in which the equilibriums of both variables are mutually dependent. This point overall illustrates that both outstanding features of economic development (i.e. balanced growth path and struc-

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[4] Banerjee and Duflo (2003) express that a change in income inequality (in any direction) is associated with a lower growth rate in the next period. Further, Grijalva (2011) concludes that an increase in income inequality level declines the rate of economic growth, however, this effect seems to vanish over the time.

[5] Refer to the *Keynesians hypothesis* the marginal propensity to save for the rich is larger than that for the poor.

tural transformation) must be combined if we intend to analyze the interaction of the variables.

Most literature in the modern economic growth focuses on the analysis of balanced growth paths (*BGP*). The main characteristics of this approach are that the economic variables grow at constant rates and the economy of today always is a scaled-up version of yesterday's economy (i.e. Kaldor facts) (for example Kaldor (1961); Barro (2004)). There is, in contrast, literature on the structural transformation that ignores these characteristics (see. Kuznets (1963); Baumol (1967); Kongsamut et al. (2001)). Theories proposed to describe structural transformation may be classified based on the driving forces of the mechanism to supply-side and demand-side. Supply-side theories emphasize the role of different sectoral technology (productivity) level and capital intensity that are reflected in the relative price of sectoral goods (Baumol, 1967; Ngai et al., 2007; Acemoglu and Guerrieri, 2008). Demand-side theories, in contrast, focus on different income elasticities of sectoral demands and highlight the role of income distribution in factor reallocation (Kongsamut et al., 2001; Comin et al., 2015)[6].

However, a question of which one of the aggregate income or the relative sectoral prices[7] is the dominant force to drive structural transformation remains yet unanswered. The differences in the slopes of Engel curves[8] seem to play a crucial role in determining the contribution of the driving forces to structural transformation. Empirical studies show that the slopes of Engel curves are persistent over time and greatly vary across consumption categories (Young, 2012)[9]. Further, Comin et al. (2015) summarize that larger slope of Engel curve is associated with more shift of employment from agriculture to service. As another case, Herrendorf et al. (2013*b*) analyze the determinants of structural transformation in USA economy. They argue that on the one hand, for the final consumption expenditure approach, the S-branch utility function (i.e. non-homothetic preference) proposed by Brown and Heien (1972) provides a good fit for empirical data. In other words, a change in the aggregate income, rather than a change in the relative prices, is the dominant force of structural transformation. On the other hand, for the consumption value-added approach, a change in the relative prices is more important than another force. It shows that a homothetic utility function is a reasonable approximation to fit the empirical data.

The arguments suggest that to analyze the interaction between income inequality and economic growth, a framework which includes a balanced growth path and structural transformation must develop. One seems that a simultaneous existence of those two features of economic growth is a theoretical challenge. This challenge is likely to becomes more intense if we intend to study the role of resource rent in economic performance. A literature review surprisingly shows that there is no serious attempt, as far as I know, to investigate the interaction between income inequality and economic growth in the presence of natural resource rent[10]. This theme provides a strong motivation to do an empirical and theoretical study. Therefore, the main contribution of this paper is to explore how income inequality and economic growth interact along the development path of an economy depended on resource rent.

Motivated by this literature, I develop the basic framework proposed by Van der Ploeg and Venables (2013). The departure of my model from their framework is to highlight both demand-side and supply-side driving forces and present a non-balanced growth model. In terms of demand-side, the novel aspect

[6] Demand-side theories have often relied on Non-homothetic preference so that the resource is reallocated towards a sector with a higher income elasticity as income level rises.

[7] As described, the aggregate income and relative prices originate from demand-side and supply-side, respectively.

[8] Engel curve is defined as the relationship between sectoral consumption share and aggregate real consumption, holding prices constant.

[9] He estimates the elasticity of real consumption of the different goods and services for 56 developing countries including 29 sub-Saharan countries.

[10] As one of the rare studies, Scognamillo et al. (2016) present an empirical study to analyze a sample database including 43 countries over the period 1980-2012. The findings show that the resource-dependence among higher-income countries is negatively correlated with Gini coefficient and the correlation between resource dependence and per capita GDP is insignificant, while the resource-dependence among lower-income countries is associated with a higher level of Gini coefficient and a lower level of per capita GDP.

of this study is to apply a non-homothetic preference to link income inequality and economic growth rate. While, in terms of supply-side, I combine two distinct sources of the Dutch disease: the growth rate of productivity level induced by Learning by Doing (LBD) (e.g. Sachs and Warner (1995)) on one side and the growth rate of capital accumulation with absorptive capacity constraints (e.g. Van der Ploeg and Venables (2013)) on the other side. In this aspect, the present framework differs from models using homothetic preferences in which long-run growth is only driven by the Total Factor Productivity (TFP) (see. Ngai et al. (2007); Acemoglu and Guerrieri (2008)). Furthermore, although the model proposed by Comin et al. (2015) is the closest to ours, their framework is not able to be used to analyze the impact of resource rent on economic performance. Since it simulates none of two features of the Dutch disease.

Finally, I present an empirical study to investigate whether the theoretical predictions are consistent with the empirical evidence. The main contribution of the empirical study is to find a body of evidence to highlight the role of the driving forces to which the interaction between income inequality and economic growth responds. In this respect, a structural model derived from the theory is designed. I first collect available data for 40 countries over the period 1975-2015 and then do estimations to evaluate the core findings of the theory. Using a panel regression for a sample database, I find some clear evidence to support all theoretical findings.

The present study yields number of theoretical and empirical results. First, the model can capture both features of economic performance in a natural resource dependent country: the Dutch disease in the context of two-sector balanced growth model and structural transformation. Second, the theory and the empirical evidence demonstrate that the sectoral income elasticities and sectoral capital intensity have fundamental roles in income inequality change. More precisely, as resource rent increases the income inequality level rises (declines) if the non-traded (traded) sector is relatively more capital intensive than the traded (non-traded) sector. Third, my investigation reveals that income inequality is *per se* a significant transmission channel through which the resource rent can stimulate the level of natural resource curse. Fourth, the political regime (democratic or non-democratic) plays a crucial role in the interaction of variables of interest.

The rest of this paper is organized as follows. Section 2 sets out an analytical framework, characterizes the demand side as well as the supply side and studies the aggregate equilibrium of a dynamics model in which balanced growth and structural transformation can simultaneously occur. Sections 3, discusses the response of economic growth and income inequality to a windfall income. Section 4, investigates the economic performance of a resource-dependent country from a political economy viewpoint. Notably, this section tries to highlight how the political participation (i.e. democracy index) of those income-groups hinders the development process. Section 5, undertakes an empirical study first to examine the relationship between income inequality and economic growth and then to find some clear evidence to support the relationship between income inequality and structural transformation. Section 6, concludes and wraps up theory developed in the paper. Systematically and consistently, these sections constitute a comprehensive framework for understanding the interaction between income inequality and economic growth from both macroeconomic and political economic viewpoints.

2   The Baseline Model

As descried, income inequality and economic growth are both endogenous and their comovement impresses the driving forces to which they are both responding. To investigate the crucial role of this interaction, a general setup in which the equilibriums of both variables of interest are mutually dependent

is developed. The framework captures both driving forces originated from demand and supply sides. In demand-side, a non-homothetic preference is utilized to clarify the role of relative demand change in economic performance. In supply-side, to capture absorption capacity constraints which matter to simulate the gradual adjustment dynamic, it is assumed a part of the capital good (e.g. equipment) to be imported and the rest of it (e.g. structure and human capital) to be domestically produced [11]. Moreover, besides the capital accumulation, the only driving force of growth in the basic model proposed by Van der Ploeg and Venables (2013), a productivity growth with learning-by-doing (LBD) is also applied [12]. Finally, I define a generalized balanced growth path (GBGP) to simultaneously satisfy the main characteristics of balanced growth path (i.e. Kolder facts) and structural transformation (i.e. Kuznets facts). My primary contribution is to discuss first, how the interaction between income inequality and economic growth responses to a permanent windfall income and second, how resource rents redistribution impresses the economic performance and development process.

2.1 Demand-side

Consider an economy consisting of two groups of households: High-income or the rich and Low-income or the poor. Each of whom, populated by a continuum of symmetric-identical households, is respectively indexed by H and L $\in [0,1]$. In this paper, following Herrendorf et al. (2013*b*), I assume each group of households maximizes his/her aggregate consumption basket [13], denoted by C^J ; $J = H, L$ in equation 1, subject to his/her budget constraint: $M^J = C_T{}^J + PC_N{}^J$

$$C^J = \left[\left(1 - \psi^J\right)^{\frac{1}{\upsilon}} \left(C_T{}^J - \bar{C}_T^J\right)^{\frac{\upsilon-1}{\upsilon}} + \left(\psi^J\right)^{\frac{1}{\upsilon}} \left(C_N{}^J + \bar{C}_N^J\right)^{\frac{\upsilon-1}{\upsilon}} \right]^{\frac{\upsilon}{\upsilon-1}} \quad ; \quad J = H, L. \tag{1}$$

Where M^J is total expenditure and $C_T{}^J, C_N{}^J$ are respectively defined as the traded and non-traded goods, demanded by groups of $J = H, L$. Price of the traded goods is normalized to unity. Thereby price of the non-traded goods, denoted by P, would be identified as the real exchange rate. Parameter υ represents the constant elasticity of substitution between the traded and non-traded goods and share of the demanded non-traded goods in aggregate consumption basket of the group J is measured by the parameter ψ^J. $\psi^J = 0$ refers that the traded goods are only consumed by the representative consumer of the group J, while $\psi^J = 1$ indicates the opposite meaning. $\left(\bar{C}_T^J > 0\right)$ is a subsistence tradable consumption level of each group of households while $\left(\bar{C}_N^J \geq 0\right)$ would be interpreted as a level of the non-traded home production goods. The latter exogenous variable may imply that household's skills engaged in a market to produce the non-traded goods can also be consumed at home. As an example, a technician who sells his skills in the labor market can also apply these skills to serve himself, instead of employing others to do those services. Precisely, a consumer may choose between the required non-traded goods produced by himself and those purchased in the market. So, the non-homothetic preference connotes that households allocate a higher share of their income to the produced non-traded good as the income level rises (refer to Engel's law). In other words, households spend a positive amount on the non-traded goods after consuming a certain level of the traded goods [14]. The following consumption demands are

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[11] It is the same as the model proposed by Van der Ploeg and Venables (2013).

[12] Using a productivity growth is necessary to satisfy a generalized balance growth path (see. Section 2.4).

[13] It is based on the S-branch utility function proposed by Brown and Heien (1972).

[14] Although the agricultural sector has the smallest share of the traded sector, at least in developing countries, the model cannot ignore a subsistence level of the traded goods since it guarantees to exist a Generalized Balanced Growth Path (GBGP).

determined by solving the maximization problem [15]:

$$C_T^J = \bar{C}_T^J + \frac{\left(1 - \psi^J\right)}{\left(e^J\left(P\right)\right)^{1-\upsilon}} \left(M^J + P\bar{C}_N^J - \bar{C}_T^J\right) \qquad ; \quad J = H, L \tag{2a}$$

$$C_N^J = -\bar{C}_N^J + \frac{\psi^J}{P^\upsilon \left(e^J\left(P\right)\right)^{1-\upsilon}} \left(M^J + P\bar{C}_N^J - \bar{C}_T^J\right) \qquad ; \quad J = H, L. \tag{2b}$$

Where the aggregate price level or the unit expenditure function of each group of households, $e^J(P)$, as in Obstfeld et al. (1996)), is calculated by

$$e^J(P) = \left[\left(1 - \psi^J\right) + \psi^J P^{1-\upsilon}\right]^{\frac{1}{1-\upsilon}} \qquad ; \qquad J = H, L. \tag{3}$$

The income elasticity of each type of goods (i.e. the traded and non-traded goods) for each group of households (i.e. the rich and the poor), $\varepsilon_{i,M}^J \equiv \frac{M^J}{C_i^J} \frac{\partial C_i^J}{\partial M^J}; \begin{array}{l} i = T, N \\ J = H, L \end{array}$, can be written as follows:

$$\varepsilon_{N,M}^J = \left(1 + s_N^J\right) \frac{M^J}{M^J + P\bar{C}_N^J - \bar{C}_T^J} \tag{4a}$$

$$\varepsilon_{T,M}^J = \left(1 - s_T^J\right) \frac{M^J}{M^J + P\bar{C}_N^J - \bar{C}_T^J}. \tag{4b}$$

$s_T^J \equiv \frac{\bar{C}_T^J}{C_T^J}$ and $s_N^J \equiv \frac{\bar{C}_N^J}{C_N^J}$ are, respectively, share of the traded subsistence consumption of demanded traded goods and share of the non-traded home production consumption of demanded non-traded goods. These relations demonstrate that income elasticity of the non-traded goods for both groups of households is larger than unity $\varepsilon_{N,M}^J > 1$ while that of the traded goods is less than unity $\varepsilon_{T,M}^J < 1$. In other words, the non-tradables and tradables are, respectively, luxury and necessary goods [16] [17]. It means, along with the development process, the demand expands faster for the non-traded goods than for the traded goods (i.e. the main reason of structural transformation) [18]. Moreover, the price elasticity of demand for the

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[15] In the case of homothetic preference $\left(\bar{C}_N^J = \bar{C}_T^J = 0\right)$ the change of relative demand of goods (the non-traded to the traded goods), for each group of households, depends only on a change in the relative price (i.e. real exchange rate) so that a rise in the relative price declines the level of relative demand. However, in the non-homothetic preference, the relative demand stimulates not only by a change in relative price but also by a change in income level.

[16] In the homothetic CES case $\left(\bar{C}^J = 0\right)$, the income elasticity $\left(\varepsilon_{i,M}^J\right)$ equals unity.

[17] Meta-analysis of calorie-income elasticities covering studies for both the developing and developed countries appear an approximately average value of 0.33 (Ogundari and Abdulai, 2013; Zhou and Yu, 2014). Moreover, an empirical work covering the dataset of 60 countries in 1980 estimates the income elasticity across different types of the non-traded goods including education, housing, communication and health in range of 1-1.58 (Falvey and Gemmell, 1996). Also, income elasticity of demand for internet services estimated by using a cross-country OECD data for the year 2000 appears to be unity or larger (Goel et al., 2006).

[18] The non-homotheticity implies that a rise in the income level switches the demand from necessary goods (i.e. the traded goods) to luxury goods (i.e. the non-traded goods). In other words, the higher the income level, the larger the relative demand of goods (Engel's law).

non-tradables and tradables, denoting by $\varepsilon_{N,P}^{J}$, $\varepsilon_{T,P}^{J}$ are respectively given as: [19] [20]

$$\varepsilon_{N,P}^{J} = -\upsilon\left(1+s_N^J\right) + \left[s_N^J - (1-\upsilon)\left(1+s_N^J\right)\right]\gamma_N^J\ \varepsilon_{N,M}^{J} \tag{5a}$$

$$\varepsilon_{T,P}^{J} = -\left[(1-\upsilon) - \frac{s_N^J}{1+s_N^J}\right]\left(1+s_T^J\right)\gamma_N^J\ \varepsilon_{N,M}^{J}. \tag{5b}$$

Where shares of consumer demands of total expenditure are defined as [21]:

$$\gamma_N^J \equiv \frac{PC_N^J}{M^J} \quad ; \quad \gamma_T^J \equiv \frac{C_T^J}{M^J} \quad and \quad \gamma_N^J + \gamma_T^J = 1. \tag{6}$$

As a proposition, suppose that the following assumption holds: $\left(\psi^H = \psi^L = \psi\right)$ [22], for a given relative price (i.e. the real exchange rate), an increase in the income level raises the relative demand (non-traded to traded goods) more for the low-income group than for the high-income group [23]. Further, it indicates that under a constantly saving ratio (see. Appendix C) one additional unit of the income level makes the relative income elasticity decrease more for the low-income group than for the high-income group [24]. When share of the non-traded goods of the aggregate consumption basket is equal for both groups of households, implying that they have an identical taste, the aggregate demand effects (i.e. redistribution of consumption) play any role in output and income inequality changes [25]. the aggregate real consumption $\left(C = C^H + C^L\right)$ and aggregate non-traded goods $C_N = C_N{}^H + C_N{}^L$ are determined by

$$M = e(P)C - P\bar{C} = C_T + PC_N \tag{7}$$

$$C_N = e_P(P)C - \bar{C}_N. \tag{8}$$

Where M is the sum of both groups' expenditure (i.e. total expenditure) while $P\bar{C}$ is introduced as the aggregate expenditure of non-tradable home production goods $\left(P\bar{C}_N\right)$ minus the aggregate expenditure of subsistence $\left(\bar{C}_T\right)$, (i.e. $P\bar{C} = P\bar{C}_N - \bar{C}_T$).

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[19] Tradables will be normal goods if and only if the elasticity of substitution (υ) becomes greater than $\frac{1}{1+s_N^J}$.

[20] Models with homothetic preferences disregard the income effects and attribute all changes in demand of the traded and non-traded goods to a pure substitution effect. Therefore, in the homothetic CES case, $\left(\bar{C}_T^J = \bar{C}_N^J = 0\right)$, the price elasticity of demand can turn out to be symmetrical as $\varepsilon_{T,P}^{J} - \varepsilon_{N,P}^{J} = \upsilon$. Further, the non-traded goods are always normal goods, while the traded goods can be Giffen goods if the elasticity of substitution between goods (υ) is less than unity.

[21] Note that $\varepsilon_{N,M}^{J}\gamma_N^J + \varepsilon_{T,M}^{J}\gamma_T^J = 1$; $J = H, L$.

[22] As mentioned, under the final consumption expenditure approach, changes in income level rather than changes in relative price are dominant. In other words, the difference between the aggregate price levels (unite expenditure functions) of two groups of households is able to be overlooked. Therefore, this assumption leads both unit expenditure function to be equal (i.e. $e^H(P) = e^L(P) = e(P)$), an increasing and concave function with respect to the relative price.

[23] It refers to Engle's law in the sense that the share of income spent on the traded (the non-traded) goods expands at a rate smaller (bigger) than the growth rate of total income.

