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The Dynamics of International Exploitation

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Abstract

This paper develops a framework to analyse imperialistic international relations and the dynamics of international exploitation. A new measure of unequal exchange across borders is proposed which captures the territorial structure of imperialistic international relations: wealthy nations are net lenders and exploiters, whereas endowment-poor countries are net borrowers and exploited. Capital flows transfer surplus from countries in the periphery of the global economy to those in the core. However, while international credit markets and wealth inequalities are central in generating international exploitation, other factors, including labour-saving technical change, are shown to be essential in explaining its persistence.

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Keywords: International exploitation; Imperialism; Unequal exchange; Uneven development; Capital movements.

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1 Introduction

The last four decades have witnessed the increasing integration of different national economies and the widespread adoption of neoliberal policies. This phenomenon, often labelled 'globalisation', has far-reaching implications, and it has stimulated a vast debate (Coe and Yeung 2001; Harvey 2003, 2005; Sheppard 2016; Yeung 2002). Globalisation has significant effects *within* each country, but special attention has been paid to its repercussions on the relations *between* countries. This is due to the economic stagnation of vast parts of the world and the large inequalities in income and standard of living among countries (Milanovic 2015; Sheppard 2016), and the asymmetries in bargaining power in the international arena. But also to the qualitatively different role that international institutions and nation-states and the use of force play in the global economy, according to various scholars, as compared to previous historical periods.

Different, if not opposite, analyses have been proposed, even outside of the neoclassical camp. Some authors argue that 'globalisation' is just a new name for old imperialistic practices by wealthy countries, including the use of force (Amin 1999; Petras and Veltmeyer 2001). According to others, a new world is taking shape, in which traditional imperialistic practices play no role, and the classical concept of imperialism is not useful to understand the global economy (Hardt and Negri 2000).

While admitting that classical approaches may be outdated, "economic globalization is certainly not just about the latest phase of uneven geographic development, deterritorialization/reterritorialization, or crisis-induced capitalist restructuring", it has "deeper historical roots in the founding of the modern nation-state" (Yeung 2002, p.288). Thus, this paper defends the theoretical and empirical relevance of the concept of imperialism to analyse current international relations and features of geographic stratification of the global economy.

Based on Roemer's (1982) theory of exploitation, a theoretical (albeit not historical) distinction can be drawn between a notion of *feudal* imperialism, in which the use of force and non-competitive distortions play a definitional role – as in 'classical' (Lenin 1970; Luxemburg 1951; Hobson 1954) and neoclassical (Schumpeter 1951) theories of imperialism; and neo-Marxist theories of dependency (Baran 1968; Franke 1978).[1] And a notion of *capitalist* imperialism, in which exploitation and mutual gains from trade may coexist. Capitalist imperialism is thus related to Hobson's (1954) "internationalism" and to the concept of "informal imperialism" (Griffin and Gurley 1985, pp.1092ff), in that power relations between states and exploitation are primarily the product of economic activities, rather than extra-economic coercion. It also captures some key aspects of Harvey's (2003; 2005) own seminal notion of capitalist imperialism, and in particular its emphasis on "imperialism as a diffuse political and economic process in space and time in which command over and use of capital take primacy" (Harvey 2003, p.26).

More precisely, in this paper capitalist imperialism is conceived of as a system "based on the export of capital from advanced countries to less developed regions ... accompanied by the utilization of political and military resources to protect and maintain the means of production over which control has been acquired" (Evans 1979, p.16), and by segmented labour

[1] For a discussion of the literature, see Griffin and Gurley (1985), Howard and King (1992), and Kvangraven (2020). The qualifier 'feudal' refers to the nature of the relations *between* countries and not to the presence of feudal elements *within* poorer countries sometimes stressed in the literature (Kvangraven 2020, p.84).

markets. Empirically, this allows us to incorporate two crucial features of the contemporary global economy, namely capital mobility and restrictions to labour movement (Harvey 1982, 2003, 2005; Sheppard 2016). Theoretically, this makes our approach conceptually close to theories of unequal exchange (Emmanuel 1972; Roemer 1983).[2]

This paper aims to show that, even granting that the feudal aspects of colonial relations may have become less significant, the concept of capitalist imperialism is relevant to analyse structural features of the global economy. First, we propose a new measure of unequal exchange across borders based on the theory of exploitation – an *exploitation intensity index*. Contrary to the received view, this measure is theoretically robust and logically consistent. Indeed, it can be used to precisely define the concept of capitalist imperialism and to provide a rigorous definition of the notions of *core* and *periphery* of the global economy that are central in dependency theory and in world systems theory (Arrighi 1994; Wallerstein 1974).

Far from being metaphysical, our exploitation index is empirically measurable based on widely available data. We calibrate our model to analyse the exploitation status of all countries in 2017, taking into account differences in the quantity *and* quality of the labour force, in addition to capital, and use the exploitation index to characterise the full structure of Imperialistic International Relations (henceforth, IIR). Indeed, unlike in post-modern approaches to globalisation, such as Hardt and Negri (2000), which depict IIR as immaterial and deterritorialised, the economic and geographic structure of imperialism can be identified, whereby wealthy nations gain, and endowment-poor countries lose from unequal exchange, as surplus is transferred *from* the latter *to* the former.

The second contribution of the paper is the analysis of the mechanism that allows such surplus transfer to occur. Unlike in classical approaches, where "characteristic of [imperialism] are: lending abroad, railroad constructions, revolutions, and wars" (Luxemburg 1951, p.419), the role of capital movements is emphasised. This is an important feature of recent accounts of imperialistic practices. As Harvey (2005, pp.134-135) notes, interconnected financial and government institutions and countries' positioning in highly connected financial markets are a primary channel through which imperialistic relations manifest.

This paper shows that competitive markets, profit-seeking, and international wealth inequalities are central in generating IIR. The exploitative nature of IIR can be understood focusing on credit relations and international capital flows: wealthy nations are net lenders and exploiters, and form the core of the global economy, whereas endowment-poor countries are net borrowers and suffer from exploitation, and are relegated to the periphery.

Crucially, however, IIR can be explained without any controversial assumptions on the existence of some inherent contradiction of capitalism that "spurs capital on to a continual extension of the market" (Luxemburg 1951, p.347). While realisation problems in accumulating economies feature prominently in classical accounts of late 19th century-early 20th century imperialism, such as Lenin (1970), Hobson (1954), and Luxemburg (1951), and overaccumulation plays a central role in Harvey's (2003; 2005) theory of new imperialism, we argue that accumulation is unnecessary to understand capitalist imperialism as an exploitative system of international relations. Indeed, we show that, under certain conditions, accumulation is *inconsistent* with the persistence of IIR. More generally, as argued by Howard

[2]See also Foot and Webber (1983), Sheppard (1984), Sheppard and Barnes (1990), and Webber and Foot (1984).

and King (1999), countries in the core have an incentive to exploit those in the periphery independently of accumulation needs: the incessant quest for profits.

As our analysis of the structure of imperialistic relations and the proposal of an index to measure international labour transfers involves the construction of a formal model and computational analyses, we shall briefly discuss some methodological aspects of our research.[3] This will also allow us to discuss some extensions of our main results.

1.1 Methodology

A detailed historical and institutional analysis is certainly crucial for a thorough understanding of imperialism and economic inequality across regions. In this paper, we use theoretical abstraction – and specifically, mathematical formalism – for various reasons.

One key contribution of the paper is the proposal of a measure of surplus transfers across countries, and all measurement is theory-specific. We set up a theoretical framework using mathematical formalism in order to define an exploitation index that can be used in the empirical analysis of international relations and uneven geographical patterns in development.

While mathematical-deductivist methods are inappropriate in the causal-explanatory analysis of open systems (Lawson 2003, 2009), our purpose here is different. Our aim is not to identify causal laws (or even tendencies) within a predictionist perspective (Lawson 2003, p.60). Rather, ours is an exercise in scientific ontology and, as Veneziani and Yoshihara (2017b) have argued, mathematical tools are appropriate when addressing the issue of measurement of certain social phenomena with a quantitative dimension. The use of formalism to derive a well-defined exploitation index is particularly important given the widespread scepticism surrounding exploitation theory in *both* mainstream *and* heterodox quarters.

The analytical methods we deploy are, as Barnes (1990, p.1004) argues, helpful "in clarifying and developing concepts," and our methodological choice contributes to the "engaged pluralism" in economic geography advocated by Barnes and Sheppard (2010), Plummer and Sheppard (2006), and Sheppard (2011), among others. Similar to Plummer, Sheppard, and Haining (2012, p.538), mathematics are adopted as "the language of theory" and their use in a Marxian framework here is intended to help clarify concepts of unequal exchange and exploitation. Thus, our approach is close to the "regional political economy" put forth by Sheppard (2011) and Plummer et al. (2012). Indeed, as Sheppard (2011) notes, Marxian mathematical models can highlight the class struggle and exploitative dynamics inherent to capitalism, and the introduction of a geographical (or spatial) dimension to these models renders the dynamics and inequalities of capitalism all the more apparent. More specifically, our analysis brings recent developments in the theory of exploitation and class to economic geography, and while Selwyn (2012, 2015) and Iliopoulos, Galanis, Kumar, and Popoyan (2021) have recently argued for greater attention to class and power, respectively, in analyses of global value chains and production networks, our emphasis on a well-defined notion of exploitation illuminates a key relationship between countries.[4]

[3]The model presented in this paper builds on Roemer (1982, 1983) and extends the framework developed by Cogliano, Veneziani, and Yoshihara (2016, 2019) to the international context.

[4]Recent research on global value chains and global production networks highlights the complexities of economic relationships between firms in different countries, as well as relationships in the nexus of firms, countries, labour, and institutions. See Gereffi and Korzeniewicz (1994) and Gereffi, Humphrey, and Sturgeon

We also aim to contribute to theoretical debates on the fundamental features of imperialistic relations, and use computational simulations to examine some simplified, counterfactual scenarios for three purposes. First, in order to investigate the nature and structure of IIR, we use theoretical abstraction in order to isolate some key characteristics of the global economy. It is remarkable, from this perspective, that an exploitation phenomenon and IIR can clearly emerge even in the absence of a number of features of real economies that play a central role in various strands of the literature, such as noncompetitive distortions, international wage and interest rate differentials, unequal access to technologies, differences in structures of production, price/value discrepancies, and spatial competition. Without denying the relevance of these factors, our analysis forcefully brings to the fore the role of credit markets, the constraints that limited wealth imposes on countries in the periphery, and their "financial dependence" (Kvangraven 2020) on core countries.

Second, the counterfactual analysis points to an explanatory gap by showing that competitive markets and inequalities in wealth and development are crucial in *generating* IIR; but they are not sufficient to make them *persistent*. Lacking any countervailing tendencies, accumulation eventually makes capital abundant, leading to the disappearance of international exploitation. This result is in stark contrast with the reality of the global economy – since capitalism is "conflictual and unstable" and produces "socio-spatial inequalities" (Sheppard 2011, p.320) – and it raises the issue of the possible mechanisms guaranteeing the persistence of exploitative relations. In this paper, we consider endogenous technical change and adaptive consumption norms, which introduce a degree of non-linearity and cyclicality in the interaction of accumulation, distribution, and technical change – arguably, two important features of the dynamics of capitalist economies (Bergmann, Sheppard, and Plummer 2009; Galanis and Kumar 2021; Galanis, Koutny, and Weber 2022; Plummer et al. 2012; Plummer and Sheppard 2006). We see this as a first, preliminary step in the analysis of the persistence of a spatially differentiated, unequal international economy.

Third, although we do not address normative issues explicitly in this paper, our analysis may be interpreted as showing that IIR can be condemned independently of the noncompetitive and violent forms they may – and usually do – take. The model provides the foundations for a condemnation of imperialism by specifying the theoretical counterfactual against which IIR should be evaluated – a desirable property of a theory of imperialism, as forcefully argued by Brewer (1999). The counterfactual is given by the economy in which international disparities in wealth are annihilated. Indeed, in the global economy wealth inequalities do seem to be morally arbitrary, as often primitive accumulation in the core has taken place – at least partly – at the expense of the periphery, as argued in chapter 31 of *Capital* I, where Marx (1976, p.926) famously refers to colonialism as robbery, looting, and plunder, such that "capital comes dripping ... from every pore, with blood and dirt."

The paper is organised as follows. The conceptual framework is laid out in section

(2005) for more on global value chains, and see Coe, Dicken, and Hess (2008), Coe (2011), Coe and Yeung (2019), and Yeung (2021) for more on global production networks. Value chain and production network analyses provide detailed accounts of the configurations of various relationships between different actors in the global economy, including possibly exploitative relationships (Selwyn 2019). Our focus on countries as the unit of analysis abstracts from much of the granular detail of value chain and production network analyses, yet it can be seen as capturing the overall sum of potentially unequal or exploitative relationships between various actors across the global economy.

2. Section 3 discusses the notions of exploitation and class and section 4 introduces the exploitation intensity index. Section 5 presents the results of the calibration of the basic model, and the simulations of its dynamics. Section 6 extends the model, and the simulations, to include endogenous technical change and consumption norms. Section 7 briefly discusses the robustness checks. The details of the formal analysis can be found in Appendix A.

2 The framework

Consider a dynamic extension of Roemer's (1982) accumulating economy with a credit market and only one good produced and consumed.[5] There are N countries that compete in the world economy for T periods, where T could be either finite or infinite. A country is generically denoted as ν.[6] At the beginning of each production period t, $t = 0, 1, \ldots, T$, there is a production technique (A_t, L_t) that specifies the amount of the produced good, A_t, and labour, L_t, necessary to produce one unit of output, where $0 < A_t < 1$ and $L_t > 0$.[7] The technique (A_t, L_t) is not necessarily fixed: it may vary over time due to technological innovations. As argued in section 1.1, we are interested in analysing unequal exchange and IIR abstracting from noncompetitive distortions and differences in the structure of production, and therefore assume that all countries have access to the same techniques.

In every period t, countries have (possibly different) endowments of labour, l^ν_{t-1}, and capital, $\omega^\nu_{t-1} \geq 0$, inherited from previous periods. The labour endowment consists of country ν's population, represented by $\ell^\nu_{t-1} > 0$, *and* of its (average) skill level, or human capital, represented by $s^\nu_{t-1} > 0$. Thus, country ν's labour endowment is defined by $l^\nu_{t-1} = \ell^\nu_{t-1} s^\nu_{t-1}$ which may also be called ν's endowment of *effective* labour.

As in Roemer (1982), production takes time and current choices are constrained by past events: every country must be able to lay out in advance the operating costs for the production activities it operates. A country ν endowed with $\left(l^\nu_{t-1}, \omega^\nu_{t-1}\right)$ can either use its own capital to operate the technique (A_t, L_t) at the production activity level $x^\nu_t \geq 0$, or it can borrow capital on international credit markets in order to operate (A_t, L_t) at the level $y^\nu_t \geq 0$. Alternatively, it can lend its capital abroad, $z^\nu_t \geq 0$. Countries can borrow or lend at a market rate r_t.

Letting p_{t-1} denote the price of the produced commodity at the end of $t-1$ and beginning of t, the market value of country ν's endowment – its wealth – is $W^\nu_{t-1} = p_{t-1}\omega^\nu_{t-1}$. The wealth that is not used for production activities, and is not lent abroad, can be saved and sold on international markets at the end of the period, $\delta^\nu_t \geq 0$.

As is standard Marxist theory, we conceive of capitalist economies as driven by the need to accumulate (formally, maximise wealth) subject to workers consuming $b_t > 0$ per unit of

[5] Focusing on one-good economies allows us to abstract from price/value disparities that are central in much of the literature on unequal exchange (see, for example, Sheppard (1984) and Sheppard and Barnes (1990); for a discussion of the literature, see Ricci (2021)). More generally, given our interest in the dynamics of exploitation, the one-good assumption yields no loss of generality. The model can be extended to include n commodities, albeit at the cost of a significant increase in technicalities and computational intensity.

[6] Following Roemer (1982, 1983), in order to focus on *international* exploitation, we consider countries as black boxes and do not explicitly analyse heterogeneity *within* each country.

[7] More precisely, production techniques (A_t, L_t) at any t are *Leontief production techniques*, requiring fixed proportions of both inputs to produce the final good.

labour performed. Country ν's labour performed is denoted by Λ_t^ν.[8] Within every period t, we consider b_t as a constant parameter, but we do allow for the possibility that b_t changes endogenously over time (more on this in section 6 below). This assumption is motivated by our focus on the dynamics of exploitation in a global economy characterised by a drive to accumulate, rather than on consumer choices. Theoretically, it is consistent with the classical-Marxian tradition where consumption is largely the product of social norms, rather than utility-maximising behaviour, and it allows us to analyse the international structure of exploitation and class abstracting from heterogeneous consumption behaviour.

Following Roemer (1982, 1983), we analyse the global economy focusing on *Reproducible Solutions* (henceforth, RS): at a RS, in every period (a) all countries maximise their wealth; (b) aggregate capital is sufficient for production (and speculative saving) plans; (c) the credit market clears; (d) aggregate supply is sufficient for consumption and accumulation plans.[9]

Let (p_{t-1}, p_t, r_t) be a profile of prices observed at period t in a RS. This price information allows us to define an implicit wage rate w_t that each country faces during t.[10] In contrast with some of the classic contributions in dependency theory, as all countries have access to the same technology, and international commodity and credit markets are competitive, the wage rate per effective labour performed is identical across countries even in the absence of an international labour market.[11]

3 Exploitation and Class

Two structural aspects of the global economy arguably characterise *imperialistic* international relations. First, the presence of some form of unequal exchange in which certain countries benefit disproportionately from interaction in the global economy compared to others. And, second, a stratification of countries into a core and a periphery – based on their position in international markets – which highlights the mechanisms that allow the former to gain at the expense of the latter. We capture the former aspect of IIR focusing on the concept of *exploitation*; and the latter by identifying *classes* of countries based on their position in the global credit market.

Consider first the concept of exploitation. The key point to note is that focusing on actual consumption in order to define labour received, and so exploitation status, would be highly misleading: poor and rich countries may have similar consumption levels and yet it would be counterintuitive to consider them as having a similar exploitation status.[12] Conceptually, exploitation status should not depend on idiosyncratic choices, and preferences, and depend instead on *potential* consumption. We define exploitation status focusing on the maximum

[8] Formally, the labour performed in country ν is defined by: $\Lambda_t^\nu \equiv L_t x_t^\nu + L_t y_t^\nu$. A detailed description of countries' behaviour can be found in Appendix A.1.

[9] For a comprehensive discussion of the Marxian roots of the concept of RS, see Roemer (1982, 1983). A rigorous definition of the RS in the context of the global economy can be found in Appendix A.1.

[10] Formally, $w_t \equiv \frac{p_t - (1+r_t)p_{t-1}A_t}{L_t}$.

[11] Observe, however, that wage rates *per unit of labour time* are different due to the differences in human capital, s_{t-1}^ν, across borders.

[12] In our model, both poor and rich countries consume b_t per unit of labour expended, but their potential consumption is very different.

level of consumption that a country can achieve subject to being able to reproduce itself over time.

Formally, for all countries ν and market prices (p_t, r_t), let $R_t^\nu\left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right)$ denote country ν's gross revenue, which depends on ν's endowments and on equilibrium prices.[13] A country ν's potential consumption, c_t^ν, is determined by gross national revenue minus the cost of reproducing the country's initial capital, $p_t\omega_{t-1}^\nu$. Formally,

$$p_t c_t^\nu = R_t^\nu\left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right) - p_t\omega_{t-1}^\nu. \tag{1}$$

Let $v_t = L_t(1-A_t)^{-1}$ denote the embodied labour value. Definition 1 identifies exploitation status in terms of a country's potential consumption.[14]

Definition 1 [Roemer (1982)]: Country ν is *exploited* at t if and only if $\Lambda_t^\nu > v_t c_t^\nu$; it is an *exploiter* if and only if $\Lambda_t^\nu < v_t c_t^\nu$.

Let $\widehat{w}_t \equiv \frac{w_t}{p_t}$ be the real wage rate at t. By using similar arguments as in Cogliano et al. (2019), it is not difficult to show that at any RS, in every period t, if $r_t > 0$ then the exploitation status of each country is determined by its wealth per unit of labour performed:[15]

$$\text{country } \nu \text{ is an exploiter if and only if } \frac{W_{t-1}^\nu}{\Lambda_t^\nu} > \frac{1}{r_t}\frac{[1-\widehat{w}_t v_t]}{v_t};$$
$$\text{country } \nu \text{ is exploited if and only if } \frac{W_{t-1}^\nu}{\Lambda_t^\nu} < \frac{1}{r_t}\frac{[1-\widehat{w}_t v_t]}{v_t},$$

This generalises analogous results by Roemer (1982), as it characterises the exploitation status of all countries even in the presence of unemployed labour. More precisely, if full employment obtains at t then $\Lambda_t^\nu = l_t^\nu$, all ν, and so exploitation status is determined by the ratio of capital and labour *endowments* as in Roemer (1982). However, if labour is not fully employed world-wide, then $\Lambda_t^\nu < l_t^\nu$ for at least some ν, and exploitation status is determined by the ratio of the capital endowment *and labour performed*.

Observe that the previous conclusions hold if and only if $r_t > 0$. If $r_t = 0$, then $\widehat{w}_t = (1/v_t) > b_t$ and $\Lambda_t^\nu = v_t c_t^\nu$ for all ν, and no exploitation exists in the economy. This correspondence between profits and exploitation is a standard result in Marxian theory (Veneziani and Yoshihara 2015).

Definition 1 provides the foundations for the analysis of the unequal exchange involved in IIR, whereby some countries gain at the expenses of others: some countries exploit, while others are exploited. However, while it permits us to identify the winners and losers of globalisation, it does not tell us much about the structural features of IIR that allow exploitation to emerge. For that purpose, we shall introduce a concept that identifies a clear stratification of countries based on their position in international markets.

[13] An explicit expression for $R_t^\nu\left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right)$ is in Appendix A.1.

[14] In what follows, exploitation and class status are defined in every period t: this is natural if the model describes a series of one-period economies, otherwise it reflects a focus on *within period* relations. For a discussion of *within period* and *whole life* exploitation and class, see Veneziani (2007, 2013).

[15] The proofs of all formal results discussed in this section are simple modifications of the demonstrations in Cogliano et al. (2019) and are shown in the Addendum.

To be specific, following Roemer (1982), in every period t *classes* can be defined based on the countries' position in the credit market. Let (a_1, a_2, a_3) be a vector where $a_i \in \{+, 0\}$, $i = 1, 2, 3$, where '+' means a positive entry. Country ν is said to be a member of class (a_1, a_2, a_3), if there is an optimal vector $(x_t^\nu, y_t^\nu, z_t^\nu, \delta_t^\nu)$ such that $(x_t^\nu, y_t^\nu, z_t^\nu)$ has the form (a_1, a_2, a_3). The notation $(+, +, 0)$ implies, for instance, that a country activates production using both its own capital and borrowed capital; $(+, 0, +)$ implies that the country uses part of its capital to activate production and lends the rest; and so on.

Although there are eight conceivable classes, only the following four can be shown to be *theoretically* relevant: C_t^1 is the set of countries which are members of class $(+, 0, +)$ but not of class $(+, 0, 0)$; C_t^2 is the set of countries which are members of class $(+, 0, 0)$; C_t^3 is the set of countries which are members of class $(+, +, 0)$ but not of class $(+, 0, 0)$; C_t^4 is the set of countries which are members of class $(0, +, 0)$.[16]

By using similar arguments as in Veneziani and Yoshihara (2017a) and Cogliano et al. (2019), it is possible to show that at any RS, in every period t, if the interest rate is positive, the set of countries can be exactly partitioned into the four classes above: all countries belong to one, and exactly one, of C_t^1-C_t^4 and a country's class depends on its position in the credit market. C_t^1 corresponds to the set of net lenders; C_t^2 comprises all countries that are neither net lenders nor net borrowers; C_t^3 corresponds to the set of net borrowers; C_t^4 comprises all countries with zero wealth at t.[17]

In other words, a precise stratification emerges in the world economy whereby countries can be sorted into classes based on their status in the international credit market, which is in turn related to their productive endowments: countries with higher (lower) wealth per capita belong to the higher (lower) echelons of the class hierarchy.

As both class and exploitation status depend on per capita wealth, it is legitimate to wonder whether a country's position in the exploitation hierarchy and its position in the credit market are linked, as predicted in theories of unequal exchange, and also in some of the classical approaches to imperialism discussed in the Introduction.

The hypothesis that a tight relation exists between class positions and exploitation status is known as the *Class-Exploitation Correspondence Principle* (CECP, Roemer (1982)), and it is possible to prove that indeed the CECP holds in the world economy: countries that enjoy a privileged position in the credit market are exploiters, while net borrowers are exploited. Formally, at any RS, at any period t, if the interest rate is strictly positive then: if $\nu \in C_t^1$ then ν is an exploiter and if $\nu \in C_t^3 \cup C_t^4$ then ν is exploited.

In other words, based on the concepts of exploitation and class that we have proposed here, building on Roemer (1982, 1983), it is possible to show that IIR are clearly characterised by a hierarchical structure that emerges endogenously, and that, contrary to postmodern claims, has a clear economic and territorial dimension: wealthy countries are exploiters and poor countries are exploited. Further, contrary to classical theories, IIR emerge from the functioning of competitive markets: wealthy countries are net creditors, poor countries are

[16] Of course, *empirically*, only $C_t^1 - C_t^3$ matter, as shown by our simulations: C_t^4 is empty because there is no country with zero wealth and producing *only* using borrowed capital.

[17] Formally, let MP_t^ν be country ν's optimisation programme at t described in Appendix A.1. Then C_t^1 is the set of countries such that $A_t y_t^\nu < z_t^\nu$ at all solutions to MP_t^ν; C_t^2 is the set of countries such that $A_t y_t^\nu = z_t^\nu$ at a solution to MP_t^ν; C_t^3 is the set of countries such that $A_t y_t^\nu > z_t^\nu$ at all solutions to MP_t^ν; C_t^4 is the set of countries such that $W_{t-1}^\nu = 0$.

net debtors, and it is the credit market that allows surplus to be transferred from the latter to the former. Thus, the previous analysis provides rigorous foundations to the concepts of *core* countries – which enjoy a privileged position in the credit market and exploit – and the *periphery* of the global economy – poor countries that need to borrow in order to activate production and reach subsistence, and are exploited.

4 An index of exploitation

The core/periphery structure that characterises IIR derived in the previous section provides some important insights on the structural injustices characterising the world economy, as Roemer (1982) has forcefully argued. Yet, simply identifying the countries in the core and in the periphery of the global economy yields a rather partial, coarse picture of the structure of IIR: international economies with similar numbers of countries belonging to each class and each exploitation category may be very different. Based on Definition 1, the normative reach of the concept of exploitation can be extended to provide a finer and more comprehensive picture of IIR, moving beyond a purely aggregate analysis to explore the *intensity of exploitation*. For, it is certainly desirable to have a notion of exploitation that allows us to make statements such as "country A is more exploited than country B", or "IIR are becoming increasingly exploitative over time".

Definition 1 states that exploitation status is determined according to whether $\Lambda_t^\nu \gtrless v_t c_t^\nu$. Therefore a natural index of the intensity of exploitation of any country ν in period t is:

$$e_t^\nu = \frac{\Lambda_t^\nu}{v_t c_t^\nu}.$$

Thus, country ν is an exploiter (exploited) if and only if $0 \leq e_t^\nu < 1$ ($e_t^\nu > 1$). Assuming e_t^ν to be a meaningful cardinal and internationally comparable measure, however, the index allows for a much richer analysis of IIR. For example, one can say that the greater e_t^ν the more exploited ν is and, for any two countries ν, μ in the periphery, if $e_t^\nu > e_t^\mu > 1$ then ν is more exploited than μ. And similarly for countries in the core. We can also analyse the dynamics of the distribution of e_t^ν, and ask a number of questions about the structure of IIR. A more polarised distribution of e_t^ν, for instance, suggests a worsening of IIR. More generally, the measurement of some aggregate degree of exploitation raises similar issues as in the debate on the measurement of income or wealth inequalities.

Three important features of the exploitation index e_t^ν should be emphasised. First, it has robust theoretical foundations. It is conceptually related to the so-called 'New Interpretation' of Marx by Duménil (1980) and Foley (1982). It can be shown that a country is exploited if the share of labour it contributes to the global economy is higher than the share of income it receives, and vice versa if it is an exploiter (Veneziani and Yoshihara 2018). It can also be proved that Definition 1, upon which the index is based, is the only definition of exploitation that satisfies the core insights of exploitation theory (Veneziani and Yoshihara 2015, 2017a,b).

Second, the exploitation index embodies some intuitive normative views. For e_t^ν can be interpreted as the rate of (effective) labour supplied relative to the labour necessary to produce ν's maximum potential consumption and exploitative relations are equivalent to inequalities in labour hours supplied to earn one unit of income (measured in the labour

numéraire). From this perspective, exploited countries need to work more than exploiters in order to secure an analogous standard of living, and the additional labour they contribute to the global economy is transferred to the latter. In IIR, exploitation represents an unreciprocated transfer of labour from the periphery to the core, and the higher the amount of labour transferred from a country in the periphery, the higher e_t^ν.

Unlike most empirical measures of unequal exchange,[18] the exploitation index does not capture price-value deviations, whose normative content is unclear (Schweickart 1991). Nor does it crucially rely on the existence of market imperfections and international wage differentials: although differences in the remuneration of labour across countries are of great relevance (Ricci 2021, 2022), the unfairness of international relations is not reducible to them, and a global economy with complete wage equalisation might still be highly unjust.

Finally, and perhaps more importantly for our purposes, contrary to a widespread view, the exploitation index is all but metaphysical, as it is entirely based on empirically measurable magnitudes.

5 Exploitation and class in space and time

This section develops a computational analysis of the basic economy, in which technology, population, and consumption norms are all constant over time (see Appendix A.1). Using 2017 data from the Penn World Table (PWT) (Feenstra, Inklaar, and Timmer 2015) to calibrate the model, the aim is to illustrate the relevance of the theoretical results derived in the previous section; and to rigorously describe the dynamics of IIR, both in their exploitation and in their class dimensions, in the benchmark case. (A thorough description of the calibration of the model, and simulation procedure can be found in Appendix A.2.)[19]

5.1 Exploitation in the world economy: a new map

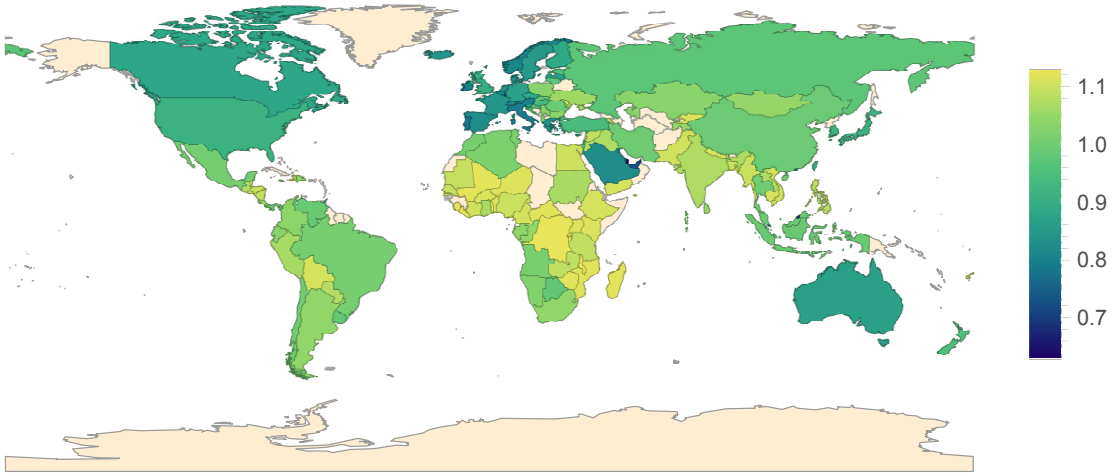
The exploitation intensity index is designed to map the hierarchical structure of the global economy giving rise to spatially-driven injustices in the form of unequal exchange, and a transfer of surplus across borders. In this section we derive its distribution across countries in 2017. To be sure, our results should not be taken as providing a comprehensive picture of IIR: they are primarily meant to illustrate the power of our measure of exploitation, while bearing in mind that ours is an imperfect calibration exercise in the context of a simplified one-good model. With this caveat in mind, the results are rather striking indeed.

Figure 1 provides a map of exploitation intensity, where the shading of each country corresponds to its value of e_1^ν: a darker (brighter) colour indicates lower (higher) values of e_1^ν. The pattern of exploitation in figure 1 chimes with intuition and with the literature discussed in the Introduction, with a concentration of darker colours around the North Atlantic, Western Europe, Australia, and Japan, while lighter colours dominate in Africa, Latin America, and South Asia.

[18] See Foot and Webber (1983) and Sheppard and Barnes (1990) for discussions of measures of unequal exchange, and Webber and Foot (1984) for an empirical analysis of the case of Canada and the Philippines.

[19] All simulations are done using *Mathematica* version 13. The simulation code is available from the authors upon request and will be made fully accessible together with the dataset for replication purposes.

Figure 1: Worldwide Exploitation Intensity - Basic economy

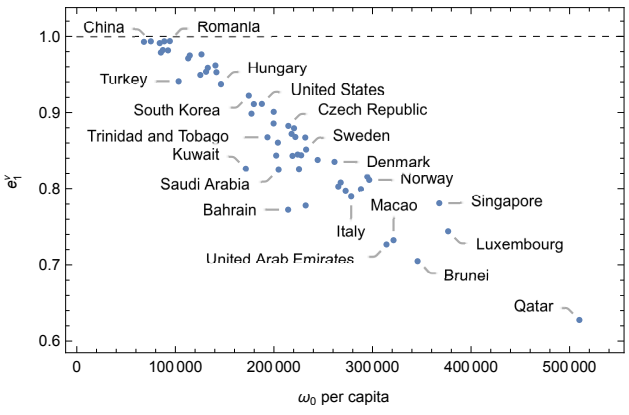


Note: Countries not shaded according to the color scale above are not included in the data set for this simulation. The shading of Alaska separately from the rest of the United States is an artefact of *Mathematica*'s mapping procedure.

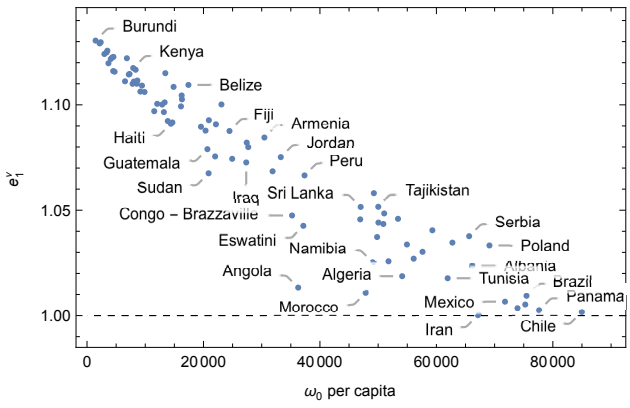
More generally, the exploitation index can be used to identify the core and the periphery of the global economy, consistent with theories of unequal exchange and uneven development. Using $e^{\nu}_1 = 1$ as the relevant threshold, in figure 2 we cluster countries into two clearly defined groups based on their exploitation status and graph e^{ν}_1 against ω^{ν}_0 per capita.[20] Both panels of figure 2 show a strong, clear inverse relation between exploitation intensity and per capita wealth, with higher wealth associated with lower levels of exploitation. The core consists of exploiter countries (figure 2(a)), whereas exploited countries are in the periphery of the global economy (figure 2(b)). Thus, figure 2 clearly shows the economic and geographic structure of IIR, and in particular the crucial relevance of wealth, and productive endowments in general, in determining a country's position within IIR.

Figure 2: Exploiter & Exploited Countries - Basic economy

(a) Exploiter Countries



(b) Exploited Countries



[20] While e^{ν}_1 is based on effective labour performed, Figure 2 uses initial wealth *per capita* on the horizontal axis. We make this choice here, and in figures 11-13 in Appendix B, for merely presentational reasons.

Tables 1 and 2 below show the complete listing of e_1^ν for all countries sorted by ω_0^ν per capita, with exploiter countries shown in table 1 and exploited countries in table 2. Apart from the Latin American members of the club, *all* of the OECD countries are in the core, with an exploitation intensity index well below 1;[21] while nearly *all* of the African countries are exploited, including the twenty most exploited.[22] Further, among the main exploiters are oil-producing countries as well as countries at the core of the international financial system. Although its exploitation index is too close to one to draw any definite conclusions, the classification of China as one of the exploiting countries is likely to reflect its increasing role in the world economy, which is moving it from the periphery to the core of IIR; and a similar point may be made about Indonesia (for an interesting discussion, see Kvangraven (2020)).

Table 1: Exploitation Intensity for Exploiter Countries at $t = 1$ - Basic economy

	e_1^ν		e_1^ν		e_1^ν
Indonesia	0.9928	South Korea	0.9223	Germany	0.8672
China	0.9935	Taiwan	0.8985	Portugal	0.7781
Venezuela	0.9912	Japan	0.9112	Sweden	0.8514
Mauritius	0.9788	United States	0.9114	Netherlands	0.8377
Uruguay	0.9820	Trinidad and Tobago	0.8675	Denmark	0.8352
Malaysia	0.9935	Finland	0.8857	Belgium	0.8027
Botswana	0.9816	United Kingdom	0.9010	Hong Kong	0.8081
Romania	0.9938	Cyprus	0.8435	Ireland	0.7972
Turkey	0.9409	Latvia	0.8605	Italy	0.7901
Lithuania	0.9711	Saudi Arabia	0.8252	Austria	0.7993
Russia	0.9750	Bahrain	0.7725	Switzerland	0.8159
Malta	0.9493	Czech Republic	0.8825	Norway	0.8116
Slovakia	0.9764	Slovenia	0.8720	United Arab Emirates	0.7268
New Zealand	0.9535	Greece	0.8431	Macao	0.7324
Croatia	0.9587	Canada	0.8794	Brunei	0.7048
Israel	0.9618	Australia	0.8679	Singapore	0.7811
Estonia	0.9529	France	0.8448	Luxembourg	0.7441
Hungary	0.9373	Spain	0.8256	Qatar	0.6277
Kuwait	0.8261	Iceland	0.8439		

5.2 Credit markets and the dynamics of exploitation

The previous subsection provides a snapshot of exploitative relations in the international context and it forcefully illustrates the importance of wealth inequalities for the *emergence* of IIR. In this section, we extend the analysis to analyse the mechanisms allowing for the transfer of surplus between countries, and derive the entire class structure of the global economy, based on the definition in section 3. Then, we tackle the issue of the dynamics of IIR by performing a counterfactual exercise. We ask: what would happen if the world economy behaved as in our model? Would exploitation *persist* in a competitive economy with significant wealth inequalities, and a drive to accumulate?

[21] Poland is the only exception, but its exploitation intensity index is only marginally above 1, which may be due to measurement error and/or the simplifying assumptions adopted in the calibration of our model.

[22] Two notable outliers are Trinidad and Tobago and, partly, Botswana. Although they have a small capital stock compared to OECD countries, they are categorised as exploiters largely due to their very small population and thus low effective labour capacity.

Table 2: Exploitation Intensity for Exploited Countries at $t = 1$ - Basic economy

	e_1^ν		e_1^ν		e_1^ν
Burundi	1.1305	Kyrgyzstan	1.1150	Sri Lanka	1.0516
Congo - Kinshasa	1.1292	Tanzania	1.0923	Morocco	1.0108
Malawi	1.1297	Haiti	1.0910	Namibia	1.0253
Mali	1.1241	Lesotho	1.0916	Ukraine	1.0581
Sierra Leone	1.1249	Bolivia	1.1085	Colombia	1.0373
Liberia	1.1257	Honduras	1.0993	Tajikistan	1.0516
Mozambique	1.1197	Vietnam	1.1045	Gabon	1.0441
Central African Republic	1.1218	Egypt	1.1026	South Africa	1.0435
Madagascar	1.1224	Belize	1.1095	Mongolia	1.0485
Niger	1.1160	Nicaragua	1.0896	Maldives	1.0258
Rwanda	1.1228	El Salvador	1.0878	Argentina	1.0459
Burkina Faso	1.1157	Guatemala	1.0790	Algeria	1.0187
Ethiopia	1.1112	Sudan	1.0675	Dominican Republic	1.0337
Zimbabwe	1.1221	Syria	1.0927	Jamaica	1.0270
Togo	1.1144	Laos	1.0755	Ecuador	1.0303
Benin	1.1146	Zambia	1.0908	Bulgaria	1.0405
Gambia	1.1100	Moldova	1.1002	Tunisia	1.0177
Kenya	1.1175	Fiji	1.0876	Kazakhstan	1.0346
Yemen	1.1110	India	1.0744	Serbia	1.0377
Uganda	1.1167	Iraq	1.0727	Albania	1.0234
Nepal	1.1100	Philippines	1.0821	Iran	1.0002
Cambodia	1.1115	Paraguay	1.0799	Poland	1.0333
Ivory Coast	1.1063	Armenia	1.0845	Mexico	1.0066
Cameroon	1.1091	Ghana	1.0685	Thailand	1.0035
Pakistan	1.1061	Jordan	1.0752	Barbados	1.0052
Senegal	1.0970	Congo - Brazzaville	1.0475	Brazil	1.0094
Myanmar	1.1005	Angola	1.0133	Panama	1.0025
Nigeria	1.1001	Eswatini	1.0426	Chile	1.0018
Mauritania	1.0966	Peru	1.0665		
Bangladesh	1.1012	Costa Rica	1.0456		

The results of the simulation can be found in figures 3-5. Figure 3 reports aggregate activity levels (y_t, z_t, δ_t) and wealth W_{t-1}, the growth rate of capital g_t, $\widehat{w}_t$ and b, and r_t.[23] In all panels, the dashed vertical line denotes the period in which the economy becomes labour constrained.

Figure 4(a) reports the dynamics of exploitation by providing a headcount of exploiting and exploited countries. Exploitation status is constant while the economy is capital constrained and exploitation ceases to exist once it becomes labour constrained.

Figure 4(b) derives the entire class structure of the global economy based on each country's position in the international credit market, while figure 4(c) compares exploitation and class status. Together, they complete our depiction of IIR, and confirm common intuitions in dependency theory. For, wealthy countries are net creditors ($Ay_t^\nu < z_t^\nu$), belong to C_t^1, and are exploiters, while poor countries are net debtors ($Ay_t^\nu > z_t^\nu$), belong to C_t^3, and are exploited.[24] Surplus is transferred from poor to rich countries via global capital markets.

[23] Aggregate x_t is not reported since $x_t = 0$, all t, without loss of generality as explained in Appendix A.2.

[24] In figure 4(b), and in all similar figures below, the class composition of the economy is shown only for the periods t with $r_t > 0$. For if the rate of return on capital vanishes the definition of classes needs to be revised (see Cogliano et al. (2019)). C_t^2 is empty in all simulations because no country satisfies the knife-edge condition $Ay_t^\nu = z_t^\nu$ exactly. This is a peculiarity of the one-good model and it can be shown that in more general economies some countries will indeed belong to C_t^2.

Figure 3: Summary results - Basic economy

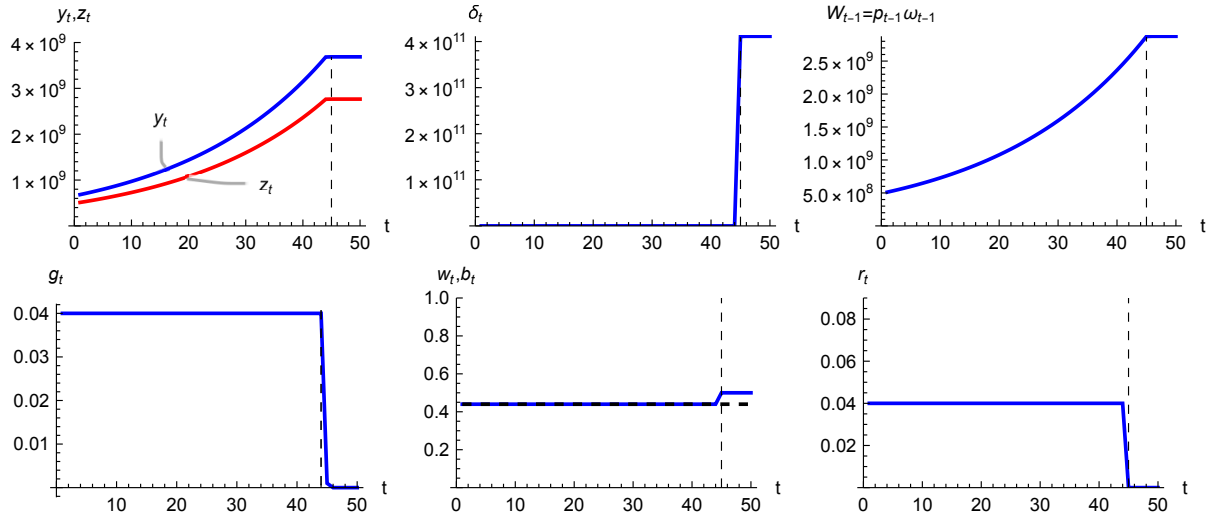


Figure 4: Class and exploitation status - Basic economy

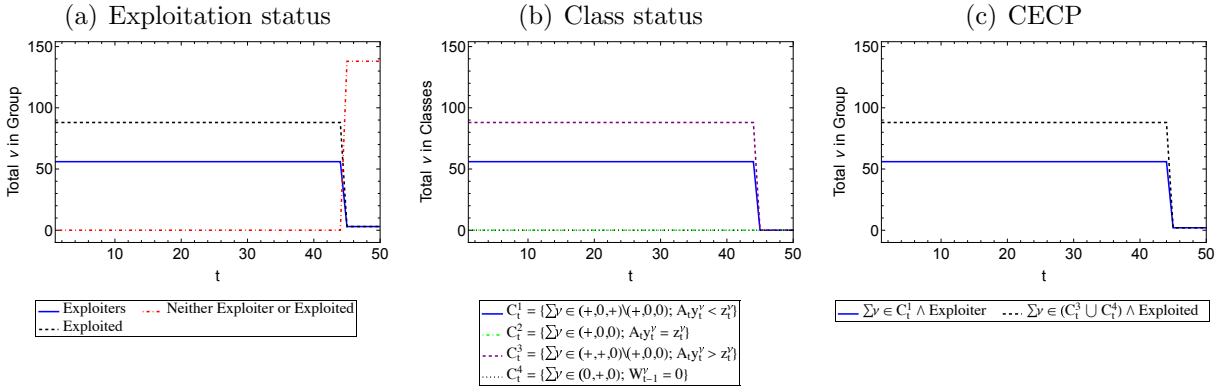
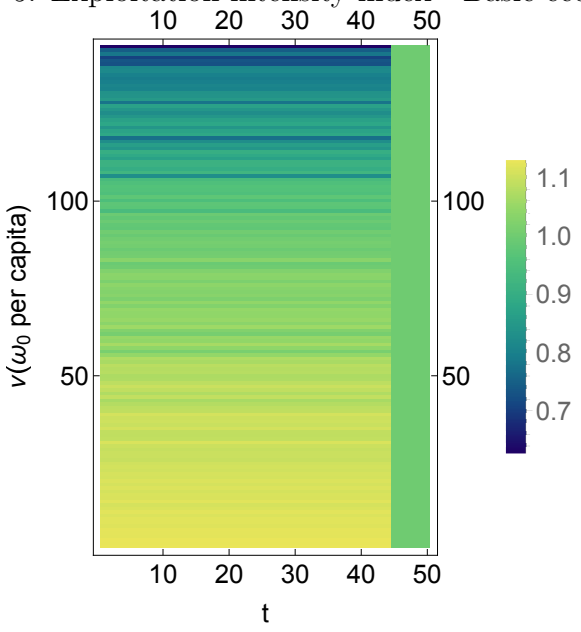


Figure 5 describes the dynamics of the distribution of the exploitation intensity index, e_t^ν, with countries sorted on the vertical axis by their initial per capita wealth (countries with the highest per capita wealth are at the top). When the economy is capital constrained, the distribution of e_t^ν is constant over time with a Gini coefficient of 0.0644787: there is no tendency for exploitation to diminish, and endowment-poor (rich) countries are exploited (exploiters). When the economy becomes labour constrained, returns on capital and exploitation disappear, and $e_t^\nu = 1$, for all countries ν.

These results confirm and generalise an argument originally suggested by Devine and Dymski (1991) and later proved by Veneziani and Yoshihara (2017a): wealth inequalities and competitive markets are sufficient for exploitation, and IIR, to emerge, but not for them to persist. Given the strong empirical evidence of persistent, if not widening, inequalities across borders, our simulation exercise suggests that something else is necessary to explain the dynamics of IIR. In the next section, we extend our analysis to incorporate some possible mechanisms to explain persistence of IIR, without having to assume the open use of force by core countries to stem the growth of those in the periphery.

Figure 5: Exploitation intensity index - Basic economy



6 Endogenising consumption and technical change

In this section we exploit the power of computational methods in dealing with complex, non-linear dynamics in economies with heterogeneous agents (Bergmann et al. 2009; Plummer et al. 2012) to allow both consumption and technology to change endogenously over time, and analyse their effect on IIR. This choice reflects both empirical and theoretical concerns. Empirically, the long-run evolution of capitalist economies has been characterised by an increase in (average) consumption opportunities and by an expansion of technical knowledge, leading to a progressive increase in labour productivity (Flaschel, Franke, and Veneziani 2013; Cogliano, Flaschel, Franke, Fröhlich, and Veneziani 2018). Theoretically, a fundamental feature of capitalism as a dynamic system is its constant tendency to revolutionise production with a strong propensity, according to Marx, for labour-saving innovations.

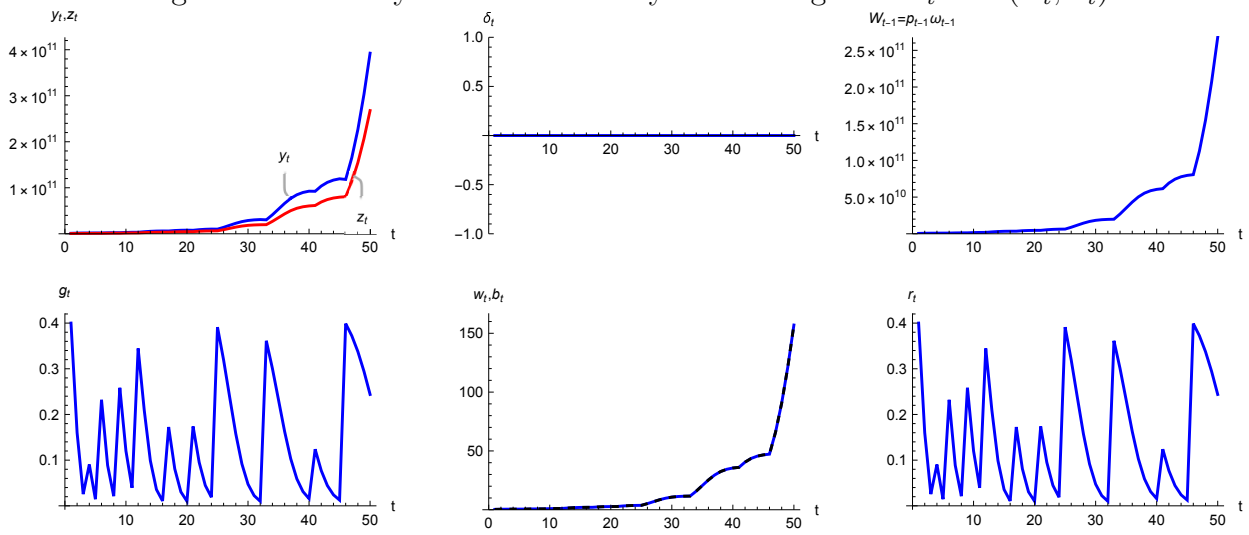
To be specific, concerning consumption, we incorporate some Marxian insights on the social nature of consumption and assume that b_t is the product of social norms, by making it an increasing function of the general level of development of the economy, as proxied by aggregate capital, and of the history of consumption itself. To be specific, we assume:

$$b_t = b_{t-1} \cdot \left(1 + \phi \frac{\omega_{t-1} - \omega_{t-2}}{\omega_{t-2}}\right), \tag{2}$$

where the parameter ϕ captures the degree to which the development of the economy influences consumption norms.

Concerning technology, we follow Marx and assume that when the rate of return on capital falls beneath a certain threshold, capitalists increase their efforts to innovate and introduce new techniques, thus leading (A_t, L_t) to change over time. In our model, given perfect competition, profitability is measured by the interest rate fetched on the international credit market. Therefore, in the computational analysis, we assume that there is a threshold

Figure 6: Summary results - Economy with endogenous b_t and (A_t, L_t)



value r^*, which represents the capitalists' minimum profitability benchmark, and depends on economic, institutional and even cultural factors, such that if at $t-1$ capitalists obtained sufficient profits ($r_{t-1} \geqq r^*$) then no innovations appear. If, however, profitability falls below the threshold ($r_{t-1} < r^*$) then R&D efforts lead to the discovery and adoption of a new technique, denoted as (A', L'), such that technical change is capital-using ($A' \geqq A_{t-1}$) and labour-saving ($L' < L_{t-1}$) à la Marx and it restores profitability.[25] This formulation of innovations is grounded theoretically in the Marxian and evolutionary tradition, as argued by Cogliano et al. (2016), and it has robust empirical support (Tavani and Zamparelli 2017).

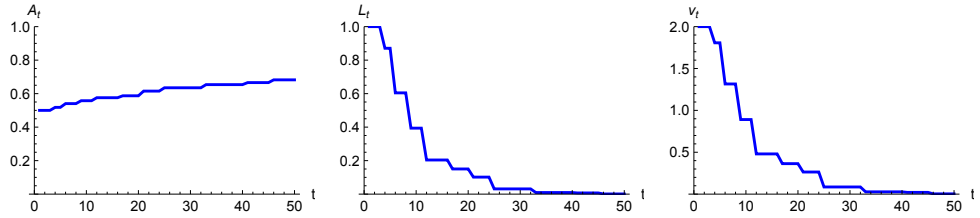
6.1 Persistent exploitation cycles

Figure 6 reports the same information as figure 3 for the basic model. Some differences clearly emerge: aggregate production, lending, and wealth, all increase over time but their growth path is no longer smooth, and g_t exhibits a cyclical downward trend, without the economy reaching a stationary state. This is caused by the joint dynamics of distribution, consumption norms, and technical change. Initially, the economy is capital constrained, and $\widehat{w}_t = b_t$. As accumulation proceeds, the subsistence norm, b_t, increases, leading to a decrease in r_t, and thus in the growth rate of aggregate output, lending, and capital, even before the economy becomes labour constrained. As the rate of return hits the critical threshold, however, capitalists manage to introduce an innovation that restores global profitability, lowers employment, and speeds up growth again, starting a new accumulation cycle. Throughout the cycles of accumulation and technical change the economy remains capital constrained, as recurrent Marx-biased technical change (cyclically) lowers labour demand and the labour embodied in the production good (figure 7). Therefore there is a secular increase in $\widehat{w}_t = b_t$, while r_t oscillates between $r_0 = 0.4$ and r^*.

In light of the cyclical behaviour of g_t and r_t, the core/periphery structure of the global economy is remarkably stable. Throughout the simulation, fifty-six countries are exploiters

[25]For a detailed description of the simulation procedure, see Appendix A.2.

Figure 7: Technology and labour values - Economy with endogenous b_t and (A_t, L_t)



Note: $A_{\max} = 0.682261$, $L_{\min} = 0.000964239$, $v_{\min} = 0.00303469$

and belong to C_t^1, and eighty-eight are exploited and belong to C_t^3, and the CECP holds at all t.[26] However, this draws only a partial picture of IIR, and beneath a seemingly unchanging surface, figures 8(a)-8(b) uncover an interesting phenomenon of "exploitation cycles" that trace the cycles in r_t. As accumulation progresses with a given technique (A_t, L_t), exploitation tends to decrease as e_t^ν tends to 1 for all ν. However, when a new technique is introduced, profitability and inequality in exploitation intensity are restored, and the pattern of accumulation and exploitation resumes until another innovation is introduced.

Figure 8: Exploitation intensity index - Economy with endogenous b_t and (A_t, L_t)

(a) Exploitation intensity across agents (b) Gini coefficient of e_t^ν

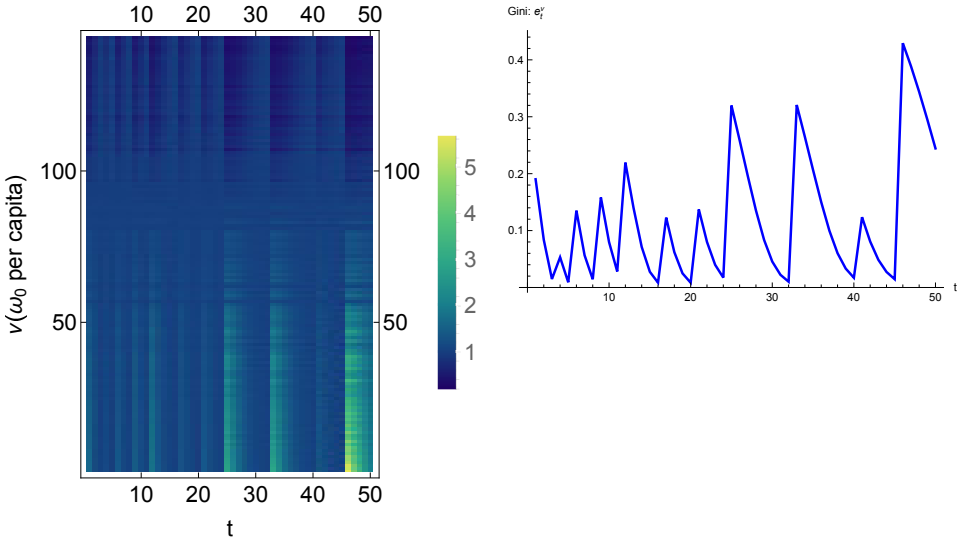


Figure 9 maps e_t^ν for all countries across select t. Unlike at $t = 1$, the distributions shown in figure 9 are counterfactuals: they show what the global distribution of e_t^ν would look like at different points in the cycles shown in figure 6.[27] In periods with high r_t $(t = 25, 50)$, international relations are more exploitative and e_t^ν is more disperse than in periods with low r_t $(t = 10, 40)$.

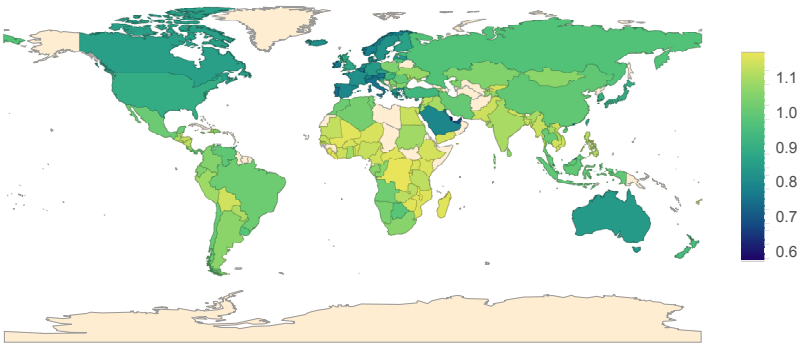
The results support the claim that capital-using labour-saving technical change can help

[26] These results are not shown for reasons of space and are available in the Addendum.

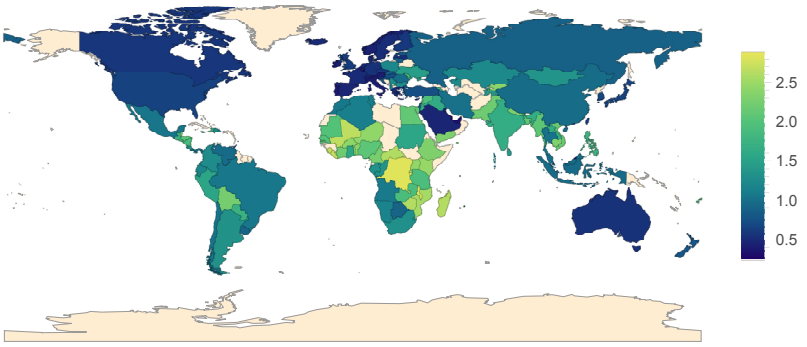
[27] The full list of values of e_t^ν at select t can be found in table 4 in Appendix B, where diagrams showing e_t^ν versus wealth per capita can also be found.

Figure 9: Worldwide Exploitation Intensity - Economy with endogenous b_t and (A_t, L_t)

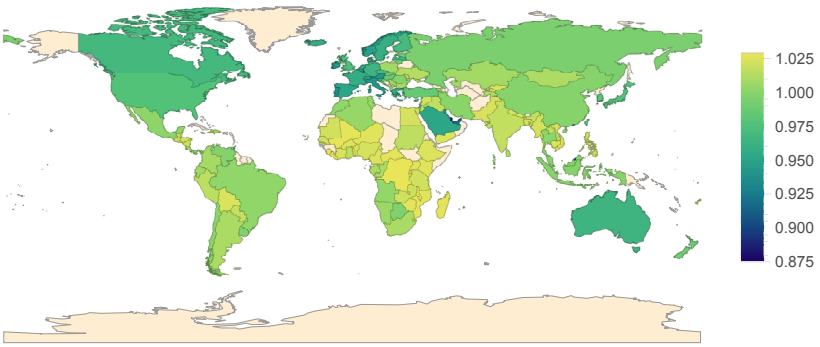
(a) $t = 10$



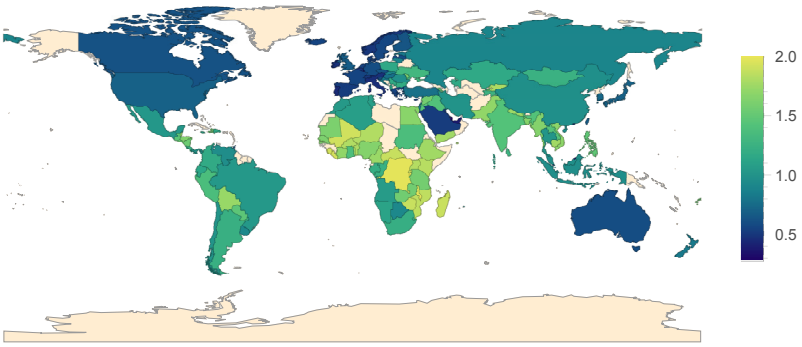
(b) $t = 25$



(c) $t = 40$



(d) $t = 50$



to explain the persistence of IIR (Skillman 1995). In the global economy, international trade and development raise (norms, expectations and therefore) living standards, including for countries in the periphery, which increases their reservation wage and tends to reduce the rate of return on capital. What can countries in the core do in order to counter this tendency, and maintain exploitation, without recourse to war and coercion? The previous analysis suggests that Marx-biased technical change may do the job as it makes capital persistently scarce relative to labour, thus maintaining the advantage of capital-rich core countries over labour-abundant countries in the periphery. In a competitive setting, countries in the core cannot coordinate their innovation efforts and therefore technical change tends to occur occasionally, which leads to cycles that capture the varying degree to which core countries are able to exploit the periphery over time.

In closing this section, we note that while the Gini of e_t^ν fluctuates widely around a mildly increasing trend, the Gini of the distribution of wealth remains constant at 0.8156 – as all countries accumulate at the rate r_t – and the Gini of the distribution of income stays within a rather narrow range, [0.780087, 0.812067].[28] This is an important point that was not evident in the basic economy: an analysis of international relations focusing on the concepts of exploitation and class is *not* reducible to a focus on income and wealth inequality (even though a strong relation exists between wealth inequalities and exploitation and class status, as shown above). The notions of exploitation and class identify the key economic and geographic structure of IIR, and the emergence in the global economy of a core and a periphery, in a way that international inequalities of income and wealth do not.

7 Robustness

We have analysed many variations of the two economies in order to assess the robustness of our results. In this section, we briefly summarise the main points.[29]

First, the empirical estimates of the global distribution of exploitation intensity in tables 1-2, and the partition of countries into exploiters and exploited, are robust to a number of perturbations. To be sure, alternative estimates of national wealth and consumption levels, or of the technological parameters A, L (and thus of embodied labour value v) may make a difference for countries that are very close to the threshold $e^\nu = 1$. But on the whole the picture of the international economy in 2017 derived in section 5.1 is quite robust.

We have also considered alternative determinations of each country's labour endowment, including (i) assigning a proxy value of one to those countries in the Penn World Table that do not report human capital attainment; and (ii) using the PWT data on persons engaged rather than population. In some respects, using persons engaged may yield better estimates of effective labour capacity, since it could ostensibly capture cultural and other differences across countries that determine different labour forces, even when populations are very similar. Option (i) expands N to 180 to include almost all countries in the world; while (ii) yields $N = 171$. Either way, our main conclusions remain unchanged.

Second, the key qualitative features of both economies are robust to a large number of perturbations of the initial conditions, production set, and, to a large extent, behavioural as-

[28] Figures for the distributions of wealth and income are omitted for space and shown in the Addendum.

[29] A complete description of all robustness checks is available in the Addendum.

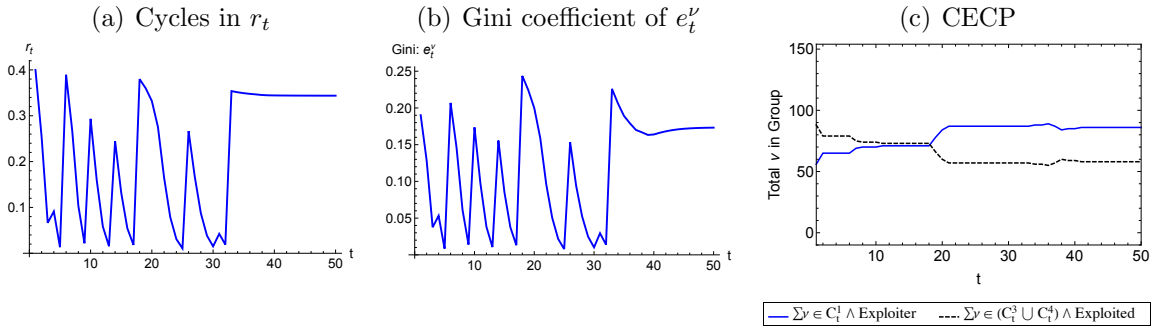
sumptions. The results in section 6.1 remain unchanged for a range of values of the threshold rate r^* and of the parameter ϕ linking the growth of consumption norms to accumulation, and they continue to hold with more general formulations of technical change.

Third, we have considered a variant of the economy with endogenous consumption norms but *exogenous* labour-saving technical change that occurs at a pace sufficient to maintain a stable r_t for all t. In this economy, the class and exploitation structure and the distribution of e_t^ν remain stable and consistent with that of the basic economy, but the economy does not reach a non-exploitative stationary state consistent with the results in section 6.1.

Fourth, it may be argued that our conclusions in section 6 depend on the rather specific dynamics of consumption norms, which are assumed to grow at the same rate as the capital stock. Although we believe this assumption to be empirically plausible, we have also tested a host of alternative specifications of consumption behaviour that largely confirm our results, except when consumption of core countries is so high that they stop accumulating straight away and there is a mild tendency for exploitation inequality to decrease.

Specifically, we examined a series of economies with highly heterogeneous consumption which we assume to be an increasing function of consumption norms, as determined in section 6, and of a country's interest revenue – the intuition being that wealthy countries tend to consume more from interest revenue and accumulate less.[30]

Figure 10: Sample results - Example economy with standard of living consumption



These economies display similar cycles to those in section 6 (see figure 10). As countries accumulate, they gradually shift toward consuming more interest income and their rate of accumulation slows. Yet, there seems to be no clear tendency for the Gini of e_t^ν to decrease. Overall, the general pattern is for a slight decrease in the intensity of exploitation over time, as most countries' exploitation status remains constant over time. However, as time goes on, some exploited countries switch to become exploiters, while some exploiting countries show notable increases in the intensity with which they exploit. This pattern of exploitation intensity is particularly interesting since it occurs even as r_t and the Gini of e_t^ν show no clear tendency to decline. Further, the structure of the CECP shown in figure 10 is robust even as standard of living-based consumption is introduced, b_t grows with aggregate accumulation, various technical changes take place, and the global economy eventually reaches a stationary state around $t = 40$, after which e_t^ν is almost constant for all ν. Stated differently, the

[30]These economies are closer to the non-linear models developed by Bergmann et al. (2009), Galanis and Kumar (2021), and Plummer et al. (2012).