[24] It can also be interpreted that sensitivity of the relative demand to a change in the income level is bigger for the low-income group than for the high-income group, holding a constantly saving ratio.

[25] If the assumption $\left(\psi^H \neq \psi^L\right)$ holds, total income will depend on share of the poor's consumption of total consumption (χ) and unit expenditure function of each group of households $\left(e^J(P); J = H, L\right)$ (i.e. $M = \left[\chi e^L + (1-\chi)e^H\right]C - P\bar{C}_N + \bar{C}_T$). Therefore, the aggregate demand will have an inevitable role in our understanding of the economic performance of a resource economy.

2.2 Supply-side

Consider a two-sector small open economy producing the traded and non-traded goods. Production function of each sector (that is X_T and X_N) employs labor and final capital good and operates under a constant return to scale. Labor force, inelastically supplied by households, can move freely across sectors. Final capital goods, made of the traded and non-traded capital goods, can be perfectly mobile sectorally while they are imperfectly mobile internationally. To expel the population growth effect, labor supply is normalized to unity. The allocation of labor and capital between two sectors are described by:

$$L_T + L_N = L = 1 \tag{9a}$$

$$K_T + K_N = K. \tag{9b}$$

Where L_i and K_i are, respectively, labor force and final capital good in sector $i = T, N$. The total stock of the capital goods (K) is flexible and plays a crucial role in our analysis [26]. Following Van der Ploeg and Venables (2013), the windfall income $(NR(0))$ is supposed to be an exogenous flow, resulting from a discovery at initial time, and it can be spent to buy financial assets (B^F) or to finance the capital over time. For simplicity, they assume *Ricardian* debt is neutrality held, impling that distribution of the natural resource wealth $(R(t))$ has no effect on the consumption of the economy. To capture this implication, they define a foreign wealth (B) as a sum of the remaining natural resource wealth and financial asset (i.e. $B \equiv R + B^F$) [27]. Thus the accumulated foreign wealth (B) [28] earns a return equal to an exogenously given world interest rate (r^*). I ignore the capital stock depreciation, then total investment (I) will be equal to capital good accumulation (i.e. $I = \dot{K}$). Finally, the budget constraint and the market clearing condition of economy are given by the following equations,

$$\dot{B} + q(P)\dot{K} = r^*B + X_T(K_T, AL_T) + PX_N(K_N, AL_N) - e(P)C + P\bar{C},$$
$$K(0) = K_0, \qquad B(0) = B_0 = R(0) + B_0^F, \qquad lim_{t\to\infty} e^{-r^*t}B(t) = 0 \tag{10}$$

$$X_N = C_N + q_p(P)\dot{K}. \tag{11}$$

$\left(e(P)C - P\bar{C} = M\right)$ is the total expenditure and a dot represents the time derivative (i.e. $\dot{B} = \frac{dB(t)}{dt}$; $\dot{K} = \frac{dK(t)}{dt}$). The unit cost function for producing capital goods is denoted by $q(P) = P^\gamma$ in which $0 \leq \gamma \leq 1$ is a share of the non-traded capital goods used to produce one more unit of the capital good [29]. Some sorts of the non-traded capital goods (e.g. structure, human capital) cannot be traded in the international capital market. So the case $\gamma = 0$, meaning that the required capital good is totally imported, doesn't seem to be a

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[26] Goderis and Malone (2011), one of the serious attempts to illustrate how income inequality responses to a windfall income assume that the total capital stock is fixed. Although this assumption is logically acceptable to analyze the mechanism in the short-term, it doesn't seem to be reasonable in the long-term. Because, in the long-term, the capital stock growth and its redistribution can stimulate the sectoral changes, return to the factors and so income inequality.

[27] The present value of the natural resource wealth is: $R(t) = \int_t^\infty NR(s)e^{-r^*(s-t)}ds$ and so $\dot{B}^F = \dot{B} - \dot{R} = \dot{B} - r^*R + NR$.

[28] Precisely, assume the windfall income starts at time zero, so the initial foreign wealth is equal to the initial financial asset $(B_0 = B_0^F)$. Furthermore, since the discovered natural resource is only used to buy the costless financial assets, I can write
$R(0) = R(t) + \Delta B^F = R(t) + B^F(t) - B_0^F = R(t) + B(t) - R(t) - B_0^F = B(t) - B_0^F \quad \Rightarrow \quad R(0) = \Delta B$

[29] Bems and de Carvalho Filho (2011) found that the share of non-traded capital goods in total capital is stable across countries and over time and is in the range 0.54-0.62.

feasible assumption [30]. Equation 10 displays the initial and transversality conditions [31]. It says that total income, gained from abroad, domestic production and non-homothetic effects $(P\bar{C})$, can be saved for investment if it exceeds the aggregate consumption. Further, market clearing condition (i.e. equation 11) states that appreciation of the real exchange rate, through a decline in the marginal cost of capital good (i.e. $q_p(P)$), induces the economy to invest more in the non-traded sector [32]. This intuitively indicates that an additional resource spending cannot immediately be absorbed by the economy since some sorts of the non-traded capital goods must domestically be produced (i.e. absorptive capacity [33] constraint)[34]. The last component of equation 11 that highlights the importance of the gradual expansion of the capital good, as one of the significant reasons of the supply bottleneck, clearly represents the implication of absorptive capacity constraints. Precisely, this kind of formulation (equations 10 and 11) says when the non-traded capital goods is totally provided by the international market $(\gamma = 0)$, the unit cost function equals unity $(q = 1)$ and so the marginal cost becomes zero. In other words, the produced non-traded goods are totally consumed by households and investment is totally generated by the traded sector. Productivity growth (i.e. human capital accumulation) is supposed to be driven by learning-by-doing (LBD) mechanism, like Sachs and Warner (1995) [35]. In this approach, LBD is generated in the traded sector with a perfect spillover to the non-traded sector [36].

$$\frac{\dot{A}}{A} = \delta L_T. \tag{12}$$

Labor-augmenting technical progress is captured by A and δ, a positive exogenous parameter, represents the rate of productivity growth for an additional unit labor employed by the traded sector [37]. This formulation proclaims that a movement of the labor force from the traded sector to the non-traded sector decelerate the rate of productivity growth.

Given the fact that the capital goods and labor force are mobile across sectors in the long-term, equalization between the sectoral marginal product of those factors determines the real wage (w) and return of capital (r). Now assume that the rich, the ownership of the capital stock [38], are capitalists and the main source of their income is total capital gains, while the poor are workers and earn the labor income. So the same as Piketty (2017) has proposed, the concept of income inequality (g) is given by share of the

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[30] Note that some natural resource-rich countries, such as Persian Gulf States, can make almost all capital goods using the traded capital goods. They can provide the required human capital and structure through employing, respectively, the foreign skilled and construction workers (Van der Ploeg and Venables, 2013).

[31] The no-Ponzi condition guarantees that the foreign assets (B^F) can not grow at a rate faster than the world interest rate.

[32] It implies that the produced non-traded goods not only are consumed but also are invested.

[33] For more information, see. Bourguignon and Sundberg (2006); Van der Ploeg and Venables (2013).

[34] For case $\gamma = 0$, representing that the final capital goods only require the traded capital goods (e.g. equipment) to be produced, the economy will swallow the natural resource rent and is instantaneously adjusted to a new long-run capital good.

[35] The approach refers to R&D model proposed by Romer (1990) which in turn is empirically supported by Ulku (2004).

[36] Torvik (2001) develop another mechanism in which both traded and non-traded sectors contribute the learning process with a spillover between two sectors.

[37] Although both introduced approaches (i.e. Sachs and Warner (1995); Torvik (2001)) let us pursue a balanced growth model, I consider the former productivity growth mechanism to simplify my analysis.

[38] The rich can be taken into account as the skilled workers if we imagine that the human capital is dominant in the production process of capital goods.

capitalist's income of the total income [39], normally known as the capital share,

$$g = \frac{rK}{wL + rK}.$$ (13)

To comprehend the effects of income inequality changes on the demanded non-traded goods, we must link income inequality and expenditure inequality (EI). If the average propensity to save (i.e. savings ratio) expands more slowly than the rate of economic growth (see. Appendix C), the expenditure inequality move in a direction the same as the income inequality goes. Thereby, we can assume that the expenditure inequality (EI), defined as follow, is an increasing function of the income inequality (g),

$$EI = \frac{M^H}{M^H + M^L} = \frac{M^H}{M} = g^{\mu}; \qquad 0 < \mu < 1.$$ (14)

Making use of the equations 6 and 14 in the aggregate non-traded goods (i.e. $C_N = C_N^H + C_N^L$), it is easy to see a linkage between the share of the non-tradables' expenditure of the total expenditure and the income inequality (the capital share).

$$\frac{PC_N}{M} = \gamma_N^L + \left(\gamma_N^H - \gamma_N^L\right) g^{\mu}.$$ (15)

This relation expresses that an increase in the capital share could enlarge the non-tradables' expenditure share in the total expenditure ($\frac{PC_N}{M}$) if and only if the rich allocate a larger share of their expenditure (income) to the non-traded goods than the poor do (i.e. $\gamma_N^H > \gamma_N^L$). Accordingly, it intuitively demonstrates the conformity of the luxury goods' demand (i.e. the non-traded goods) from income inequality, in the sense that rising inequality level increases the luxury goods' demand, holding all other variables constant. In point of fact, if the factor prices due to a rise in windfall income are distributed in favor of the rich, income inequality will appreciate and so, as a consequence, the consumption of the non-traded goods will expand.

As a key point, in the homothetic case, the income share, spent on the non-traded goods, is similar for both groups of households $\left(\gamma_N^H = \gamma_N^L\right)$. Therefore, income-group shares of the non-traded goods of the aggregate consumption basket will be equal (ψ). Hence, a change in income inequality level will play no role in changing the demanded non-traded goods (see. equation 15) and so the rate of capital accumulation (see section 3.2). In contrast, if a non-homothetic preference is exerted the effect of income inequality on demand side and so economic growth will endogenously be captured.

2.3 Dynamic model

Let us assume a benevolent social planer (e.g. Government) who makes all decisions in the economy. He/She maximizes the utility function (equation 16) [40] subject to the budget constraint and the market

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[39] Goderis and Malone (2011) introduce income inequality index (g) as a ratio of the capital gain to the labor gain (i.e $g = \frac{rK}{wL}$). As a matter of fact, they evaluate the ratio of the top income quintile to the bottom income quintile. This index is linked to Gini Coefficient as follow $g = \frac{1}{0.5 - Gini} - 1$, while Equation 13 shows that Gini Coefficient and the ratio of the top income quintile to the bottom income quintile equal $g - \frac{1}{2}$ and $\frac{g}{1-g}$, respectively.

[40] In fact, the utility is a CRRA function as $U_J\left(C^J\right) = \frac{\left(C^J\right)^{1-\frac{1}{\sigma}} - 1}{1 - \frac{1}{\sigma}}$; $J = H, L$, where σ is the elasticity of intertemporal substitution.

clearing condition (i.e. equations 10 and 11, respectively),

$$\max_{C^H, C^L, K, B} \int_0^\infty \left[\theta U_H \left(C^H \right) + (1-\theta) U_L \left(C^L \right) \right] e^{-\rho t} dt, \quad U_J' > 0, \ U_J'' < 0; \quad J = H, L. \tag{16}$$

ρ denotes the rate of discount or the agent's rate of time preference, while θ can be defined as an index that represents the political power (participation) of the rich to impress the decision making of the benevolent social planer [41]. It is straightforward to show the optimality conditions as follows:

$$U_H' \left(C^H \right) = e \left(P \right) \frac{\lambda}{\theta} \tag{17a}$$

$$U_L' \left(C^L \right) = e \left(P \right) \frac{\lambda}{1-\theta} \tag{17b}$$

$$\frac{\dot{\lambda}}{\lambda} = \rho - r^* \tag{17c}$$

$$\frac{X_K \left(P, A, K \right)}{q \left(P \right)} = r^* - \frac{\dot{q}}{q}. \tag{17d}$$

Lagrangian multiplier (λ) is defined as the social value (marginal utility) of wealth, held in the form of foreign wealth (B), and $X_K \left(P, A, K \right)$ is the marginal product of capital [42]. Briefly, two first optimality conditions, intertemporal envelop conditions, link the marginal utility of consumption to the social value of wealth and the political power index (θ). The third condition is the familiar Keynes-Ramsey rule, implying that marginal utility growth rate is equal to a fixed rate of return. Under a perfect international financial market, the rate of discount and the world interest rate can be imagined to be equal $(\rho = r^*)$. It means that the social value of wealth can be supposed to be constant over time $\left(\lambda = \bar{\lambda} \right)$ [43]. Like Van der Ploeg and Venables (2013), I evaluate the response of the dynamic system to a change in the level of λ rather than a natural resource boom (see Appendix A). The last condition represents an equality between the marginal product of capital (capital gain) per unit cost of the installed capital and its cost, the world rental charge minus the cost rate.

To sake of simplicity, suppose that the unit expenditure function is defined as $e \left(P \right) = P^\beta$, with $0 < \beta < 1$, consumption share of the non-traded goods [44]. Hence, the growth rate of aggregate consumption is deduced and total expenditure, equation 7, is rewritten as:

$$\frac{\dot{C}}{C} = \sigma \left[r^* - \rho - \beta \frac{\dot{P}}{P} \right] \tag{18}$$

$$M = P \left(\frac{\tau \left(\theta \right)}{P^{1-\beta(1-\sigma)} \lambda^\sigma} - \bar{C} \right). \tag{19}$$

Where $\tau \left(\theta \right) \equiv \theta^\sigma + (1-\theta)^\sigma$ is called the aggregate political power index and represents the response of total expenditure to a change in the political power index (see. Section 4). Equation 18 states that the growth rate of aggregate consumption is only stimulated by a change in the inflation rate of the

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[41] The difference in political power (voice) is likely to originate from a difference in income (Saint Paul and Verdier, 1996). Well-known evidence, implying that the political participation and so political voice is larger for the rich than for the poor, are documented by Petrocik and Shaw (1991); Benabou (2000).

[42] As in Van der Ploeg and Venables (2013), $X = X_T + P X_N$ is (non-windfall) gross national product. Furthermore, because of freely capital mobile across sectors in the long-term, $X_K = r_T + r_N = 2r$ where r_T and r_N are return to capital of the traded and non-traded sectors, respectively.

[43] This standard assumption in the small open economy's literature satisfies the existence of a nonzero finite steady-state equilibrium in a dynamic model (Turnovsky, 2009).

[44] This assumption verifies the characteristics of equation 3, $(e_P > 0, \ e_{PP} < 0)$.

real exchange rate (relative price). In other words, for any given real exchange rate, more distribution of market income in favor of the rich (an increase in the return of capital) decreases the relative price inflation (see. equation 20b) and subsequently accelerates the growth of the aggregate consumption. The latter equation indicates that for any given relative price and the political power index, a natural resource discovery which can be translated as a drop in the social value of wealth (see Appendix A) increases the aggregated expenditure (income). As a point, a natural resource discovery is likely to raise the aggregate consumption level if increasing the expenditure (income) is not compensated by reducing the difference between the non-traded home-production goods and subsistence goods (i.e. $P\bar{C}$) [45]. Making use of equations 15 and 19 in the market clearing condition (equation 11), rewriting the productivity growth (i.e. equation 12) and equation 17d, the dynamic system is eventuated,

$$\frac{\dot{K}}{K} = \left[\frac{X_P(P,A,K)}{K} - \frac{1}{K} \left(\frac{\tau(\theta)}{P^{1-\beta(1-\sigma)}\,\lambda\sigma} - \bar{C} \right) \left(\gamma_N^L + (\gamma_N^H - \gamma_N^L)\,g^\mu \right) \right] \frac{P^{1-\gamma}}{\gamma} \tag{20a}$$

$$\frac{\dot{P}}{P} = \frac{1}{\gamma} \left[r^* - \frac{X_K(P,A,K)}{P^\gamma} \right] \tag{20b}$$

$$\frac{\dot{A}}{A} = \delta L_T(P,A,K). \tag{20c}$$

A permanent decline in the social value of wealth, the consequence of a natural resource discovery at time zero, affects the economy through increasing the demand for the non-traded goods and subsequently decreasing the growth rate of the capital goods [46]. Therefore, equation 20a can clarify how the resource rent discourages the long-term investment in the capital goods [47]. It precisely shows that economies depending on the windfall income may neglect to invest in the non-traded capital good (such as education and infrastructure) because they see no immediate need for it (for more information see Gylfason and Zoega (2002)). We can also assess the growth rate of income inequality by using the real wage and return of capital growth rate, leading to the sectoral changes,

$$\frac{\dot{g}}{g} = (1-g) \left[\frac{\dot{K}}{K} + \frac{\dot{r}}{r} - \frac{\dot{w}}{w} \right]. \tag{21}$$

In the short-term when the capital stock can be supposed to be the fixed, the growth rate of the capital share responses only to a change in the growth rate of real wage. However, in the long term, it is stimulated not only by a change in the growth rate of real wage but also by a change in the growth rate of capital stock and return to capital. In what follows, I study the concept of a generalized balanced growth path (GBGP) for two cases, depending on the capital intensity.

2.4 Simplified model (Sector-Specific Capital)

The sectoral capital intensity is a key to realize the sectoral changes and income redistribution in an economy, induced by a permanent windfall income. To keep this matter as simple as possible and let a generalized balanced growth path (GBGP) exists, I assume the produced capital goods can only be used

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[45] Note that the non-traded home production good and subsistence goods are exogenous and constant variables.

[46] Unlike the model proposed by Goderis and Malone (2011) in which the capital stock is supposed to be the fixed and the dynamic model is only driven by the productivity level change, in this dynamic system the windfall income impresses the rate of the productivity growth and the relative price inflation through stimulating the growth rate of capital accumulation.