CECP persists even as the world economy switches from a capital accumulation regime to a stationary one, thus the structure of exploitation and class is robust to shifts in the stage of world development – further confirming the analysis in section 5.

8 Conclusions

In this paper, we have developed a rigorous conceptual framework to analyse the new guise that IIR have taken in the global economy, and have derived a new measure of unequal exchange across borders – an exploitation intensity index. Contrary to the received view, this measure is theoretically robust, logically consistent, and empirically grounded. We have used it to derive the complete structure of IIR.

Unlike in post-modern approaches to globalisation, which depict IIR as immaterial and deterritorialised, the spatial-economic structure of the new imperialism can be identified, whereby wealthy nations are net lenders and exploiters, whereas endowment-poor countries are net borrowers and exploited. In line with a long tradition in radical geography, our model precisely identifies a set of countries in the core of the global economy, and those in the periphery based on their position in the class and exploitation structure.

We have also shown that unlike in classical theories, which emphasise monopolistic distortions, and the contradictions in the process of capital accumulation in core economies, competitive markets, profit-seeking, and international inequalities in development and wealth are central in generating IIR. The exploitative nature of IIR can be understood focusing on credit relations, which transfer surplus from the periphery to the core of the global economy.

While international credit markets and wealth inequalities are sufficient to generate an exploitation phenomenon, we show that they are not sufficient for it to persist. We have therefore explored some mechanisms to guarantee the persistence of IIR – without assuming the sheer use of force from core countries. Consistent with a classic Marxian intuition, we show that capital-using labour-saving technical change may play this role.

Indeed, if one adopts an evolutionary model of the creation and adoption of technical innovations, it is possible to show that the world economy displays endogenous fluctuations in the growth rate of output, as well as profitability and exploitation. Although ours is an exercise in scientific ontology – trying to identify the nature of IIR and an appropriate index to measure exploitative relations – these results suggest a possible explanation of the turbulent dynamics of the global economy. We leave this issue for further research.

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A Mathematical appendix

A.1 The basic economy

In this subsection, we analyse the *basic economy*, which is characterised by constant population, technology, consumption norms, and human capital. Formally, let $\mathcal{N}_t$, $\mathcal{P}_t$ denote, respectively, the set of agents and the set of available technologies at t. In the basic economy, $\mathcal{N}_t = \mathcal{N}$, $\mathcal{P}_t = \mathcal{P} = \{(A, L)\}$, $b_t = b$, and $l^\nu_{t-1} = l^\nu$ for all t and all ν. The basic economy provides a theoretical benchmark and a natural starting point for our analysis, but the framework, concepts, and definitions presented in this section, and in the next one, can be easily extended and the results derived continue to hold in more general economies (as confirmed also by the simulations).

We assume throughout that technology is sufficiently advanced to allow for the production of a surplus: $1 - vb > 0$, at all t. This condition is equivalent to $(1 - bL) > A$: it implies that if Ax units of capital are invested in the production process, gross output x is sufficient for necessary consumption bL and to replace capital used up in production, or $x > bLx + Ax$.

In every t, given (p_t, r_t), every country ν chooses $(x^\nu_t, y^\nu_t, z^\nu_t, \delta^\nu_t)$ to maximise its wealth subject to consuming b per unit of labour performed (3) and to the constraints set by its capital (4) and labour (5) endowments. Formally, every ν solves the following programme:[31]

$$(MP^\nu_t) \max_{(x^\nu_t, y^\nu_t, z^\nu_t, \delta^\nu_t)} p_t \omega^\nu_t$$

subject to

$$\begin{aligned} p_t x^\nu_t + [p_t - (1 + r_t) p_{t-1} A]\, y^\nu_t + (1 + r_t) z^\nu_t + p_t \delta^\nu_t &= p_t b \Lambda^\nu_t + p_t \omega^\nu_t && (3) \\ p_{t-1} A x^\nu_t + z^\nu_t + p_{t-1} \delta^\nu_t &= p_{t-1} \omega^\nu_{t-1}, && (4) \\ L x^\nu_t + L y^\nu_t &\leqq l^\nu. && (5) \end{aligned}$$

The *basic economy* is defined by the set of countries, $\mathcal{N}$, technology, (A, L), consumption bundle, b, labour endowments, $(l^\nu)_{\nu \in \mathcal{N}}$, and initial capital endowments, $(\omega^\nu_0)_{\nu \in \mathcal{N}}$; and is denoted as $E(\mathcal{N}, (A, L), b, (l^\nu)_{\nu \in \mathcal{N}}, (\omega^\nu_0)_{\nu \in \mathcal{N}})$. Let $x_t \equiv \sum_{\nu \in \mathcal{N}} x^\nu_t$, and likewise for y_t, z_t, δ_t, ω_t, Λ_t, and l. Based on Roemer (1982), the concept of a reproducible solution can be defined.

Definition A.1: A *reproducible solution* (RS) for $E(\mathcal{N}, (A, L), b, (l^\nu)_{\nu \in \mathcal{N}}, (\omega^\nu_0)_{\nu \in \mathcal{N}})$ is a sequence of vectors (p_t, r_t) and associated actions $(x^\nu_t, y^\nu_t, z^\nu_t, \delta^\nu_t)_{\nu \in \mathcal{N}}$, such that at all t:

(a) $(x^\nu_t, y^\nu_t, z^\nu_t, \delta^\nu_t)$ solves MP^ν_t for all $\nu \in \mathcal{N}$ (optimality);

(b) $A(x_t + y_t) + \delta_t \leqq \omega_{t-1}$ (feasibility of production);

(c) $p_{t-1} A y_t = z_t$ (credit market);

(d) $(x_t + y_t) + \delta_t \geqq b\Lambda_t + \omega_t$ (goods market).

[31] Although we are focusing on an one-good economy, we provide a general formulation of programme MP^ν_t, and of the rest of the economy, in order to point the reader to the n-good extension of our analysis. Observe that if $\mathcal{P}$ is not a singleton, as in the model of section 6, then countries also choose A, L optimally.

At a RS, in every period (a) all countries maximise their wealth; (b) aggregate capital is sufficient for production (and speculative saving) plans; (c) the credit market clears; (d) aggregate supply is sufficient for consumption and accumulation plans.[32]

Given the structure of the one-good economy, we shall focus on RS's with strictly positive prices without loss of generality,[33] and we can take the produced commodity as the numéraire, setting $p_t = 1$, all t.[34] This implicitly defines a real wage rate $\widehat{w}_t$ at any t. It is immediate to prove that at any nontrivial RS, the real wage is at least enough to cover subsistence and the interest rate is nonnegative. Formally, if $\omega_{t-1} > 0$, then $\widehat{w}_t \geqq b$ and $r_t \geqq 0$, all t.

Given the previous observations, by constraints (3)-(4), it follows that at any RS, for all countries ν, the following equation must hold in every period t

$$\omega_t^\nu = \omega_{t-1}^\nu + r_t \left(A x_t^\nu + z_t^\nu\right) + \left(\widehat{w}_t - b\right) L \left(x_t^\nu + y_t^\nu\right). \tag{6}$$

Equation (6) implies that for all countries at the solution to MP_t^ν, if the interest rate is strictly positive, no wealth is used for speculative savings ($\delta_t^\nu = 0$ all ν), and if the wage rate is above subsistence, then the labour constraint (5) binds.

It is not difficult to show that this has some implications for the set of RS's: the interest rate can be strictly positive *and* the real wage rate can be greater than the subsistence norm only if the aggregate (effective) labour and capital endowments satisfy the knife-edge condition $l = LA^{-1}\omega_{t-1}$. If capital (labour) is abundant, the interest rate (the real wage rate) drops to zero (the subsistence level). This observation provides the foundations for the analysis of the dynamics of the global economy in the simulations.[35]

For every country ν, its gross revenue minus the subsistence cost is given by:

$$V_t^\nu \left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right) \equiv (1 + r_t) W_{t-1}^\nu + (w_t - p_t b) \Lambda_t^\nu.$$

Therefore, $R_t^\nu \left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right) \equiv V_t^\nu \left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right) + p_t b \Lambda_t^\nu$. Moreover, taking the produced commodity as the numéraire for each t, it follows that $V_t^\nu \left(W_{t-1}^\nu, \Lambda_t^\nu; (p_t, r_t)\right)$ can be reduced to $V_t^\nu \left(W_{t-1}^\nu, \Lambda_t^\nu; (1, r_t)\right)$ as defined below, and from equation (6) the growth rate of capital, g_t^ν, is also defined in period t:[36]

$$V_t^\nu \left(W_{t-1}^\nu, \Lambda_t^\nu; (1, r_t)\right) = (1 + r_t) \omega_{t-1}^\nu + \left(\widehat{w}_t - b\right) \Lambda_t^\nu, \tag{7}$$

$$g_t^\nu = r_t + \left(\widehat{w}_t - b\right) \frac{\Lambda_t^\nu}{\omega_{t-1}^\nu}. \tag{8}$$

From equation (8) it follows that, at all t, the aggregate growth rate of the economy is $g_t = r_t + \left(\widehat{w}_t - b\right) \frac{l}{\omega_{t-1}}$.

[32] The economy can thus be interpreted either as a sequence of generations living for one period or as a single generation in a sequence of temporary equilibria.

[33] Formally, $p_t, p_{t-1} > 0$ all t. Observe that from MP_t^ν it immediately follows that if there is some t' such that $p_{t'} = 0$, then at any RS it must be $p_t = 0$ for all $t > t'$.

[34] Given the commodity as the numéraire, r_t should be considered to represent the *real* interest rate at period t, which is defined by the *nominal* interest rate minus the inflation rate. Therefore one will invest or lend (rather than storing the good) provided $r_t \geqq 0$.

[35] A characterisation of the set of RS's can be derived using similar arguments as in Cogliano et al. (2019).

[36] Recall that $W_{t-1}^\nu = p_{t-1}\omega_{t-1}^\nu$, that $\widehat{w}_t = \frac{w_t}{p_t}$ and that we are setting $p_t = p_{t-1} = 1$.

A.2 The simulation routine and model calibration

A.2.1 The basic economy

The simulation begins with data on the various parameters of the model. The set of countries, and the distribution of capital and labour endowments are calibrated using 2017 data from the Penn World Table (PWT) (Feenstra et al. 2015). The PWT estimates of nations' capital stock at current PPPs (millions of 2011 U.S. dollars) are taken as ω_0^ν for each country ν. The values of l^ν are set by multiplying each country's population by the Penn estimates of average human capital attainment and scaling this figure up by 100,000 to ensure $l > LA^{-1}\omega_0$.[37] Countries for which there are no estimates of the capital stock or average human capital attainment are removed from the simulations, leaving $N = 144$.[38]

As for technology and consumption, we set: $A = 0.75$, $L = 0.5$, and $b = 0.44$, thus $v = 2$.

The choices of initial parameter values, and the scaling up of labour endowments, allow the simulations to start far from the knife-edge condition $l = LA^{-1}\omega_{t-1}$ and ensure a reasonable initial value of r_t such that the dynamics of the simulation have room to play out before the simulation becomes labour constrained, but – as discussed in section 7 – our key insights are robust to different choices of parameters.

For all countries and time periods, we restrict the computational analysis to solutions of MP_t^ν of the form $(0, y_t^\nu, z_t^\nu, \delta_t^\nu)$. As shown in Cogliano et al. (2019), this is without any loss of generality and it allows us to focus more closely on the interaction of countries in international credit markets and the resulting exploitative dynamics.

To be specific, at any t, we set $(x_t^\nu, y_t^\nu, z_t^\nu, \delta_t^\nu) = \left(0, \frac{A^{-1}\omega_{t-1}}{l} l^\nu, \omega_{t-1}^\nu, 0\right)$, $(x_t^\nu, y_t^\nu, z_t^\nu, \delta_t^\nu) = \left(0, L^{-1}l^\nu, \frac{l}{LA^{-1}\omega_{t-1}}\omega_{t-1}^\nu, \omega_{t-1}^\nu - z_t^\nu\right)$, or $(x_t^\nu, y_t^\nu, z_t^\nu, \delta_t^\nu) = \left(0, L^{-1}l^\nu, \omega_{t-1}^\nu, 0\right)$, for all ν, depending on whether the economy is capital constrained, labour constrained, or on the knife-edge. This specification of agents' optimal choices guarantees that the conditions in Definition A.1 are always satisfied.

To see this, observe that the economy is capital constrained, labour constrained, or on the knife-edge depending on whether $l \gtreqless LA^{-1}\omega_{t-1}$. Suppose the economy is capital constrained with $l > LA^{-1}\omega_{t-1}$, some t. Then at any RS it must be $\widehat{w}_t = b$, so that $r_t > 0$ and labour performed does not produce any net income for accumulation. Thus, for all ν, any $(0; y_t^\nu; z_t^\nu; 0)$ with $z_t^\nu = \omega_{t-1}^\nu$ solves MP_t^ν. Therefore since $z_t = \omega_{t-1}$ and $l > LA^{-1}\omega_{t-1}$, we choose a suitable profile (y_t^ν) for all ν such that $Ay_t = z_t$ and all conditions of Definition A.1 are satisfied at t. A similar logic holds in the other cases.

The simulation runs for $T = 50$ periods. The simulation first checks whether the economy is capital constrained, labour constrained, or on the knife-edge and updates r_t accordingly. Given the choice of ω_0, the simulation begins with r_1 such that $\widehat{w}_1 = b$ and countries then choose activities $(0, y_t^\nu, z_t^\nu)$ to maximise their wealth subject to their existing wealth and

[37] In the PWT (Feenstra et al. 2015), capital stocks are estimated using a perpetual inventory method and include six assets: structures (residential and non-residential); transport equipment; computers; communication equipment; software; and other machinery and assets. The human capital index in the PWT is based on average years of schooling, provided by Barro and Lee (2013), and assumptions about the rate of return to education from Psacharopoulos (1994).

[38] Robustness checks are run using proxies for average human capital attainment, but the main results of the simulations are not altered by reintroducing these countries. See section 7.

labour endowments and their subsistence needs. Wealth endowments are then updated according to equation (6) and the simulation repeats as necessary.

A.2.2 The economy with endogenous technical change

In our simulations, we set $r^* = 0.01$. Let $r^{(\widehat{w}_t;A_{t-1},L_{t-1})}$ be the interest rate given the real wage $\widehat{w}_t$ at t and the production technique adopted at $t-1$. Formally,

$$r^{(\widehat{w}_t;A_{t-1},L_{t-1})} \equiv \frac{1 - A_{t-1} - \widehat{w}_t L_{t-1}}{A_{t-1}},$$

where either $\widehat{w}_t = b_t$ or $\widehat{w}_t = \frac{1-A_{t-1}}{L_{t-1}}$ depending on whether the economy is capital constrained or labour constrained in period t. If $r^{(\widehat{w}_t;A_{t-1},L_{t-1})} \geq r^*$ then $(A_t, L_t) = (A_{t-1}, L_{t-1})$. When $r^{(\widehat{w}_t;A_{t-1},L_{t-1})} < r^*$, the new technique prevailing at t is identified by first selecting an interest rate, r', from the set of all previous interest rates $\{r_\tau\}_{\tau<t}$, such that $r_\tau > r^*$ and then randomly choosing an increase in A_{t-1} in the range $[0.01, 0.03]$ and setting $L_t = \frac{1-A_t-A_t r'}{\widehat{w}_t}$. To ensure that $A_t < 1$ a limit is set such that $A_{\max} = 0.991$. If r' and A_t entail a negative L_t, r' is adjusted downward by 0.02 so that $L_t > 0$.[39] These parameter values are chosen to ensure that new techniques restore a higher interest rate while not being so large as to preclude additional new innovations over the course of the simulation, i.e. these values allow us to examine the impact of a series of new techniques on exploitation and the core-periphery structure of the global economy. New techniques also provide the highest possible interest rate during any t. Given the persistently rising b_t, a new technique provides a higher interest rate than older techniques, thus there is no desire for any kind of reswitching.

The simulation occurs in the following order: (i) initialisation, $t = 1$; (ii) subsistence b_t is updated; (iii) $\widehat{w}_t$ and $r^{(\widehat{w}_t;A_{t-1},L_{t-1})}$ are determined depending on whether the economy is capital constrained or labour constrained;[40] (iv) given $r^{(\widehat{w}_t;A_{t-1},L_{t-1})}$, A_t and r_t are updated if appropriate, leading L_t to be subsequently updated to reflect the new technology; (v) countries' actions are determined as in section A.2.1 and wealth endowments are updated according to equation (6);[41] and (vi) the sequence (ii)-(v) is repeated for all T periods.

The simulation runs for $T = 50$, with $A_0 = 0.5$, $L_0 = 1$, $b_0 = 0.3$, and $\phi = 1$. Parameters are chosen to allow the dynamics of technical change and evolving consumption norms to play out over T, and similar to section 5, $v_1 = 2$ and declines thereafter as a result of technical change. The effective labour endowments and the initial distribution of wealth are determined as in the basic model.

[39] The downward adjustment of r' by 0.02 is only to ensure that the simulations run smoothly and does not actually take place in the simulation results shown below. Similarly, the upper limit on A_t is not actually reached and new techniques in the simulation results fit the Marx-biased pattern described above.

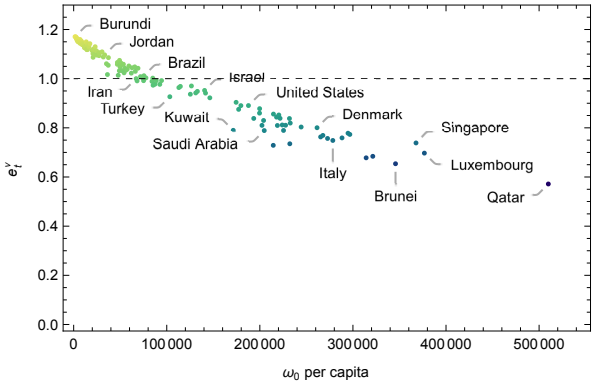
[40] In principle, the global economy could also be on the knife-edge, in which case we would need to specify a rule to determine the distributive variables. However, our simulations do not encounter this situation.

[41] Given the changes in consumption norms and technical changes that take place. Note that if prices are in a state of disequilibrium, the consumption norms determined by the equation (2) may violate feasibility, however, this does not occur in our simulations.

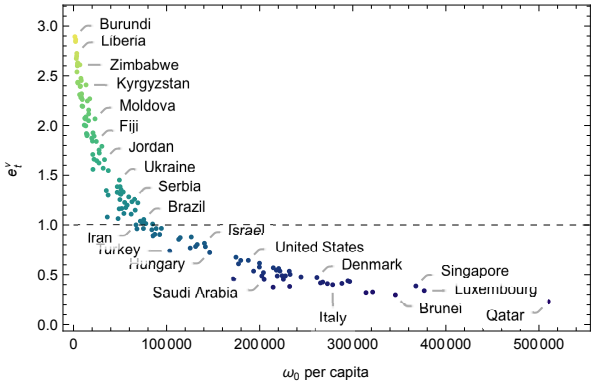
B Exploitation and class in the global economy with endogenous technical change

Figure 11: Worldwide Exploitation Intensity vs. Wealth per Capita - Economy with endogenous b_t and (A_t, L_t)

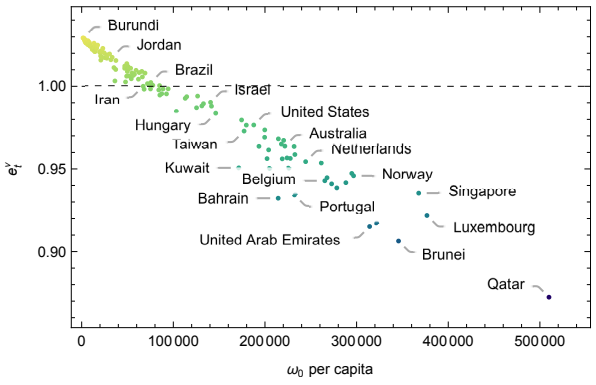
(a) $t = 10$



(b) $t = 25$



(c) $t = 40$



(d) $t = 50$

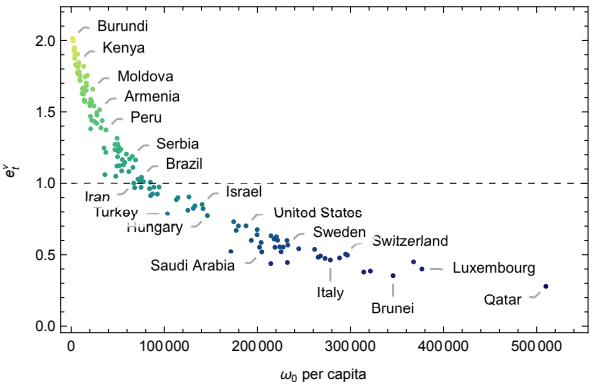
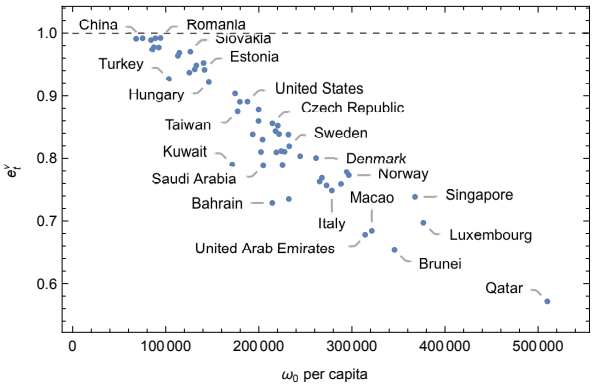
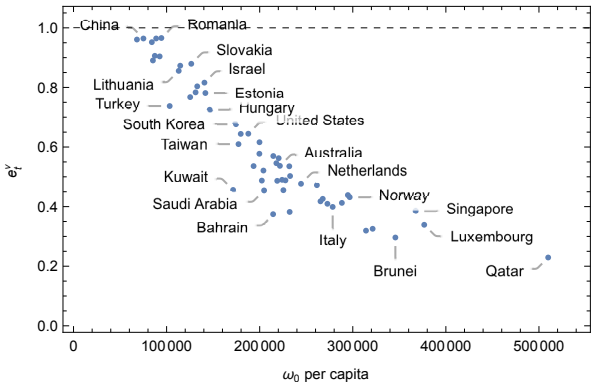


Figure 12: Exploiter Countries - Economy with endogenous b_t and (A_t, L_t)

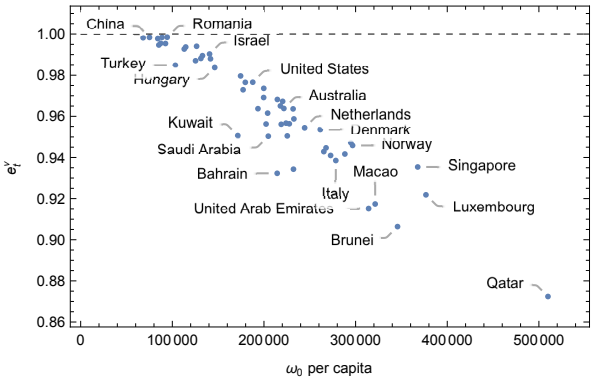
(a) $t = 10$



(b) $t = 25$



(c) $t = 40$



(d) $t = 50$

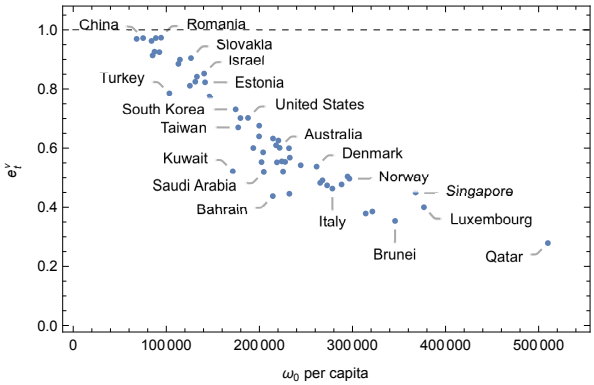
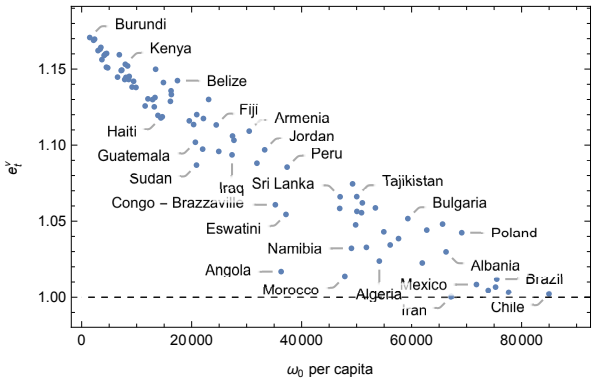
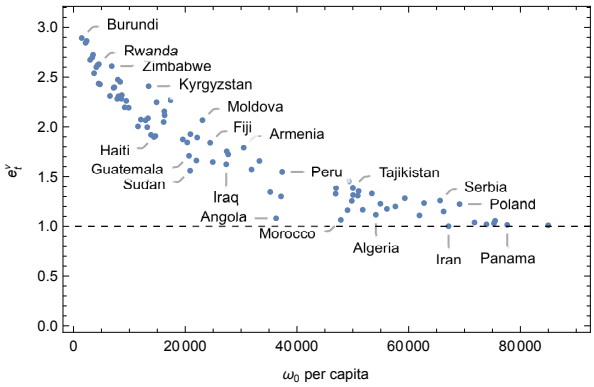


Figure 13: Exploited Countries - Economy with endogenous b_t and (A_t, L_t)

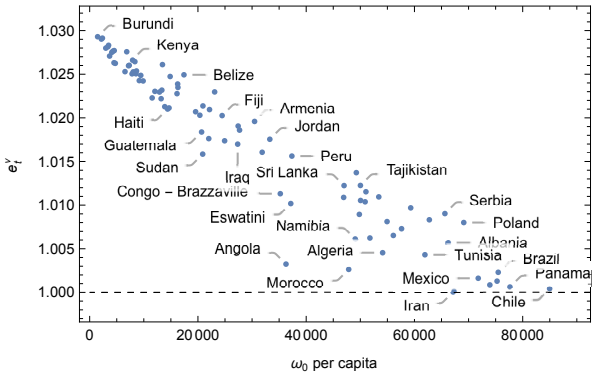
(a) $t = 10$



(b) $t = 25$



(c) $t = 40$



(d) $t = 50$

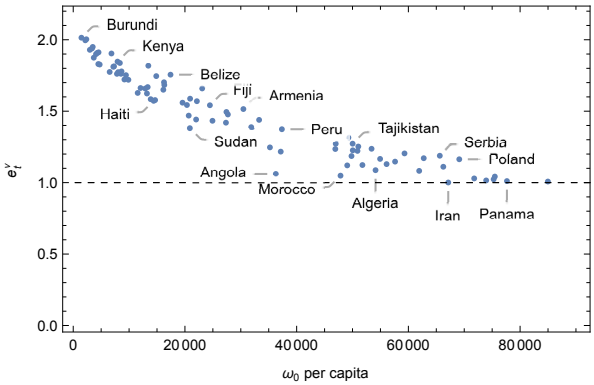


Table 3: Exploitation Intensity for Exploiter Countries at select t with countries sorted by initial per capita wealth - Economy with endogenous b_t and (A_t, L_t)

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.97654	0.99098	0.96075	0.99823	0.96952
China	0.97865	0.99180	0.96422	0.99839	0.97224
Venezuela	0.97116	0.98887	0.95192	0.99781	0.96259
Mauritius	0.93254	0.97331	0.89045	0.99468	0.91351
Uruguay	0.94257	0.97742	0.90610	0.99551	0.92614
Malaysia	0.97870	0.99182	0.96431	0.99839	0.97231
Botswana	0.94131	0.97691	0.90413	0.99541	0.92456
Romania	0.97962	0.99218	0.96583	0.99846	0.97350
Turkey	0.82697	0.92652	0.73754	0.98476	0.78503
Lithuania	0.90969	0.96373	0.85555	0.99271	0.88501
Russia	0.92117	0.96858	0.87295	0.99371	0.89928
Malta	0.84880	0.93675	0.76749	0.98699	0.81094
Slovakia	0.92534	0.97033	0.87934	0.99407	0.90449
New Zealand	0.86020	0.94197	0.78345	0.98812	0.82461
Croatia	0.87438	0.94836	0.80365	0.98948	0.84174
Israel	0.88300	0.95217	0.81609	0.99029	0.85221
Estonia	0.85859	0.94124	0.78118	0.98796	0.82266
Hungary	0.81771	0.92208	0.72510	0.98378	0.77414
Kuwait	0.58765	0.78990	0.45592	0.95065	0.52128
South Korea	0.78071	0.90377	0.67672	0.97964	0.73120
Taiwan	0.72654	0.87515	0.60972	0.97291	0.66998
Japan	0.75478	0.89035	0.64410	0.97653	0.70165
United States	0.75529	0.89062	0.64473	0.97659	0.70223
Trinidad and Tobago	0.66270	0.83828	0.53602	0.96372	0.60020
Finland	0.69912	0.85975	0.57740	0.96915	0.63970
United Kingdom	0.73185	0.87805	0.61609	0.97361	0.67589
Cyprus	0.61782	0.81006	0.48732	0.95624	0.55261
Latvia	0.64914	0.82996	0.52104	0.96155	0.58569
Saudi Arabia	0.58610	0.78884	0.45433	0.95035	0.51968
Bahrain	0.50463	0.72881	0.37460	0.93230	0.43769
Czech Republic	0.69253	0.85595	0.56978	0.96820	0.63248
Slovenia	0.67142	0.84352	0.54576	0.96506	0.60957
Greece	0.61708	0.80957	0.48653	0.95611	0.55183
Canada	0.68624	0.85229	0.56256	0.96728	0.62563
Australia	0.66340	0.83870	0.53679	0.96382	0.60094
France	0.62024	0.81163	0.48988	0.95667	0.55515
Spain	0.58686	0.78937	0.45512	0.95050	0.52047
Iceland	0.61854	0.81053	0.48808	0.95637	0.55336
Germany	0.66211	0.83791	0.53535	0.96362	0.59955
Portugal	0.51266	0.73512	0.38216	0.93430	0.44561
Sweden	0.63217	0.81930	0.50263	0.95873	0.56770
Netherlands	0.60760	0.80334	0.47656	0.95440	0.54194
Denmark	0.60321	0.80042	0.47198	0.95360	0.53737
Belgium	0.54963	0.76301	0.41779	0.94285	0.48253
Hong Kong	0.55816	0.76920	0.42621	0.94468	0.49116
Ireland	0.54117	0.75678	0.40951	0.94098	0.47401
Italy	0.53033	0.74867	0.39901	0.93851	0.46316
Austria	0.54431	0.75910	0.41257	0.94168	0.47717
Switzerland	0.57071	0.77814	0.43874	0.94729	0.50392
Norway	0.56370	0.77317	0.43172	0.94584	0.49678
United Arab Emirates	0.44385	0.67799	0.31939	0.91517	0.37881
Macao	0.45091	0.68419	0.32563	0.91736	0.38555
Brunei	0.41733	0.65392	0.29634	0.90638	0.35369
Singapore	0.51707	0.73854	0.38634	0.93537	0.44997
Luxembourg	0.46594	0.69712	0.33906	0.92184	0.39998
Qatar	0.33588	0.57160	0.22922	0.87240	0.27873

Table 4: Exploitation Intensity for Exploited Countries at select t with countries sorted by initial per capita wealth - Economy with endogenous b_t and (A_t, L_t)

	e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}		e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}
Burundi	1.6254	1.1707	2.8931	1.0293	2.0143	Laos	1.3056	1.0974	1.6613	1.0176	1.4416
Congo - Kinshasa	1.6163	1.1689	2.8446	1.0290	1.9961	Zambia	1.3838	1.1175	1.8929	1.0209	1.5699
Malawi	1.6199	1.1697	2.8638	1.0291	2.0033	Moldova	1.4359	1.1300	2.0672	1.0230	1.6591
Mali	1.5824	1.1621	2.6735	1.0280	1.9294	Fiji	1.3669	1.1133	1.8400	1.0203	1.5416
Sierra Leone	1.5874	1.1631	2.6975	1.0281	1.9390	India	1.3000	1.0959	1.6461	1.0174	1.4328
Liberia	1.5929	1.1643	2.7248	1.0283	1.9498	Iraq	1.2917	1.0936	1.6235	1.0170	1.4195
Mozambique	1.5538	1.1562	2.5392	1.0271	1.8744	Philippines	1.3384	1.1060	1.7544	1.0191	1.4946
Central African Republic	1.5670	1.1590	2.5999	1.0275	1.8995	Paraguay	1.3276	1.1032	1.7232	1.0186	1.4770
Madagascar	1.5714	1.1599	2.6206	1.0276	1.9080	Armenia	1.3508	1.1092	1.7911	1.0196	1.5149
Niger	1.5304	1.1512	2.4355	1.0263	1.8301	Ghana	1.2716	1.0881	1.5706	1.0161	1.3881
Rwanda	1.5734	1.1603	2.6302	1.0277	1.9119	Jordan	1.3040	1.0969	1.6569	1.0175	1.4390
Burkina Faso	1.5285	1.1508	2.4272	1.0262	1.8265	Congo - Brazzaville	1.1781	1.0608	1.3461	1.0113	1.2466
Ethiopia	1.5004	1.1447	2.3105	1.0253	1.7745	Angola	1.0457	1.0168	1.0802	1.0032	1.0606
Zimbabwe	1.5692	1.1594	2.6103	1.0276	1.9038	Eswatini	1.1577	1.0544	1.3014	1.0102	1.2169
Togo	1.5202	1.1490	2.3922	1.0260	1.8111	Peru	1.2624	1.0855	1.5469	1.0156	1.3737
Benin	1.5216	1.1493	2.3981	1.0260	1.8137	Costa Rica	1.1703	1.0584	1.3289	1.0109	1.2353
Gambia	1.4932	1.1431	2.2817	1.0250	1.7614	Sri Lanka	1.1954	1.0660	1.3850	1.0122	1.2721
Kenya	1.5394	1.1532	2.4746	1.0266	1.8470	Morocco	1.0369	1.0137	1.0644	1.0026	1.0488
Yemen	1.4996	1.1445	2.3074	1.0253	1.7732	Namibia	1.0896	1.0322	1.1625	1.0061	1.1205
Uganda	1.5342	1.1521	2.4522	1.0264	1.8373	Ukraine	1.2240	1.0745	1.4518	1.0137	1.3149
Nepal	1.4933	1.1431	2.2823	1.0251	1.7617	Colombia	1.1361	1.0476	1.2559	1.0089	1.1859
Cambodia	1.5026	1.1452	2.3193	1.0254	1.7786	Tajikistan	1.1957	1.0661	1.3857	1.0123	1.2726
Ivory Coast	1.4712	1.1382	2.1964	1.0243	1.7217	Gabon	1.1640	1.0564	1.3151	1.0105	1.2261
Cameroon	1.4881	1.1420	2.2615	1.0249	1.7521	South Africa	1.1612	1.0556	1.3092	1.0104	1.2221
Pakistan	1.4701	1.1379	2.1922	1.0242	1.7197	Mongolia	1.1822	1.0620	1.3552	1.0115	1.2526
Senegal	1.4178	1.1257	2.0046	1.0223	1.6277	Maldives	1.0914	1.0328	1.1660	1.0062	1.1231
Myanmar	1.4376	1.1304	2.0732	1.0230	1.6621	Argentina	1.1714	1.0587	1.3313	1.0109	1.2369
Nigeria	1.4355	1.1299	2.0660	1.0230	1.6585	Algeria	1.0652	1.0237	1.1161	1.0045	1.0870
Mauritania	1.4154	1.1252	1.9967	1.0222	1.6237	Dominican Republic	1.1221	1.0430	1.2270	1.0081	1.1660
Bangladesh	1.4413	1.1313	2.0866	1.0232	1.6687	Jamaica	1.0961	1.0344	1.1752	1.0065	1.1296
Kyrgyzstan	1.5241	1.1499	2.4086	1.0261	1.8183	Ecuador	1.1085	1.0385	1.1998	1.0073	1.1470
Tanzania	1.3921	1.1195	1.9196	1.0213	1.5839	Bulgaria	1.1490	1.0517	1.2829	1.0097	1.2044
Haiti	1.3854	1.1179	1.8978	1.0210	1.5725	Tunisia	1.0616	1.0225	1.1095	1.0043	1.0822
Lesotho	1.3885	1.1186	1.9079	1.0211	1.5778	Kazakhstan	1.1255	1.0441	1.2341	1.0083	1.1709
Bolivia	1.4844	1.1412	2.2472	1.0247	1.7455	Serbia	1.1377	1.0481	1.2591	1.0090	1.1882
Honduras	1.4306	1.1288	2.0488	1.0228	1.6500	Albania	1.0827	1.0298	1.1492	1.0057	1.1110
Vietnam	1.4604	1.1357	2.1559	1.0239	1.7024	Iran	1.0007	1.0003	1.0012	1.0001	1.0009
Egypt	1.4497	1.1333	2.1167	1.0235	1.6835	Poland	1.1202	1.0424	1.2233	1.0080	1.1634
Belize	1.4900	1.1424	2.2690	1.0249	1.7556	Mexico	1.0223	1.0083	1.0386	1.0016	1.0294
Nicaragua	1.3777	1.1160	1.8734	1.0207	1.5595	Thailand	1.0117	1.0044	1.0200	1.0009	1.0153
El Salvador	1.3679	1.1135	1.8430	1.0203	1.5432	Barbados	1.0177	1.0066	1.0305	1.0013	1.0233
Guatemala	1.3226	1.1019	1.7090	1.0184	1.4690	Brazil	1.0321	1.0119	1.0558	1.0023	1.0424
Sudan	1.2672	1.0869	1.5590	1.0158	1.3811	Panama	1.0083	1.0031	1.0142	1.0006	1.0109
Syria	1.3943	1.1201	1.9266	1.0214	1.5876	Chile	1.0059	1.0022	1.0101	1.0004	1.0077

Addendum for the paper "*The Dynamics of International Exploitation*". Not for publication.

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August 10, 2022

Abstract

Section 1 provides the formal results supporting the analytical framework of the paper. Section 2 demonstrates that in all of the simulations, conditions (b)-(d) of Definition 1 are satisfied. Section 3 shows supplementary figures for the main simulations in the paper. Sections 4-7 present the results of the robustness checks.

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Contents

1 Formal Results

The formal results below support the analytical conclusions of the main paper, and are straightforward extensions of the formal presentation in Cogliano et al. [1]. The formal presentation below explores implications of Definition A.1 and equation (6) of the main paper, as well as further characterising the notion of equilibrium in Definition A.1. Lemma 1 proves that if the interest rate is strictly positive, then all wealth is used productively and if the wage rate is above the minimum standard b, then the labour constraint (3) binds for all agents at the solution to MP_t^ν.

As in the main paper, let $E\left(\mathcal{N},(A,L),b,(l^\nu)_{\nu\in\mathcal{N}},(\omega_0^\nu)_{\nu\in\mathcal{N}}\right)$ denote the basic economy defined by the set of countries $\mathcal{N}$, technology (A,L), consumption bundle b, labour endowments, $(l^\nu)_{\nu\in\mathcal{N}}$, and initial capital endowments $(\omega_0^\nu)_{\nu\in\mathcal{N}}$, with E_0 as a shorthand notation.

Lemma 1. *Let $(\mathbf{1},r)$ be a RS for E_0. At any t: if $r_t>0$, then $A\left(x_t^\nu\right)+z_t^\nu=\omega_{t-1}^\nu$, all $\nu\in\mathcal{N}$; and if $\widehat{w}_t>b$, then $L\left(x_t^\nu+y_t^\nu\right)=l^\nu$, all $\nu\in\mathcal{N}$.*

Proof. By equation (6), if $r_t>0$, but $A\left(x_t^\nu\right)+z_t^\nu<\omega_{t-1}^\nu$, some $\nu\in\mathcal{N}$, then ν can increase z_t^ν and capital accumulation, contradicting optimality. Similarly, if $\widehat{w}_t>b$ and $L\left(x_t^\nu+y_t^\nu\right)<l^\nu$, $\nu\in\mathcal{N}$, then ν can increase $x_t^\nu+y_t^\nu$ and capital accumulation, contradicting optimality. ■

Next, it is possible to derive an explicit expression for the value of MP_t^ν and for the growth rate of capital, g_t^ν, for all agents.

Lemma 2. *Let $(\mathbf{1},r)$ be a RS for E_0. Then $V_t^\nu\left(\omega_{t-1}^\nu;(1,r_t)\right)=(1+r_t)\,\omega_{t-1}^\nu+(\widehat{w}_t-b)\,l^\nu$, and $g_t^\nu=r_t+(\widehat{w}_t-b)\,\frac{l^\nu}{\omega_{t-1}^\nu}$, for all $\nu\in\mathcal{N}$.*

Proof. Straightforward from equation (6). ■

Lemma 2 has some interesting implications concerning the dynamics of accumulation. Let $r^{\max}\equiv\frac{1-A-bL}{A}$. Firstly, at all t, the aggregate growth rate of the economy is $g_t=r_t+(\widehat{w}_t-b)\,\frac{l}{\omega_{t-1}}$. Hence, if $l=LA^{-1}\omega_{t-1}$, then $g_t=r^{\max}$, and if $\widehat{w}_t=b$, then $g_t^\nu=g_t=r^{\max}$, for all $\nu\in\mathcal{N}$ such that $\omega_{t-1}^\nu>0$. Secondly, if $\widehat{w}_t>b$, then for any $\nu,\mu\in\mathcal{N}$, $g_t^\nu>g_t^\mu$ if and only if $\frac{l^\nu}{\omega_{t-1}^\nu}>\frac{l^\mu}{\omega_{t-1}^\mu}$. Finally, if $r_t=0$ then $g_t^\nu=\frac{(1-vb)}{v}\frac{l^\nu}{\omega_{t-1}^\nu}$, for all $\nu\in\mathcal{N}$ such that $\omega_{t-1}^\nu>0$, and $g_t=\frac{(1-vb)}{v}\frac{l}{\omega_{t-1}}$. Therefore, if there exists $t'\geqq 1$ such that $r_t=0$ for all $t\geqq t'$, then the growth rate of the basic economy decreases over time and tends asymptotically to zero.

Lemma 3 derives a useful property of the set of solutions of MP_t^ν.

Lemma 3. *Let $(\mathbf{1},r)$ be a given price vector such that $r_t\geqq 0$ and $\widehat{w}_t\geqq b$, some t. If ξ_t^ν solves MP_t^ν, then $\xi_t'^\nu\in\mathbb{R}_+^4$ also solves MP_t^ν whenever $x_t'^\nu+y_t'^\nu=x_t^\nu+y_t^\nu$ and $z_t'^\nu-Ay_t'^\nu=z_t^\nu-Ay_t^\nu$.*

Proof. It is easy to check that $\xi_t'^\nu$ satisfies constraints (1)-(3). Moreover, labour performed is the same in ξ_t^ν and $\xi_t'^\nu$. Then the result follows from equation (6). ■

Lemma 3 implies that if $(x_t^\nu;y_t^\nu;z_t^\nu;\delta_t^\nu)$ solves MP_t^ν, then there is another vector $(0;y_t'^\nu;z_t'^\nu;\delta_t^\nu)$ which solves MP_t^ν. In the simulations, this allows us to select one of the many potential solutions of MP_t^ν by setting $x_t^\nu=0$ for all $\nu\in\mathcal{N}$.

Theorem 1 characterises the equilibrium of the economy.

Theorem 1. *Let* $\left((\mathbf{1},r),(\xi^{\nu})_{\nu\in\mathcal{N}}\right)$ *be a RS for* E_0*. At any* t*:*
(i) If $r_t>0$ *and* $\widehat{w}_t>b$*, then* $l=LA^{-1}\omega_{t-1}$*;*
(ii) If $l>LA^{-1}\omega_{t-1}>0$ *then* $\widehat{w}_t=b$*;*
(iii) If $l<LA^{-1}\omega_{t-1}$ *then* $r_t=0$*.*

Proof. Part (i). By Lemma 1, $A(x_t^{\nu})+z_t^{\nu}=\omega_{t-1}^{\nu}$ and $L(x_t^{\nu}+y_t^{\nu})=l^{\nu}$, for all $\nu\in\mathcal{N}$. Therefore, $A(x_t)+z_t=\omega_{t-1}$ and $L(x_t+y_t)=l$. By Definition A.1(c), $A(x_t+y_t)=\omega_{t-1}$. Since $(x_t+y_t)=A^{-1}\omega_{t-1}$, we have $L(x_t+y_t)=LA^{-1}\omega_{t-1}=l$. To prove the second part of the statement, take any $(1,\widehat{w}_t')$ such that $r_t'\geqq 0$ and $\widehat{w}_t'\geqq b$. Then, it is immediate to show that ξ_t^{ν} solves MP_t^{ν} at $(1,\widehat{w}_t')$ for all ν and $(\xi_t^{\nu})_{\nu\in\mathcal{N}}$ satisfies conditions (b)-(d) of Definition A.1 by assumption.

Part (ii). Suppose, contrary to the statement, that $\widehat{w}_t>b$. Then, for all $\nu\in\mathcal{N}$, by (2), $Ax_t^{\nu}+z_t^{\nu}\leqq\omega_{t-1}^{\nu}$ and by Lemma 1, $L(x_t^{\nu}+y_t)^{\nu}=l^{\nu}$. But, since $l>LA^{-1}\omega_{t-1}$, $Ay_t<z_t$ holds, contradicting Definition A.1(c). Therefore $\widehat{w}_t=b$.

Part (iii). Suppose, contrary to the statement, that $r_t>0$. Then, for all $\nu\in\mathcal{N}$, by (3), $L(x_t^{\nu}+y_t^{\nu})\leqq l^{\nu}$ and by Lemma 1, $Ax_t^{\nu}+z_t^{\nu}=\omega_{t-1}^{\nu}$. But, since $l<LA^{-1}\omega_{t-1}$, $Ay_t>z_t$ holds, contradicting Definition A.1(c). Therefore $r_t=0$. ■

Theorem 2 characterises the exploitation status of every country, based on their wealth per unit of labour performed:

Theorem 2. *Let* $(\mathbf{1},r)$ *be a RS for* E_0*. At any* t*, if* $r_t>0$*:*
(i) country ν *is an exploiter if and only if* $\frac{W_{t-1}^{\nu}}{\Lambda_t^{\nu}}>\frac{1}{r_t}\frac{[1-\widehat{w}_t v]}{v}$*;*
(ii) country ν *is exploited if and only if* $\frac{W_{t-1}^{\nu}}{\Lambda_t^{\nu}}<\frac{1}{r_t}\frac{[1-\widehat{w}_t v]}{v}$*;*

Proof. Because, $V_t^{\nu}\left(W_{t-1}^{\nu};(1,\widehat{w}_t)\right)=(1+r_t)W_{t-1}^{\nu}+(\widehat{w}_t-b)l^{\nu}$, it follows that $c_t^{\nu}=r_tW_{t-1}^{\nu}+(\widehat{w}_t-b)l^{\nu}+b\Lambda_t^{\nu}$, for all t and all $\nu\in\mathcal{N}$. Therefore for any $\widehat{w}_t\geqq b$, $c_t^{\nu}=r_tW_{t-1}^{\nu}+\widehat{w}_t\Lambda_t^{\nu}$, for all t and all $\nu\in\mathcal{N}$. But then country ν is an exploiter if and only if $v\left(r_tW_{t-1}^{\nu}+\widehat{w}_t\Lambda_t^{\nu}\right)>\Lambda_t^{\nu}$, and the first part of the statement follows from simple algebraic manipulations. The other part follows in like manner. ■

Theorem 3 characterises the class structure of the world economy.

Theorem 3. *Let* $(\mathbf{1},\widehat{w})$ *be a RS for* E_0*. At any* t*, if* $r_t>0$*:*

$$\begin{array}{lll}
\textit{(i)}\ \nu & \in & (+,0,+)\backslash(+,0,0)\ \textit{if and only if}\ Ay_t^{\nu}<z_t^{\nu}\ \textit{for all}\ \xi_t^{\nu}\in\mathcal{A}^{\nu}(1,r_t)\,;\\
\textit{(ii)}\ \nu & \in & (+,0,0)\ \textit{if and only if}\ Ay_t^{\nu}=z_t^{\nu}\ \textit{for some}\ \xi_t^{\nu}\in\mathcal{A}^{\nu}(1,r_t)\,;\\
\textit{(iii)}\ \nu & \in & (+,+,0)\backslash(+,0,0)\ \textit{if and only if}\ Ay_t^{\nu}>z_t^{\nu}\ \textit{for all}\ \xi_t^{\nu}\in\mathcal{A}^{\nu}(1,\widehat{w}_t)\,;\\
\textit{(iv)}\ \nu & \in & (0,+,0)\ \textit{if and only if}\ W_{t-1}^{\nu}=0.
\end{array}$$

Proof. 1. If $r_t>0$, then by Lemma 1, for all $\nu\in\mathcal{N}$, $A(x_t^{\nu})+z_t^{\nu}=\omega_{t-1}^{\nu}$ for all $\xi_t^{\nu}\in\mathcal{A}^{\nu}(1,r_t)$. Therefore $\nu\in(0,+,0)$ implies $W_{t-1}^{\nu}=0$. Conversely, it is easy to see that for all $\widehat{w}_t\geqq b$, if $W_{t-1}^{\nu}=0$, then $\nu\in(0,+,0)$.

2. Consider agents with $W_{t-1}^{\nu}>0$. By the convexity of MP_t^{ν}, if $Ay_t^{\nu}<z_t^{\nu}$ for some $\xi_t^{\nu}\in\mathcal{A}^{\nu}(1,r_t)$ and $Ay_t'^{\nu}>z_t'^{\nu}$ for some $\xi_t'^{\nu}\in\mathcal{A}^{\nu}(1,r_t)$, then there is $\xi_t''^{\nu}\in\mathcal{A}^{\nu}(1,r_t)$ such that $Ay_t''^{\nu}=z_t''^{\nu}$. Therefore, for all agents with $W_{t-1}^{\nu}>0$: either $Ay_t^{\nu}<z_t^{\nu}$ for all

$\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$; or $Ay_t^\nu > z_t^\nu$ for all $\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$; or $Ay_t^\nu = z_t^\nu$ for some $\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$. The latter are mutually exclusive and exhaustive cases.

3. *Part (i).* Suppose $Ay_t^\nu < z_t^\nu$ for all $\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$. We consider two cases.

Case 1: $\widehat{w}_t > b$. By Lemma 1, at all $\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$, it must be $Ax_t^\nu + z_t^\nu = \omega_{t-1}^\nu$ and $L(x_t^\nu + y_t^\nu) = l^\nu$. From the latter equations, it follows that $LA^{-1}z_t^\nu - Ly_t^\nu = LA^{-1}\omega_{t-1}^\nu - l^\nu$. Since $Ay_t^\nu < z_t^\nu$ for all $\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$, then $LA^{-1}\omega_{t-1}^\nu > l^\nu$.

Consider $\xi_t'^\nu = (x_t'^\nu; 0; z_t'^\nu; 0)$ such that $Lx_t'^\nu = l^\nu$, and $x_t'^\nu + y_t'^\nu = x_t^\nu + y_t^\nu$. Note that $z_t'^\nu = z_t^\nu - Ay^\nu > 0$ and so noting that $z_t'^\nu - Ay_t'^\nu = z_t^\nu - Ay_t^\nu$, by Lemma 3 it follows that $\xi_t'^\nu \in \mathcal{A}^\nu(1, r_t)$. Hence, $\nu \in (+, 0, +)$.

It remains to show that $\nu \notin (+, 0, 0)$. Suppose, by way of contradiction, that there is $\xi_t^\nu = (x_t^\nu; 0; 0; 0) \in \mathcal{A}^\nu(1, r_t)$. Since $r_t > 0$, then by Lemma 1, $Ax_t^\nu = \omega_{t-1}^\nu$ and so $Lx_t^\nu = LA^{-1}\omega_{t-1}^\nu > l^\nu$, which violates the labour constraint.

Case 2: $\widehat{w}_t = b$. In this case, any ξ_t^ν such that $\delta_t^\nu = 0$, $Ax_t^\nu + z_t^\nu = \omega_{t-1}^\nu$, and $L(x_t^\nu + y_t^\nu) \leqq l^\nu$, solves MP_t^ν. Therefore, it is immediate to see that $\nu \in (+, 0, +)$. Further, $\xi_t^\nu = \left(0; L^{-1}l^\nu; \omega_{t-1}^\nu; 0\right) \in \mathcal{A}^\nu(1, r_t)$, and therefore $Ay_t^\nu < z_t^\nu$ for all $\xi_t^\nu \in \mathcal{A}^\nu(1, r_t)$ implies $LA^{-1}\omega_{t-1}^\nu > l^\nu$. Hence the same argument as in Case 1 can be used to prove $\nu \notin (+, 0, 0)$.

4. *Parts (ii) and (iii)* are proved similarly. ■

Theorem 3 provides a complete partition of countries into classes, based on their status in the international credit market. An immediate implication of Theorem 3 is that the class status of each country is related to its productive endowments: countries with higher (lower) wealth per capita will belong to the higher (lower) echelons of the class hierarchy.

Corollary 1. *Let $(\mathbf{1}, r)$ be a RS for E_0. Consider any t, such that $r_t > 0$. Then, $\nu \in C_t^1$ if and only if $LA^{-1}\omega_{t-1}^\nu > l^\nu$ and $\nu \in C_t^4$ if and only if $W_{t-1}^\nu = 0$. Furthermore, if $\widehat{w}_t > b$, then $\nu \in C_t^2$ if and only if $LA^{-1}\omega_{t-1}^\nu = l^\nu$ and $\nu \in C_t^3$ if and only if $LA^{-1}\omega_{t-1}^\nu < l^\nu$; whereas if $\widehat{w}_t = b$, then $\nu \in C_t^2$ if and only if $LA^{-1}\omega_{t-1}^\nu \leqq l^\nu$ and $C_t^3 = \varnothing$.*

The next result proves that the CECP holds in the world economy: countries that hold a privileged position in the credit market are exploiters, while net borrowers are exploited.

Theorem 4 (CECP). *Let $(\mathbf{1}, r)$ be a RS for E_0. At any t, such that $r_t > 0$, if $\nu \in C_t^1$ then ν is an exploiter and if $\nu \in C_t^3 \cup C_t^4$ then ν is exploited. Furthermore, if $\widehat{w}_t > b$ then:*

$$\begin{aligned} &(i) \quad \nu \in C_t^1 \text{ if and only if } \nu \text{ is an exploiter;} \\ &(ii) \quad \nu \in C_t^2 \text{ if and only if } \nu \text{ is neither exploited nor an exploiter;} \\ &(iii) \quad \nu \in C_t^3 \cup C_t^4 \text{ if and only if } \nu \text{ is exploited.} \end{aligned}$$

Proof. 1. If $\widehat{w}_t > b$, then the result follows immediately from Corollary 1 and Theorem 2, noting that by Lemma 1, $\Lambda_t^\nu = l^\nu$ and $\frac{1}{r_t}\frac{[1-\widehat{w}_t v]}{v} = \frac{A}{L}$.

2. Suppose that $\widehat{w}_t = b$. By Corollary 1, $\nu \in C_t^3 \cup C_t^4 \Leftrightarrow W_{t-1}^\nu = 0$. Hence by Theorem 2, if $\Lambda_t^\nu > 0$, then ν is exploited. Further, by Corollary 1, $\nu \in C_t^1 \Leftrightarrow LA^{-1}\omega_{t-1}^\nu > l^\nu$. Noting that $\frac{W_{t-1}^\nu}{\Lambda_t^\nu} \geqq \frac{W_{t-1}^\nu}{l^\nu} > \frac{A}{L} = \frac{1}{\pi_t}\frac{[1-\widehat{w}_t v]}{v}$, the result follows from Theorem 2. ■

2 Equilibrium Conditions

The Figures in this section show that, in all of our simulations, conditions (b)-(d) of Definition 1 in the paper are satisfied, and so we are analysing the equilibrium dynamics of the economies considered.

Figure 1: Equilibrium conditions - Basic model

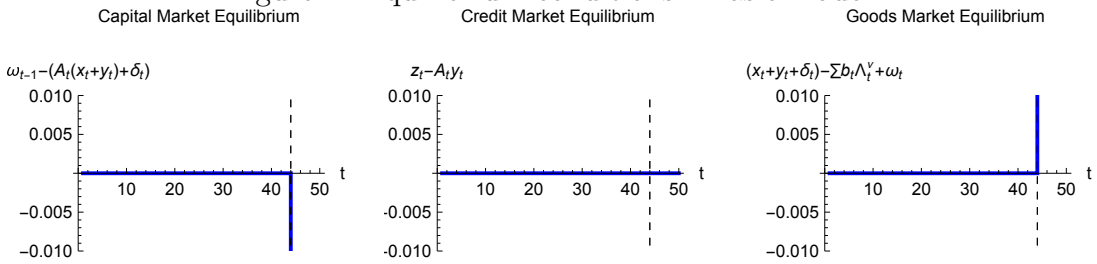
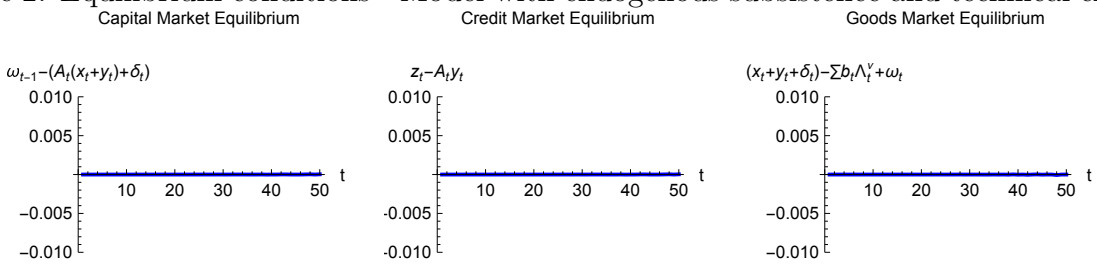


Figure 2: Equilibrium conditions - Model with endogenous subsistence and technical change



3 Supplementary Figures for Main Simulations

3.1 Basic model

Figure 3 shows the distribution of income. Figure 3(a) shows the distribution of shares of income over t and figure 3(b) shows the Gini coefficient of income over t.

Figure 3: Distribution of Income - Basic Model

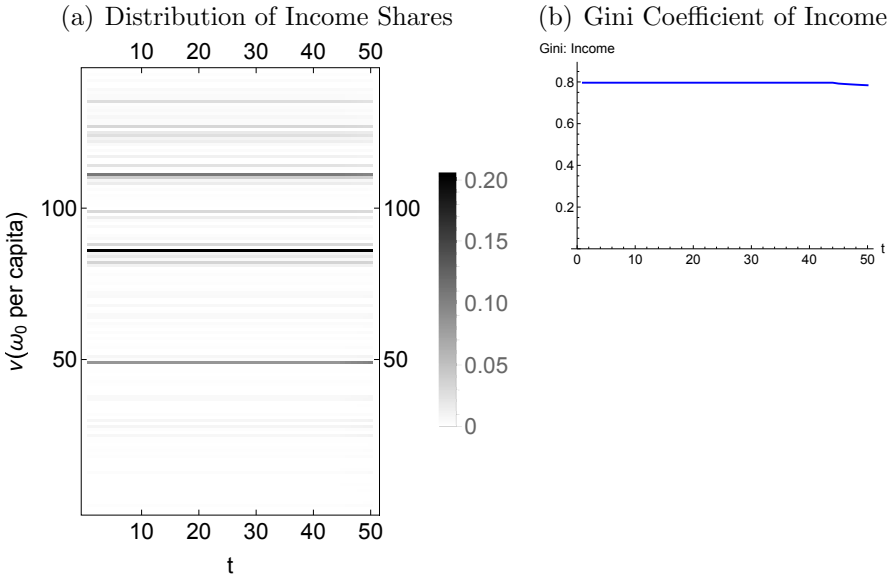


Figure 4 shows additional summary results for the basic model not shown in the main summary results, notably x_t, aggregate net output $(1 - A)y_t$, and net output per capita $(1 - A)y_t/N$.

Figure 4: Additional Summary Results - Basic Model

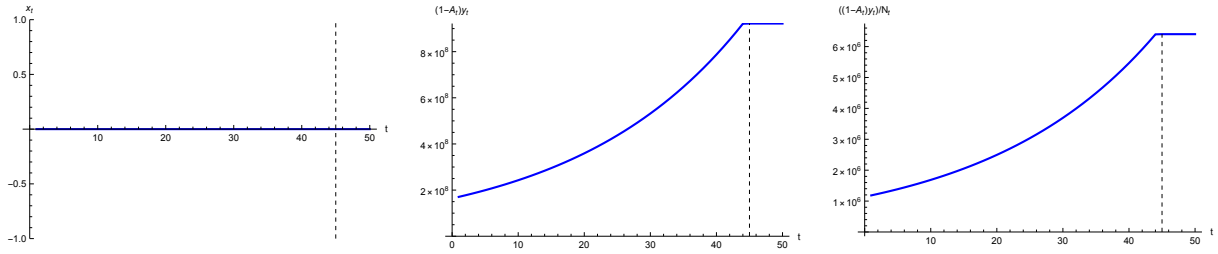
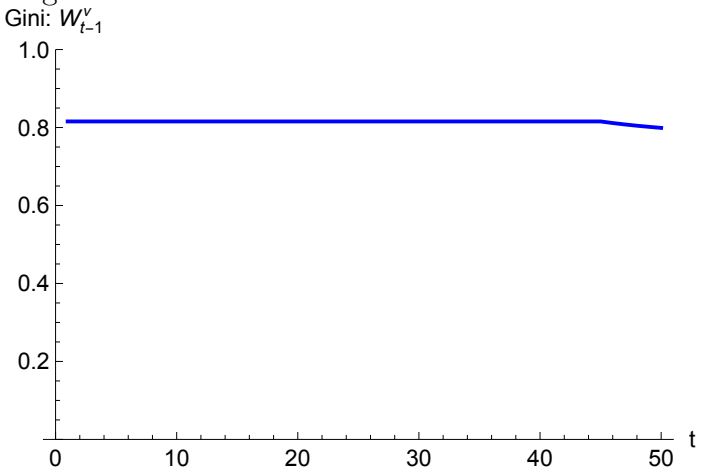


Figure 5 shows the Gini coefficient of the distribution of wealth.

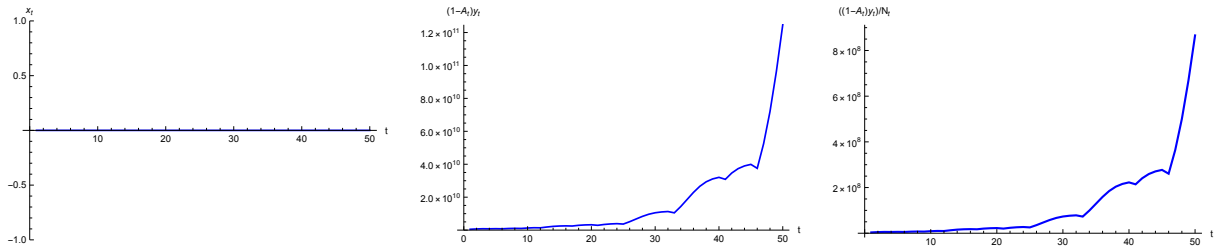
Figure 5: Gini coefficient of wealth - Basic Model



3.2 Model with endogenous subsistence and technical change

Figure 6 shows additional summary results for the model with endogenous subsistence and technical change not shown with the main summary results, notably x_t, aggregate net output $(1 - A_t)y_t$, and net output per capita $(1 - A_t)y_t/N$.

Figure 6: Additional Summary Results - Model with endogenous subsistence and technical change



Figures 7(a)-7(b) show the persistence and stability of the basic exploitation and class structure of the economy produced by the introduction of technical change. Figure 7(c) confirms that the CECP continues to hold in the more general case of endogenous consumption and technical change.

Figure 8 shows the Gini coefficient of the distribution of wealth.

Figure 9 shows the distribution of income shares over t and the Gini coefficient of income.

Figure 7: Class and exploitation status - Model with endogenous subsistence and technical change

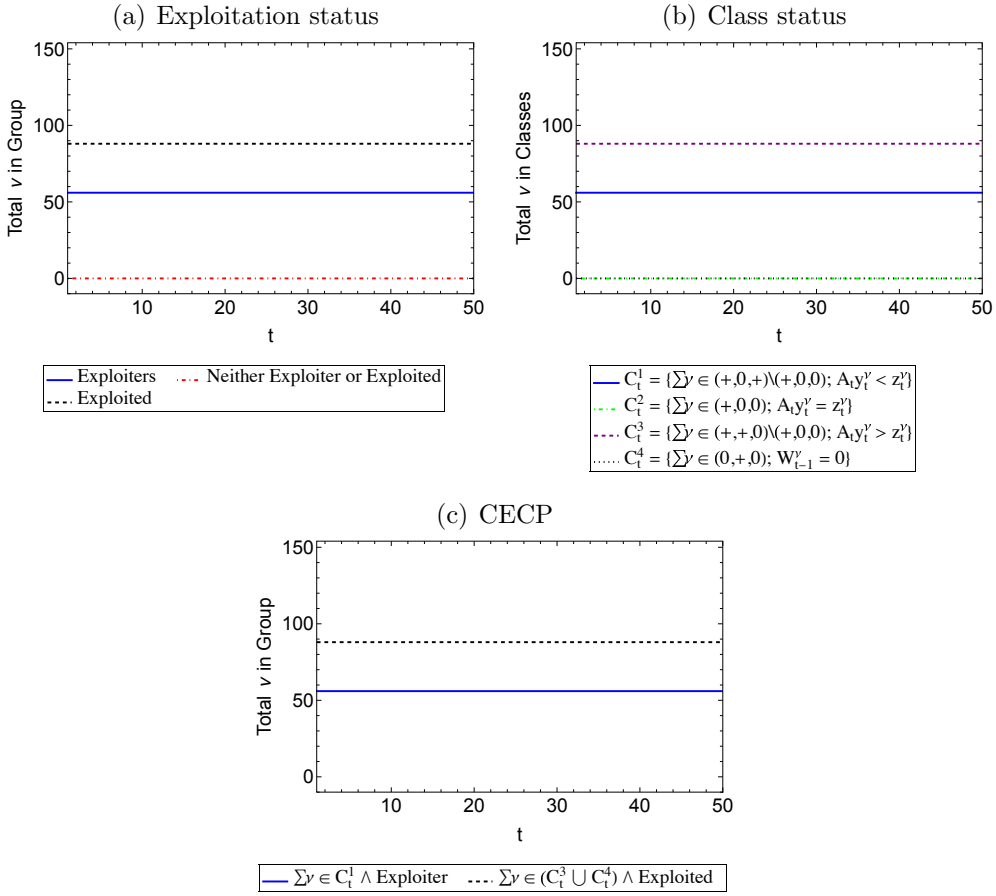


Figure 8: Gini coefficient of wealth - Model with endogenous subsistence and technical change

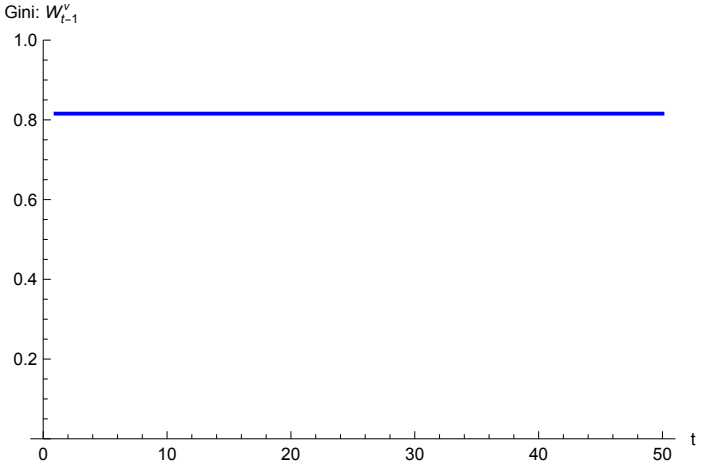
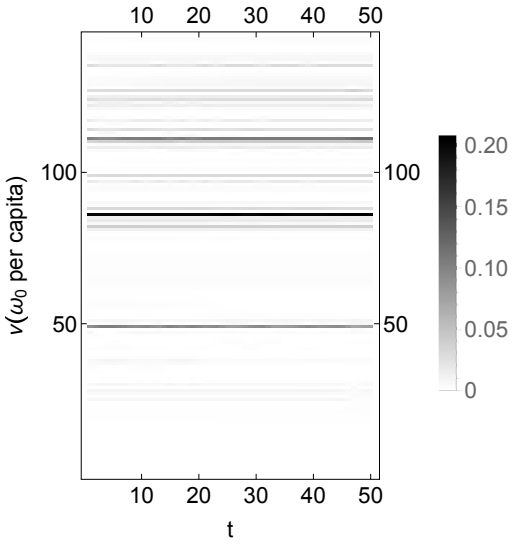
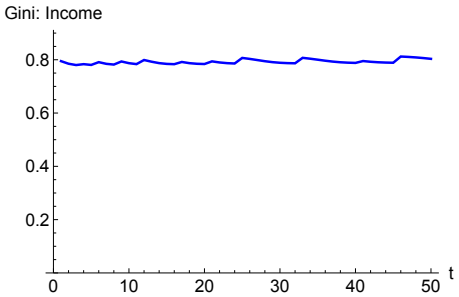


Figure 9: Distribution of Income - Model with endogenous subsistence and technical change

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



4 Heterogeneous Standard of Living Consumption

This section presents results for an extension of the model with endogenous consumption and technical change that incorporates consumption based on a country's standard of living, which can go beyond the subsistence consumption featured in the main simulations. To consume beyond subsistence, $b_t\Lambda_t^\nu$, a country needs to consume out of wealth, or at least out of newly generated capital income (or interest revenue) during any t, $r_t\omega_{t-1}^\nu$. Consumption based on wealth can be thought of as varying across countries depending on differences in standards of living. Standard of living-based consumption can be conceptualised as a function of subsistence b_t and a country's interest revenue $r_t\omega_{t-1}^\nu$: $D_t^\nu\left(b_t, \varphi_t\right)$, where φ_t is a monotonically increasing function of each country's interest revenue $r_t\omega_{t-1}^\nu$.