[47] It may demonstrate why the natural resource economies encounter a reduction in capital accumulation growth.

by one of these sectors [48].

$$X_i = AL_i \qquad ; \qquad i = T, N \tag{22a}$$

$$X_j = K^\alpha (AL_j)^{1-\alpha} \quad ; \qquad j = N, T. \tag{22b}$$

Under a constant returns to scale production function, case $j = T$ can be construed as a condition that the traded sector is relatively capital intensive while case $j = N$ states that the non-traded sector is relatively capital intensive [49]. Let me now define variable ϕ as a ratio of the capital good to the productivity level (i.e. $\phi = \frac{K}{A}$) and substitute equation 22 in equations 20 and 21. Endogenous variables (ϕ, P, g) are determined by the following dynamic model.

(a) Capital good used only to produce the traded goods (i.e. $j = T$):

$$\frac{\dot{\phi}}{\phi} = \frac{1}{\phi} \left[1 - \frac{1}{A(\phi,P)} \left(\frac{\tau(\theta)}{P^{1-\beta(1-\sigma)} \lambda \sigma} - \bar{C} \right) \left(\gamma_N^L + \left(\gamma_N^H - \gamma_N^L \right) g^\mu \right) \right] \frac{P^{1-\gamma}}{\gamma} - \left(\delta\phi + \frac{P^{1-\gamma}}{\gamma} \right) \left(\frac{1-\alpha}{P} \right)^{\frac{1}{\alpha}} \tag{23a}$$

$$\frac{\dot{P}}{P} = \frac{1}{\gamma} \left[r^* - \frac{\alpha (1-\alpha)^{\frac{1-\alpha}{\alpha}}}{P^{\frac{1}{\alpha}+\gamma-1}} \right] \tag{23b}$$

$$\frac{\dot{g}}{g} = (1-g) \left[\frac{\dot{\phi}}{\phi} - \frac{1}{\alpha} \frac{\dot{P}}{P} \right]. \tag{23c}$$

(b) Capital good used only to produce the non-traded goods (i.e. $j = N$):

$$\frac{\dot{\phi}}{\phi} = \left[((1-\alpha)P)^{\frac{1-\alpha}{\alpha}} - \frac{1}{\phi A(\phi,P)} \left(\frac{\tau(\theta)}{P^{1-\beta(1-\sigma)} \lambda \sigma} - \bar{C} \right) \left(\gamma_N^L + \left(\gamma_N^H - \gamma_N^L \right) g^\mu \right) \right] \frac{P^{1-\gamma}}{\gamma} + \delta\phi \left[(1-\alpha)P \right]^{\frac{1}{\alpha}} - \delta \tag{24a}$$

$$\frac{\dot{P}}{P} = \frac{1}{\gamma} \left[r^* - (1-\alpha)^{\frac{1-\alpha}{\alpha}} P^{\frac{1}{\alpha}-\gamma} \right] \tag{24b}$$

$$\frac{\dot{g}}{g} = (1-g) \left[\frac{\dot{\phi}}{\phi} + \frac{1}{\alpha} \frac{\dot{P}}{P} \right]. \tag{24c}$$

When we apply the non-homothetic preference, the budget constraint (equation 10) shows that a balanced growth path along which all variables expands at a constant rate cannot be existed (for a homothetic case see Appendix B). Therefore, our next task is to search a tighter concept of the growth path along which structural change is adjusted. As a matter of fact, we need to have a compatible characterization of the dynamic growth model in which the balanced growth in macroeconomic and the sectoral transformation can occur simultaneously. For this purpose, let me first define a Generalized Balanced Growth Path (GBGP).

Definitions: *A Generalized Balanced Growth Path is a trajectory along which the relative price of final goods (the real exchange rate) is constant* [50].

To demonstrate the existence of this trajectory, I rewrite the labor market equilibrium.

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[48] The final results of my analysis don't rely on this simplification.

[49] Note that this production structure captures the features of an economy with a capital intensity in sector j, corresponding to a labor intensity in sector i. Therefore, we have:

First case $(j = T)$,

$$L_T = \frac{K}{A} \left(\frac{1-\alpha}{P} \right)^{\frac{1}{\alpha}}, \qquad w = PA, \quad r = X_K = \alpha \left(\frac{1-\alpha}{P} \right)^{\frac{1-\alpha}{\alpha}}, \qquad \frac{\dot{w}}{w} = \frac{\dot{P}}{P} + \frac{\dot{A}}{A}, \quad \frac{\dot{r}}{r} = -\frac{1-\alpha}{\alpha} \frac{\dot{P}}{P}$$

Second case $(j = N)$,

$$L_T = 1 - \frac{K}{A} ((1-\alpha)P)^{\frac{1}{\alpha}}, \quad w = A, \qquad r = X_K = (1-\alpha)^{\frac{1-\alpha}{\alpha}} P^{\frac{1}{\alpha}}, \quad \frac{\dot{w}}{w} = \frac{\dot{A}}{A}, \qquad \frac{\dot{r}}{r} = \frac{1}{\alpha} \frac{\dot{P}}{P}$$

[50] It is the same as the definition proposed by Meckl (2002).

(a) Capital good used only to produce the traded goods (i.e. $j = T$):

$$P = (1 - \alpha) \left(\frac{\phi}{L_T(\phi, P)} \right)^\alpha. \tag{25}$$

(b) Capital good used only to produce the non-traded goods (i.e. $j = N$):

$$P = \frac{1}{(1 - \alpha)} \left(\frac{L_N(\phi, P)}{\phi} \right)^\alpha. \tag{26}$$

Considering that the labor forces are independently determined at the dynamic equilibrium, the capital-productivity ratio (ϕ) will be constant along the trajectory as long as the real exchange rate stays constant or vice versa. It, therefore, says that both capital good and productivity grow at the same rate (ξ) when the real exchange rate becomes constant. This constraint guarantees that sector's outputs and total output expand equally [51]. As a point, the simplified model exposes that the return of capital remains unchanged [52] as long as the real exchange rate is constant. Owing to presence of the non-homotheticity effects, rising total income and so total expenditure induce the aggregate demand for the non-traded (traded) goods to expand at a rate larger (smaller) than the growth rate of total aggregate demand (i.e. Engel's law) [53].

Proposition 1: *For the simplified model, a Generalized Balanced Growth Path (GBGP) exists. It satisfies main characteristics of a balanced growth model (i.e.Kaldor facts) in the sense that the return of capital and the capital-output ratio will be constant in the long-term. Further,*

(a) as long as the real exchange rate stays constant, the sectoral and total output, and more likely the total income and total expenditure grow at a rate the same as the capital good and productivity do.

(b) total aggregate demand is likely to grow at a rate the same as the economy does and so the demand for the non-traded and traded goods expand, respectively, faster and slower than the economic growth rate.

3   Economic response to a windfall income

In this section, I discuss how the economy responses to a windfall income flow, resulting from a natural resource discovery. For any given political policy (see section 4), when the windfall income is permanently increased, the dynamic model is thrown out of the initial steady-state equilibrium. To analyze the response of the non-linear dynamic system to an externality, let me draw the linear approximation of isoclines (i.e. phase diagram). In fact, the slope as well as how to shift the isoclines can be determined by the implicit function theorem. More precisely, we need to compute the partial derivatives of P with

---

[51] $\frac{\dot{X}_T}{X_T} = \frac{\dot{X}_N}{X_N} = \frac{\dot{X}}{X} = \frac{\dot{K}}{K} = \frac{\dot{A}}{A} = \xi$. Further, since growth rate of saving ratio is as follow: $\frac{\dot{S}}{S} = \frac{r^*B}{Y}\xi$ (see. Appendix C), we have $\frac{\dot{Y}}{Y} = \left(1 - \frac{r^*B}{Y}\right)\xi = \xi_Y$ and $\frac{\dot{M}}{M} = \left(1 - \frac{r^*B}{M}\right)\xi = \xi_M$ where $\xi_M < \xi_Y < \xi$. These indicate that the saving ratio is likely to converge to initial level (i.e. $\frac{\dot{S}}{S} \simeq 0$) and so growth rate of total income and total expenditure converge to economic growth rate (i.e. $\frac{\dot{Y}}{Y} = \frac{\dot{M}}{M} \simeq \xi$), as the expansion of economy pushes $\frac{r^*B}{Y}$ to converge to zero.

[52] Kongsamut et al. (2001) refer to this constraint as the definition of *Generalized Balanced Growth Path*.

[53] $\frac{\dot{C}_N}{C_N} = (1 + s_N)\xi_C > \xi_C$ and $\frac{\dot{C}_T}{C_T} = (1 - s_T)\xi_C < \xi_C$ where $\xi_C = \frac{\dot{C}}{C} = \left(1 - \frac{P\bar{C}_N - \bar{C}_T}{e(p)C}\right)\xi_M$. Given that the importance of the non-traded home-production goods and the subsistence level will decline as the economy grows, the growth rate of total aggregate demand converges to the growth rate of total expenditure and so economic growth rate.

respect to ϕ, g with respect to P and finally ϕ with respect to g [54].

The response of the real exchange rate for any given level of the capital-productivity ratio and vice versa are explored in Appendix B. The second case observes the reaction of the capital share (income inequality) for any given level of the real exchange rate and vice versa. The results of this set of computation are:

(*a*) *Capital goods are used intensively in the traded sector:*

$$
\left[\frac{\partial g}{\partial P} \right]_{\frac{\dot{P}}{P}=0} = - \frac{\frac{\partial (\dot{P}/P)}{\partial P} > 0}{\frac{\partial (\dot{P}/P)}{\partial g} = 0} \quad ; \quad \left[\frac{\partial g}{\partial P} \right]_{\frac{\dot{g}}{g}=0} = - \frac{\frac{\partial (\dot{g}/g)}{\partial P} > 0}{\frac{\partial (\dot{g}/g)}{\partial g} < 0}. \tag{27}
$$

(*b*) *Capital goods are used intensively in the non-traded sector:*

$$
\left[\frac{\partial g}{\partial P} \right]_{\frac{\dot{P}}{P}=0} = - \frac{\frac{\partial (\dot{P}/P)}{\partial P} < 0}{\frac{\partial (\dot{P}/P)}{\partial g} = 0} \quad ; \quad \left[\frac{\partial g}{\partial P} \right]_{\frac{\dot{g}}{g}=0} = - \frac{\frac{\partial (\dot{g}/g)}{\partial P} > 0}{\frac{\partial (\dot{g}/g)}{\partial g} < 0}. \tag{28}
$$

They represent the inflation locus line to be vertical in the $p - g$ axis (see figure 1). Further, they demonstrate if the traded (non-traded) sector is intensive in the capital goods, rising (falling) the relative price on the right-hand side of the inflation locus $\left(\dot{P}/P = 0 \right)$ will be consistent to keep stationary in its place. It is because that an increase in the relative price decreases (increases) the return of capital and subsequently depreciates (appreciates) the incentive to invest. The other aspect of this phase diagram comes from the isocline of income inequality (g) [55] that has a positive slope in both cases. To shed light on the reason for this positively sloped line, let me notice that, on the one hand, I assume when the real exchange rate appreciates, increasing the rate of the capital-productivity ratio is stronger than decreasing the inflation [56]. Thereby, as summarized, the higher the relative price, the more acceleration the income inequality growth [57]. On the other hand, because of the absorptive capacity of the capital stock, If the expenditure share of the non-traded goods is larger for the rich than for the poor (i.e. $\gamma_H^N > \gamma_L^N$) [58], rising income inequality and subsequently increasing the demand for the non-traded goods decelerates the growth of capital-productivity ratio (see equation 20a). As a result, appreciation of the real exchange rate in a neighborhood of steady-state makes income inequality isocline shifts down to the left.

The last phase diagram studies the interaction of capital-productivity ratio and income inequality (Figure 1). Making use of the implicit function theorem gives:

(*a*) *Capital goods are used intensively in the traded sector:*

$$
\left[\frac{\partial \phi}{\partial g} \right]_{\frac{\dot{\phi}}{\phi}=0} = - \frac{\frac{\partial (\dot{\phi}/\phi)}{\partial g} < 0}{\frac{\partial (\dot{\phi}/\phi)}{\partial \phi} < 0} \quad ; \quad \left[\frac{\partial \phi}{\partial g} \right]_{\frac{\dot{g}}{g}=0} = - \frac{\frac{\partial (\dot{g}/g)}{\partial g} < 0}{\frac{\partial (\dot{g}/g)}{\partial \phi} < 0}. \tag{29}
$$

---

[54] They refer to $\left[\frac{\partial P}{\partial \phi} \right]_{\frac{\dot{P}}{P}=0, \frac{\dot{\phi}}{\phi}=0}$, $\left[\frac{\partial g}{\partial P} \right]_{\frac{\dot{g}}{g}=0, \frac{\dot{P}}{P}=0}$ and $\left[\frac{\partial \phi}{\partial g} \right]_{\frac{\dot{\phi}}{\phi}=0, \frac{\dot{g}}{g}=0}$, respectively.

[55] Referring to Proposition 1, income inequality follows the capital share.

[56] Given the fact that in the long-term the real exchange rate converges to its initial level, this assumption seems to be reasonable.

[57] This can clearly be demonstrated from the following relation: $\frac{\partial (\dot{g}/g)}{\partial P} = (1 - g) \left[\frac{\partial (\dot{\phi}/\phi)}{\partial P} \pm \frac{\partial (\dot{P}/P)}{\partial P} \right]$.

[58] The assumption is in line with Engel's law, as households become richer their share of expenditure on necessaries (i.e. traded goods such as foods) decrease.

(*b*) *Capital goods are used intensively in the non-traded sector:*

$$\left[\frac{\partial \phi}{\partial g}\right]_{\frac{\dot{\phi}}{\phi}=0} = -\frac{\frac{\partial(\dot{\phi}/\phi)}{\partial g} < 0}{\frac{\partial(\dot{\phi}/\phi)}{\partial \phi} > 0} \quad ; \quad \left[\frac{\partial \phi}{\partial g}\right]_{\frac{\dot{g}}{g}=0} = -\frac{\frac{\partial(\dot{g}/g)}{\partial g} < 0}{\frac{\partial(\dot{g}/g)}{\partial \phi} > 0}. \tag{30}$$

These relations disclose that the isoclines have a negative (positive) slope when the capital goods are used intensively in the traded (non-traded) sector. As a matter of fact, whenever the non-traded sector is relatively labor intensive, a rise in the real exchange rate, leading to a decline in the return of capital and conversely an increase in the real wage (*Stolper-Samuelson theorem*) [59], diminishes the income inequality level. The falling of return of capital (i.e. marginal product of capital) and rising of the real wage (i.e. marginal product of labor) tend to decrease the capital-productivity ratio in the long-term. Therefore, we can conclude that a decline (rise) in income inequality will be accompanied by a decrease (increase) in the capital-productivity ratio.

 For the purpose of the dynamic analysis, we need to know how a permanent rise in the windfall income moves the relative price, the capital-productivity ratio, and income inequality. Regarding the property of *Engel* law, suppose the rich spend a higher share of their expenditure on the non-traded goods (i.e. the luxury goods) than the poor do. A permanent windfall income through decreasing the social value of wealth (λ) tends to increase the demand for the non-traded goods. Thereby, for a given production level of the non-traded sector [60], the required investment to produce the capital goods must reduce. In other words, the pressure of the absorptive capacity constraint encourages households to consume more the windfall income flows, rather than to invest. Accordingly, an increase in the resource windfall income tends to slow down the capital-productivity ratio. The real exchange rate follows the boldly directed line (see in figure 2). It clarifies that the relative price appreciates suddenly in the short term to confront the rising demand of the non-traded goods. This temporary appreciation will vanish as the gradual changes of capital-productivity ratio push the economy to converge to the long-term steady-state, displayed by E_∞. To complete the description of the dynamic effects of a windfall income, let me now distinguish two following cases.
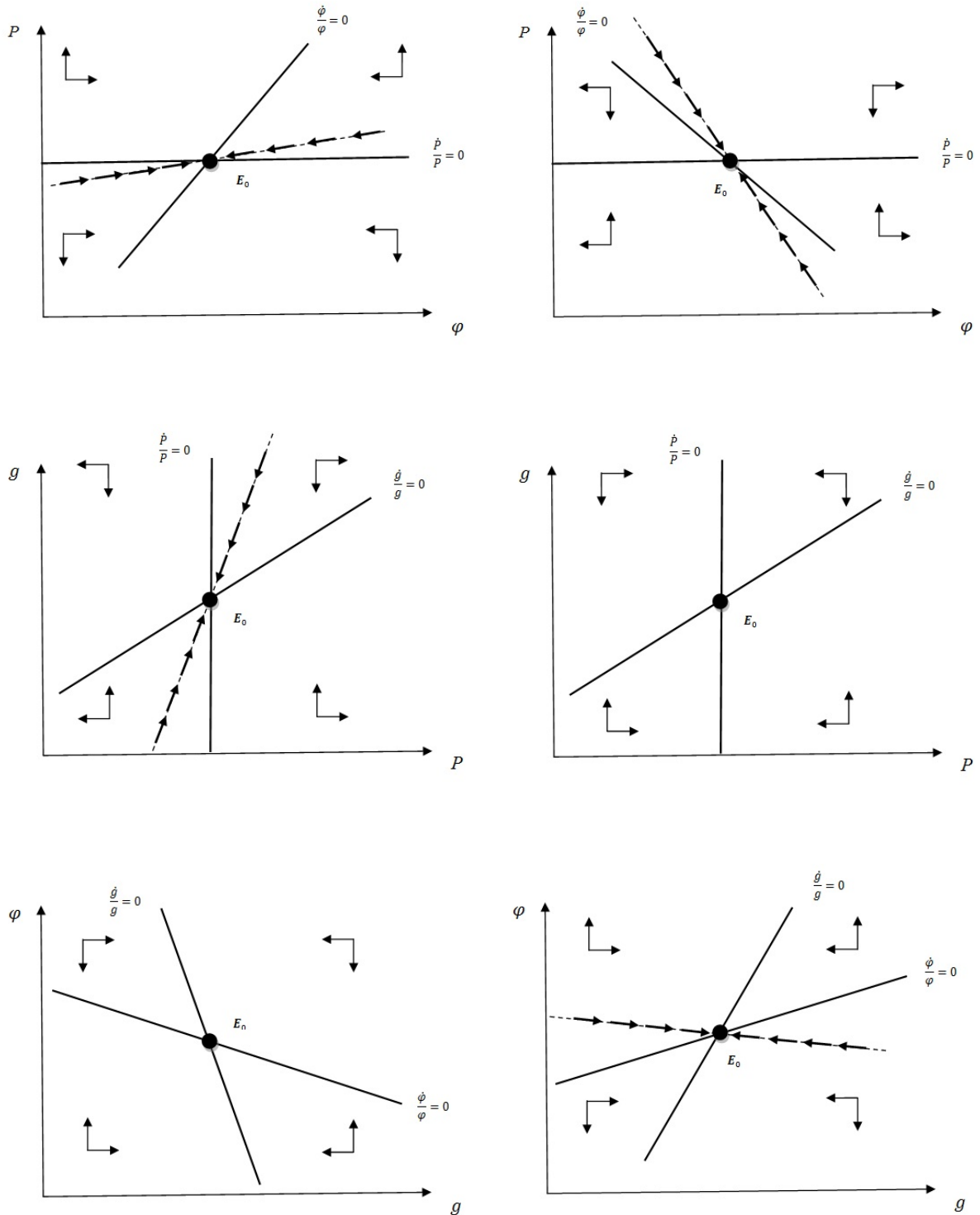
(*a*) *Capital goods are used intensively in the traded sector*
The growth rate deceleration of the capital-productivity ratio resulting from an increase in the windfall income represents that the $\frac{\dot{\phi}}{\phi} = 0$ locus must go to the left in the $(P - \phi)$ axis and go down to the left in the $(\phi - g)$ axis to be re-established the steady-state equilibrium. Subsequently, the $\frac{\dot{g}}{g} = 0$ locus, in the $(\phi - g)$ axis, goes down to the left to the extent that income inequality stays constant at its initial level. The intersected point (E_1) can infer the same results as a homothetic case does (This version of the model is described in Appendix B). In brief, rising the windfall income leads to a decline in the capital-productivity ratio. The implication of this remark can be clarified by *Stolper-Samuelson theorem*. The relative price appreciation brings about a drop in the return of capital and conversely a rise in the real wage which in turn enforce the economy to expand the productivity level and to decumulate the capital goods [61]. If human capital (a sort of the non-traded capital good) is intensively used to produce the final capital good, the recent result, decumulation of the capital goods, can indirectly be paraphrased as a skilled worker outflow (i.e. *Brain-Drain*). The reallocation of labor and capital goods causes the productivity level to slow down (i.e. *the Dutch disease*) and the size of the traded sector to shrink (i.e.