Implementing this kind of alternative consumption modifies MP_t^ν from the main paper. Standard of living-based consumption replaces the $p_t b_t \Lambda_t^\nu$ expression in the right-hand side of constraint (1) in MP_t^ν with $p_t D_t^\nu$. This alteration means that agents no longer solve MP_t^ν. Instead, they determine $(x_t^\nu, y_t^\nu, z_t^\nu)$ as in the main paper, but now ω_t^ν is a residual based on $(x_t^\nu, y_t^\nu, z_t^\nu)$ and D_t^ν, i.e. constraint (1) becomes:

$$p_t x_t^\nu + [p_t - (1+r_t)p_{t-1}A_t]y_t^\nu + (1+r_t)z_t^\nu + p_t\delta_t^\nu = p_t D_t^\nu + p_t\omega_t^\nu.$$

Four possible versions of D_t^ν with different forms of φ_t, or other approaches to incorporating interest revenue into consumption, are examined in the subsections below. All parameters and initial conditions are the same as those for the endogenous subsistence and technical change simulation in the main paper.

4.1 Version 1

This subsection examines the case of:

$$D_t^\nu = b_t\left(\Lambda_t^\nu + \varphi_t(\max\{0, r_t\omega_{t-1}^\nu - b_t\Lambda_t^\nu\})\right), \tag{1}$$

where φ_t takes the form:

$$\varphi_t = \begin{cases} \frac{r_t\omega_{t-1}^\nu}{b_t} & \text{if } r_t\omega_{t-1}^\nu - b_t\Lambda_t^\nu > 0 \\ 0 & \text{otherwise} \end{cases}.$$

Figure 10 shows the summary results of the simulation. Figure 11 shows the technology (A_t, L_t) and labour values over t.

Figure 12 shows the composition of exploitation and class status over the course of the simulation. Figures 13(a) and 13(b) show, respectively, the distribution of e_t^ν and the Gini coefficient of the distribution of e_t^ν over t.

Figures 14-16 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited, or how this status may change.

Tables 1 and 2 report e_t^ν for countries that begin the simulation as exploiters and exploited, respectively, for the same select t as figures 14-16. Note that while a country may

begin the simulation as either an exploiter or exploited, given the specification of D_t^{ν}, it is possible that countries shift between exploiter and exploited status over the simulation.

Figures 17 and 18 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 10: Summary results - Model with standard of living consumption

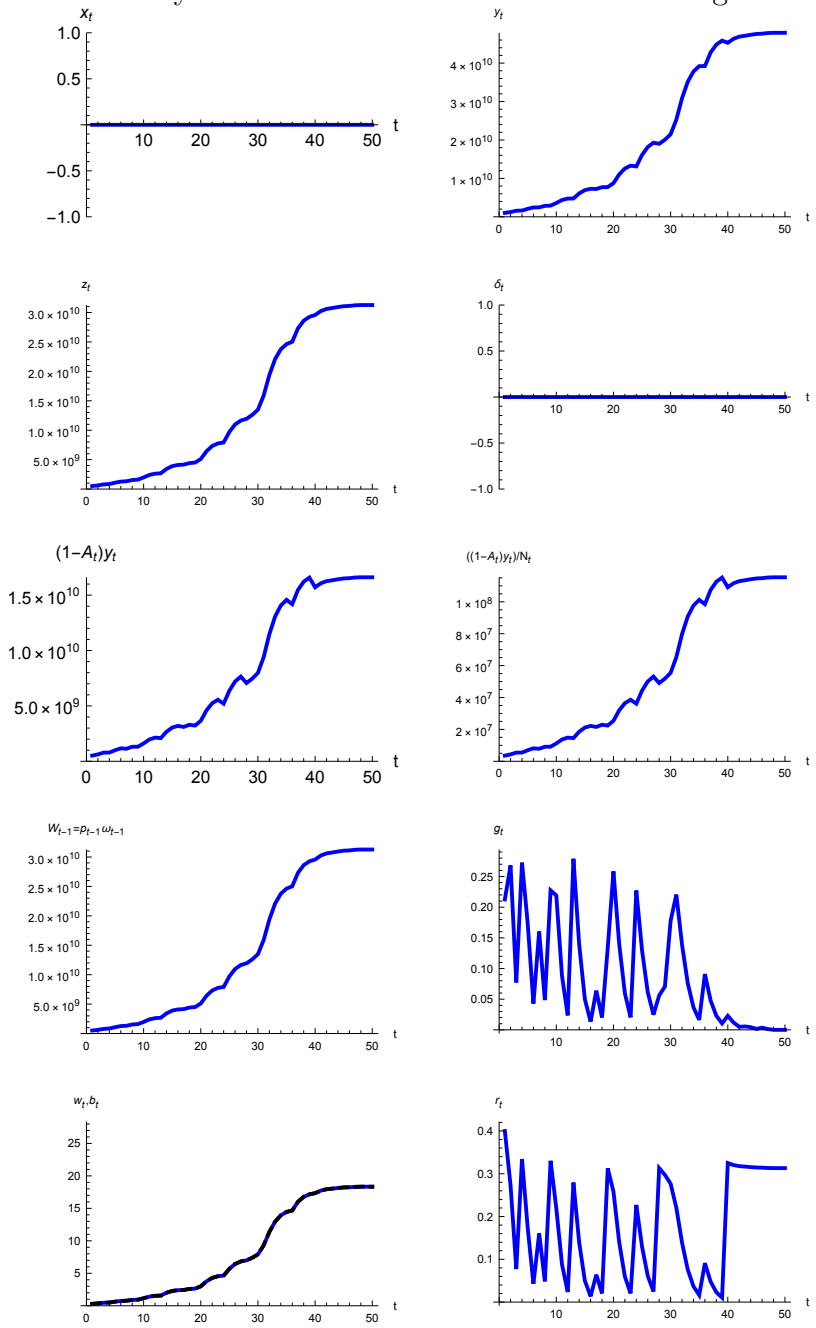


Figure 11: A_t, L_t, and labour values - Model with standard of living consumption

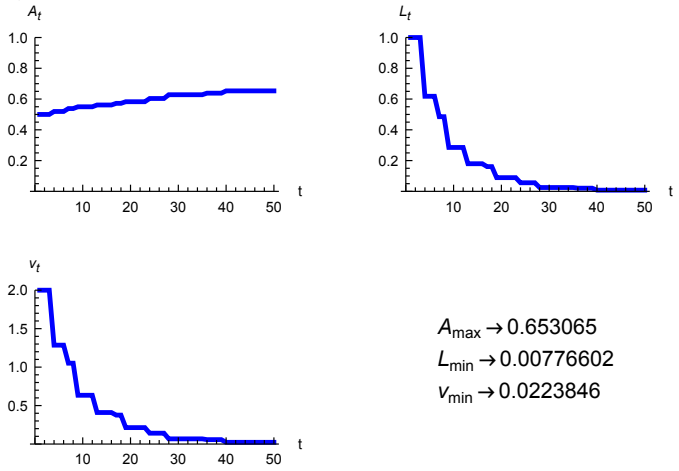
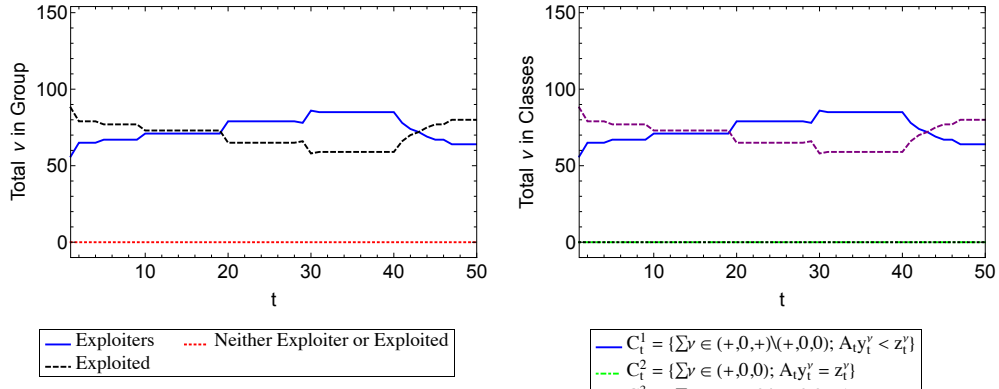


Figure 12: Class and exploitation status - Model with standard of living consumption

(a) Exploitation status

(b) Class status



(c) CECP

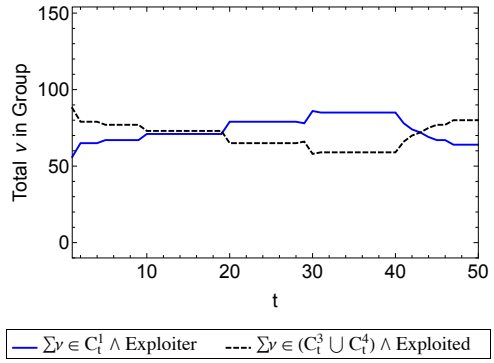


Figure 13: Exploitation intensity index - Model with standard of living consumption

(a) Exploitation intensity index across agents

(b) Gini coefficient of e_t^{ν}

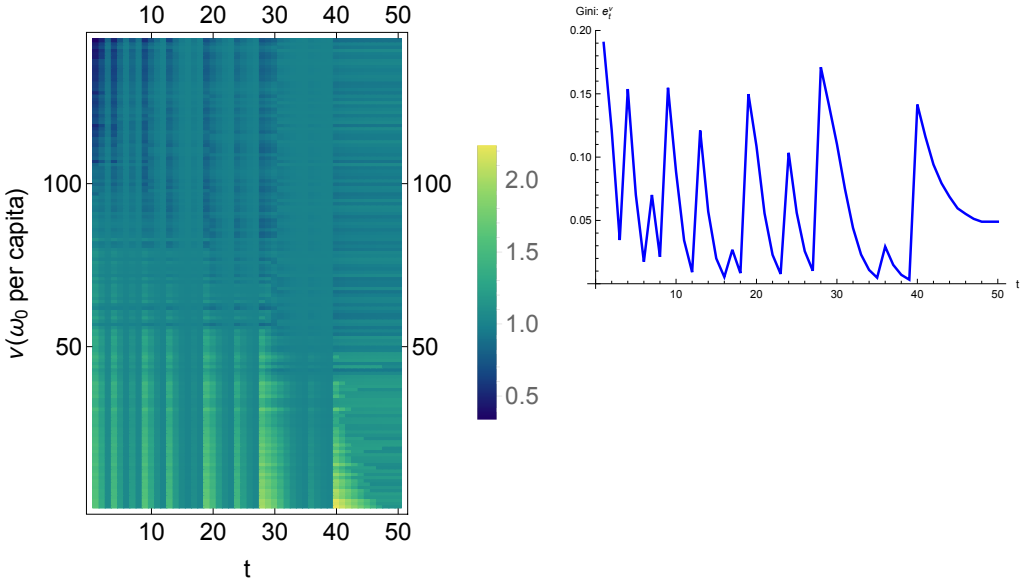
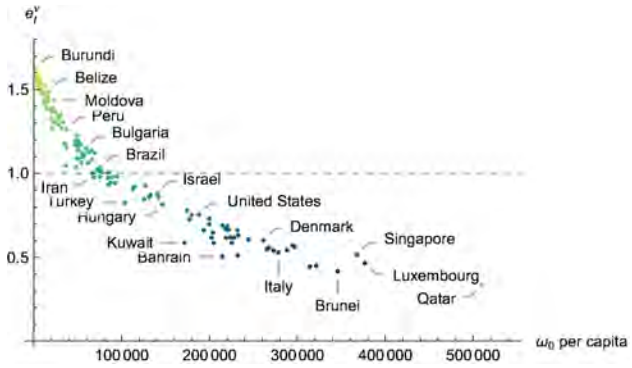
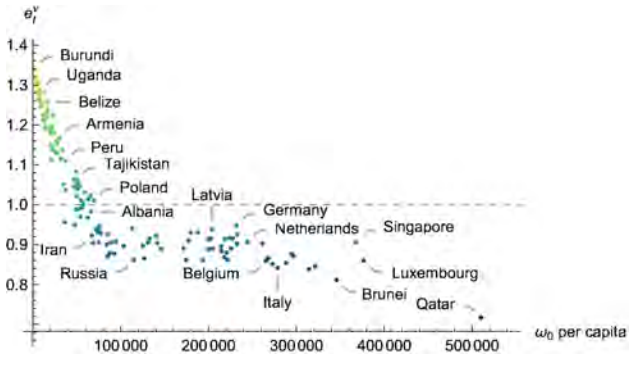


Figure 14: Worldwide Exploitation Intensity - Model with standard of living consumption

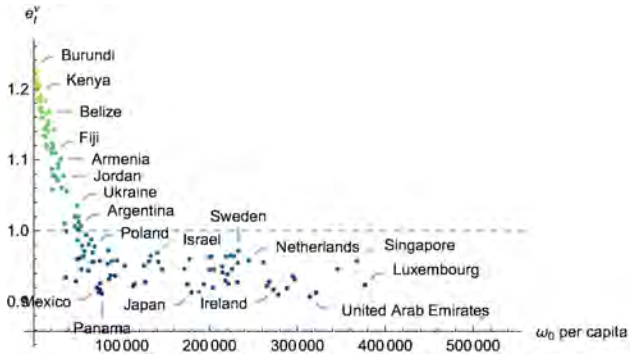
(a) $t = 1$



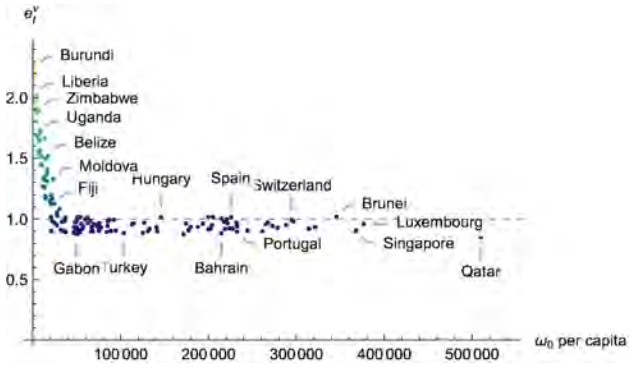
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

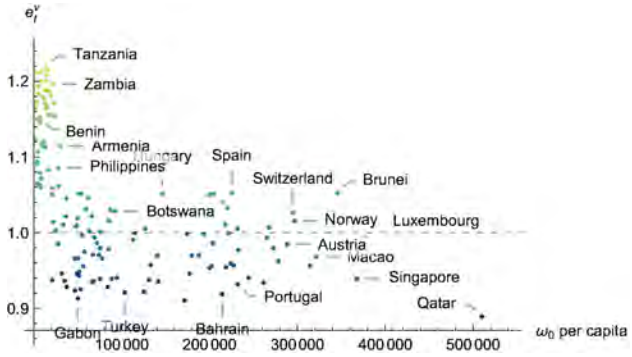
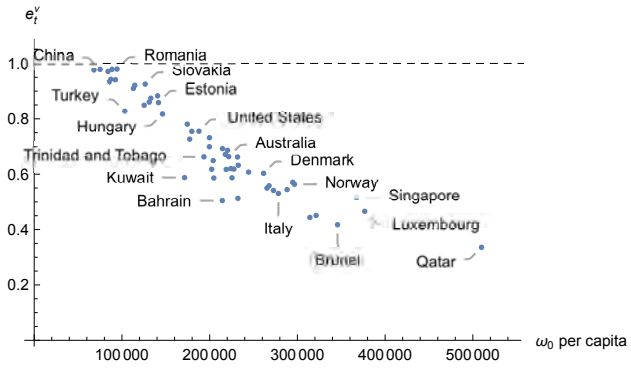
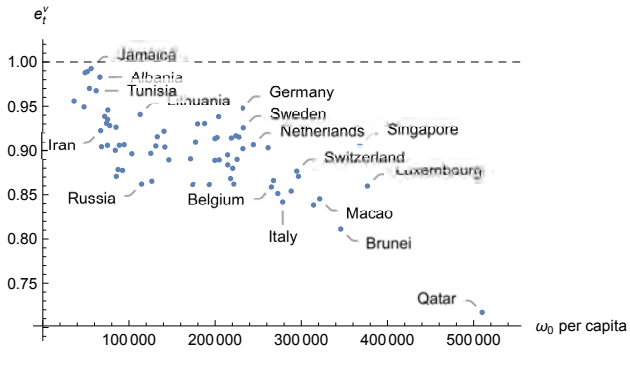


Figure 15: Exploiter Countries - Model with standard of living consumption

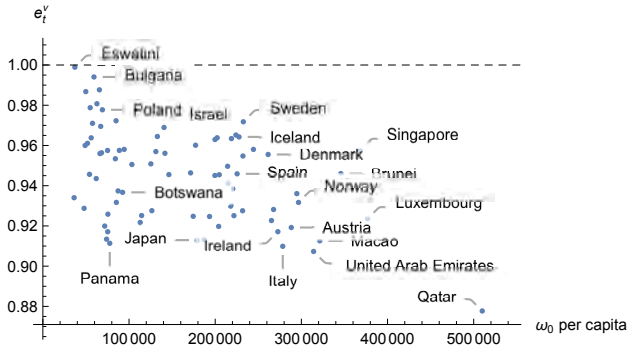
(a) $t = 1$



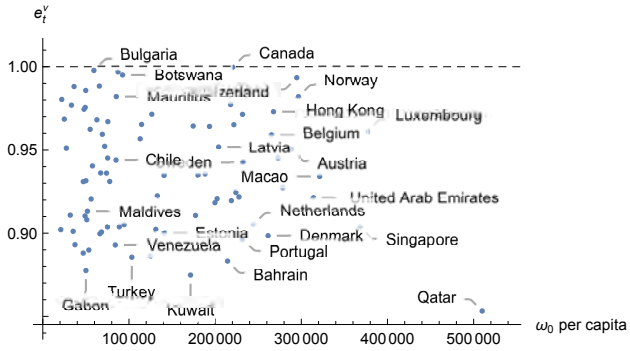
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

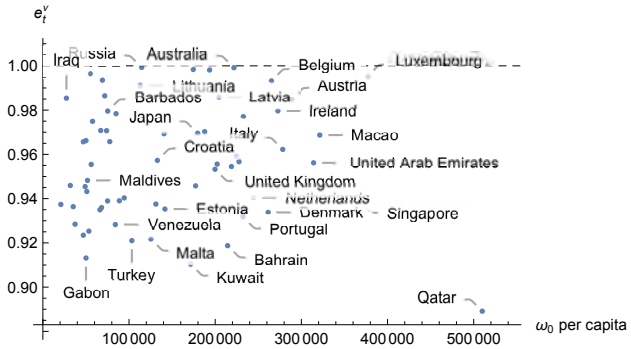
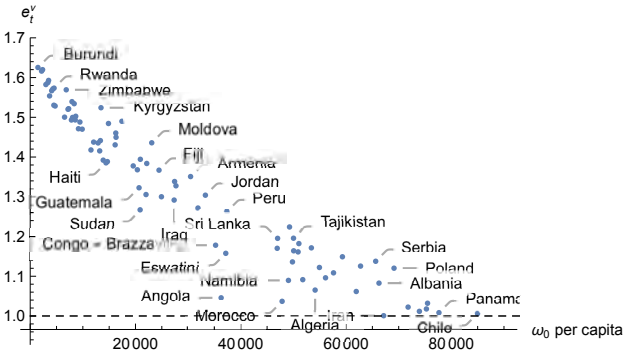
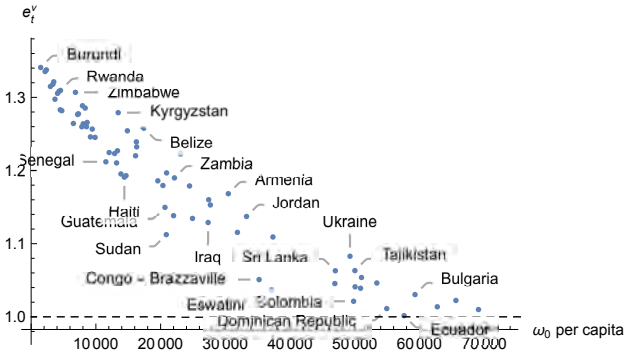


Figure 16: Exploited Countries - Model with standard of living consumption

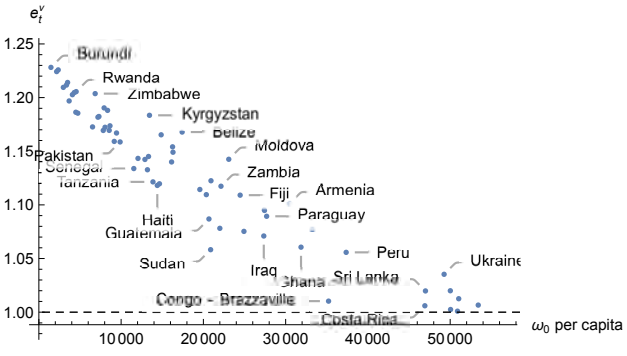
(a) $t = 1$



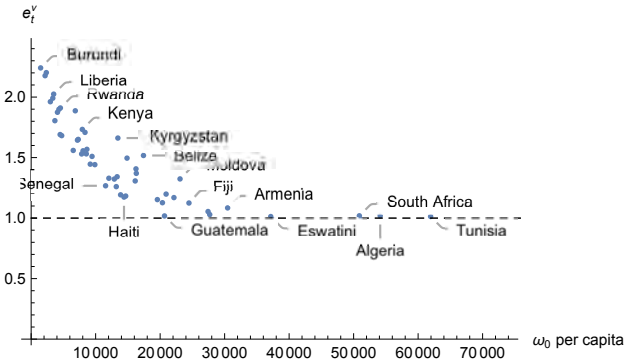
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

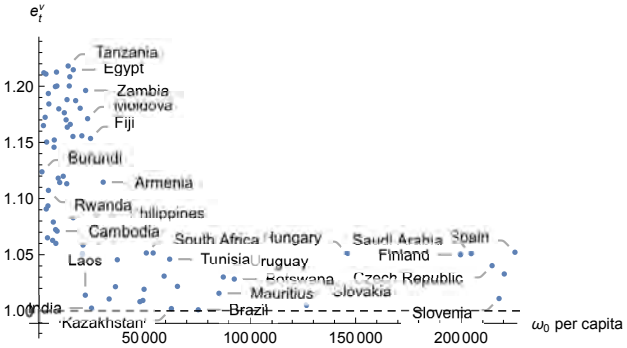


Table 1: Exploitation Intensity for Exploiter Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.9765	0.9043	0.9564	0.9007	0.9359
China	0.9786	0.9059	0.9575	0.9037	0.9389
Venezuela	0.9712	0.9002	0.9534	0.8929	0.9283
Mauritius	0.9325	0.8708	0.9317	0.9821	1.0156
Uruguay	0.9426	0.8785	0.9374	0.9970	1.0301
Malaysia	0.9787	0.9059	0.9575	0.9038	0.9390
Botswana	0.9413	0.8775	0.9367	0.9951	1.0283
Romania	0.9796	0.9066	0.9581	0.9051	0.9403
Turkey	0.8270	0.8963	0.9506	0.8855	0.9210
Lithuania	0.9097	0.9408	0.9217	0.9567	0.9909
Russia	0.9212	0.8620	0.9252	0.9653	0.9993
Malta	0.8488	0.8967	0.9509	0.8863	0.9218
Slovakia	0.9253	0.8652	0.9276	0.9714	1.0053
New Zealand	0.8602	0.9051	0.9570	0.9023	0.9375
Croatia	0.8744	0.9155	0.9645	0.9224	0.9573
Israel	0.8830	0.9217	0.9690	0.9347	0.9693
Estonia	0.8586	0.9039	0.9561	0.9000	0.9353
Hungary	0.8177	0.8895	0.9455	1.0186	1.0512
Kuwait	0.5876	0.8906	0.9464	0.8748	0.9105
South Korea	0.7807	0.8615	0.9248	0.9644	0.9984
Taiwan	0.7265	0.9095	0.9601	0.9107	0.9458
Japan	0.7548	0.9301	0.9129	0.9349	0.9696
United States	0.7553	0.9304	0.9132	0.9356	0.9703
Trinidad and Tobago	0.6627	0.8614	0.9247	0.9641	0.9981
Finland	0.6991	0.8888	0.9451	1.0174	1.0500
United Kingdom	0.7318	0.9134	0.9630	0.9183	0.9533
Cyprus	0.6178	0.9146	0.9638	0.9207	0.9556
Latvia	0.6491	0.9384	0.9198	0.9517	0.9860
Saudi Arabia	0.5861	0.8893	0.9454	1.0184	1.0510
Bahrain	0.5046	0.8951	0.9497	0.8832	0.9187
Czech Republic	0.6925	0.8838	0.9413	1.0074	1.0403
Slovenia	0.6714	0.8683	0.9299	0.9773	1.0110
Greece	0.6171	0.9140	0.9634	0.9196	0.9545
Canada	0.6862	0.8799	0.9385	0.9997	1.0328
Australia	0.6634	0.8619	0.9251	0.9652	0.9992
France	0.6202	0.9165	0.9652	0.9244	0.9592
Spain	0.5869	0.8900	0.9459	1.0197	1.0522
Iceland	0.6185	0.9152	0.9642	0.9218	0.9567
Germany	0.6621	0.9479	0.9275	0.9714	1.0052
Portugal	0.5127	0.9021	0.9548	0.8965	0.9318
Sweden	0.6322	0.9256	0.9718	0.9425	0.9770
Netherlands	0.6076	0.9066	0.9580	0.9051	0.9403
Denmark	0.6032	0.9031	0.9555	0.8985	0.9338
Belgium	0.5496	0.8587	0.9227	0.9591	0.9932
Hong Kong	0.5582	0.8660	0.9282	0.9730	1.0068
Ireland	0.5412	0.8513	0.9171	0.9452	0.9796
Italy	0.5303	0.8417	0.9099	0.9274	0.9622
Austria	0.5443	0.8541	0.9192	0.9504	0.9847
Switzerland	0.5707	0.8766	0.9361	0.9934	1.0267
Norway	0.5637	0.8707	0.9317	0.9820	1.0156
United Arab Emirates	0.4439	0.8384	0.9073	0.9213	0.9562
Macao	0.4509	0.8453	0.9126	0.9341	0.9687
Brunei	0.4173	0.8112	0.9460	1.0200	1.0525
Singapore	0.5171	0.9059	0.9575	0.9037	0.9389
Luxembourg	0.4659	0.8598	0.9235	0.9611	0.9952
Qatar	0.3359	0.7171	0.8777	0.8532	0.8891

Table 2: Exploitation Intensity for Exploited Countries at select t - Model with standard of living consumption

	e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}		e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}
Burundi	1.6254	1.3409	1.2282	2.2411	1.1238	Laos	1.3056	1.1383	1.0782	0.9804	1.0140
Congo - Kinshasa	1.6163	1.3354	1.2242	2.1767	1.1650	Zambia	1.3838	1.1899	1.1174	1.1694	1.1962
Malawi	1.6199	1.3376	1.2258	2.2021	1.2120	Moldova	1.4359	1.2235	1.1425	1.3237	1.1711
Mali	1.5824	1.3149	1.2095	1.9616	1.1723	Fiji	1.3669	1.1789	1.1091	1.1247	1.1535
Sierra Leone	1.5874	1.3179	1.2117	1.9908	1.2109	India	1.3000	1.1345	1.0753	0.9685	1.0024
Liberia	1.5929	1.3213	1.2141	2.0242	1.0907	Iraq	1.2917	1.1289	1.0710	0.9511	0.9854
Mozambique	1.5538	1.2975	1.1969	1.8049	1.1503	Philippines	1.3384	1.1601	1.0948	1.0543	1.0857
Central African Republic	1.5670	1.3055	1.2027	1.8744	1.0651	Paraguay	1.3276	1.1530	1.0894	1.0292	1.0614
Madagascar	1.5714	1.3082	1.2047	1.8987	1.0935	Armenia	1.3508	1.1683	1.1011	1.0842	1.1146
Niger	1.5304	1.2830	1.1863	1.6903	1.1935	Ghana	1.2716	1.1154	1.0606	0.9108	0.9459
Rwanda	1.5734	1.3094	1.2056	1.9100	1.1073	Jordan	1.3040	1.1372	1.0773	0.9769	1.0106
Burkina Faso	1.5285	1.2818	1.1855	1.6814	1.1842	Congo - Brazzaville	1.1781	1.0509	1.0103	0.9011	0.9364
Ethiopia	1.5004	1.2643	1.1727	1.5592	1.0628	Angola	1.0457	0.9558	0.9340	0.9881	1.0215
Zimbabwe	1.5692	1.3069	1.2037	1.8866	1.0791	Eswatini	1.1577	1.0366	0.9989	1.0128	1.0455
Togo	1.5202	1.2767	1.1817	1.6440	1.1457	Peru	1.2624	1.1091	1.0558	0.8931	0.9285
Benin	1.5216	1.2776	1.1824	1.6503	1.1521	Costa Rica	1.1703	1.0455	1.0060	0.8880	0.9235
Gambia	1.4932	1.2598	1.1694	1.5301	1.1997	Sri Lanka	1.1954	1.0630	1.0198	0.9310	0.9657
Kenya	1.5394	1.2885	1.1904	1.7328	1.0723	Morocco	1.0369	0.9493	0.9287	0.9745	1.0082
Yemen	1.4996	1.2639	1.1723	1.5561	1.0601	Namibia	1.0896	0.9879	0.9600	0.9103	0.9454
Uganda	1.5342	1.2854	1.1881	1.7084	1.2126	Ukraine	1.2240	1.0828	1.0353	0.9755	1.0093
Nepal	1.4933	1.2599	1.1694	1.5306	1.2002	Colombia	1.1361	1.0213	0.9868	0.9857	1.0192
Cambodia	1.5026	1.2657	1.1737	1.5682	1.0710	Tajikistan	1.1957	1.0632	1.0200	0.9315	0.9662
Ivory Coast	1.4712	1.2460	1.1592	1.4457	1.1181	Gabon	1.1640	1.0410	1.0025	0.8776	0.9132
Cameroon	1.4881	1.2566	1.1670	1.5098	1.1799	South Africa	1.1612	1.0391	1.0009	1.0190	1.0516
Pakistan	1.4701	1.2453	1.1587	1.4417	1.1143	Mongolia	1.1822	1.0538	1.0125	0.9081	0.9432
Senegal	1.4178	1.2119	1.1339	1.2671	1.1199	Maldives	1.0914	0.9892	0.9611	0.9132	0.9482
Myanmar	1.4376	1.2246	1.1433	1.3293	1.1764	Argentina	1.1714	1.0463	1.0066	0.8899	0.9253
Nigeria	1.4355	1.2233	1.1423	1.3227	1.1701	Algeria	1.0652	0.9701	0.9457	1.0190	1.0515
Mauritania	1.4154	1.2104	1.1327	1.2600	1.1132	Dominican Republic	1.1221	1.0112	0.9788	0.9624	0.9964
Bangladesh	1.4413	1.2270	1.1451	1.3417	1.1881	Jamaica	1.0961	0.9926	0.9638	0.9205	0.9555
Kyrgyzstan	1.5241	1.2791	1.1835	1.6614	1.1635	Ecuador	1.1085	1.0016	0.9710	0.9404	0.9749
Tanzania	1.3921	1.1953	1.1214	1.1923	1.2180	Bulgaria	1.1490	1.0304	0.9941	0.9978	1.0309
Haiti	1.3854	1.1909	1.1181	1.1736	1.2002	Tunisia	1.0616	0.9675	0.9436	1.0133	1.0460
Lesotho	1.3885	1.1930	1.1197	1.1822	1.2084	Kazakhstan	1.1255	1.0137	0.9808	0.9681	1.0020
Bolivia	1.4844	1.2543	1.1653	1.4955	1.1660	Serbia	1.1377	1.0224	0.9877	0.9884	1.0218
Honduras	1.4306	1.2202	1.1400	1.3070	1.1553	Albania	1.0827	0.9829	0.9560	0.8997	0.9349
Vietnam	1.4604	1.2391	1.1541	1.4068	1.0829	Iran	1.0007	0.9224	0.9695	0.9362	0.9708
Egypt	1.4497	1.2324	1.1491	1.3697	1.2147	Poland	1.1202	1.0099	0.9777	0.9594	0.9935
Belize	1.4900	1.2578	1.1679	1.5173	1.1872	Mexico	1.0223	0.9386	0.9199	0.9522	0.9864
Nicaragua	1.3777	1.1859	1.1144	1.1528	1.1804	Thailand	1.0117	0.9306	0.9134	0.9361	0.9707
El Salvador	1.3679	1.1795	1.1095	1.1272	1.1559	Barbados	1.0177	0.9351	0.9171	0.9451	0.9796
Guatemala	1.3226	1.1497	1.0869	1.0179	1.0505	Brazil	1.0321	0.9458	0.9258	0.9670	1.0010
Sudan	1.2672	1.1124	1.0582	0.9021	0.9374	Panama	1.0083	0.9281	0.9114	0.9311	0.9658
Syria	1.3943	1.1967	1.1225	1.1984	1.0586	Chile	1.0059	0.9263	0.9723	0.9439	0.9784

Figure 17: Distribution of wealth - Model with standard of living consumption

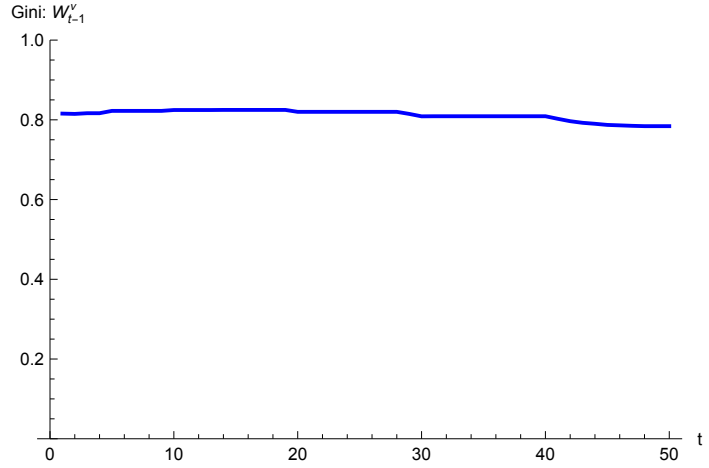
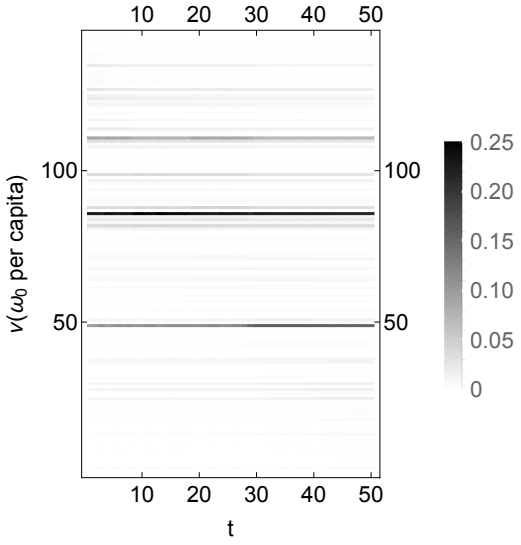
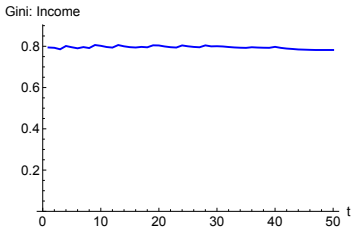


Figure 18: Distribution of Income - Model with standard of living consumption

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



4.2 Version 2

This subsection shows results for the case of:

$$D_t^\nu = b_t \left(1 + \varphi_t(\max\{0, r_t\omega_{t-1}^\nu - b_t\})\right), \tag{2}$$

where φ_t takes the form:

$$\varphi_t = \begin{cases} \frac{r_t\omega_{t-1}^\nu}{b_t} & \text{if } r_t\omega_{t-1}^\nu - b_t > 0 \\ 0 & \text{otherwise} \end{cases}.$$

Figure 19 shows the summary results of the simulation. Figure 20 shows the technology (A_t, L_t) and labour values over t.

Figure 21 shows the composition of exploitation and class status over the course of the simulation. Figures 22(a) and 22(b) show, respectively, the distribution of e_t^ν and the Gini coefficient of the distribution of e_t^ν over t.

Figures 23-25 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited.

Tables 3 and 4 report e_t^ν for countries that begin the simulation as exploiters and exploited, respectively, for the same select t as figures 23-25.

Figures 26 and 27 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 19: Summary results - Model with standard of living consumption

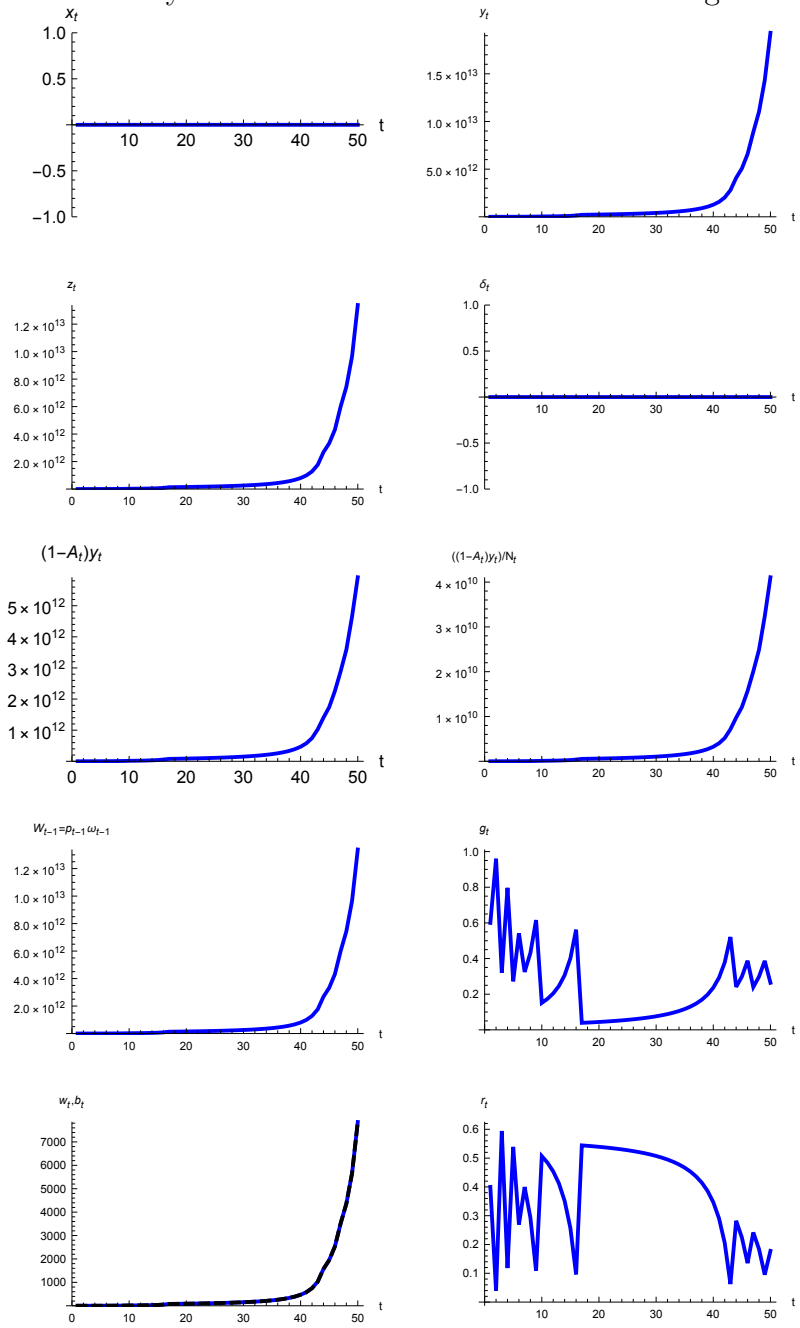


Figure 20: A_t, L_t, and labour values - Model with standard of living consumption

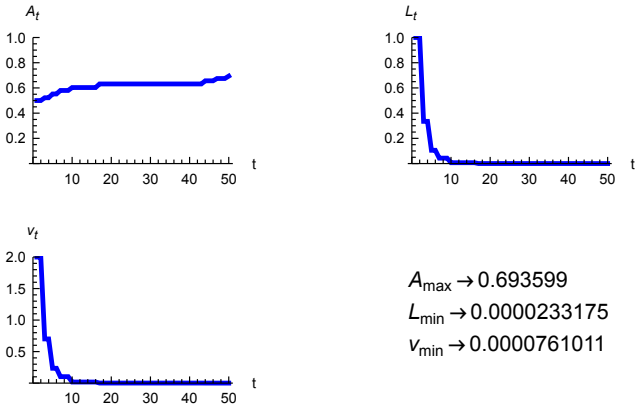
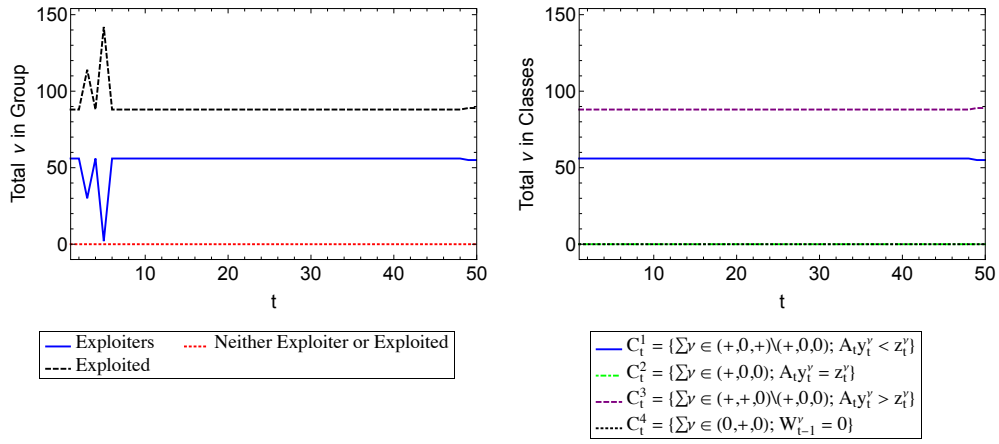


Figure 21: Class and exploitation status - Model with standard of living consumption

(a) Exploitation status

(b) Class status



(c) CECP

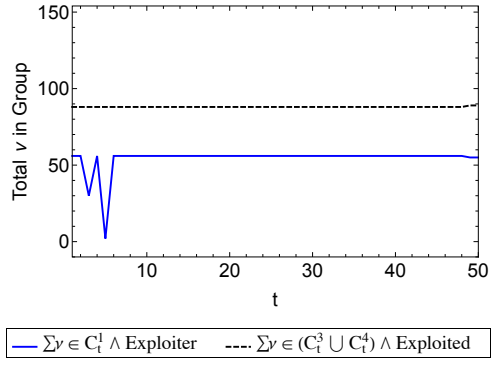
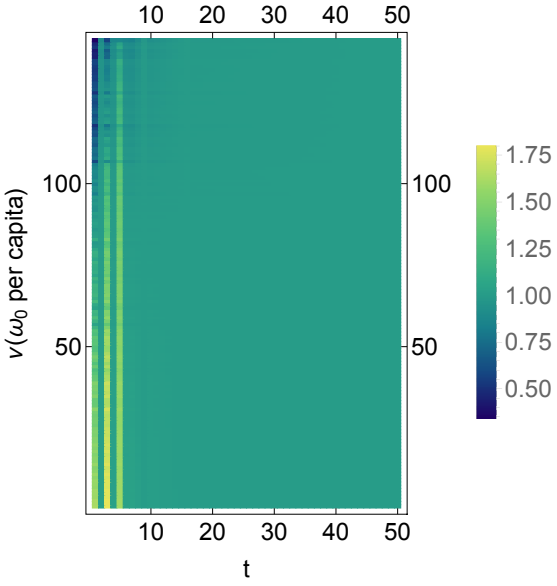


Figure 22: Exploitation intensity index - Model with standard of living consumption

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^{ν}

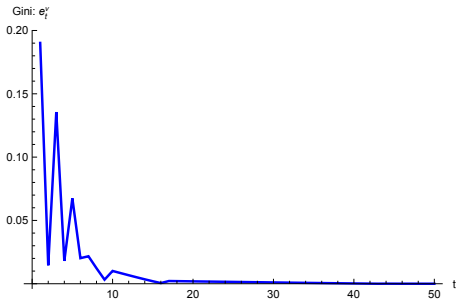
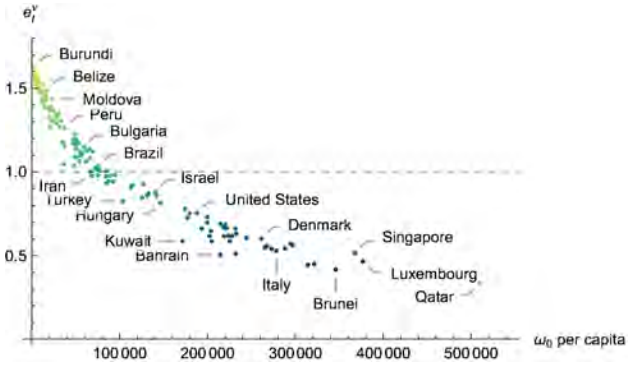
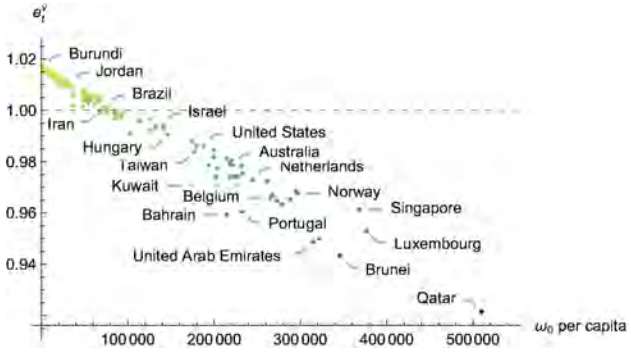


Figure 23: Worldwide Exploitation Intensity - Model with standard of living consumption

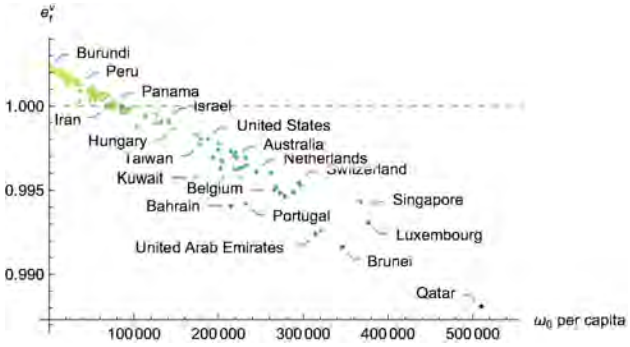
(a) $t = 1$



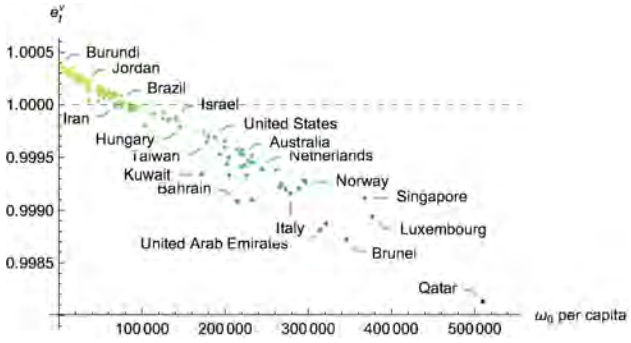
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

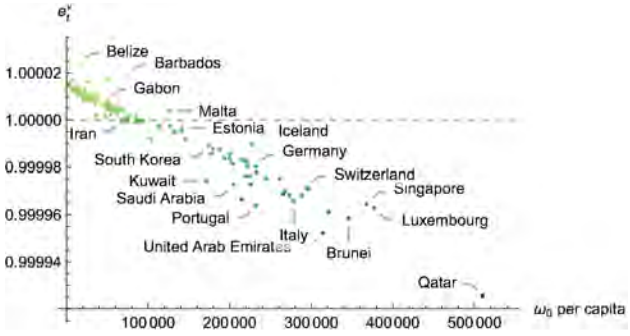
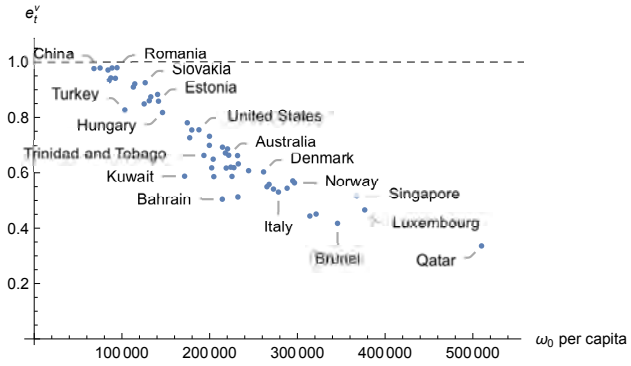
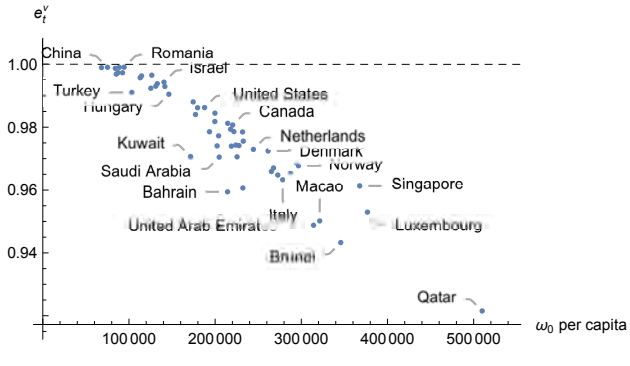


Figure 24: Exploiter Countries - Model with standard of living consumption

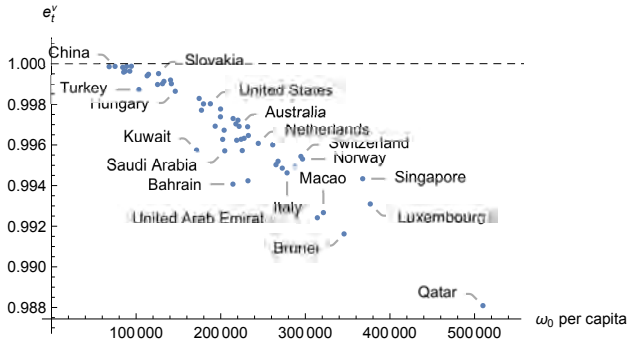
(a) $t = 1$



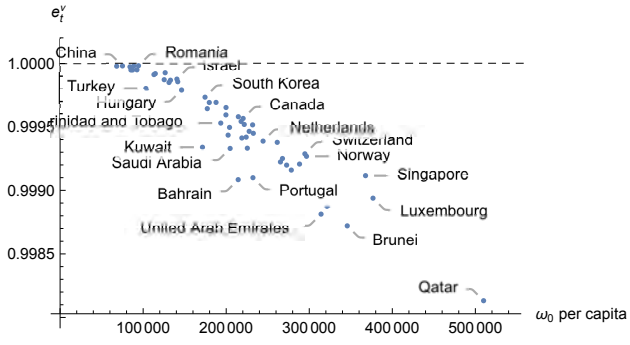
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

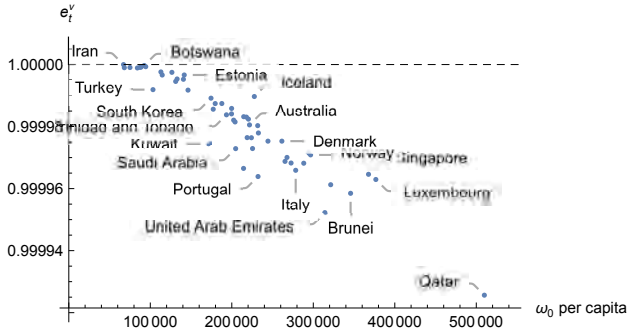
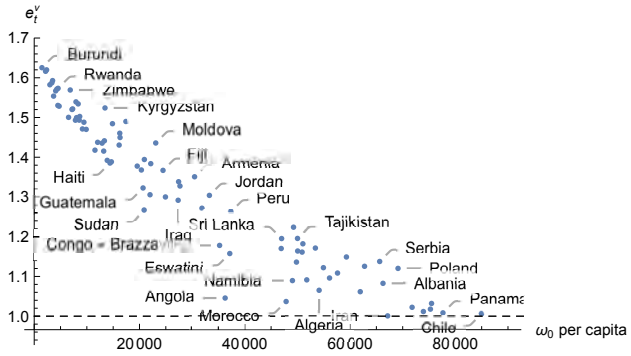
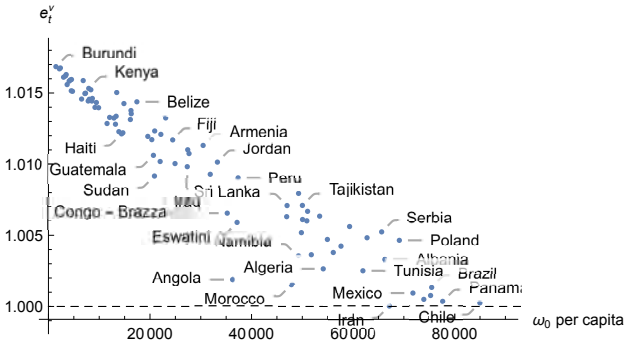


Figure 25: Exploited Countries - Model with standard of living consumption

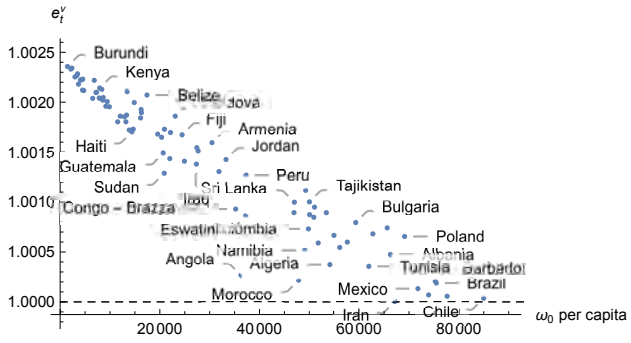
(a) $t = 1$



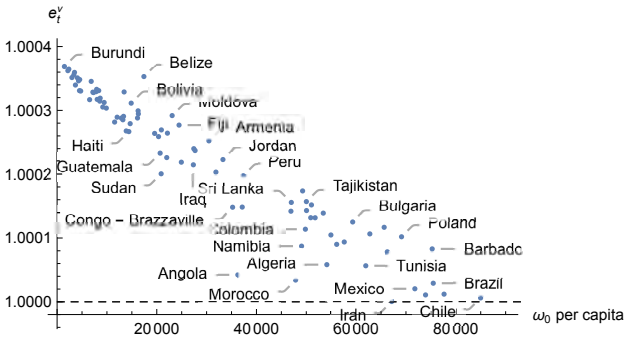
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

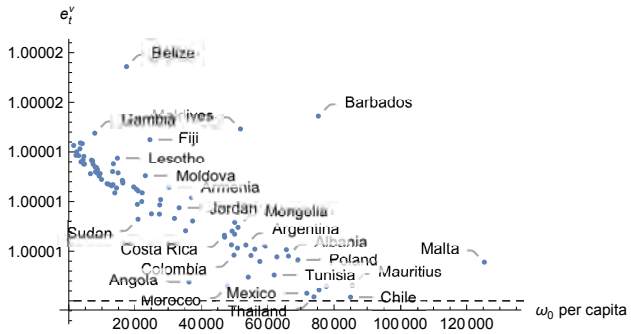


Table 3: Exploitation Intensity for Exploiter Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.976541966	0.998966281	0.999852967	0.999976851	0.999998986
China	0.978647343	0.999060961	0.999866292	0.99997887	0.999999051
Venezuela	0.971158892	0.998722513	0.999819124	0.999971972	0.999998906
Mauritius	0.932541249	0.996898654	0.999583102	0.999947327	1.000001546
Uruguay	0.942566141	0.997383869	0.999636434	0.999947446	0.999999092
Malaysia	0.978703508	0.999063649	0.999867481	0.999979475	0.999999201
Botswana	0.941309712	0.997323937	0.999631512	0.999948556	0.9999997
Romania	0.979622518	0.999104948	0.99987376	0.999980672	0.999999316
Turkey	0.826967083	0.991067881	0.998724901	0.999801164	0.999991912
Lithuania	0.909691055	0.995743736	0.999402763	0.999911043	0.999997619
Russia	0.921171118	0.996327458	0.999477733	0.999918418	0.999996624
Malta	0.848798369	0.992397428	0.998974525	0.999870649	1.0000039
Slovakia	0.925342641	0.996537509	0.999511353	0.999925576	0.99999749
New Zealand	0.860199679	0.993049253	0.999014021	0.999848669	0.99999456
Croatia	0.874383609	0.993850996	0.999129224	0.999866819	0.999995351
Israel	0.882995254	0.994325179	0.999194197	0.99987545	0.999995251
Estonia	0.85858511	0.992958804	0.99901281	0.999854606	0.99999664
Hungary	0.817710917	0.990489522	0.998643683	0.99978954	0.999991756
Kuwait	0.587649569	0.970663946	0.995745528	0.999339407	0.999974475
South Korea	0.780707518	0.98804575	0.998289099	0.999733156	0.99998916
Taiwan	0.726543823	0.984046799	0.997709489	0.999642931	0.999985599
Japan	0.7547769	0.986198747	0.99802137	0.999691217	0.999987422
United States	0.755286198	0.986236153	0.998026687	0.999691991	0.999987436
Trinidad and Tobago	0.662703906	0.978550927	0.996923285	0.999529296	0.999983793
Finland	0.69912436	0.981801007	0.997384986	0.99959383	0.999984098
United Kingdom	0.731849009	0.98446299	0.997769359	0.999651919	0.999985852
Cyprus	0.617820292	0.974052896	0.996272908	0.999434507	0.999982069
Latvia	0.649138986	0.977250914	0.996726102	0.999495367	0.999981497
Saudi Arabia	0.586098345	0.970479704	0.995710453	0.999329919	0.999972892
Bahrain	0.50463072	0.959436922	0.994070515	0.999084306	0.999966512
Czech Republic	0.692529507	0.981235366	0.997300165	0.999579467	0.999983186
Slovenia	0.671416958	0.979357654	0.997033723	0.999542357	0.999983055
Greece	0.617075462	0.973967135	0.996230214	0.999412118	0.999976443
Canada	0.686238595	0.980686405	0.997218356	0.999565913	0.999982409
Australia	0.663397453	0.978612427	0.996914405	0.999518534	0.999980541
France	0.62024044	0.974304757	0.996278307	0.999418646	0.999976405
Spain	0.586864784	0.970570046	0.995723602	0.999331813	0.999972918
Iceland	0.618538994	0.974137829	0.996326302	0.999464237	0.999989695
Germany	0.662105182	0.97849095	0.996895891	0.999515293	0.999980307
Portugal	0.512663102	0.960665608	0.994236632	0.999099658	0.999963897
Sweden	0.632172509	0.975551018	0.996464639	0.999448862	0.99997794
Netherlands	0.607595772	0.972934959	0.996076209	0.999387507	0.999975302
Denmark	0.603206873	0.972447435	0.996006294	0.999377854	0.999975302
Belgium	0.549630343	0.965909057	0.995027536	0.999223448	0.999968779
Hong Kong	0.558160498	0.967027966	0.995196652	0.999250575	0.999970054
Ireland	0.54116615	0.964767427	0.994858825	0.999198561	0.999968252
Italy	0.53032751	0.963254767	0.994625874	0.999159437	0.999965903
Austria	0.544305967	0.965194468	0.994920549	0.999206906	0.999968185
Switzerland	0.570712121	0.968617543	0.995433982	0.999287407	0.999971424
Norway	0.563698455	0.967737611	0.995303811	0.999267799	0.999970874
United Arab Emirates	0.443854348	0.948793613	0.992416342	0.998813041	0.999952264
Macao	0.450912309	0.950170757	0.99267044	0.99887468	0.999961257
Brunei	0.41732574	0.943284379	0.991621163	0.998720688	0.999958485
Singapore	0.517067965	0.961326689	0.994337259	0.999115683	0.99996461
Luxembourg	0.465935677	0.952958572	0.993094599	0.9989385	0.99996294
Qatar	0.335883397	0.92151994	0.988090458	0.998131811	0.999925637

Table 4: Exploitation Intensity for Exploited Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.625365	1.016853	1.002358	1.000369	1.000016	Laos	1.305580	1.010185	1.001436	1.000226	1.000010
Congo - Kinshasa	1.616259	1.016698	1.002332	1.000362	1.000015	Zambia	1.383824	1.012092	1.001696	1.000264	1.000011
Malawi	1.619901	1.016760	1.002342	1.000365	1.000015	Moldova	1.435850	1.013249	1.001861	1.000292	1.000013
Mali	1.582432	1.016110	1.002253	1.000351	1.000015	Fiji	1.366936	1.011705	1.001674	1.000277	1.000016
Sierra Leone	1.587352	1.016197	1.002269	1.000356	1.000015	India	1.300028	1.010040	1.001409	1.000219	1.000009
Liberia	1.592862	1.016295	1.002285	1.000360	1.000016	Iraq	1.291677	1.009822	1.001380	1.000215	1.000009
Mozambique	1.553836	1.015592	1.002181	1.000340	1.000014	Philippines	1.338398	1.011010	1.001545	1.000240	1.000010
Central African Republic	1.566984	1.015834	1.002223	1.000351	1.000016	Paraguay	1.327607	1.010744	1.001512	1.000237	1.000010
Madagascar	1.571391	1.015912	1.002225	1.000346	1.000014	Armenia	1.350835	1.011315	1.001595	1.000252	1.000011
Niger	1.530384	1.015155	1.002121	1.000331	1.000014	Ghana	1.271642	1.009287	1.001305	1.000203	1.000008
Rwanda	1.573423	1.015949	1.002231	1.000348	1.000015	Jordan	1.303970	1.010143	1.001426	1.000223	1.000009
Burkina Faso	1.528461	1.015118	1.002117	1.000330	1.000014	Congo - Brazzaville	1.178095	1.006556	1.000930	1.000148	1.000007
Ethiopia	1.500379	1.014574	1.002039	1.000317	1.000013	Angola	1.045664	1.001885	1.000268	1.000042	1.000002
Zimbabwe	1.569218	1.015873	1.002219	1.000345	1.000014	Eswatini	1.157668	1.005907	1.000861	1.000148	1.000010
Togo	1.520209	1.014961	1.002097	1.000329	1.000014	Peru	1.262430	1.009035	1.001270	1.000198	1.000008
Benin	1.521622	1.014988	1.002099	1.000328	1.000014	Costa Rica	1.170306	1.006309	1.000894	1.000142	1.000007
Gambia	1.493204	1.014437	1.002043	1.000329	1.000017	Sri Lanka	1.195376	1.007090	1.000999	1.000156	1.000006
Kenya	1.539374	1.015324	1.002142	1.000333	1.000013	Morocco	1.036878	1.001534	1.000218	1.000034	1.000001
Yemen	1.499626	1.014560	1.002038	1.000317	1.000013	Namibia	1.089555	1.003556	1.000516	1.000087	1.000006
Uganda	1.534250	1.015227	1.002129	1.000331	1.000013	Ukraine	1.223977	1.007945	1.001118	1.000174	1.000007
Nepal	1.493339	1.014435	1.002020	1.000314	1.000013	Colombia	1.136097	1.005187	1.000731	1.000114	1.000005
Cambodia	1.502579	1.014618	1.002047	1.000319	1.000013	Tajikistan	1.195682	1.007100	1.001002	1.000157	1.000007
Ivory Coast	1.471203	1.013989	1.001959	1.000305	1.000013	Gabon	1.164006	1.006109	1.000874	1.000143	1.000008
Cameroon	1.488076	1.014330	1.002006	1.000312	1.000013	South Africa	1.161247	1.006017	1.000848	1.000132	1.000005
Pakistan	1.470108	1.013966	1.001954	1.000304	1.000012	Mongolia	1.182176	1.006684	1.000949	1.000152	1.000007
Senegal	1.417779	1.012856	1.001804	1.000282	1.000012	Maldives	1.091379	1.003635	1.000590	1.000132	1.000017
Myanmar	1.437571	1.013285	1.001861	1.000289	1.000012	Argentina	1.171428	1.006343	1.000894	1.000139	1.000006
Nigeria	1.435517	1.013241	1.001854	1.000288	1.000012	Algeria	1.065170	1.002642	1.000374	1.000058	1.000002
Mauritania	1.415442	1.012806	1.001804	1.000285	1.000013	Dominican Republic	1.122060	1.004708	1.000666	1.000105	1.000005
Bangladesh	1.441340	1.013365	1.001871	1.000291	1.000012	Jamaica	1.096064	1.003792	1.000545	1.000090	1.000005
Kyrgyzstan	1.524083	1.015035	1.002106	1.000329	1.000014	Ecuador	1.108542	1.004236	1.000599	1.000094	1.000004
Tanzania	1.392134	1.012282	1.001722	1.000268	1.000011	Bulgaria	1.148992	1.005617	1.000795	1.000125	1.000006
Haiti	1.385365	1.012128	1.001704	1.000267	1.000011	Tunisia	1.061619	1.002507	1.000356	1.000057	1.000003
Lesotho	1.388505	1.012203	1.001730	1.000279	1.000014	Kazakhstan	1.125524	1.004827	1.000682	1.000106	1.000004
Bolivia	1.484419	1.014257	1.001997	1.000311	1.000013	Serbia	1.137671	1.005240	1.000742	1.000117	1.000005
Honduras	1.430623	1.013136	1.001843	1.000288	1.000012	Albania	1.082673	1.003302	1.000475	1.000078	1.000005
Vietnam	1.460407	1.013766	1.001927	1.000299	1.000012	Iran	1.000699	1.000030	1.000004	1.000001	1.000000
Egypt	1.449712	1.013543	1.001896	1.000295	1.000012	Poland	1.120242	1.004645	1.000655	1.000102	1.000004
Belize	1.489986	1.014381	1.002072	1.000353	1.000024	Mexico	1.022329	1.000942	1.000133	1.000020	1.000001
Nicaragua	1.377667	1.011950	1.001680	1.000264	1.000011	Thailand	1.011671	1.000497	1.000070	1.000011	1.000000
El Salvador	1.367900	1.011722	1.001649	1.000259	1.000011	Barbados	1.017689	1.000769	1.000207	1.000083	1.000019
Guatemala	1.322645	1.010619	1.001492	1.000233	1.000010	Brazil	1.032058	1.001340	1.000189	1.000029	1.000001
Sudan	1.267154	1.009165	1.001289	1.000201	1.000008	Panama	1.008316	1.000357	1.000057	1.000012	1.000001
Syria	1.394292	1.012331	1.001729	1.000269	1.000011	Chile	1.005887	1.000252	1.000037	1.000006	1.000000

Figure 26: Distribution of wealth - Model with standard of living consumption

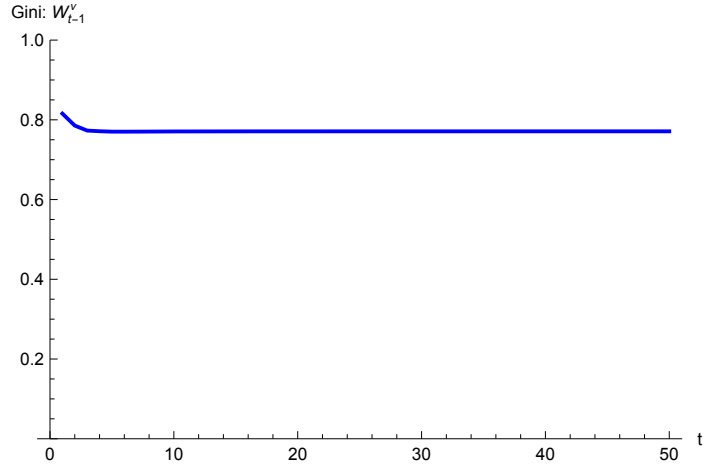
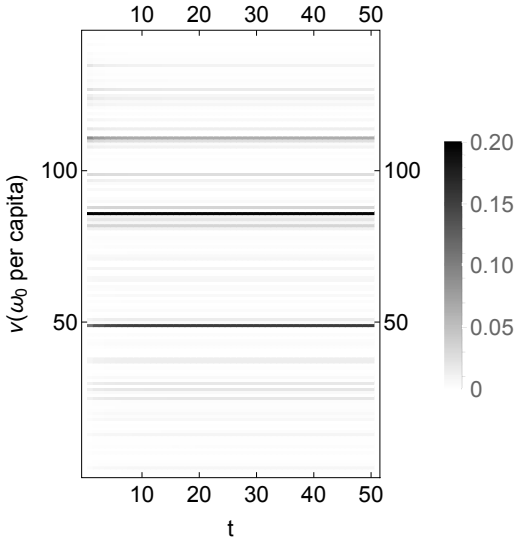
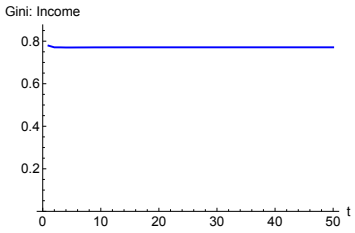


Figure 27: Distribution of Income - Model with standard of living consumption

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



4.3 Version 3

This subsection shows results for the case of:

$$D_t^\nu = b_t \Lambda_t^\nu + \min\left\{\frac{r_t \omega_{t-1}^\nu}{r_t \omega_0^*}, 1\right\} r_t \omega_{t-1}^\nu, \tag{3}$$

where ω_0^* is a reference capital stock set at the 91st percentile of the initial world capital stock.