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[59] Stolper and Samuelson (1941).
[60] Regarding the concept of the absorptive capacity constraint, considering that the economy cannot immediately absorb the windfall income, there is a bottleneck in the supply side to respond to an increase in the demand.
[61] Even though the capital goods accumulate, the capital-productivity ratio can still diminish if and only if increasing the level of the capital good is smaller than increasing the productivity level.

(e) Capital goods are used intensively in the traded sector (f) Capital goods are used intensively in the non-traded sector

Figure 1: Phase Diagram

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Deindustrialization). As a conclusion, a natural resource discovery decelerates not only the growth rate of productivity level but also the growth rate of capital stock and finally growth rate of the economy [62]. The response of the capital stock and productivity level to a windfall income is only one side of the analysis. Let me, therefore, investigate the interaction of income inequality level and economic performance. As for equation 23a, a decline in income inequality level, given level for other variables, causes the demand for the non-traded goods to decrease and so growth rate of the capital-productivity ratio to increase. Hence, to re-establish equilibrium, $\frac{\dot{\phi}}{\phi} = 0$ locus goes up to the right and subsequently $\frac{\dot{g}}{g} = 0$ locus goes down to the left [63] as they meet each other at point E_∞. Because of the structure of model, this theoretical finding is not unexpected. On the one hand, it is because of that a decrease of the capital-productivity ratio indicates that the income has been redistributed in favor of the poor (i.e. workers) and so a fall in income inequality (with respect to its initial level). On the other hand, as mentioned above, the non-homotheticity implies that a decline in the income level and so expenditure level switches the demand from the luxury goods (i.e. non-traded goods) to the necessary goods (i.e. traded goods). In other words, the lower the income level, the smaller the relative demand. These two points infer that a portion of increasing the demand for the non-traded goods could be dampened by decreasing income inequality. Therefore, the reduction of the income inequality level in long-term causes the capital-productivity ratio to decrease less (see figure 2, point E_∞ instead of point E_1 in which the income inequality level is constant) which in turn can be read as a less decrease in the rate of productivity growth. In short, a decline in the income inequality level moderates the adverse effects of a windfall income (i.e. a lower level of the Dutch disease and Deindustrialization).

(b) Capital goods are used intensively in the non-traded sector
As before, I start from an initial stationary point. An increase in the windfall income that, leading to a decrease in the rate of the capital-productivity ratio, shifts the $\frac{\dot{\phi}}{\phi} = 0$ locus up to the left and afterward pushes the $\frac{\dot{g}}{g} = 0$ locus to go up and left. They can cross each other at the point E_1 to keep the income inequality level in its place. So a rise in the windfall income tends to increase the capital-productivity ratio. It refers to the fact that the real exchange rate appreciation causes the return of capital to increase and the real wage to decrease (i.e. rising the income inequality). These, in turn, say that the capital stock must accumulate and productivity level must diminish to reset the equilibrium. Accordingly, decelerating the growth rate of productivity level and shrinking the size of the traded sector clarify the natural resource curse.

 Rising the income inequality indicates that income is redistributed in favor of the rich (i.e. Capitalists) and so a higher share of income is spent on the non-traded goods (i.e. luxury goods). Therefore, the demand for the non-traded goods enlarges more and subsequently, the capital-productivity ratio expands more to be re-established the steady-state equilibrium. Graphically, $\frac{\dot{\phi}}{\phi} = 0$ locus goes up to the left while $\frac{\dot{g}}{g} = 0$ locus goes down to the right so that the cross point (E_∞) is placed in an upper level of income inequality and the capital-productivity ratio (with respect to E_1). Hence, with respect to the case in where income inequality is supposed to be fixed at E_1, the productivity level grows more slowly, and the size of the traded sector shrinks more. These can be translated into a higher level of the Dutch disease and Deindustrialization. Finally, I can conclude that a permanent rise in the windfall income deepens the natural resource curse through the rising of income inequality level.
I summarize my discussion in the following proposition.
Proposition 2: *Consider an economy in where the capital goods are produced by a combination of the traded capital (e.g. equipment) and non-traded capital (e.g. structure, human capital and quality of*

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[62] In the long-term, the economy grows at a rate the same as the capital stock and productivity do (see section 3).
[63] As described in equations 29 and 30.
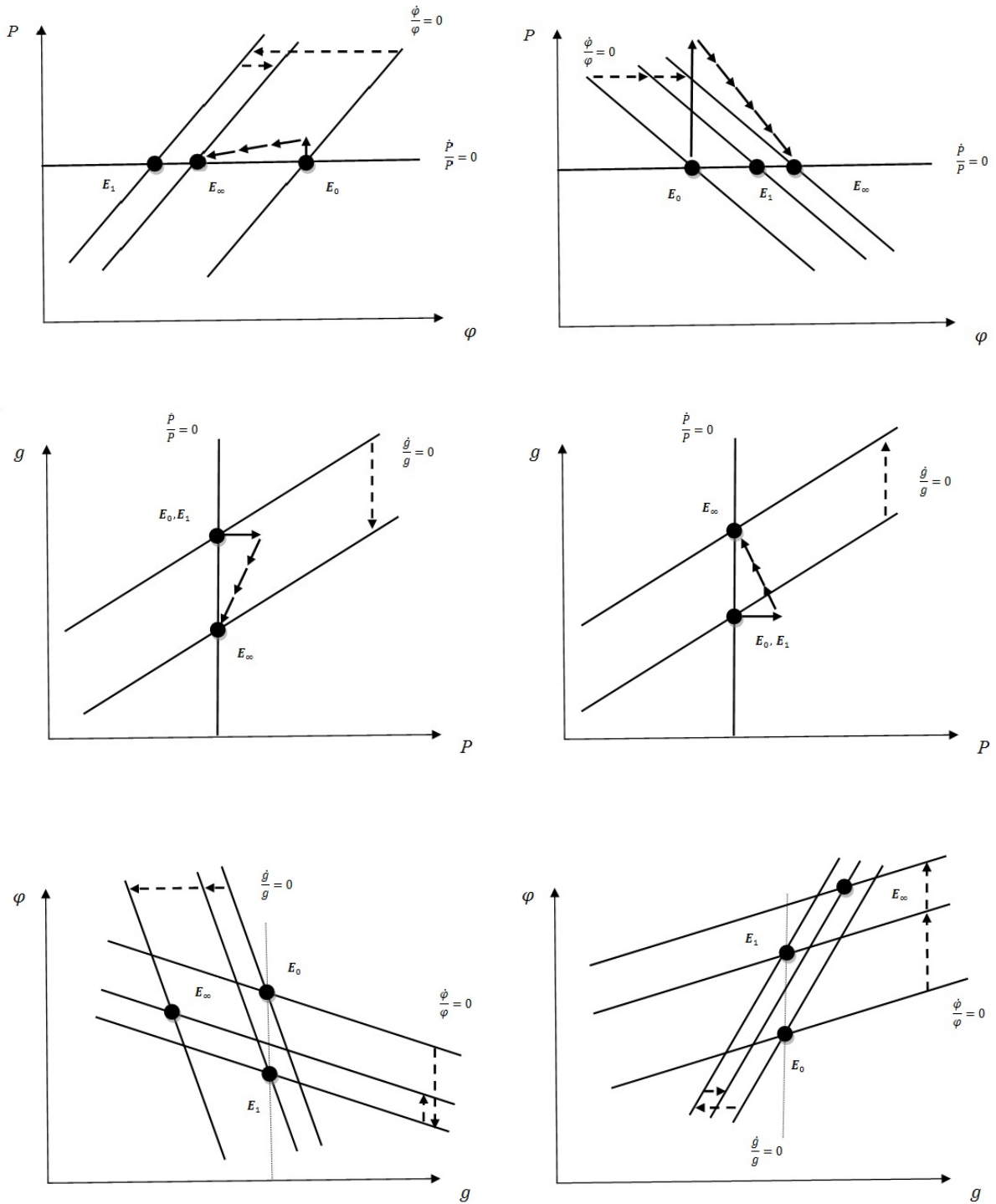
(e) Capital goods are used intensively in the traded sector (f) Capital goods are used intensively in the non-traded sector

Figure 2: Dynamic response to a permanent windfall income shock

institution) goods. A permanent rise in windfall income leads the traded sector to shrink (i.e. Deindustrialization) and economic growth rate to decelerate (i.e. the Dutch disease). Further:

(a) if the traded sector is relatively intensive in the capital goods, a permanent rise in windfall income decreases income inequality, while if the non-traded sector is relatively intensive in the capital goods, a permanent rise in windfall income increases income inequality.

(b) redistribution of income in favor of the poor (i.e. falling income inequality) through decreasing the demand for the non-traded goods (i.e. the luxury goods) tends to moderate the natural resource curse (i.e. less deceleration of economic growth and lower level of Deindustrialization) while redistribution of income in favor of the rich (i.e. rising income inequality) through increasing the demand for the non-traded goods (i.e. the luxury goods) tends to deepen the natural resource curse (i.e. more deceleration of economic growth and higher level of Deindustrialization).

In light of the fact that the absorptive capacity constraint plays a crucial role in the description of the presented model, let me now study briefly how a change in the level of this restriction can bias our conclusion. A higher level of the absorptive capacity constraint can be paraphrased as a more intensity of the capital goods to the non-traded capital good (i.e. structure) than the traded capital good (i.e. equipment). In point of fact, it states that the higher the constraint level, the larger the share of the non-traded capital goods used to produce one more unit of the capital goods (γ). given the fact that a lower level of the absorption constraint (smaller γ) means a less unit cost function, the rich tend to enhance the investment when the constraint degrades. In other words, the absorption capacity constraint (e.g. infrastructure constraint) is likely to be the key reason for a lower level of investment in most of the natural resource economies (e.g. sub-sharahen countries). A decrease of the constraint level can lead the capital and so productivity level to expand faster. Further, it tends to distribute the national income more evenly and consequently, through this way, it may crowd out the natural resource curse [64]. As a remark:

Proposition 3: *if the capital goods are used intensively in the non-traded (traded) sector, a higher level of the absorptive capacity constraint makes income inequality level increase more (decrease less) and so the natural resource curse (i.e. the Dutch disease and Deindustrialization) is more (less) intensive.*

4 Political power distribution and economic performance

Although the preceding section describes how income inequality can influence market trajectory path of an economy depending on windfall income, it dose not address the role of the political economy's variables. Indeed, I study the interaction of income inequality and economic performance under the fixed political variables. However, as Newberry (1986) says, understanding the behavior of politicians is a key to explain the economic performance in resource-dependent countries. To highlight this issue, I investigate how the political environment can impress the economic performance of resource countries. The literature concentrates mainly on the explanation of how windfall income biases the political structure (Ross, 2001; Lam and Wantchekon, 2002) [65] or how natural resource impresses income per capita when the institutional quality (Mehlum et al., 2006; Arezki and Van der Ploeg, 2011) or the constitutional system (Andersen and Aslaksen, 2008) is considered as the key criteria to distinguish economies

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[64] López (2003) finds empirically that infrastructure development (i.e. decrease of absorption capacity constraint) raises growth rate and reduces income inequality.

[65] These studies show that the natural resource (boom or abundance) makes less democratic or tends to consolidate authoritarianism.

[66]. Nevertheless, my paper is related to motivating politicians or political participation of voters. In point of fact, the proposed model allows us to disentangle the role of political power (participation) distribution in economic performance.

Even though political economy theories which often argue natural resource curse are well understood, surprisingly there is no serious attempt to highlight how the economic performance of a resource economy can reflect a political power distribution. The nearest thing might be an idea of a connection between democracy and natural resource rent. As an example, Collier and Hoeffler (2005) examine this relationship using panel data estimation. They find that in developing countries the combination of democratic system and natural resource rent tends to retard growth. Moreover, this issue can also be related to the notion of "petro populism", clarified by Matsen et al. (2016). Using a rent-seeking approach, they predict that better visibility and more information of voter may increase over-extraction and so economic performance is likely to be affected adversely. Nevertheless, the role of political power distribution in economic performance of resource-dependent economies seems to be in a darkroom. Therefore, in this sub-section, I try to briefly clarify how a political power distribution distinguishes the intensity of natural resource curse and the level of income inequality.

In an authoritarianism or a dictatorship system, a closed elite's group controls government as well as resource rent (see. Lam and Wantchekon (2002)). Thus, it can be logical to consider a lower political power for the poor. Now let me imagine that political power operates in a democratic system. The argument that redistribution of political power may tend to change the market-based performance of a democratic economy rests on the following steps. First, the political motivation of each income-groups is likely to depend on the national income share dedicated to that group so that the higher transfer of the national income share, the more political support by voters of that income group (Lane and Tornell, 1996). Second, in an actual economy income distribution is right-skewed and so the median is located on the left-hand side of the mean. It implies that the skewness in an income distribution increases and so the gap between the median and mean extends as income inequality rises. Third, the net transferred share is determined by majority voting. Consequently, in response to an increase in income inequality, the households vote to transfer a larger share of national income to the low-income group. These indicate that the political power is likely to be distributed more fairly in a democratic country than in a non-democratic country. This point can let us implicitly link the level of democracy and political power distribution so that the higher the level of democracy, the more evenly the political power distribution.

In the present theory, a political structure enables to implicitly impress economic performance through a change in the political power index of income-groups (i.e. θ, equation 16). Choosing a larger political power index for the poor reflects the more fairly distribution of political power in a democratic country than in a non-democratic country [67]. The political power index of both income groups emerges in $\tau(\theta)$, called aggregate political power (participation) index (see. Figure 3) [68]. This exogenous variable, in turn, motivates the driving forces directly through a change in the demand for the non-traded goods and indirectly through a change in the social value of wealth (see Appendix A). Let us suppose that the indirect impact of political power index is ignorable and political power influences the economic performance only through stimulating the demand-side.

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[66] Mehlum et al. (2006) argue that the resource is a blessing when institutions are good and is a curse when institutions are bad. Arezki and Van der Ploeg (2011) find that natural resource curse is particularly intense in countries with a low level of institutional quality. Andersen and Aslaksen (2008) remark that the resource curse observes in presidential, not parliamentary democracies.

[67] An increase in the political power (voice) index of the poor is equivalent to a decrease in θ and vice versa.