Figure 28 shows the summary results of the simulation. Figure 29 shows the technology (A_t, L_t) and labour values over t.

Figure 30 shows the composition of exploitation and class status over the course of the simulation. Figures 31(a) and 31(b) show, respectively, the distribution of e_t^ν and the Gini coefficient of the distribution of e_t^ν over t.

Figures 32-34 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited.

Tables 5 and 6 report e_t^ν for countries that begin the simulation as exploiters and exploited, respectively, for the same select t as figures 32-34.

Figures 35 and 36 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 28: Summary results - Model with standard of living consumption

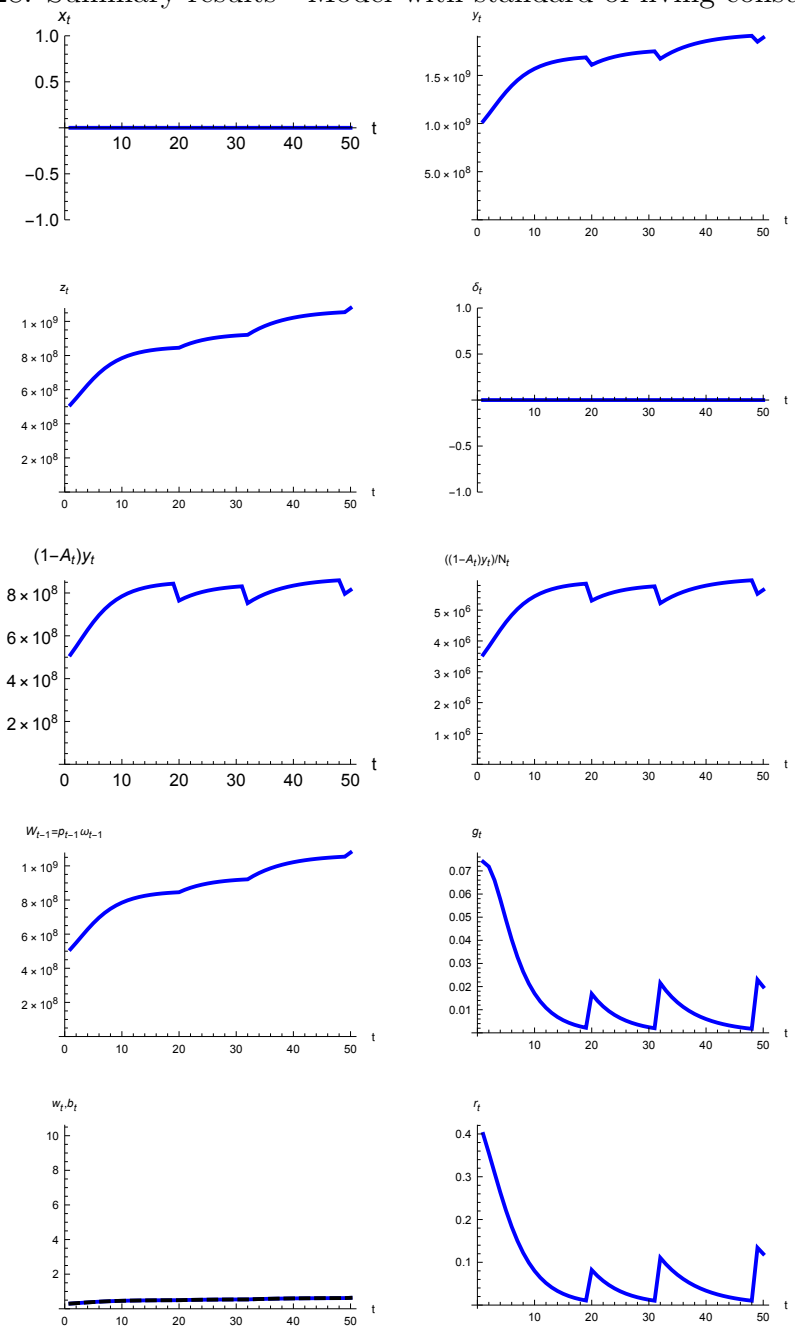


Figure 29: A_t, L_t, and labour values - Model with standard of living consumption

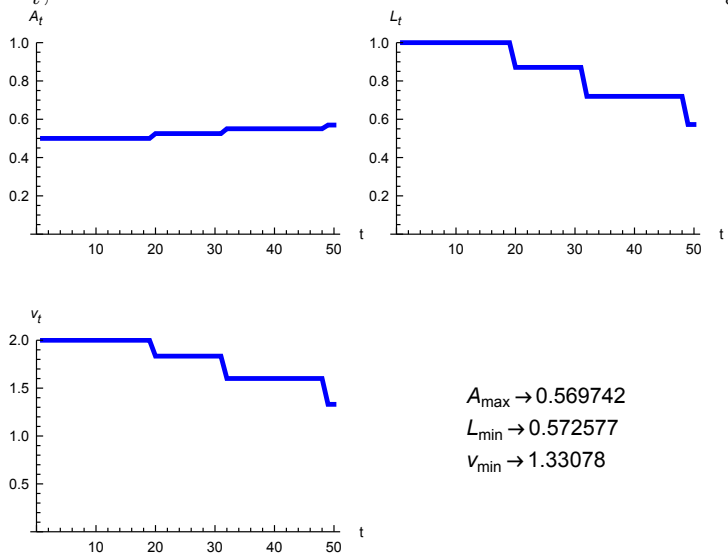
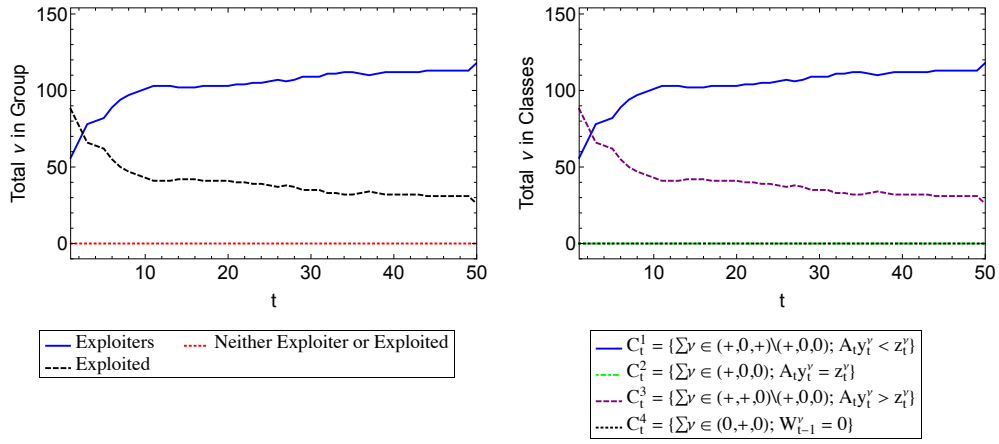


Figure 30: Class and exploitation status - Model with standard of living consumption

(a) Exploitation status

(b) Class status



(c) CECP

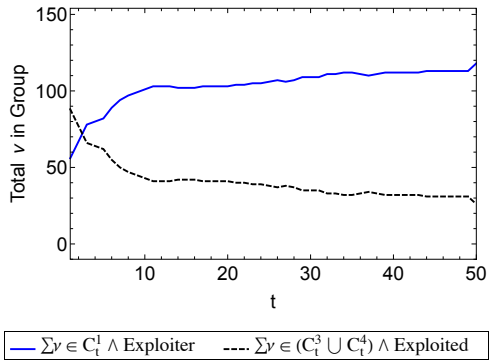


Figure 31: Exploitation intensity index - Model with standard of living consumption

(a) Exploitation intensity index across agents

(b) Gini coefficient of e_t^{ν}

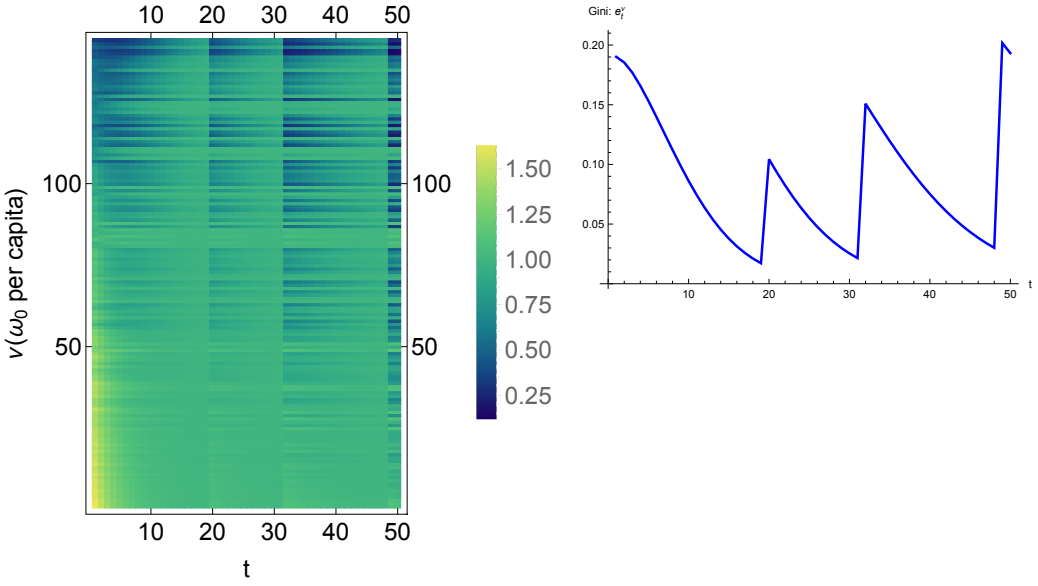
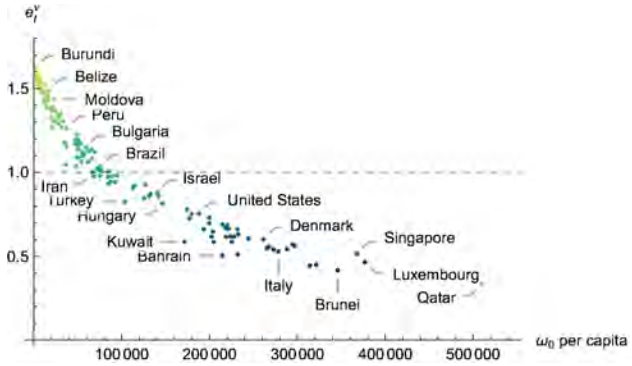
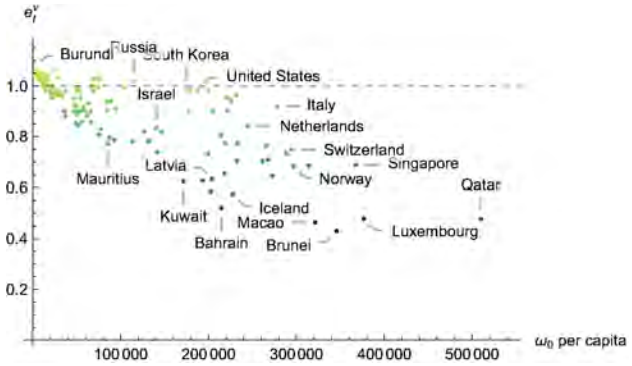


Figure 32: Worldwide Exploitation Intensity - Model with standard of living consumption

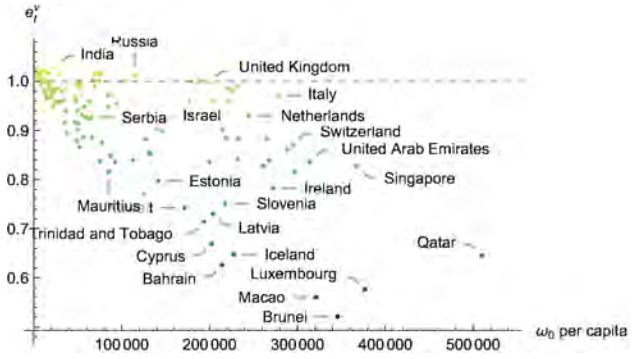
(a) $t = 1$



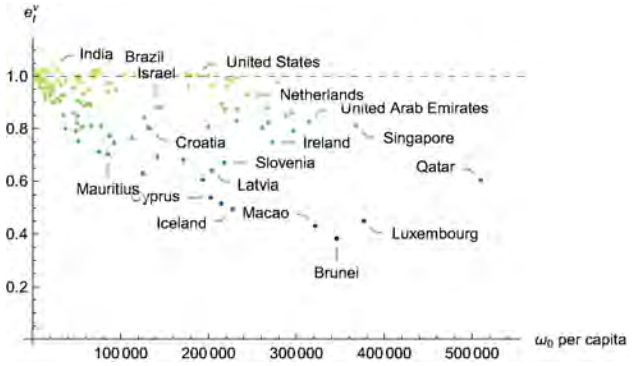
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

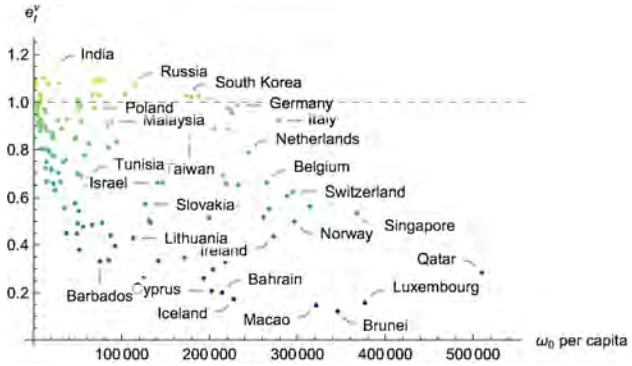
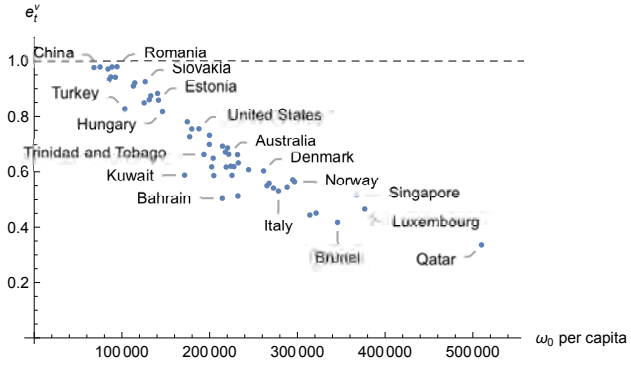
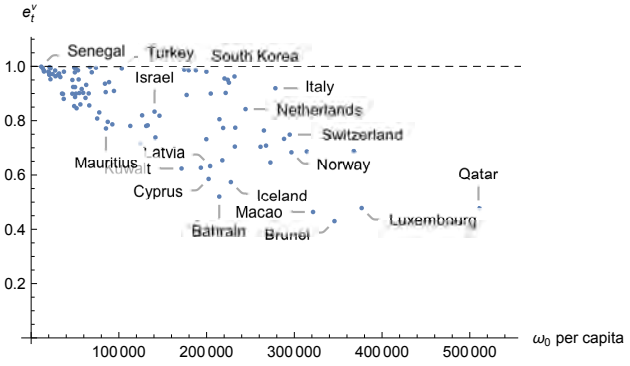


Figure 33: Exploiter Countries - Model with standard of living consumption

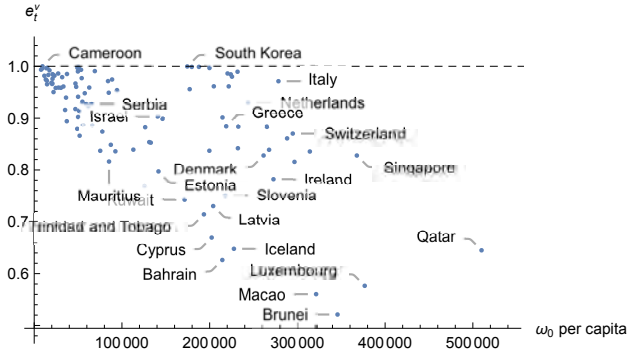
(a) $t = 1$



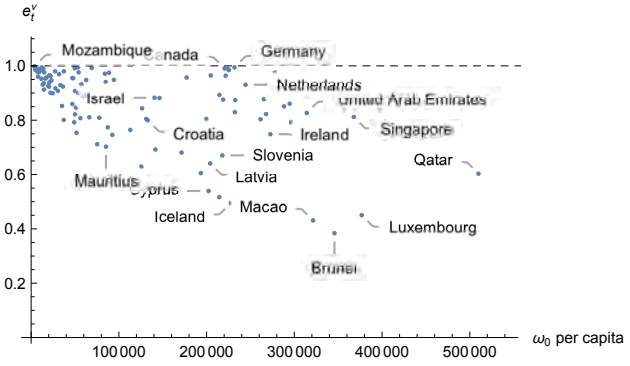
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

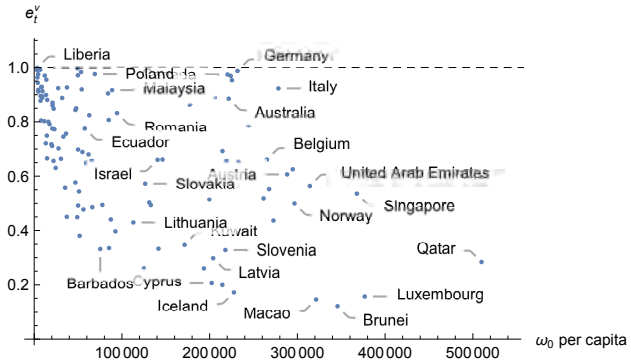
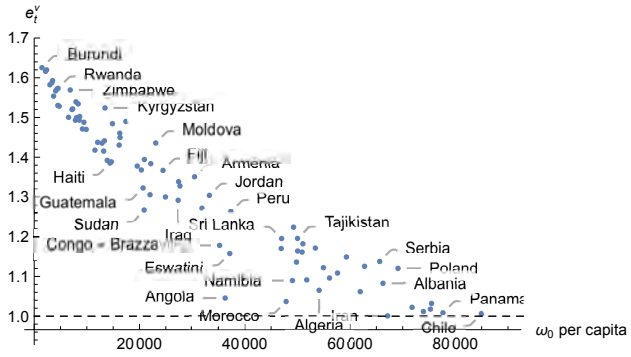
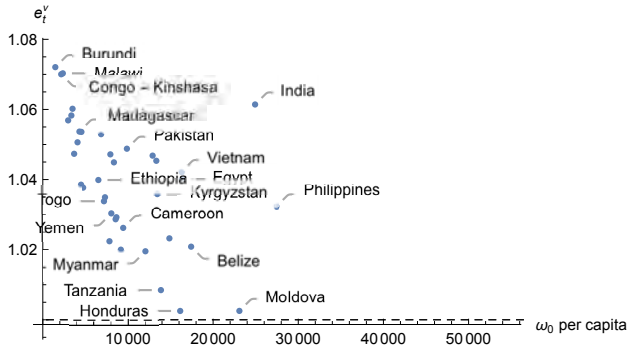


Figure 34: Exploited Countries - Model with standard of living consumption

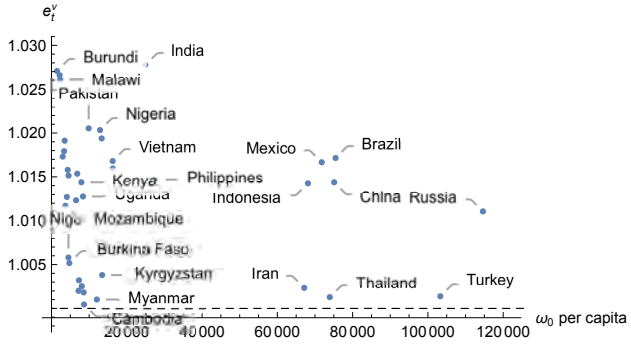
(a) $t = 1$



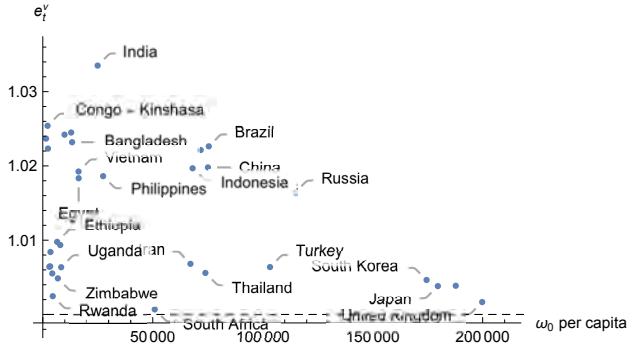
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

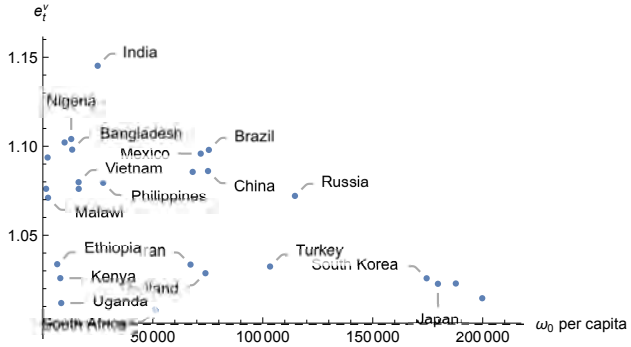


Table 5: Exploitation Intensity for Exploiter Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.9765	1.0253	1.0143	1.0197	1.0856
China	0.9786	1.0256	1.0144	1.0198	1.0861
Venezuela	0.9712	0.9361	0.9714	0.9711	0.9046
Mauritius	0.9325	0.7713	0.8162	0.7025	0.3356
Uruguay	0.9426	0.7957	0.8485	0.7736	0.4407
Malaysia	0.9787	0.9420	0.9745	0.9748	0.9169
Botswana	0.9413	0.7865	0.8359	0.7460	0.3968
Romania	0.9796	0.9095	0.9540	0.9485	0.8321
Turkey	0.8270	0.9926	1.0014	1.0064	1.0324
Lithuania	0.9097	0.7807	0.8392	0.7642	0.4296
Russia	0.9212	1.0169	1.0111	1.0164	1.0721
Malta	0.8488	0.7181	0.7686	0.6291	0.2606
Slovakia	0.9253	0.8196	0.8825	0.8436	0.5720
New Zealand	0.8602	0.7806	0.8537	0.8048	0.5034
Croatia	0.8744	0.7829	0.8527	0.8000	0.4935
Israel	0.8830	0.8333	0.9032	0.8826	0.6603
Estonia	0.8586	0.7383	0.7972	0.6920	0.3332
Hungary	0.8177	0.8183	0.8987	0.8816	0.6613
Kuwait	0.5876	0.6241	0.7428	0.6808	0.3474
South Korea	0.7807	0.9879	0.9996	1.0046	1.0258
Taiwan	0.7265	0.8947	0.9558	0.9572	0.8635
Japan	0.7548	0.9857	0.9988	1.0038	1.0227
United States	0.7553	0.9858	0.9988	1.0039	1.0229
Trinidad and Tobago	0.6627	0.6270	0.7143	0.6052	0.2605
Finland	0.6991	0.7317	0.8371	0.8047	0.5149
United Kingdom	0.7318	0.9805	0.9967	1.0017	1.0146
Cyprus	0.6178	0.5855	0.6696	0.5394	0.2067
Latvia	0.6491	0.6331	0.7304	0.6408	0.2978
Saudi Arabia	0.5861	0.8998	0.9613	0.9648	0.8883
Bahrain	0.5046	0.5204	0.6263	0.5168	0.2001
Czech Republic	0.6925	0.8053	0.9013	0.8930	0.6923
Slovenia	0.6714	0.6538	0.7510	0.6703	0.3283
Greece	0.6171	0.7731	0.8843	0.8756	0.6551
Canada	0.6862	0.9554	0.9861	0.9907	0.9744
Australia	0.6634	0.9022	0.9612	0.9640	0.8853
France	0.6202	0.9506	0.9844	0.9891	0.9691
Spain	0.5869	0.9399	0.9800	0.9845	0.9532
Iceland	0.6185	0.5739	0.6479	0.4950	0.1720
Germany	0.6621	0.9628	0.9895	0.9943	0.9875
Portugal	0.5127	0.7045	0.8419	0.8297	0.5672
Sweden	0.6322	0.7742	0.8836	0.8740	0.6512
Netherlands	0.6076	0.8426	0.9304	0.9304	0.7880
Denmark	0.6032	0.7038	0.8279	0.8035	0.5179
Belgium	0.5496	0.7638	0.8832	0.8775	0.6611
Hong Kong	0.5582	0.7080	0.8389	0.8224	0.5525
Ireland	0.5412	0.6455	0.7820	0.7485	0.4366
Italy	0.5303	0.9195	0.9712	0.9755	0.9231
Austria	0.5443	0.7329	0.8609	0.8510	0.6064
Switzerland	0.5707	0.7486	0.8702	0.8608	0.6254
Norway	0.5637	0.6833	0.8155	0.7913	0.4996
United Arab Emirates	0.4439	0.6864	0.8356	0.8266	0.5638
Macao	0.4509	0.4638	0.5604	0.4311	0.1459
Brunei	0.4173	0.4301	0.5211	0.3840	0.1210
Singapore	0.5171	0.6884	0.8278	0.8119	0.5356
Luxembourg	0.4659	0.4782	0.5765	0.4504	0.1569
Qatar	0.3359	0.4761	0.6450	0.6032	0.2839

Table 6: Exploitation Intensity for Exploited Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.62537	1.07206	1.02707	1.02368	1.07610	Laos	1.30558	0.95261	0.95024	0.90077	0.65640
Congo - Kinshasa	1.61626	1.07003	1.02659	1.02540	1.09368	Zambia	1.38382	0.99325	0.98234	0.96226	0.84835
Malawi	1.61990	1.07030	1.02606	1.02233	1.07107	Moldova	1.43585	1.00253	0.98193	0.94670	0.77320
Mali	1.58243	1.05688	1.01731	1.00642	0.99368	Fiji	1.36694	0.97157	0.95825	0.89912	0.63033
Sierra Leone	1.58735	1.05828	1.01793	1.00647	0.99051	India	1.30003	1.06142	1.02775	1.03351	1.14521
Liberia	1.59286	1.06019	1.01913	1.00841	0.99858	Iraq	1.29168	0.98466	0.98606	0.97969	0.92417
Mozambique	1.55384	1.04735	1.01170	0.99838	0.96337	Philippines	1.33840	1.03232	1.01468	1.01862	1.07947
Central African Republic	1.56698	1.05063	1.01271	0.99636	0.94382	Paraguay	1.32761	0.96359	0.95888	0.91732	0.70229
Madagascar	1.57139	1.05368	1.01580	1.00552	0.99479	Armenia	1.35084	0.96819	0.95852	0.90767	0.66419
Niger	1.53038	1.03853	1.00580	0.98761	0.91747	Ghana	1.27164	0.97376	0.97901	0.96949	0.88795
Rwanda	1.57342	1.05359	1.01514	1.00246	0.97563	Jordan	1.30397	0.96069	0.96098	0.92908	0.74565
Burkina Faso	1.52846	1.03770	1.00517	0.98625	0.91140	Congo - Brazzaville	1.17809	0.89969	0.91557	0.85240	0.55752
Ethiopia	1.50038	1.03987	1.01234	1.00977	1.03376	Angola	1.04566	0.89832	0.93953	0.92375	0.75668
Zimbabwe	1.56922	1.05295	1.01536	1.00486	0.99207	Eswatini	1.15767	0.88026	0.89404	0.80095	0.45037
Togo	1.52021	1.03381	1.00201	0.97879	0.87769	Peru	1.26243	0.98034	0.98512	0.97993	0.92670
Benin	1.52162	1.03495	1.00321	0.98236	0.89497	Costa Rica	1.17031	0.89933	0.91742	0.85971	0.57652
Gambia	1.49320	1.02240	0.99345	0.96052	0.80466	Sri Lanka	1.19538	0.94989	0.96679	0.95523	0.84380
Kenya	1.53937	1.04719	1.01439	1.00935	1.02590	Morocco	1.03688	0.92410	0.96035	0.95479	0.84979
Yemen	1.49963	1.03035	1.00253	0.98740	0.92835	Namibia	1.08955	0.85365	0.87940	0.79216	0.44909
Uganda	1.53425	1.04490	1.01277	1.00636	1.01191	Ukraine	1.22398	0.99507	0.99704	0.99813	0.99721
Nepal	1.49334	1.02868	1.00182	0.98707	0.92860	Colombia	1.13610	0.97795	0.99002	0.99095	0.97154
Cambodia	1.50258	1.02925	1.00045	0.98048	0.89436	Tajikistan	1.19568	0.92376	0.94121	0.90774	0.69795
Ivory Coast	1.47120	1.02000	0.99600	0.97694	0.88881	Gabon	1.16401	0.88715	0.90223	0.82181	0.49192
Cameroon	1.48808	1.02621	0.99996	0.98333	0.91278	South Africa	1.16125	0.99388	0.99820	1.00068	1.00824
Pakistan	1.47011	1.04880	1.02054	1.02421	1.10214	Mongolia	1.18218	0.89954	0.91406	0.84691	0.54376
Senegal	1.41778	0.99880	0.98172	0.95246	0.80234	Maldives	1.09138	0.84569	0.86609	0.75350	0.38018
Myanmar	1.43757	1.01954	1.00101	0.99414	0.97032	Argentina	1.17143	0.98552	0.99324	0.99433	0.98361
Nigeria	1.43552	1.04682	1.02033	1.02450	1.10407	Algeria	1.06517	0.95182	0.97707	0.97606	0.91948
Mauritania	1.41544	0.99310	0.97452	0.93108	0.72101	Dominican Republic	1.12206	0.90184	0.93161	0.90134	0.68907
Bangladesh	1.44134	1.04535	1.01939	1.02319	1.09811	Jamaica	1.09606	0.85993	0.88632	0.80756	0.47734
Kyrgyzstan	1.52408	1.03586	1.00380	0.98338	0.89891	Ecuador	1.10854	0.91668	0.94799	0.93182	0.77607
Tanzania	1.39213	1.00846	0.99620	0.98948	0.95527	Bulgaria	1.14899	0.90261	0.92698	0.88714	0.64843
Haiti	1.38536	0.98525	0.97224	0.93581	0.74936	Tunisia	1.06162	0.88381	0.92374	0.89572	0.68009
Lesotho	1.38850	0.98104	0.96531	0.91254	0.66587	Kazakhstan	1.12552	0.93182	0.95896	0.94792	0.82429
Bolivia	1.48442	1.02323	0.99703	0.97606	0.88054	Serbia	1.13767	0.90040	0.92692	0.88932	0.65558
Honduras	1.43062	1.00252	0.98333	0.95298	0.80032	Albania	1.08267	0.85613	0.88549	0.81060	0.48584
Vietnam	1.46041	1.04214	1.01681	1.01925	1.07982	Iran	1.00070	0.99740	1.00235	1.00682	1.03353
Egypt	1.44971	1.04010	1.01596	1.01834	1.07607	Poland	1.12024	0.97826	0.99070	0.99209	0.97609
Belize	1.48999	1.02085	0.99214	0.95725	0.79150	Mexico	1.02233	1.03161	1.01667	1.02214	1.09586
Nicaragua	1.37767	0.98062	0.96807	0.92625	0.71772	Thailand	1.01167	0.99530	1.00129	1.00559	1.02868
El Salvador	1.36790	0.97706	0.96594	0.92354	0.71148	Barbados	1.01769	0.80797	0.83698	0.71152	0.33196
Guatemala	1.32265	0.96919	0.96699	0.93904	0.77545	Brazil	1.03206	1.03289	1.01715	1.02264	1.09795
Sudan	1.26715	0.96954	0.97585	0.96447	0.87037	Panama	1.00832	0.83038	0.87416	0.80884	0.49426
Syria	1.39429	0.99718	0.98478	0.96591	0.86056	Chile	1.00589	0.90521	0.94896	0.94040	0.80678

Figure 35: Distribution of wealth - Model with standard of living consumption

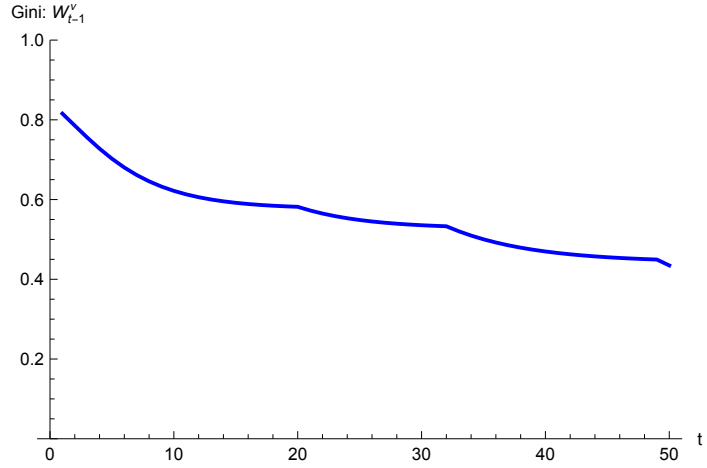
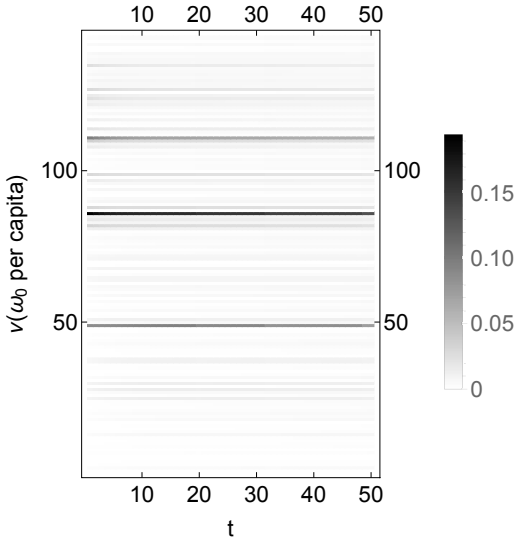
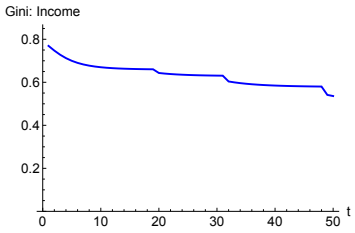


Figure 36: Distribution of Income - Model with standard of living consumption

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



4.4 Version 4

This subsection shows results for the case of:

$$D_t^\nu = b_t \Lambda_t^\nu + \min\left\{\frac{r_t \omega_{t-1}^\nu}{r_1 \omega_0^*}, 1\right\} r_t \omega_{t-1}^\nu, \tag{4}$$

where ω_0^* is a reference capital stock set at the 91st percentile of the initial world capital stock.