[68] $\tau(\theta) \equiv \theta^{\sigma} + (1-\theta)^{\sigma}$. The function will be concave if and only if the elasticity of intertemporal substitutions is less than unity. As a stylized fact to support constraint, see a recent well known empirical study done by Havranek et al. (2015). They collect a meta-analysis of 169 published studies that cover 104 countries during different time periods and report a mean elasticity of 0.5.
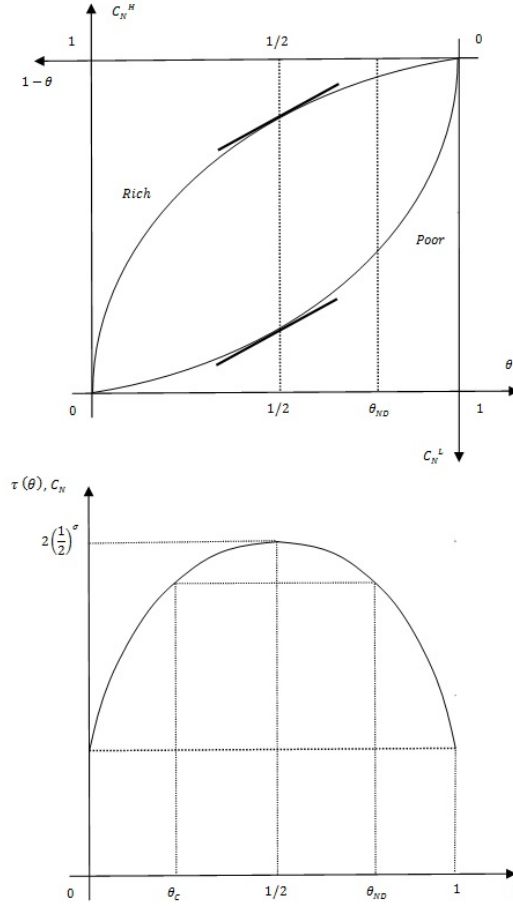
Figure 3: Political power distribution

Figure 3 shows symmetrically the relationship between the political power index of each of income groups (i.e. θ and $1 - \theta$) and the non-traded goods demanded by them (i.e. C_N^H and C_N^L). A bigger political power index (θ) is likely to associate with a larger national income share (Dahl, 1973; Lane and Tornell, 1996). Then one seems to be logical that the demand for the non-traded (luxury) goods reacts to a change in the political power the same as it responds to a change in the income level (i.e. Engel curve). It implies when the political power is distributed unevenly, the sensitivity of the non-tradables' demand to one additional unit of political power is less for an influential group than that for another group. In other words, in non-democratic countries in where a higher share of political power is dedicated to the rich, the marginal demand for the non-traded goods of the rich is smaller than that of the poor [69]. Moreover, it represents that in an ideal democratic system in where power distributes evenly between two groups ($\theta = 0.5$), the marginal demand for the non-traded goods of the rich equals that of the poor and so the marginal demand for the aggregate non-traded goods will be equal to zero [70]. These arguments clarify the reason of symmetric concave function for the aggregate demand of the non-traded goods (C_N) with respect to the political power index of the rich (θ). As summarized, first, the aggregate demand of the non-traded goods (C_N) is a linear function of aggregate political power index ($\tau(\theta)$) (see. equation 19). Second, on the right-hand side of the ideal point, one additional unit of the political power index for the rich (θ) causes a decrease in the demand for the poor to be larger than an increase in the

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[69] A gentle slope for the luxury demand curve of the rich and a steep slope for that of the poor at a political power index bigger than 0.5 display this point.

[70] When $\theta = 0.5$ then $\frac{d\tau}{d\theta} = 0 \Rightarrow \frac{\partial C_N}{\partial \theta} = \frac{\partial C_N}{\partial \tau} \frac{\partial \tau}{\partial \theta} = 0$. Moreover, $\frac{\partial C_N}{\partial \theta} = \frac{\partial C_N^H}{\partial \theta} + \frac{\partial C_N^L}{\partial \theta} = 0 \Rightarrow \frac{\partial C_N^H}{\partial \theta} = -\frac{\partial C_N^L}{\partial \theta} = \frac{\partial C_N^L}{\partial (1-\theta)}$.

demand for the rich. Consequently, the aggregate demand of the non-traded goods (C_N) falls in response to an increase in the political power index for the rich. Third, on the left-hand side of the ideal point, one additional unit of political power index for the poor $(1 - \theta)$ causes an increase in the demand for the poor to be smaller than a decrease in the demand for the rich. The same as second point, the aggregate demand of the non-traded goods (C_N) falls in response to an increase in the political power index for the poor.

Let me now highlight the role of political power distribution in economic performance of a resource-dependent economy. As mentioned, it is acceptable to assume that the political power in a non-democratic country is distributed unequally in favor of the rich. Then I graphically set θ_{ND} in figure 3 to represent the political power index of the rich in these countries. Instead, in a democratic county, the political power of the rich must be set at a point between the ideal point and θ_{ND}. It is because of that, in reality, each group attempts to influence policy in various ways. For example, lobbying the rich in democratic countries or the role of parallel powerful institutions in semi-democratic countries (such as Iran, Venezuela, and most of the natural resource African countries) may be obstacles to distribute the political power evenly. Therefore, the ideal point ($\theta = 0.5$) seems to be only a theoretical and philosophical criterion so that a closer point to the ideal point reflects a larger democracy index. Figure 3 shows that a smaller index in a democratic country, with respect to that in a non-democratic country, is associated with a higher level of the demand for the non-traded goods. In other words, the response of economic performance to a windfall income will be stronger in a democratic country than that in a non-democratic country. As a conclusion, it seems that a redistribution of the political power in favor the poor (larger democracy index) causes the natural resource curse (i.e. the Dutch disease and Deindustrialization) to be more intensive. Moreover, if the capital goods are used intensively in the non-traded (traded) sector, a windfall income leads the income inequality level to increase more (decrease less) in a democratic country than in a non-democratic country. In fact, if we imagine that there are two similar economies in where only the political structures are different, in response to a windfall income, the level of income inequality set for a democratic country lies above that level set for a non-democratic country.

Proposition 4: *First, the natural resource curse (i.e. the Dutch disease and Deindustrialization) seems to be more intensive in a democratic country than in a non-democratic country. Second, for both cases, the capital goods are used intensively in the non-traded or traded sector, a windfall income causes income inequality to increase more in a democratic country than in a non-democratic country.*

5   Empirical approach

This section describes the econometric methodology and provides strong evidence to support the theoretical findings. The aim of this study is to examine the contribution of income inequality to both features of the development process in natural resource economies. Therefore, I demonstrate, first, the interaction between income inequality and economic growth and, second, the role of income inequality in the structural transformation.

More precisely, in this empirical study, I try to find some evidence for the following theoretical findings.
a) If capital goods are used intensively in the non-traded (traded) sector, income inequality increases (declines) as the windfall income rises.
b) An increase in income inequality deepens the natural resource curse.
c) A decline in the absorptive capacity constraints leads to crowding out income inequality.

d) The more political participation or the higher level of democracy index, the more increase in income inequality as the windfall income rises.

5.1 Income Inequality and Economic Growth

Methodology and Data

Empirical attempts to find the interaction between income inequality and economic growth have predominantly been performed using cross-sectional regression. This procedure unable to capture the effect of a change in income inequality, within a country, on the economic growth (Barro, 2000). Accordingly, in line with the recent empirical works (e.g. Lundberg and Squire (2003); Barro (2000, 2008); Forbes (2000)), I utilize a panel data approach to elaborate this interaction. The structural model is a system of two-panel data regressions, estimated simultaneously.

$$Ineq_{i,t} = \alpha_0 + \alpha_1 \log Y_{i,t} + \alpha_2 \log^2 Y_{i,t} + \alpha_3 WI_{i,t} + \alpha_4 DTK_{i,t} + \alpha_5 (WI_{i,t} * DTK_{i,t}) + \alpha_6 Z_{1\,i,t} + \mu_{g1} + \varepsilon_{1\,i,t}$$
$$(31a)$$

$$GY_{i,t} = \beta_0 + \beta_1 \log Y_{i,t} + \beta_2 Ineq_{i,t} + \beta_3 WI_{i,t} + \beta_4 (WI_{i,t} * Ineq_{i,t}) + \beta_5 Z_{2\,i,t} + \mu_{g2} + \varepsilon_{2\,i,t}. \qquad (31b)$$

The first regression model estimates the impact of windfall income on income inequality under the condition of sectoral capital intensity, while the second equation is a multiple regression model with an interaction term between windfall income and income inequality, also known as a moderated regression model. The model allows us to evaluate the overall impact of windfall income on economic growth and also to clarify the role of income inequality, as one of the transmission channels, in economic performance [71].

In my benchmark, the subscripts $i = 1, ...N$ and $t = 1, ...T$ index the countries and periods in the panel, respectively. In Equation 31a, *Ineq* denotes income inequality, $\log Y$ stands for the natural logarithm of per capita GDP (or income) and $\log^2 Y$ is included to assess the validity of Kuznets curve. I measure the windfall income (WI) by the percentage share of total natural resources rents of GDP. DTK is a dummy variable equal to one whenever the traded sector is relatively capital-intensive. Further, in equation 31b, GY is the average growth rate of per capita GDP [72] and $\log Y$, the natural logarithm of per capita GDP, is estimated to test the hypothesis of the convergence result in balance growth models. Z_1 and Z_2 are the vectors of control variables that are expected to affect income inequality and growth rate, respectively. Moreover, μ_g is a country-group time invariant unobservable effect and $\varepsilon_{i,t}$ denotes the disturbance term. The unbalance panel sample comprises 40 countries and covers the available data observed from 1975 to 2015 [73].

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[71] The aim of this empirical procedure is not to systematically analyze both direct and indirect effect, through changing income inequality, of resource rent on the outcome. A moderated mediation model proposed by Muller et al. (2005) could be used to deal this issue.

[72] Note that to capture the adverse effect of natural resource rent on the economic performance we can replace the growth rate of Non-Windfall GDP instead of total growth rate, however, my survey shows no significant difference in results.

[73] The countries included in the sample database is: Albania, Argentina, Australia, Azerbaijan, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, Ethiopia, Honduras, India, Indonesia, Iran, Kazakhstan, Kyrgyz Republic, Malaysia, Mexico, Mongolia, Morocco, New Zealand, Norway, Pakistan, Paraguay, Peru, Philippine, Romania, Russia, South-Africa, Thailand, Trinidad and Tobago, Ukraine, United Kingdom and Venezuela.

The average for 5-year periods of per capita GDP (PPP in constant 2011 international dollars) [74] and Total natural resources rents (percentage of GDP), a proxy for the windfall income (per capita) level, are sourced from the World Bank's World Development Indicator Database (WDI). Also, income inequality, measured by Gini index, is collected from University of Texas Inequality project dataset [75].

As theoretically described, the sectoral factor intensity is an essential element to describe the mechanism of the proposed model. To capture this condition, I first construct an index, ratio of the traded sector labor share to the non-traded sector labor share (relative labor share) (*RLS*), and then use the index to specify a dummy variable (*DTK*), equal to one whenever the capital goods are intensively used in the traded sector. The equalization of the marginal product of labor in two sectors, under Cobb-Douglas production functions, gives the relative labor share (the traded to the non-traded).

$$RLS_{i,t} = \frac{1-\alpha_{i,t}}{1-\beta_{i,t}} = P_{i,t} \frac{X_{N_{i,t}}}{X_{T_{i,t}}} \frac{L_{T_{i,t}}}{L_{N_{i,t}}} \ . \tag{32}$$

This relation indicates that the traded sector is relatively capital-intensive (i.e. $\alpha > \beta$) if $RLS_{i,t} < 1$. Accordingly, the dummy variable is specified as following:

$$DTK_{i,t} = \begin{cases} 1 & if \quad RLS_{i,t} < 1 \Leftrightarrow \alpha_{i,t} > \beta_{i,t} \\ 0 & if \quad RLS_{i,t} > 1 \Leftrightarrow \alpha_{i,t} < \beta_{i,t} \end{cases} \tag{33}$$

To determine the relative labor share ratio ($RLS_{i,t}$), we face the fundamental issue of how to define a traded and non-traded sector. Consistent with the proposed theory, the final goods produced by the traded sector can move across borders, while the final goods produced by the non-traded sector cannot be importd or exported.

The first step to determine *RLS* is to measure the price indexes of the traded and non-traded goods and so to approximate the real exchange rate. In this paper, according to the available data, I follow one of the conventional procedures used to specify price indexes (for other procedures see Engel (1999); Betts and Kehoe (2008)). The price of the non-traded goods is measured by consumer price index (*CPI*), classifying service and housing as the non-tradables and commodity as the tradables. Also, the producer price index (*PPI*) [76] is often considered as a logical proxy for the price of the traded goods since it does not comprise services and is heavily weighted by the tradables. The data of *CPI* and *PPI* are collected from *WDI*, *UNCTADstat*, *UNdata* and *OECD* databases.

In the second step, I apply "the International Standard Industrial Classification of all economic activities" (*ISIC Rev.*3.1) proposed by United Nation to classify the traded and non-traded sectors and so to determine the sectoral value-added shares, defined by *TV* and *NTV*, respectively [77] (See. Appendix D).

$$\begin{aligned} TV &= AV - FV + MV \\ NTV &= \underbrace{IV - MV + FV - NR}_{CV} + SV. \end{aligned} \tag{34}$$

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[74] The WDI database doesn't provide GDP per capita dataset before 1990. I calculate the missing data from 1970 to 1989 (every year) using the following formula: $Y_{t-1} = \frac{Y_t}{1-(GY_t/100)}$. GY_t denotes growth rate of GDP per capita which in turn is calculated by the available dataset of population growth (*GN*) and rate of GDP growth (*G*), taken by WDI database, as following: $GY_t = \left[\frac{1+(G_t/100)}{1+(GN_t/100)}\right] * 100$.

[75] The Estimated Household Income Inequality dataset (EHII) is derived from the econometric relationship between UTIP-UNIDO and the World Bank's Deininger and Squire (1996) dataset (i.e. Galbraith and Kum (2005)).

[76] It is also known as the Wholesale Price Index (*WPI*).

[77] Although the presented theory has developed based on the final consumption expenditure approach, the lack of data forces us to apply the value-added approach (for more information see Herrendorf et al. (2013*a*)).

AV, *MV* and *FV* denote agriculture, manufacturing, and forest value-added shares, while service, industry, and construction value-added shares are respectively represented by *SV*, *IV*, and *CV*. Further, *NR* signifies total natural resource rent. The data is sourced from *WDI* and *UNdata* databases.

The natural resource sector (e.g. oil, natural gas, mines, and forests) is normally physical capital oriented (Bohn and Deacon, 2000) and requires less human capital than other productive-sectors (Gylfason and Zoega, 2006). Moreover, in line with the theory, we need only consider the labor share of the primary production of resource sector and not the labor share of processing, service to production and wholesale. As an evidence, statistic analysis for Canada over 1991-2001 shows that approximately one percent of total employment worked in the primary production of mining and energy sectors (Alasia and Hardie, 2011). Accordingly, we can assume the employment share of the resource sector is negligible and thus the employment share of the traded sector will be the sum of the shares of labor force in agriculture and manufacturing sectors (i.e. $L_T = L_A + L_M$) [78]. The data for employment share of agriculture, service, and industry sectors are available and are collected from *WDI* database. To estimate the employment shares in manufacturing and construction sectors, two components of industry sector, I assume that in each period the ratio of their employment shares is proportional to the ratio of their value-added shares. In other words, their capital intensities (or capital share) are supposed to be equal [79]. The average (over time periods) of the estimated relative labor share ratio for each country (RLS_i) is reported in Table I.

In line with the recent empirical studies, I suggest several control variables for each regression model. Firstly, income inequality is affected by human capital accumulation. Knight and Sabot (1983) show empirically that the expansion of education increases the relative size of the group with higher education and tends initially to expand wage inequality, but eventually to shrink it. Under a political economy model, Saint-Paul and Verdier (1993) argue that the poor vote to set a higher tax rate when the inequality level is initially high. It is because of that a higher tax rate causes more public education to be redistributed in favor of them. Accordingly, the inequality level declines as the human capital grows over time. Further, Gregorio and Lee (2002) demonstrate empirically that a higher educational attainment and an equal distribution of education make income distribution be more evenly. Our measure of human capital is an index constructed by *Penn World Table*. This index is based on Barro and Lee (2013) database for the average years of schooling and an estimated rate of return for primary, secondary, and tertiary education, introduced by Caselli (2005). Following the recent work of Barro (2008), I observe human capital index at the start of each period.

Investment is also closely linked with income inequality. Investment in infrastructure helps the lower income group to be connected to core economic activities and so to access the additional productive opportunities. Accordingly, one seems that infrastructure investment (investment in the non-traded goods) tends to increase the average income of the lower income group. The hypothesis is empirically confirmed by López (2003). The investment ratio [80] observed as averages for the 5-year periods, the same as in Barro (2008), is derived from *WDI*.

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[78] Employment share of the non-traded sector is the rest of share (i.e. $L_N = L_S + L_C = 1 - L_T$).

[79] As another logical case, we can assume in each period the labor share ratio of manufacturing to construction sectors ($RLS_{M,C}$) is equal to that ratio of the traded to the non-traded sectors (RLS), denoted in equation 32. We can use an iteration approach to estimate a converged ratio. More precisely, an initial value of $RLS_{M,C}$ is supposed to equal one, the same as the latter case, and so the initial value of RLS will be estimated. In the next iteration, we replace the former value of $RLS_{M,C}$ by the value of RLS estimated in the last iteration and then approximate a new value for RLS. This algorithm can be repeated insofar as the estimated value is unchangeable. However, the dummy variable (i.e. $DTK_{i,t}$) defined by this approach will be similar to the former case. We can prove this claim by showing the following relation: $L_M = \frac{L_I}{1 + \frac{(P\,X_C)/X_M}{RLS_{M,C}}}$. It demonstrates that if the initial value of RLS becomes larger (smaller) than one, the final value of RLS, and so the final value of $RLS_{M,C}$, converges to a value bigger (smaller) than the initial value. Therefore, applying each of these cases does not affect our final regression results.

[80] Gross capital formation, in the percentage of GDP, is used to proxy the investment ratio.

Table I: Average (over time periods) of the estimated relative labor share ratio

	Period	*RLS*		Period	*RLS*
Albania	1995-2015	3.568	Kazakhstan	1995-2015	2.458
Argentina	1990-2015	0.746	Kyrgyz Rep.	1995-2015	1.596
Australia	1975-2015	0.904	Malaysia	1985-2010	1.463
Azerbaijan	1995-2010	4.351	Mexico	1985-2015	1.650
Bolivia*	1975-2010	0.865	Mongolia	1990-2010	1.971
Brazil	1980-2015	1.976	Morocco	1990-2010	2.122
Bulgaria	1995-2015	1.389	New Zealand	1985-2015	1.080
Canada	1975-2015	0.792	Norway*	1975-2015	1.174
Chili	1975-2015	1.261	Pakistan	1975-2015	2.497
China	1985-2015	1.951	Paraguay	1995-2015	1.368
Colombia*	1975-2015	0.690	Peru	1990-2015	0.514
Costa Rica	1985-2015	1.328	Philippine*	1975-2015	1.168
Dominican Rep.*	1990-2015	1.114	Romania	1995-2015	2.375
Ecuador	1985-2015	0.643	Russia	1995-2015	1.495
Egypt	1990-2010	1.451	South Africa	1995-2015	1.360
Ethiopia	1995-2010	4.588	Thailand	1975-2015	3.667
Honduras*	1975-2015	1.140	Trinidad and Tobago	1980-2005	1.050
India	1980-2010	3.032	Ukraine	2000-2015	1.408
Indonesia	1985-2015	2.079	United Kingdom	1990-2015	1.074
Iran	1995-2015	2.049	Venezuela*	1975-2015	0.989

* These countries exhibit both types of observation (i.e. *RLS* > 1 and *RLS* < 1).

The main idea proposed to describe the Kuznets curve is the reallocation of economic activity across sectors (i.e. structural transformation) (Barro, 2008). A ratio of value-added of the non-traded to the traded sector and a ratio of the labor force employed by the non-traded sector to that employed by the traded sector are applied as two different proxies [81] to measure structural transformation. Considering that most of the economies included in the sample dataset are classified as developing countries, it is likely that income inequality arises as the proxies increase (see. Barro (2000)).

Furthermore, I investigate the trade openness' effects. Heckscher-Ohlin (*HO*) theory in which developing and developed countries are respectively supposed to be labor and capital (or human capital) abundant predicts that a large openness level declines income inequality in developing countries but increases income inequality in developed countries. This hypothesis has been perused empirically by other researchers (e.g. Anderson (2005) and Meschi and Vivarelli (2009)). I collect data of trade to GDP ratio, a proxy for openness level, from *WDI* database [82].

Finally, I represent an indicator to discuss the political economy's aspects of the present model. The effect of income inequality on political participation has recently been studied (e.g. Solt (2008); Anderson and Beramendi (2008)). These empirical studies all find that the higher level of income inequality, the lower amount of political participation. Nevertheless, it is somewhat surprising that the opposite dependence (i.e. the impact of political participation on income inequality) seems to remain in the black box. As illustrated in the preceding section 4, the theory forecasts that more political participation (a proxy for democracy) leads to more inequality change. To test this hypothesis, I collect the average data of voice and accountability indicator, proposed by *World Bank's Governance Indicators Project*,

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[81] Note that I measure the average of proxies for each 5-year periods.

[82] The trade to GDP ratio is observed as averages for 5-year periods, the same as Barro (2008) proposed.

for each period [83]. The indicator reflects political participation of country's citizens as well as freedom of expression, freedom of association, and a free media [84].

A review of recent empirical studies intended to estimate economic growth (equation 31b) reveals that most of them employ several determinants for the regression model. First, per capita growth rate of natural resource economies can be related to human capital level. Natural resources seem likely to decelerate economic growth in countries with the lower level of human capital (Gylfason et al., 1999; Bravo-Ortega and De Gregorio, 2005).

Growth is also associated with the investment. An analysis of data for 94 countries over the period 1960-2000 suggests that an increase in investment ratio predicts a higher growth rate in the long run (Bond et al., 2010). Agénor (2012) points out that increase of public investment raises the labor productivity as well as the private capital and thereby accelerates growth rate. Moreover, investment in infrastructure enables producers and consumers to be better integrated into the market (Bourguignon and Sundberg, 2006). The contribution of infrastructure to economic growth has empirically been discussed by López (2003). He found that increasing telephone density as infrastructure indicator raises the rate of economic growth. In the context of resource economies, windfall income decreases incentives to save and thereby decelerates growth rate (Gylfason and Zoega, 2006), however, in some sub-Saharan countries invested resource revenue in the development of transport infrastructure and irrigation (e.g. Chad) has increased the capital stock and the technical progress for several years (Levy, 2007).

Trade openness in mineral dependent economies seems to have a negative impact on growth rate. Falkinger and Grossmann (2005) propose a model and argue that in a closed economy the owners of natural resources tend to support education to rise the labor productivity level and so to develop the domestic production. In contrast, in a open economy it is likely that the owners of natural resources have no incentive to reinforce domestic production. Therefore, from this viewpoint, trade openness may make growth slower. This hypothesis is confirmed empirically in the study by Butkiewicz and Yanikkaya (2010).

Following the theory as well as the recent literature (Collier and Hoeffler, 2005) [85], I include voice indicator, a proxy for political participation (power) and level of democracy, to check the existence of a negative correlation between political power and economic growth.

The coefficients of Gini and growth regression models are estimated by the Instrumental Variables Three-Stage Least Squares ($IV3SLS$) approach, like Lundberg and Squire (2003). The simultaneous causality between income inequality and per capita GDP level can lead to endogeneity problem. More precisely, Gini index observed at time t is correlated to per capita GDP level in the same period and is thus correlated with the error term. It states that the hypothesis of non-correlation between the explanatory variables and error is relaxed. The standard way to deal with this type of bias is to apply the instrumental variables regression. Therefore, to avoid endogeneity bias in growth regression (equation 31b), I use the five-year lagged value of the Gini index, as an instrument, instead of the current value [86].

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[83] The data are observed form 1996 to 2015. For preceding periods, the indicator is assumed to be equal the earliest value available.

[84] The indicator is in the range of approximately -2.5 (weak) to $+2.5$ (strong).

[85] They suggest that in natural resource developing economies a more slowly growth rate is associated with a larger democracy index.

[86] It is important to note that windfall income indicator (WI) is also measured for the lagged value and following Barro (2000, 2008), $logY$ is observed at the start of each period.

Estimation analysis

Let me now discuss the results of my empirical analysis [87]. The baseline model estimates the average empirical association for pooling data of the countries included in the dataset. I first summarize the pairwise correlations between the main independent variables of the baseline model. As shown in Table II, windfall income is positively associated with income inequality (Gini index) and also per capita GDP level, while income inequality, *per se*, is negatively correlated with per capita GDP level. In other words, more windfall income, by rising income inequality, is likely to be accompanied by lower GDP per capita level. Hence, this simple correlation matrix reveals the crucial role of income inequality in the evaluation of windfall income's effects on economic performance of resource economies.

The matrix correlation can also be used to investigate the multicollinearity problem [88] in the panel growth regression (equation 31b). Although the correlation between the interaction term and windfall income is really high, it does not seem to be the main issue. That is why a high correlation between the interaction term and independent variable (windfall income in the regression model), unlike the case of a high correlation between two independent variables, does not reflect the multicollinearity problem (Disatnik and Sivan, 2016).

The presence of unobservable heterogeneity across countries is rejected using a *Breusch − Pagan Lagrange multiplier* test [89]. It would mean that random-effects estimators could be appropriate and so the pooled estimators, which ignore heterogeneity across individuals, could be applied. On the other hand, given the fact that country heterogeneity may undermine the reliability of the empirical results, the baseline specification may need to include fixed-effects estimators [90]. Following Bester and Hansen (2016), I consider a grouped-effects estimator as intermediate to pooled and fixed effects estimators to better control for unobserved time-invariant heterogeneity [91]. In light of the fact that high-income countries usually document a lower level of absorptive capacity constraints [92], I specify the grouped-effects dummy variables based on income country classification. The dummy variables are categorized into three country-groups, based on the classification of the *World Bank*: 1) high income, 2) upper−middle income and 3) lower− middle and low-income economies. Moreover, this estimation includes a separate intercept for each time period [93].

The empirical results for income inequality regression model (i.e. equation 31) are reported in Table III. Column (1) presents the empirical estimations for the baseline specification that includes country-group fixed effects and time dummy variables. As the first point, the results of Table III show that there is a significantly positive and negative impact on income inequality from per capita GDP and squared per capita GDP, respectively. This represents a clear evidence of a quadratic relationship between income inequality and income per capita, called *Kuznets curve*.

The human capital index and investment ratio enter with a negative sign and are significant at 1 percent. In line with the empirical findings proposed in the literature, these results acknowledge that a higher educational attainment makes the income distribution be more evenly (Gregorio and Lee, 2002) and investment in infrastructure improves the redistribution of income in favor of the poor (López, 2003).

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[87] All estimation and statistical tests described in continue are carried out using STATA 14.2 software.

[88] Multicollinearity problem occurs when two independent variables of a regression model are highly correlated.

[89] A test for the baseline specifications of income inequality and economic growth has a *p − value* of 0.000 and 0.008, respectively.

[90] The *Hausman* test checking that the preferred model is random effects is rejected with a *p − value* of 0.000 and 0.04 for income inequality and economic growth regressions, respectively.

[91] The estimation shows that applying the fixed-effects estimators do not change the qualitative results.

[92] Referring to poor governance, lack of human capital and physical capital (Bourguignon and Sundberg, 2006).

[93] A test that these time dummy variables are jointly equal to zero is rejected with a *p − value* of 0.000 and 0.036 for income inequality and growth regression models, respectively.

Table II: Correlation Matrix for the main independents

	Windfall income	Gini index	per capita GDP (Log)	Windfall income *Gini index
Windfall income	1			
Gini index	0.1374**	1		
per capita GDP (Log)	0.1318**	-0.4486***	1	
Windfall income*Gini index	0.9901***	0.2292***	0.1145*	1

Note: ***, ** and * denote significance at 1, 5 and 10 precent levels, respectively.

From my point of view, increasing human capital or developing public investment is paraphrased as decreasing absorptive capacity constraints. Therefore, an increase in the human capital index or the investment ratio tends to reduce unit-cost function and so leads to crowding out income inequality. Overall, these findings seem to present some strong evidence to support Proposition 3.

Furthermore, I find that a larger value-added or labor force ratio is significantly related to a higher level of income inequality. Considering that first, most of the countries included in the dataset are developing economies and second, the baseline model estimates the average empirical association for the sample database, these findings seem to be acceptable to confirm the main idea behind the *Kuznets hypothesis*. Precisely, the findings argue that in a development process along which structural transformation and adoption of market forces are adjusted, income inequality first rises and then as the market forces become widespread it tends to decline.

There is a significantly negative correlation between the openness index and income inequality. It implies that a one-standard-deviation increase in the openness index reduces the income inequality level by about 2 % per year. Since most of the countries included in the dataset are likely to be considered as the labor-abundant developing countries, this finding seems to represent evidence for the prediction of Heckscher-Ohlin (HO) theory.

Finally, the empirical analysis demonstrates that windfall income is positively associated with income inequality, the same as recent empirical studies (Buccellato et al., 2009; Gylfason and Zoega, 2002; Scognamillo et al., 2016)[94]. The significant coefficient stresses that income inequality level, on average, rises by about 17 % per year as a one−standard−deviation increases in windfall income. This robustness of correlation unfolds the importance of mineral resource endowments, rather than other determinants such as trade openness, in income distribution (Bourguignon and Morrisson, 1990).

Following the theory, a distinction of economies, based on the relative labor share ratio, to the non-traded capital-intensive and non-traded labor-intensive, can help us to better understand the link between windfall income, economic growth, and income inequality. Hence, I next include the relative labor share ratio (RLS) to test this hypothesis. The result is reported in Table III, Column (2). The relative labor share ratio enters with a significant positive sign and suggests that the larger the capital-intensive non-traded sector, the higher the level of income inequality.

The impact of relative labor share ratio on income inequality, in the presence of the level of absorptive capacity constraint, has been investigated in Table III, Column (3). It seems that we can postulate log of per capita GDP as a proxy for absorptive capacity constraints since low-income countries have usually exhibited the higher level of constraint and high-income countries, in contrasts, have documented the

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[94] Buccellato et al. (2009); Gylfason and Zoega (2002) do a cross-sectional study and apply an orthogonal assumption to ignore the endogeneity problem, arising across equations, while Scognamillo et al. (2016) follows a panel data study and drops the assumptions so that growth rate regression includes income inequality and vice versa.

Table III: Estimation results for Income Inequality

Explanatory variable	(1)	(2)	(3)	(4)	(5)	(6)
Log (per capita GDP)	110.3***	124.3***	130.3***	124.8***	124.6***	112.9***
	(9.022)	(9.628)	(10.66)	(9.577)	(9.591)	(10.63)
Log (per capita GDP) squared	-15.60***	-17.33***	-17.99***	-17.38***	-17.43***	-15.91***
	(1.211)	(1.278)	(1.368)	(1.272)	(1.275)	(1.405)
Human Capital index	-3.725***	-3.504***	-3.361***	-3.699***	-3.597***	-3.639***
	(0.592)	(0.583)	(0.584)	(0.587)	(0.585)	(0.578)
Investment ratio	-0.146***	-0.181***	-0.169***	-0.183***	-0.173***	-0.149***
	(0.0332)	(0.0338)	(0.0324)	(0.0336)	(0.0342)	(0.0352)
Value added ratio (NT to T sector)	0.711***	0.430*	0.647**	0.485*	0.394*	0.697**
	(0.264)	(0.267)	(0.274)	(0.275)	(0.268)	(0.292)
Labor force ratio (NT to T sector)	0.583***	0.973***	0.892***	0.9262***	0.963***	1.124***
	(0.185)	(0.210)	(0.212)	(0.230)	(0.209)	(0.217)
Openness index	-0.0164**	-0.0152**	-0.0153**	-0.0136**	-0.0162**	-0.0139**
	(0.00700)	(0.00688)	(0.00680)	(0.00693)	(0.00690)	(0.00688)
Windfall income	0.166***	0.165***	0.141***	0.176***	0.188***	0.145***
	(0.0316)	(0.0310)	(0.0328)	(0.0324)	(0.0356)	(0.0396)
Relative labor share ratio (T to NT sector)		0.993***	3.274**	1.093***	0.940***	0.958***
		(0.266)	(1.342)	(0.279)	(0.268)	(0.264)
(Relative labor share ratio) * Log (per capita GDP)			-0.671**			
			(0.326)			
Dummy TK (T is relatively Capital intensive)				1.476*		
				(0.769)		
Dummy TK * Windfall income				-0.162*		
				(0.0892)		
Voice Indicator (Political participation)					0.571	1.606***
					(0.428)	(0.602)
Voice Indicator* Value added ratio						-0.577**
						(0.239)
Constant	-141.38***	-170.1***	-183.6***	-171.9***	-169.8***	-148.5***
	(17.22)	(18.62)	(21.36)	(18.50)	(18.55)	(20.30)
Country-group fixed effects	YES	YES	YES	YES	YES	YES
Time period fixed effects	YES	YES	YES	YES	YES	YES
Observations	223	223	223	223	223	223
R-squared	0.756	0.764	0.770	0.768	0.766	0.772

Note: The dependent variable is Gini index. Standard errors are reported in parentheses. ***, ** and * denote significance at 1, 5 and 10 precent levels.

lower level of the constraint. The significantly negative coefficient on the interaction term between the relative labor share ratio and per capita GDP (in log) indicates that the effect of capital intensity level (*RLS*) on income inequality is stronger for low-income countries and this impact attenuates as the income level rises. These findings encourage us to declare that the high level of income inequality in most of the resource economies (Boyce and Ndikumana, 2012) may originate from two following reasons: 1) a high level of absorptive capacity constraints 2) their non-traded sector is relatively more capital intensive than the traded sector.

In Table III, Column (4), I attempt to test the hypothesis described in Proposition 2, if capital goods are used intensively in the traded sector, income inequality will decline as windfall income rises. The baseline model includes a dummy variable (*DTK*), equal to one when the traded sector is relatively capital intensive. The interaction term between dummy variable and windfall income index enters with a negative sign and is significant at 10 percent. The lower significance level is most likely to be driven by the fewer number of observations in which *RLS* is less than 1 (see. Table I). However, the result follows the theoretical prediction, if the capital intensity is dominated in the traded sector, an increase in windfall income is associated with a decrease in income inequality level.

To evaluate the political economy's findings of the model, I next add voice indicator (a proxy for democracy index) to the baseline specification model. The estimated coefficient, reported in Table III Column (5), is insignificant. This may originate from mix heterogeneity across countries that attenuate the correlation. Further, it can be supplemented by the point that a change in the political power indirectly influences income inequality through a change in the relative demand and so reallocation of factors. Therefore, it is likely to disappear the robustness of correlation coefficient. To capture this indirect impact, I include an interaction term between voice indicator and the value-added ratio (NT to T), as a proxy to represent a change in the relative demand and reallocation of factor inputs. Table III, Column (6) reports the result. The voice indicator is significant at 1 percent and enters with a positive sign, as the present theory foretastes (i.e. Section 4). The average estimated outcome seems to be clear evidence to support Proposition 4, the more political participation (power) and so the higher level of democracy index, the more increase in income inequality or, in other words, more sensitivity of income inequality to increase of democracy index. Furthermore, the significantly negative coefficient on the interaction term infers that the impact of an increase in political participation on income inequality is stronger in countries with the lower level of value-added ratio. Considering that the lower level of the value-added ratio is associated with the higher level of income inequality [95], the income distribution has the more sensitivity to a change in the political power index (see. section 4). Consequently, even if an expansion of the political participation (voice indicator) leads to a small increase in the political power of the poor (i.e. an increase in democracy index), a change in the relative income, relative demand and so reallocation of labor and capital may be intensive.

Table IV presents the estimated coefficients for the determinants of GDP growth (i.e. equation 31b). The main findings of Column (1) reporting the results of the baseline specification model are as follows. First, the log of per capita GDP has a significantly positive coefficient. It seems to confirm the hypothesis that low-income countries tend to grow faster than high-income countries, holding fixed the other explanatory variables. Second, the human capital index, as well as the investment ratio, enters with a significantly positive sign. In line with the recent empirical studies (Gylfason et al., 1999; Levy, 2007; López, 2003; Bond et al., 2010), these findings accentuate the role of investment in the non-traded capital goods (e.g. human capital and structure) to accelerate the GDP per capita growth rate. In other words, the results reveal that a decline in the level of absorptive capacity constraint is likely to stimulate

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[95] It can be concluded from the point that the lower level of the value-added ratio is associated with the lower level of GDP per capita (see. Figure 4) and the lower level of GDP per capita, in turn, is associated with the higher level of income inequality (see. Table II).

Table IV: Estimation results for Economic Growth

Explanatory variable	(1)	(2)
Log (per capita GDP)	-4.556***	-4.472***
	(0.776)	(0.740)
Human Capital index	1.492***	1.297***
	(0.475)	(0.453)
Investment ratio	0.177***	0.172***
	(0.0253)	(0.0241)
Openness index	-0.000650	-0.000237
	(0.00517)	(0.00493)
Voice Indicator (Political participation)	-0.557*	-0.619**
	(0.325)	(0.311)
Gini index	0.0661*	-0.0754*
	(0.0344)	(0.0432)
Windfall income	-0.0140	-1.056***
	(0.0286)	(0.228)
(Windfall income) * (Gini index)		0.0228***
		(0.00495)
Constant	9.330**	16.31***
	(4.184)	(4.209)
Country-group fixed effects	YES	YES
Time period fixed effects	YES	YES
Observations	223	223
R-squared	0.436	0.489

Note: The dependent variable is average growth of GDP per capita. ***, ** and * denote significance at 1, 5 and 10 precent levels.

per capita GDP to expand faster. Third, a negative sign of the estimated coefficient for openness index seems to be consistent with the literature (Falkinger and Grossmann, 2005; Butkiewicz and Yanikkaya, 2010). However, the coefficient is insignificant and has a negligible amount. This may reflect that the mixture of cross-country heterogeneity has weakened the robustness of correlation or that the relation has fluctuated over time. Finally, a 1% increase in voice indicator (i.e. political participation) estimates to decelerate GDP per capita growth rate by approximately 0.6% annually. It highlights the proposed hypothesis that an increase in democracy index and so a change in the political power in favor of the poor, through an increase in relative demand of the non-traded to the traded goods, not only rises income inequality level but also reduces the rate of GDP per capita growth (i.e. proposition 4).

Furthermore, in column (1) of Table IV, the estimated positive coefficient for the correlation between income inequality and GDP per capita may challenge the theoretical finding, predicting a negative sign for the correlation. It may support the conventional hypothesis that an uneven distribution of national income in favor of the rich (a higher level of income inequality) makes the saving increase and thereby economic growth expand at a higher rate (Forbes, 2000). Nevertheless, the empirical studies (Forbes, 2000; Barro, 2000) point out that inequality is bad for growth in low-income countries but good for growth in high-income countries. Therefore, considering that most of countries included in the panel dataset are classified as developing countries (not high-income countries or developed countries), the interpretation proposed for the average estimated coefficient does not seem to be acceptable. This theme can be made clear when we observe the impact of windfall income on growth. Although the estimated coefficient for resource dependence index (a proxy for windfall income) is negative and so it follows

the recent findings of the natural resource curse (e.g. Gylfason and Zoega (2002); Scognamillo et al. (2016)), its robustness is insignificant and the magnitude of the coefficient is negligible. This result may arise because of a trade-off between income inequality and growth performance (Forbes, 2000). To address this concern, overall treatment effect of windfall income on economic growth, I include an interaction term. The results of this regression estimation are reported in Table IV, column (2). Despite the previous results, income inequality enters with a negative sign and windfall income is significant. The negative sign for income inequality could intuitively mean, following the theory, a rise in inequality level, through increasing the relative demand of the non-traded to the traded goods (the luxury to the necessary goods) and so a reallocation of factor inputs, decelerates the average rate of economic growth. Moreover, the interaction term is positive and significant at 1 percent. This point, besides the negative sign for income inequality and economic growth, implies that, on average, the adverse impact of income inequality on GDP per capita growth rate is stronger in the natural resource-poor countries. More precisely, given the fact that in all natural resource-rich countries [96] the non-traded sector is relatively capital-intensive (see. Table I) rising income inequality is likely to be compensated by distributing a larger share of the rent in favor of the poor and so, as a consequence, the adverse impact of income inequality on economic growth is likely to be moderated.

5.2   Income Inequality and Structural transformation

Methodology

Aligned with the theoretical model, I formulate an empirical approach to analyze structural transformation in the resource economies. The empirical regression models (i.e. the structural model), given below, are simultaneously estimated by an Instrumental Variables Three-Stage Least Squares (*IV3SLS*) technique [97].

$$Ineq_{i,t} = \alpha_0 + \alpha_1 \log Y_{i,t} + \alpha_2 \log^2 Y_{i,t} + \alpha_3 WI_{i,t} + \alpha_4 Z_{1\,i,t} + \mu_{g1} + \varepsilon_{1\,i,t} \tag{35a}$$

$$D_{i,t} = \gamma_0 + \gamma_1 \log Y_{i,t} + \gamma_2 \log^2 Y_{i,t} + \gamma_3 WI_{i,t} + \gamma_4 Ineq_{i,t} + \gamma_6 Z_{3\,i,t} + \mu_{g3} + \varepsilon_{3\,i,t}. \tag{35b}$$

The dependent variables are income inequality ($Ineq_{i,t}$) and an index measuring structural transformation level ($D_{i,t}$). Two common measurements of structural transformation are the relative employment (labor) and value-added shares (the non-traded to the traded sector). A natural logarithm of per capita GDP and its square (i.e. $\log Y$ and $\log^2 Y$) are included to investigate the relationship between structural transformation and income level and thus to evaluate the Kuznets hypothesis. The percentage share of total natural resources rents of GDP, as in the previous estimations, is used as a proxy for windfall income (WI). As discussed in detail, there is a tendency in the literature to make clear how an economic activity responds to a change in the inequality level. The core hypothesis is that the relative demand of the non-traded to the traded goods increases as income inequality rises. The immediate impact is to expand the non-traded sector and to shrink the traded sector (for both employment and value-added shares). To test the hypothesis, Gini index is recommended to represent the income inequality level. Since it is likely that some other factors cause the structural transformation to change, an explanatory

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[96] The resource economies, having a windfall income index (percentage share of total natural resource rents of GDP) bigger than 10, are Azerbaijan, Chili, Ethiopia, Iran, Kazakhstan, Malaysia, Mongolia, Russia, Trinidad and Tobago and Venezuela.

[97] The instrumental variables are the same as the previous section (5.1).

variable vector, denoted by Z_3, is applied in the baseline regression model [98].

Human capital could be one of the drivers of structural transformation. One way to understand this matter is to disentangle the implication of skilled labor-augmenting technological progress. It states that an improvement in the general level of technology causes the relative labor productivity of skilled to unskilled workers to rise. As an immediate impact, human capital intensive industries grew faster (Ciccone and Papaioannou, 2009) and thereby structural transformation happens in a higher rate (Teixeira and Queirós, 2016).

Change in the investment ratio is strongly likely to bring about structural transformation. Investment on a new technology results in structural transformation through stimulating the capital accumulation (Morrison, 1997). Furthermore, a recent study, documenting data of 40 countries between 1995 and 2011, demonstrates that the value-added originated from service sector is employed more intensively to produce the consumption goods than the investment goods (García-Santana et al., 2016). It intuitively implies that investment in the investment goods, usually produced by the traded sector, rather than in the consumption goods can crowd out the structural transformation.

Trade openness is likely to be associated with the structural transformation. According to Heckscher-Ohlin (HO) theory, the relative factor-abundant between countries and the relative factor intensity across sectors specify the pattern of comparative advantage. Precisely, suppose the economy is a labor-abundant country. Therefore, if labor is used intensively in the traded sector, the economy is likely to gain from an increase in openness index and so, as a consequence, it is likely to go through an expansion of the traded sector and a shrinkage of the non-traded sector (in terms of both employment and value-added shares).

The presented model predicts to have a positive correlation between the political power (a democracy index) and the structural change. Our theoretical finding says precisely that rising the political voice leads to the expansion of the non-traded demand and thereby the reallocation of factor inputs will be more intensive. To evaluate this finding, I add voice indicator to the vector of control variables. The relative employment (labor) and value-added shares are indirectly affected by the voice indicator through the relative demand change. As argued in the previous section (5.1), it is more likely to see a stronger impact of the political power on the relative value-added share than the relative labor employment share. Therefore, I include voice indicator in the vector of explanatory variables only when estimating the determinants of the relative value-added share.

Estimation analysis

Table V represents the estimation results of determinants for the relative employment share and relative value-added share, respectively. The regression models include fixed effects dummy variables to capture

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[98] The vector of control variables for income inequality regression model (Z_1), like the former study, includes the Human capital index, Investment ratio, Openness index and Voice indicator. Further, to avoid a simultaneous endogeneity bias (two side endogeneity), I consider the relative employment (labor) share in the vector when the relative value-added share is used to measure the level of structural transformation, while the relative value-added share is included in the vector when I estimate the relative labor share as the proxy for the level of structural transformation.
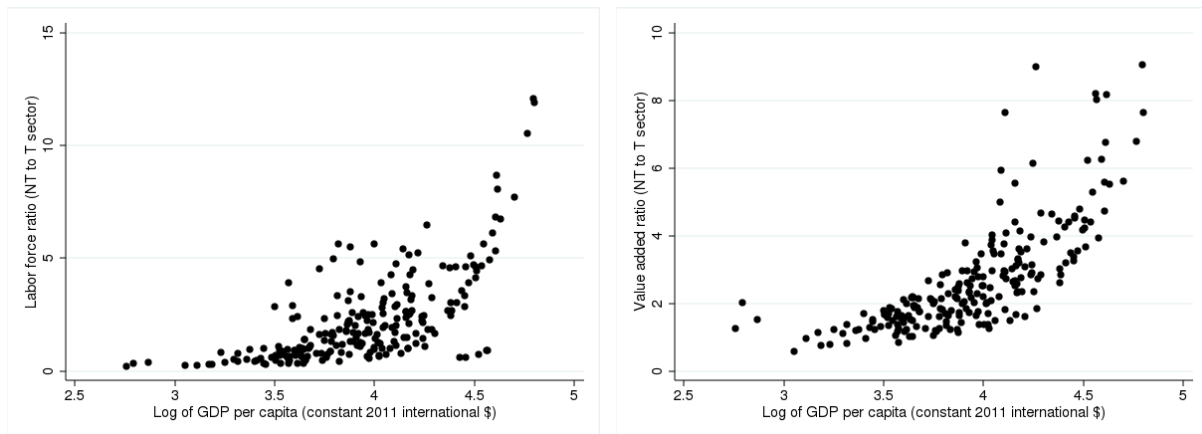
Figure 4: Relative Labor employment and Value added share

heterogeneity across group countries [99] and also time period fixed effects [100]. The regression results in columns (1) to (4) present a clear evidence of a non-linear relationship between the level of per capita GDP and the structural transformation indexes, the relative labor employment and value-added shares. The estimated coefficients of log of GDP per capita and its squared are strongly significant and enter respectively with a negative and positive sign. These results are consistent with the findings reported by Kongsamut et al. (2001) and state that along with the development process the non-traded sector expands faster than the traded sector. To make clear these stylized facts, I next graphically show the labor employment and value-added shares with respect to per capita GDP levels (see. Figure 4).

The plots reveal two patterns of structural transformation. First, when the level of GDP per capita is small (i.e. a low level of development), the relative share for the value-added is larger than that for the labor employment. Although the traded sector (e.g. agriculture sector) has the lowest level of productivity among sectors, this result implies that in low-income countries a larger share of the labor force is employed in the traded sector [101]. Second, when the log of GDP per capita reaches around 4.5, the relative shares, both labor employment and value-added, tend to expand sharply. It suggests that dropping the level of absorptive capacity constraint in high-income countries pushes the non-traded sector to grow at a rate higher than the traded sector growth rate. The finding makes explicitly clear the role of absorptive capacity constraints in structural transformation. Also, it may implicitly support the hypothesis that along the development path the demand for the non-traded goods grows faster than the economic growth rate while the demand for the traded goods expands slower than the economic growth rate (i.e. Proposition 1).

The coefficient estimated for the human capital index has a significantly positive sign in terms of the relative labor employment share (column 1), while it has an insignificantly negative sign in terms of the relative value-added share (column 4). According to the theory and the recent literature (Ciccone and Papaioannou, 2009; Teixeira and Queirós, 2016), the non-identical signs may rest on the following two-step reasoning. First, in most of the countries included in the database, the capital goods are used

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[99] *Breusch − Pagan Lagrange multiplier* test for the baseline model of the relative employment (labor force) share or the relative value-added share rejects the presence of unobservable heterogeneity across countries ($p − value$ are 0.000 and 0.000, respectively). It concludes that a random-effects estimator is appropriate to use. One the other hand, a *Hausman* test for the baseline specification ($p − value$ are 0.000 and 0.035, respectively) infers that we can apply a fixed-effects estimator rather than a random-effects estimator. However, the estimation demonstrates that applying the fixed-effects estimators do not change the qualitative results.

[100]A test that the time dummy variables are jointly equal to zero is rejected with a $p − value$ of 0.003 and 0.000 for the relative employment and relative value-added shares, respectively.

[101]This finding is in line with the evidence presented by Restuccia et al. (2008).

Table V: Estimation results for structural transformation

Explanatory variable	Labor force in NT to T (1)	Labor force in NT to T (2)	Labor force in NT to T (3)	Value added of NT to T (4)
Log (per capita GDP)	-30.63***	-29.84***	-30.09***	-12.66***
	(3.907)	(3.398)	(3.767)	(2.847)
Log (per capita GDP) squared	4.442***	4.2992***	4.369***	1.913***
	(0.521)	(0.453)	(0.502)	(0.383)
Human Capital index	0.494**	0.172	0.569**	-0.112
	(0.249)	(0.223)	(0.241)	(0.179)
Investment ratio	-0.0307**	-0.0154	-0.0315**	-0.0183*
	(0.0132)	(0.0116)	(0.0131)	(0.00944)
Openness index	-0.00460*	-0.000281	-0.00506*	-0.000325
	(0.00278)	(0.00247)	(0.00273)	(0.00200)
Gini index	0.107***	0.0963***	0.125***	0.0586***
	(0.0211)	(0.0184)	(0.0239)	(0.0153)
Windfall income	-0.0322**	-0.0435***	0.0895*	0.0167*
	(0.0136)	(0.0123)	(0.0535)	(0.0115)
Dummy TK (T is relatively Capital intensive)		1.002***		
		(0.250)		
Dummy TK * Windfall income		0.0645**		
		(0.0318)		
(Windfall income) * (Gini index)			-0.00246**	
			(0.00123)	
Voice Indicator (Political participation)				0.199*
				(0.126)
Constant	48.98***	47.45***	47.11***	20.10***
	(6.929)	(6.026)	(6.703)	(4.989)
Country-group fixed effects	YES	YES	YES	YES
Time period fixed effects	YES	YES	YES	YES
Observations	223	223	223	223
R-squared	0.716	0.786	0.718	0.763

Note: The dependent variable are relative labor employment share and value added share (non-traded to traded sector). ***, ** and * denote significance at 1, 5 and 10 precent levels.

intensively in the non-traded sector (see. Table I). Second, an increase in the human capital index makes the labor productivity raise more. Consequently, the relative value-added share increases as the labor productivity rises [102] and the labor forces move from the traded sector to the non-traded sector to equalize the marginal productivity between sectors [103].

The investment ratio has a negative impact on structural transformation (see. column 1 and 4). The significantly negative coefficient may be interpreted by two following points. First, The findings of García-Santana et al. (2016) indicate that the investment goods are intensively related to the value-added

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[102]We have $\frac{X_N}{X_T} = A^{\alpha-\beta} \frac{K_N^\beta}{K_T^\alpha} \frac{L_N^{1\beta}}{L_T^{1-\alpha}}$. Considering that $\alpha < \beta \Rightarrow \frac{X_N}{X_T}$ declines if A rises.

[103]An improvement in the productivity level increases the marginal product of labor and capital more in the traded sector than in the non-traded sector. Nevertheless, the movement of the labor forces to the non-traded sector seems to be a challenge. In fact, the labor (capital) moves to the non-traded (traded) sector when, in the traded sector, increasing the marginal product of capital is much larger than that of labor. The verification of this point will be a key question left to be studied in future.

originated from the traded sector. Second, the natural resource-rich economies have a lower, and often a negative, genuine saving rates [104] (Van der Ploeg, 2011), meaning that a smaller share of the natural revenue is invested in the productive wealth [105]. Accordingly, given the fact that in resource economies, on average, the traded sector can be supposed to be relatively labor-intensive, the value-added and labor employment shares of the traded sector gain as investment raises.

For both criteria, the correlation between the trade openness index and structural transformation is negative. Nevertheless, the estimated coefficient is significant only when the relative employment share is applied as the proxy. Although the coefficients are little, the negative signs seem to support the prediction of Heckscher-Ohlin (HO) theory. More precisely, considering that most of the countries of the dataset have the labor-intensive traded sector (see. Table I) and also they can be categorized as the labor-abundant developing countries, the labor moves to the traded sector as openness index increases.

The lagged level of income inequality, for both criteria, enters with a positive sign and is significant at 1 percent. This clear evidence supports the hypothesis summarized in Proposition 2 and implies that an increase in the income inequality level tends to raise the relative labor employment and value-added shares through changing the relative demand (the non-traded to the traded goods). The findings also suggest that 1% increase in the Gini index is estimated to raise the relative labor employment and value-added shares by about 11% and 6%, respectively. In fact, as discussed, rising income inequality tends to increases the demand for the non-traded goods. But given that absorptive capacity constraints do not permit the non-traded capital goods to expand immediately, a smaller size for the relative value-added share than the relative labor employment share is understandable.

I next discuss how the windfall income affects the relative labor employment and relative-value added shares. The estimated results for the baseline specification are shown in the columns 1 and 4. When the relative value-added share is the dependent variable (i.e. column 4), the coefficient enters with a significantly positive sign. The finding is in line with the results reported by other researchers (e.g. Corden and Neary (1982); Van der Ploeg (2011)) and indicates that the economy is de-industrialized as windfall income boosts. Nevertheless, for the relative labor employment share (i.e. column 1), the estimated coefficient is significantly negative. The negative sign for the baseline specification in which the non-traded sector of most of the countries is relatively capital-intensive seems to follow the theoretical predictions. As a matter of fact, the theory foretastes that a permanent increase in windfall income tends to raise more the marginal product of a factor that is used intensively in the non-traded sector than another factor. To re-establish the relative factor price equalization, the factor inputs move towards the sector using that factor intensively. More precisely, when the non-traded sector is relatively capital-intensive, in response to a windfall income capital move to the non-traded sector to decrease the return of capital and labor move to the traded sector to increase the real wage. To support the theoretical prediction more clearly I test another case, the capital goods are used intensively in the traded sector. The estimation results are reported in the column 2. The coefficient for the interaction term enters with a significantly positive sign. This result demonstrates that the labor force moves towards the non-traded labor-intensive sector as windfall income boosts.

Since the factor reallocation is stimulated by both windfall income and income inequality, I next include an interaction term between these two variables of interest to investigate the overall treatment effect. The results reported in column 3 imply that the sign of the coefficients for both income inequality and windfall income is positive. Further, the positive coefficients for the variables of interest are accompanied by the negative coefficient of the interaction term. These argue that the impact of income inequality on the relative labor employment share is most positive for the resource-richest countries. Given that

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[104]The index represents the net changes in produced, natural and human capital stocks, valued in monetary terms.
[105]Following the theory, it indicates the investment in the traded capital goods (e.g. equipment) rather than the non-traded capital goods (e.g. structure).

resource-rich economies enable to distribute a larger share of windfall income in favor of the poor, it is more likely to see a decline in the size of the labor reallocation.

Finally, the estimation shows that the voice indicator enters with a positive sign and is significant at 10 percent when the relative value-added share is the dependent variable of the regression model. The result is consistent with the hypothesis that an economy with a high level of political participation (larger democracy index) is more sensitive to resource rent than an economy with a low level of political participation. So that, a windfall income increases the relative demand and so the relative value-added share more in a democratic country than in a non-democratic country.

6   Conclusion

This study was designed to theoretically and empirically investigate the economic performance of the natural resource dependent economies. The main contribution of this paper is to analyze the simultaneous interaction between income inequality and economic growth following a windfall income. In the theoretical model, a combination of the Dutch disease and non-homothetic preference lead to a pattern of balanced growth path along which structural transformation is adjusted (i.e. Generalized Balanced Growth Path). The same as the standard Dutch disease model, I model two kinds of goods, the traded and non-traded goods. The departure of this model from the standard framework is to apply a non-homothetic preference. Therefore, with reference to Engel's law, these goods are respectively the necessary and luxury goods. Moreover, I introduce two income-groups, the rich and the poor, and premise that the rich spend a larger share of their income on the non-traded goods (the luxury goods) than the poor do. The model is derived by two driving forces: 1) a composition of productivity growth with Learning-by-Doing (*LBD*) and capital accumulation with absorptive capacity constraint on the supply-side and, 2) a change in the relative demand of the non-traded to the traded goods on the demand-side. I clarify how driving forces are induced by a windfall income, how they cause economic growth and income inequality to change and how these two variables of interest interact. I also investigate the political economy's aspects of the theory. Notably, I analyze the response of economic performance to the redistribution of resource rents in favor of the poor and a change in democracy index.

In line with the theory, I present a panel data study to evaluate the theoretical findings. In this respect, the information data for 40 countries over the period 1975-2015 is collected, a required index, the relative labor share ratio, is constructed and corresponding to that a dummy variable is introduced. The baseline model is a system of two-panel data regressions which are simultaneously estimated by the Instrumental Variables Three-Stage Least Squares (*IV3SLS*) technique. This empirical study first shows some clear evidence to support the crucial role of income inequality in economic performance and second analyzes the Dutch disease and sectoral reallocation patterns across resource-dependent economies.

The present study yields number of theoretical findings supported by empirical evidence. First, a permanent rise in windfall income leads to the reallocation of factor inputs, shrinkage of the traded sector (i.e. Deindustrialization) and deceleration of economic growth (i.e. the Dutch disease). Second, in response to a windfall income, income inequality rises if the non-traded sector is relatively capital intensive while income inequality falls if the non-traded sector is relatively labor intensive. Third, redistribution of income in favor of the poor (i.e. falling income inequality) through decreasing the demand for the non-traded goods (i.e. the luxury goods) tends to moderate the natural resource curse (i.e. less deceleration of economic growth and lower level of Deindustrialization) while redistribution of income in favor of the rich (i.e. rising income inequality) through increasing the demand for the non-traded

goods (i.e. the luxury goods) tends to deepen the natural resource curse (i.e. more deceleration of economic growth and higher level of Deindustrialization). Fourth, a higher level of absorptive capacity constraints leads income inequality level to increase more (to decrease less) if the capital goods are used intensively in the non-traded (traded) sector. Fifth, for both cases, the capital goods are used intensively in the non-traded or the traded sector, a redistribution of windfall income in favor of the poor (i.e. falling income inequality) moderates the adverse effects of resource rent. Sixth the natural resource curse is positively associated with democracy index so that the higher the democracy index, the more intensive the natural resource curse and also a windfall income makes the income inequality level increase more in a democratic country than in a non-democratic country.

Although the highlighted literature is a useful addition to our knowledge, my findings are not comparable to those. It is because of that those literature have been proposed to study the linkage between a structural transformation and balanced growth path in the non-resource economies. Therefore, a full investigation of whether the approach, presented in this paper, would be practically appropriate to analyze the economic performance of a non-resource country is a question left for future research.

Appendix

A   Windfall income and social value of wealth

The size of the social value of wealth (λ) stimulated by a natural resource discovery (R_0) is determined using the economy's present value budget constraint, given by:

$$\int_0^\infty \left[e(P)\left(C^H + C^L\right) - P\bar{C} + q(P)I \right] exp(-r^*t)\, dt = B_0^F + R_0 + \int_0^\infty X(P,A,K)\, exp(-r^*t)\, dt.$$

Where B_0^F is the initial value of the foreign asset and $B_0 = B_0^F + R_0$ represents the initial foreign wealth. By replacing $C^H = \left[e(P)\frac{\lambda}{\theta} \right]^{-\sigma}$ and $C^L = \left[e(P)\frac{\lambda}{1-\theta} \right]^{-\sigma}$ in the last equation, A sudden falling in the size of the social value of wealth caused by a permanent jump in the natural resource discovery can apparently be derived from the following relation:

$$\lambda = \left[\frac{\int_0^\infty e(P)^{1-\sigma}\tau(\theta)exp(-r^*t)dt}{B_0^F + R_0 + \int_0^\infty \left[X(P,A,K) - q(P)I + P\bar{C} \right]exp(-r^*t)dt} \right]^{\frac{1}{\sigma}}$$

Where $\tau(\theta) \equiv \theta^\sigma + (1-\theta)^\sigma$.

B   Analysis of the simplified model for the homothetic case

This appendix describes a version of the model in which the homothetic preference has been taken into account [106]. This kind of the preference is incompatible to link income inequality and the capital growth

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[106]Although the specific purpose of this paper is to build a framework to study the interaction of income inequality and economic performance, in this appendix, I try as far as possible to shed light on the direct effect of absorption capacity constraints on economic growth and income inequality.

rate. It is because that the decision making of consumption depends only on changes in the relative price of final goods and not to the income distribution. In point of fact, income inequality is determined independently. Thereby the model doesn't have the ability to investigate how a change in the income inequality level affects the rate of economic growth and vice versa. The optimal maximization problem, as discussed in section 2.3, yields the dynamic system.

(a) Capital good used only to produce the traded goods (i.e. $j = T$):

$$\frac{\dot{\phi}}{\phi} = \frac{1}{\phi}\left[1 - \frac{1}{A(\phi,P)}\left(\frac{\beta\,\tau(\theta)}{P^{1-\beta(1-\sigma)}\,\lambda\sigma}\right)\right]\frac{P^{1-\gamma}}{\gamma} - \left(\delta\phi + \frac{P^{1-\gamma}}{\gamma}\right)\left(\frac{1-\alpha}{P}\right)^{\frac{1}{\alpha}}$$

$$\frac{\dot{P}}{P} = \frac{1}{\gamma}\left[r^* - \frac{\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}}}{P^{\frac{1}{\alpha}+\gamma-1}}\right]$$

(b) Capital good used only to produce the non-traded goods (i.e. $j = N$):

$$\frac{\dot{\phi}}{\phi} = \left[((1-\alpha)P)^{\frac{1-\alpha}{\alpha}} - \frac{1}{\phi A(\phi,P)}\left(\frac{\beta\,\tau(\theta)}{P^{1-\beta(1-\sigma)}\,\lambda\sigma}\right)\right]\frac{P^{1-\gamma}}{\gamma} + \delta\phi\left[(1-\alpha)P\right]^{\frac{1}{\alpha}} - \delta$$

$$\frac{\dot{P}}{P} = \frac{1}{\gamma}\left[r^* - (1-\alpha)^{\frac{1-\alpha}{\alpha}}P^{\frac{1}{\alpha}-\gamma}\right]$$

If the capital good and the productivity level grow at the same rate (ξ), the relative price becomes constant and also the sectoral output, the total output, the sectoral aggregate demand and the total aggregate demand expand symmetrically (see section 2.4 for more information). Briefly, as long as the real exchange rate is constant, the economy remains in a balanced growth path (BGP). Accordingly, given that the inflation locus extracted from a dynamic optimization is horizontal [107] (see. figure 5), we can assume in the long-term steady-state in where the windfall effects are disappeared the relative price is constant and thus the Kaldor facts are satisfied.

As discussed in section 3, we can invoke the implicit function theorem to observe how the isoclines react to a permanent windfall income change. Specifically, I compute the partial derivatives of P with respect to ϕ along the isoclines of capital-productivity ratio (i.e. $(\dot{\phi}/\phi) = 0$) and real exchange rate (i.e. $(\dot{P}/P) = 0$), respectively.

$$\left[\frac{\partial P}{\partial \phi}\right]_{\frac{\dot{\phi}}{\phi}=0} = -\frac{\frac{\partial(\dot{\phi}/\phi)}{\partial\phi}}{\frac{\partial(\dot{\phi}/\phi)}{\partial P}} \quad \text{and} \quad \left[\frac{\partial P}{\partial \phi}\right]_{\frac{\dot{P}}{P}=0} = -\frac{\frac{\partial(\dot{P}/P)}{\partial\phi}}{\frac{\partial(\dot{P}/P)}{\partial P}}.$$

For the first case, the traded sector is capital-intensive, it is easy to see a positively sloped isocline for capital-productivity ratio $(\dot{\phi}/\phi) = 0$ and an horizontal isocline for the inflation locus $(\dot{P}/P = 0)$ [108] (Figure 5-a). The calculations say when the real exchange rate appreciates in a neighborhood of steady-state, the isocline related to the capital-productivity ratio shifts up to the left. It indicates that the new isocline must lie on the left-hand side above of the old isocline. Further, an increase in the real exchange rate (or the relative price) declines the return of capital and so depreciates the incentive to invest. Thereby, rising the real exchange rate above the inflation locus $(\dot{P}/P = 0)$ is consistent to keep stationary in its place.

To clarify how an economy is touched by a windfall income, I next investigate how to be adjusted the transitional path of the dynamic model. As long as the windfall income doesn't influence the economy, the isoclines cross each other at the initial steady-state equilibrium, shown by E_0 in figure 5. A windfall income, through a decline in the social value of wealth (λ), increases the demand for the non-traded goods and so depresses the growth rate of the capital-productivity ratio [109]. Therefore, the $\frac{\dot{\phi}}{\varphi} = 0$ locus must shift up to the left to re-establish the steady-state equilibrium. In the short-term in when we can

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[107]It is because the inflation is not stimulated by the capital-productivity ratio.

[108]Van der Ploeg and Venables (2013) find the phase diagrams in the same way.

[109]It implies that the capital goods accumulate more slowly for a given productivity level or the productivity level grow faster for a given stock of capital goods.
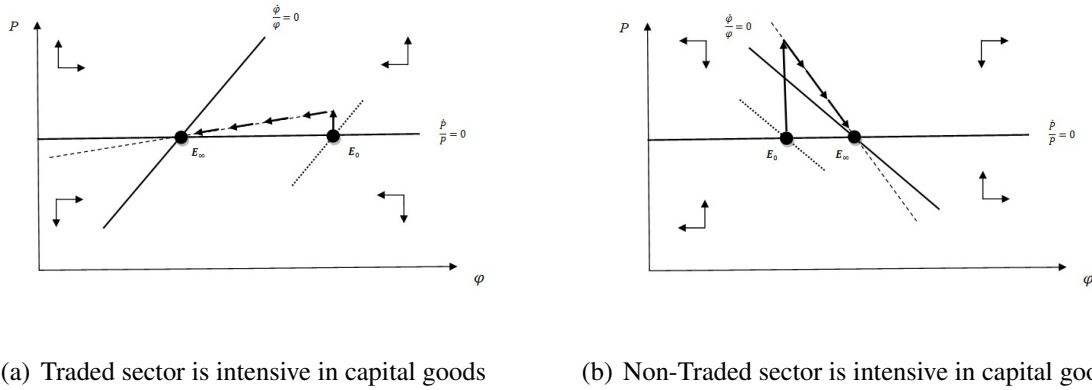
(a) Traded sector is intensive in capital goods   (b) Non-Traded sector is intensive in capital goods

Figure 5: Dynamic effects of windfall income

assume a fixed allocation of labor and capital stock, an increase in the windfall income arouses the real exchange rate to rise suddenly. This rising is temporary and will vanish in the long-term equilibrium, displayed by the bold line in figure 5. I can finally conclude that a decline in the capital-productivity ratio makes the labor force move from the traded sector to the non-traded sector (i.e. the Dutch disease). As a point, in contrast with Van der Ploeg and Venables (2013) presenting that the capital goods (i.e. structure) must decumulate if the traded sector is capital-intensive, this model intuitively states that the capital goods can be accumulated if the capital goods increase less than the productivity level. Falling the capital-productivity ratio also say that the real exchange rate appreciation leads to an increase in the real wage and conversely to a fall in the return of capital [110] (*Stolper-Samuelson theorem*). So if the capital goods are employed intensively to produce the traded goods, income inequality declines.

The phase diagram for the second case, an economy in where the traded sector is labor-intensive, is given in figure 5-b. My analysis shows that the inflation locus stays unchanged and is still horizontal, however, the isocline of capital-productivity ratio has a negative slope. A real exchange rate appreciation around the stationary shifts the isocline of ϕ up to the right. The same as the first case, it implies when the real exchange rate appreciates the new isocline is placed upper than the old isocline. Unlike the first case, the relative price is falling above the stationary. It is because of that a rise in the real exchange rate increases the return of capital and so investment. Consequently, the relative price must decline to rebalance the economy.

As before, an increase in the windfall income influences the capital-productivity ratio to be adjusted more slowly. Because of $\frac{\partial(\dot{\phi}/\phi)}{\partial\phi} > 0$, $\left(\frac{\dot{\phi}}{\phi} = 0\right)$ locus must shift to the right. It says that the capital-productivity ratio must be expanded to re-establish the steady-state equilibrium. The real exchange rate follows the bold line. This adjustment path can be paraphrased in the same way I do for the first case. I conclude the discussion of this case according to two following points. First, a rise in the relative price which increases the return of capital and decreases the real wage leads to an increase in the income inequality level. Second, an increase in the capital-productivity ratio which stimulates the labor force to move from the traded sector to the non-traded sector causes the traded sector to shrink (i.e. Deindustrialization). The discussion can be summarized as the following proposition.

Proposition B: *Consider an economy in where the capital goods are produced by a combination of the traded capital (e.g. equipment) and non-traded capital (e.g. structure, human capital and quality*

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[110]In a simplified model, the return of capital stays unchanged in the long-term steady-state equilibrium (see. Section 3).

of institution) goods. If the traded (non-traded) sector is capital-intensive, Deindustrialization coincides with falling (rising) the income inequality.

C   Average propensity to save

As mentioned, the average propensity to save (i.e. saving ratio) is defined as: $S \equiv \frac{q_p(P)I}{Y}$, where Y denotes total income of the economy (i.e. $Y = wL + rK + r^*B = X_T + PX_N + r^*B = X + r^*B$). Given that P in equilibrium is constant and both capital stock and productivity level (and so non-windfall gross national product) grow at the same rate in the long term (see. Section 2.4), the average propensity to save expands much more slowly than the economic growth rate.

$$\frac{\dot{S}}{S} = \frac{\dot{K}}{K} - \frac{\dot{Y}}{Y} = \left(1 - \frac{X}{Y}\right)\frac{\dot{K}}{K} = \frac{r^*B}{Y}\xi < \xi$$

Furthermore, considering that the role of windfall gain in the total income can approximately fade as economy expands (i.e. $\frac{r^*B}{Y} \approx 0$), the total income converges to the non-windfall gross national product so that the saving ratio can be supposed to be constant (i.e. $\frac{\dot{S}}{S} \approx 0$) (at least in the long term).

D   Classification of Traded and Non-Traded sectors

According to "the International Standard Industrial Classification of all economic activities" (*ISIC Rev.*3.1), we have:

$AV = AHFV + FV$, $IV = MOV + MC + CV$ and $SV = 1 - AV - IV$.

Where AV, IV and SV are the value-added of agriculture, industry and service sectors, respectively. Where AV, IV and SV are the value-added of agriculture, industry and service sectors, respectively. Two components of agriculture sector are agriculture, hunting and fishing ($AHFV$) and forestry (FV). Also, mining and quarrying (MQV), manufacturing (MV) and construction, electricity, gas and water supply (CV) are three components of industry sector. Moreover, total natural resource rent (NR) is defined as the sum of mining and quarrying (MQV) and forestry (FV), (i.e. $NR = MQV + FV$).
The data of AV, IV, SV, NR, FV and MV are collected from WDI and $UNdata$ databases. Consequently, the rest of data are determined as follow:

$AHFV = AV - FV$, , $MQV = NR - FV$ and $CV = IV - MQV - MV = IV - MV + FV - NR$.

Finally the value-added of Traded (TV) and Non-Traded (NTV) sectors are calculated as $TV = AHFV + MV$ and $NTV = CV + SV$.

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