Figure 37 shows the summary results of the simulation. Figure 38 shows the technology (A_t, L_t) and labour values over t.

Figure 39 shows the composition of exploitation and class status over the course of the simulation. Figures 40(a) and 40(b) show, respectively, the distribution of e_t^ν and the Gini coefficient of the distribution of e_t^ν over t.

Figures 41-43 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited.

Tables 7 and 8 report e_t^ν for countries that begin the simulation as exploiters and exploited, respectively, for the same select t as figures 41-43.

Figures 44 and 45 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 37: Summary results - Model with standard of living consumption

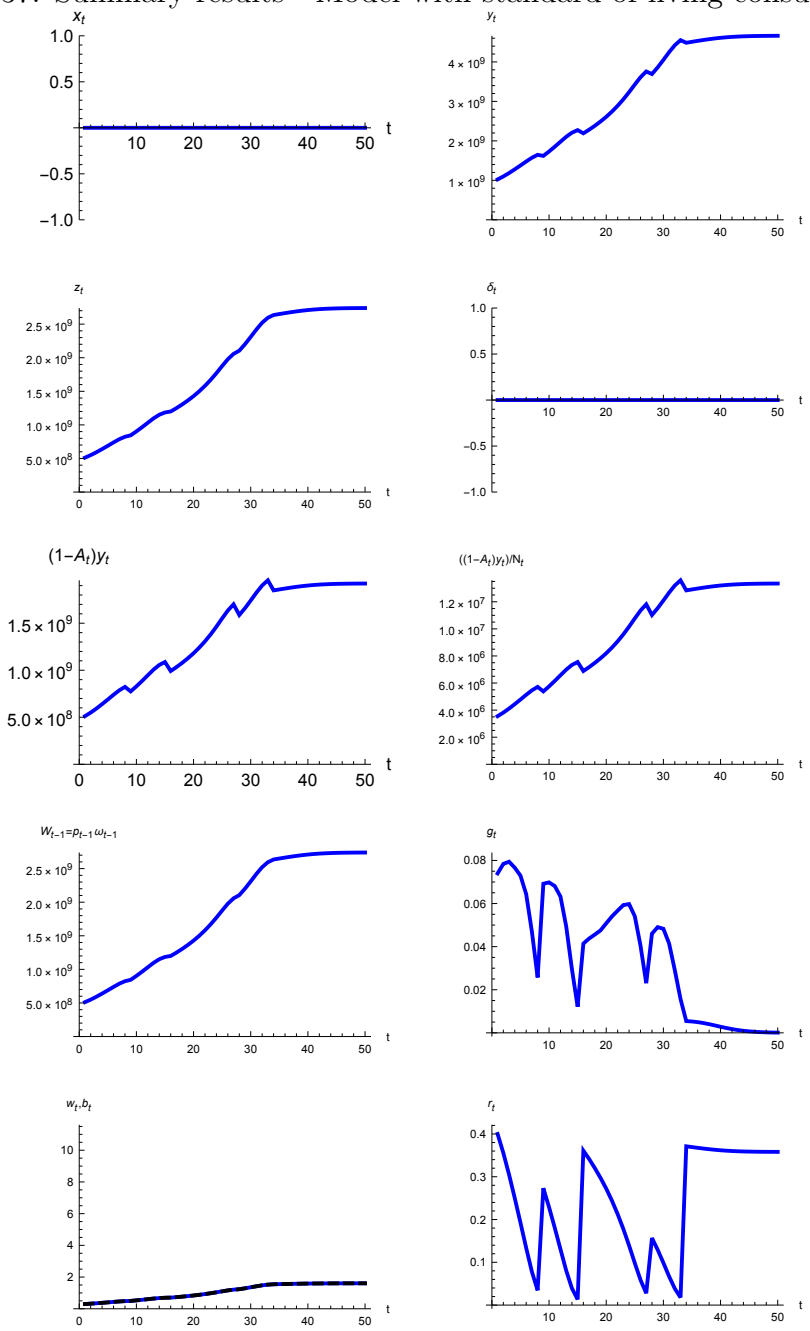


Figure 38: A_t, L_t, and labour values - Model with standard of living consumption

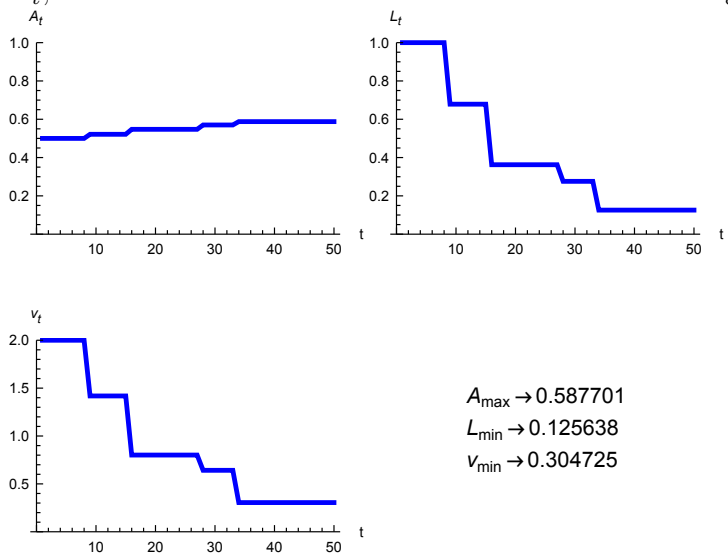
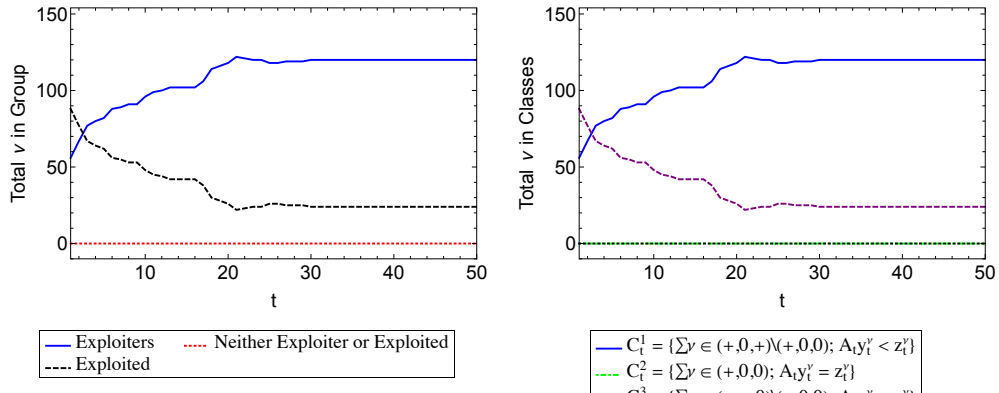


Figure 39: Class and exploitation status - Model with standard of living consumption

(a) Exploitation status

(b) Class status



(c) CECP

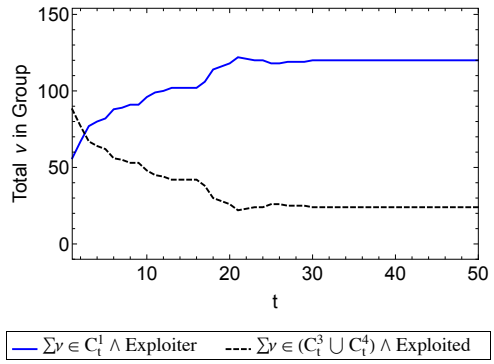
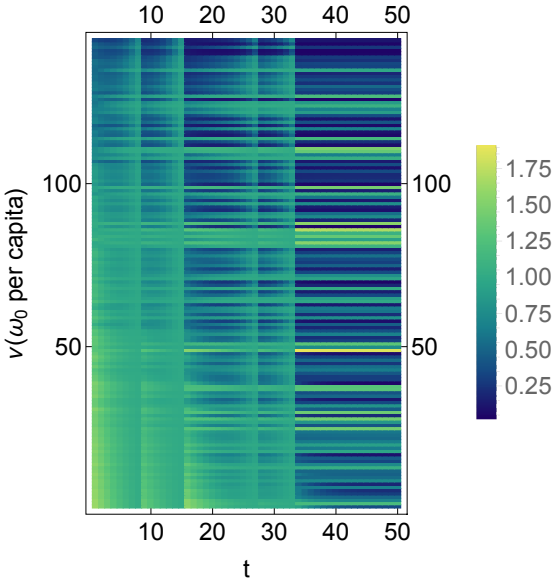


Figure 40: Exploitation intensity index - Model with standard of living consumption

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^{ν}

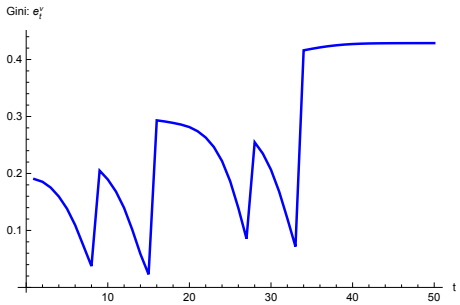
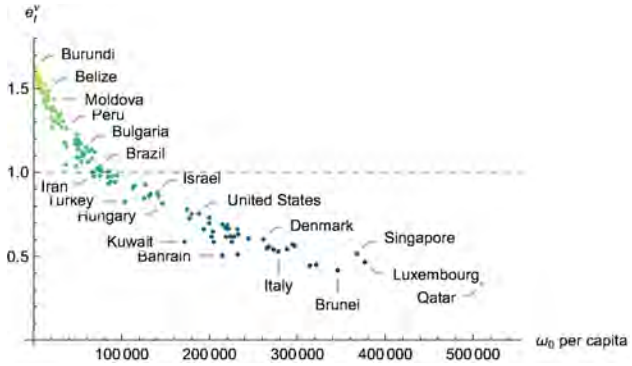
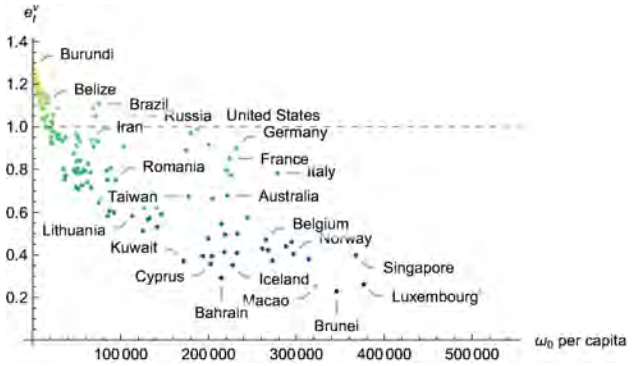


Figure 41: Worldwide Exploitation Intensity - Model with standard of living consumption

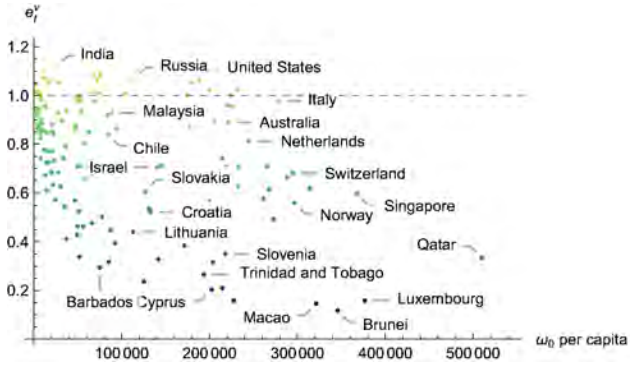
(a) $t = 1$



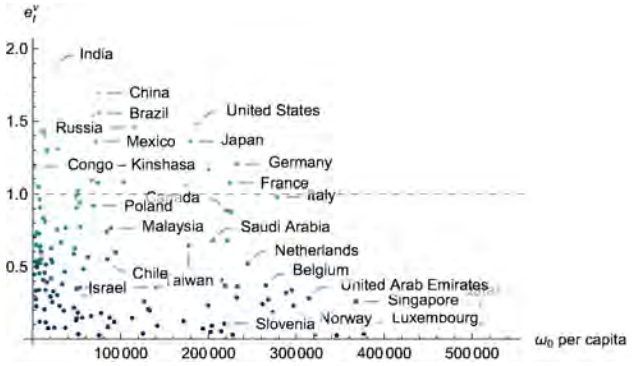
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

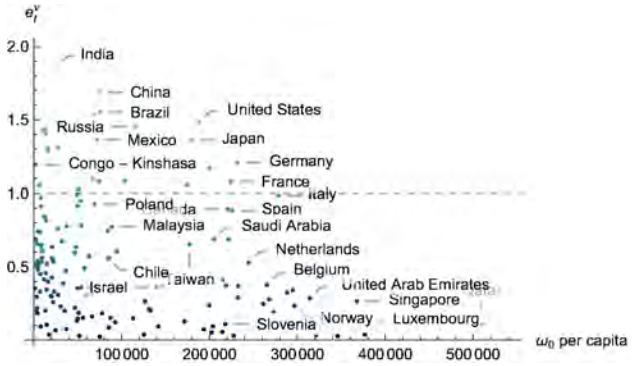
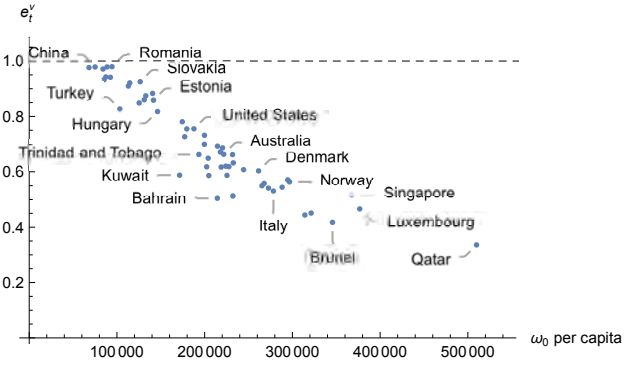
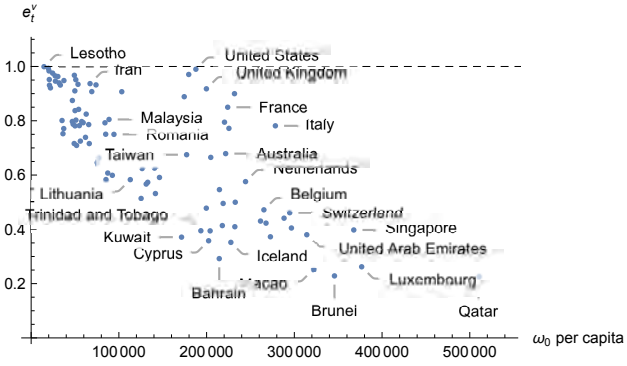


Figure 42: Exploiter Countries - Model with standard of living consumption

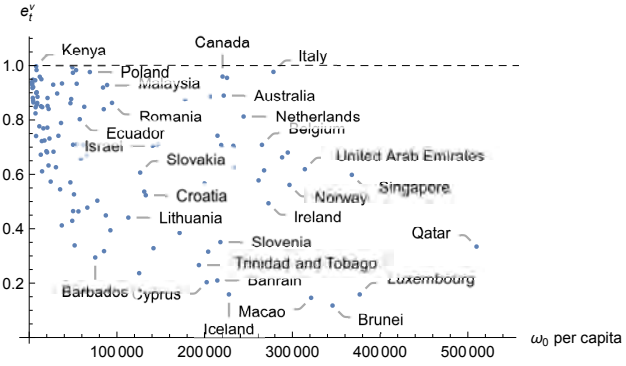
(a) $t = 1$



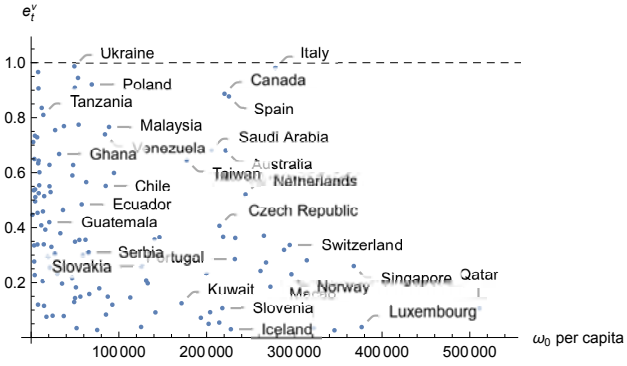
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

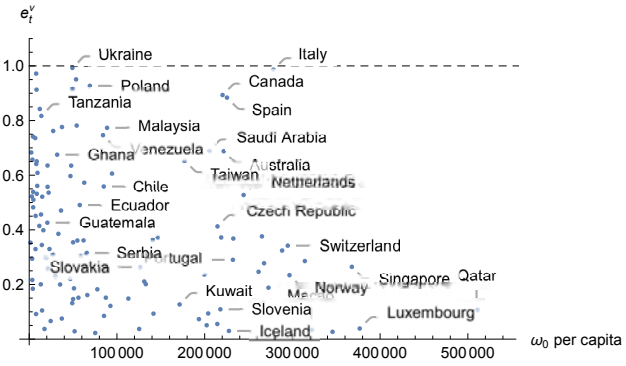
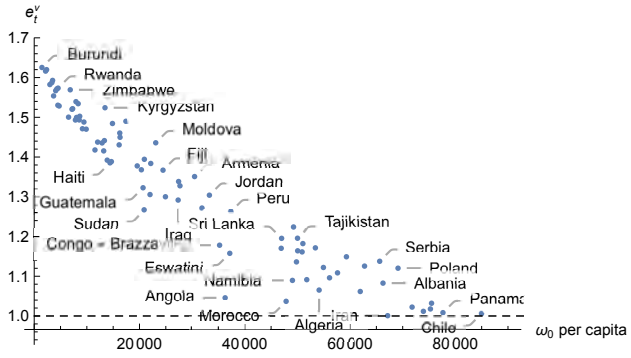
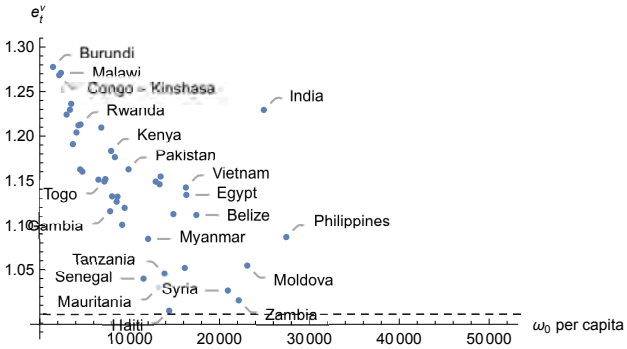


Figure 43: Exploited Countries - Model with standard of living consumption

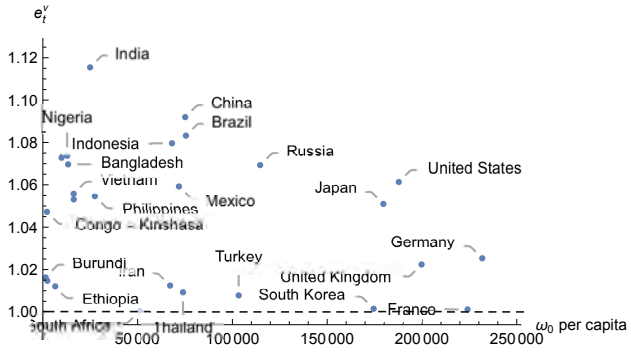
(a) $t = 1$



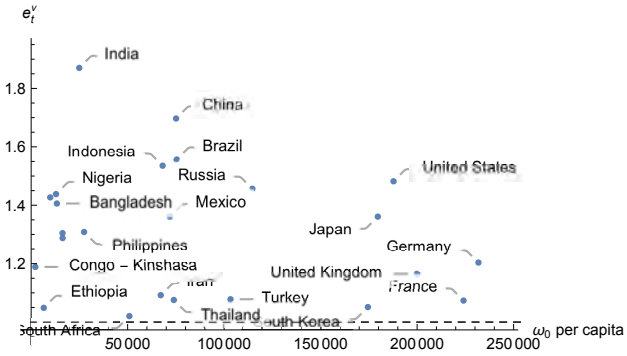
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

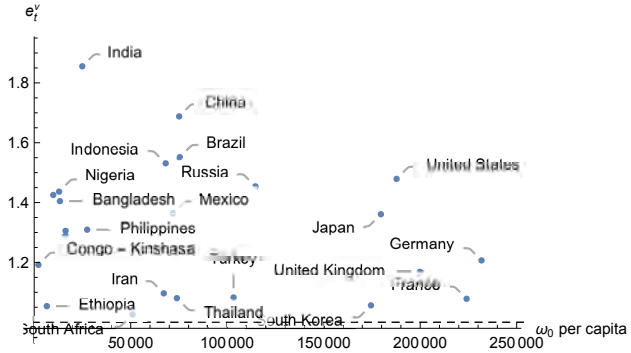


Table 7: Exploitation Intensity for Exploiter Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.97654	1.08522	1.07961	1.53545	1.53120
China	0.97865	1.11134	1.09198	1.69703	1.68809
Venezuela	0.97116	0.79251	0.91923	0.73929	0.74649
Mauritius	0.93254	0.58335	0.31763	0.08347	0.08516
Uruguay	0.94257	0.60736	0.44904	0.14885	0.15171
Malaysia	0.97870	0.80486	0.92854	0.76623	0.77336
Botswana	0.94131	0.59900	0.39429	0.11929	0.12164
Romania	0.97962	0.74994	0.86284	0.59885	0.60602
Turkey	0.82697	0.90702	1.00780	1.07812	1.08284
Lithuania	0.90969	0.58306	0.44100	0.14563	0.14843
Russia	0.92117	1.05187	1.06932	1.45633	1.45409
Malta	0.84880	0.51378	0.23666	0.03845	0.03721
Slovakia	0.92534	0.62402	0.60648	0.25914	0.26365
New Zealand	0.86020	0.56679	0.53652	0.20716	0.21094
Croatia	0.87438	0.57329	0.52315	0.19753	0.20117
Israel	0.88300	0.62551	0.70506	0.35692	0.36257
Estonia	0.85859	0.53183	0.32843	0.09145	0.09329
Hungary	0.81771	0.59116	0.71087	0.36475	0.37048
Kuwait	0.58765	0.37121	0.38471	0.12455	0.12699
South Korea	0.78071	0.88863	1.00149	1.05125	1.05629
Taiwan	0.72654	0.67495	0.87717	0.64595	0.65320
Japan	0.75478	0.97057	1.05098	1.36102	1.36094
United States	0.75529	0.98989	1.06133	1.48204	1.47916
Trinidad and Tobago	0.66270	0.39475	0.26632	0.07174	0.07320
Finland	0.69912	0.47795	0.56663	0.23238	0.23653
United Kingdom	0.73185	0.91773	1.02240	1.16502	1.16853
Cyprus	0.61782	0.35785	0.20339	0.04975	0.05079
Latvia	0.64914	0.39432	0.31569	0.09208	0.09393
Saudi Arabia	0.58610	0.66508	0.88839	0.68165	0.68891
Bahrain	0.50463	0.29210	0.20973	0.05432	0.05545
Czech Republic	0.69253	0.54631	0.74208	0.40648	0.41260
Slovenia	0.67142	0.41381	0.35085	0.10704	0.10917
Greece	0.61708	0.49543	0.70786	0.36634	0.37209
Canada	0.68624	0.79477	0.95958	0.88692	0.89347
Australia	0.66340	0.67895	0.88957	0.68051	0.68777
France	0.62024	0.84982	1.00118	1.07362	1.07840
Spain	0.58686	0.77201	0.95488	0.87734	0.88396
Iceland	0.61854	0.35195	0.15857	0.03022	0.02998
Germany	0.66211	0.89978	1.02533	1.20376	1.20665
Portugal	0.51266	0.40957	0.62691	0.28544	0.29029
Sweden	0.63217	0.49983	0.70509	0.36249	0.36820
Netherlands	0.60760	0.57576	0.81259	0.52059	0.52747
Denmark	0.60321	0.43042	0.57778	0.24212	0.24640
Belgium	0.54963	0.47179	0.70850	0.37028	0.37607
Hong Kong	0.55816	0.42286	0.61460	0.27301	0.27771
Ireland	0.54117	0.37253	0.49366	0.18482	0.18826
Italy	0.53033	0.78138	0.97679	0.98056	0.98635
Austria	0.54431	0.44112	0.66246	0.31903	0.32428
Switzerland	0.57071	0.46129	0.68016	0.33672	0.34217
Norway	0.56370	0.40490	0.56117	0.23006	0.23417
United Arab Emirates	0.44385	0.38012	0.61893	0.28098	0.28578
Macao	0.45091	0.25160	0.14600	0.03434	0.03507
Brunei	0.41733	0.22846	0.11754	0.02626	0.02682
Singapore	0.51707	0.39766	0.59818	0.26004	0.26456
Luxembourg	0.46594	0.26199	0.15846	0.03800	0.03880
Qatar	0.33588	0.22737	0.33432	0.10460	0.10669

Table 8: Exploitation Intensity for Exploited Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.62537	1.27765	1.01627	0.44644	0.35302	Laos	1.30558	0.92111	0.63268	0.25473	0.25919
Congo - Kinshasa	1.61626	1.26845	1.04723	1.18880	1.19193	Zambia	1.38382	1.01552	0.84037	0.52921	0.53614
Malawi	1.61990	1.27103	1.01470	0.71136	0.68316	Moldova	1.43585	1.05452	0.73178	0.32988	0.32982
Mali	1.58243	1.22418	0.93873	0.53580	0.52210	Fiji	1.36694	0.97547	0.57330	0.07930	0.06628
Sierra Leone	1.58735	1.22955	0.92988	0.33513	0.29429	India	1.30003	1.22940	1.11546	1.87025	1.85541
Liberia	1.59286	1.23625	0.93628	0.27656	0.21656	Iraq	1.29168	0.96553	0.92974	0.75470	0.76186
Mozambique	1.55384	1.19092	0.91777	0.64971	0.65696	Philippines	1.33840	1.08655	1.05465	1.30831	1.30931
Central African Republic	1.56698	1.20411	0.88104	0.22706	0.18439	Paraguay	1.32761	0.94599	0.68322	0.30368	0.30875
Madagascar	1.57139	1.21211	0.94808	0.73416	0.74137	Armenia	1.35084	0.96308	0.62611	0.22947	0.22918
Niger	1.53038	1.16259	0.87146	0.53904	0.53910	Ghana	1.27164	0.93955	0.89731	0.66778	0.67504
Rwanda	1.57342	1.21307	0.92082	0.49523	0.48247	Jordan	1.30397	0.93157	0.74175	0.37945	0.38532
Burkina Faso	1.52846	1.16011	0.86456	0.51113	0.51000	Congo - Brazzaville	1.17809	0.80093	0.54488	0.19636	0.19998
Ethiopia	1.50038	1.15103	1.01208	1.04872	1.05379	Angola	1.04566	0.75228	0.78892	0.46412	0.47067
Zimbabwe	1.56922	1.20956	0.94588	0.72866	0.73588	Eswatini	1.15767	0.77112	0.41223	0.07818	0.07527
Togo	1.52021	1.14900	0.82425	0.33860	0.32967	Peru	1.26243	0.94813	0.93414	0.76921	0.77633
Benin	1.52162	1.15169	0.84681	0.45368	0.45108	Costa Rica	1.17031	0.79735	0.57051	0.21673	0.22065
Gambia	1.49320	1.11559	0.74095	0.11961	0.09183	Sri Lanka	1.19538	0.87468	0.86159	0.58972	0.59686
Kenya	1.53937	1.18329	0.99731	0.96599	0.97192	Morocco	1.03688	0.78732	0.87691	0.62776	0.63498
Yemen	1.49963	1.13234	0.89943	0.63390	0.64113	Namibia	1.08955	0.71615	0.42914	0.12918	0.13170
Uganda	1.53425	1.17634	0.98360	0.90664	0.91306	Ukraine	1.22398	0.96748	0.99409	0.98693	0.99266
Nepal	1.49334	1.12627	0.90195	0.64358	0.65083	Colombia	1.13610	0.91012	0.97358	0.90888	0.91528
Cambodia	1.50258	1.13191	0.85641	0.52508	0.53198	Tajikistan	1.19568	0.83735	0.70893	0.34873	0.35431
Ivory Coast	1.47120	1.10034	0.86256	0.55388	0.56091	Gabon	1.16401	0.78113	0.46479	0.14367	0.14645
Cameroon	1.48808	1.11934	0.88512	0.60135	0.60853	South Africa	1.16125	0.95130	1.00035	1.02037	1.02576
Pakistan	1.47011	1.16273	1.07279	1.42693	1.42539	Mongolia	1.18218	0.80244	0.52640	0.18254	0.18594
Senegal	1.41778	1.03988	0.77662	0.40829	0.41442	Maldives	1.09138	0.70913	0.33875	0.03421	0.02864
Myanmar	1.43757	1.08450	0.95888	0.83558	0.84243	Argentina	1.17143	0.93429	0.98321	0.94466	0.95078
Nigeria	1.43552	1.14885	1.07374	1.43823	1.43642	Algeria	1.06517	0.84200	0.93321	0.77458	0.78168
Mauritania	1.41544	1.03006	0.67229	0.20553	0.20050	Dominican Republic	1.12206	0.78206	0.71050	0.35526	0.36090
Bangladesh	1.44134	1.14588	1.06968	1.40588	1.40482	Jamaica	1.09606	0.72503	0.46376	0.14884	0.15170
Kyrgyzstan	1.52408	1.15458	0.85057	0.45896	0.45624	Ecuador	1.10854	0.79709	0.80281	0.48413	0.49082
Tanzania	1.39213	1.04552	0.94981	0.81006	0.81704	Bulgaria	1.14899	0.79290	0.66071	0.29919	0.30421
Haiti	1.38536	1.00381	0.72240	0.33909	0.34456	Tunisia	1.06162	0.73897	0.70850	0.35571	0.36136
Lesotho	1.38850	0.99923	0.61111	0.11533	0.10495	Kazakhstan	1.12552	0.82447	0.84841	0.56553	0.57260
Bolivia	1.48442	1.11239	0.84729	0.51442	0.52127	Serbia	1.13767	0.78597	0.67083	0.31033	0.31548
Honduras	1.43062	1.05191	0.76914	0.39258	0.39858	Albania	1.08267	0.71595	0.47765	0.15832	0.16134
Vietnam	1.46041	1.14226	1.05575	1.30443	1.30551	Iran	1.00070	0.93680	1.01243	1.09200	1.09654
Egypt	1.44971	1.13394	1.05312	1.28755	1.28896	Poland	1.12024	0.90740	0.97624	0.92076	0.92707
Belize	1.48999	1.11138	0.72451	0.07548	0.03724	Mexico	1.02233	1.05005	1.05923	1.36264	1.36253
Nicaragua	1.37767	0.99337	0.68502	0.29525	0.30022	Thailand	1.01167	0.93215	1.00928	1.07570	1.08045
El Salvador	1.36790	0.98362	0.68082	0.29281	0.29776	Barbados	1.01769	0.64570	0.29431	0.02738	0.02261
Guatemala	1.32265	0.95188	0.77183	0.41986	0.42609	Brazil	1.03206	1.10579	1.08323	1.55667	1.55185
Sudan	1.26715	0.93090	0.88074	0.62820	0.63542	Panama	1.00832	0.66269	0.50317	0.17899	0.18234
Syria	1.39429	1.02652	0.85160	0.55030	0.55732	Chile	1.00589	0.75041	0.83958	0.55155	0.55857

Figure 44: Distribution of wealth - Model with standard of living consumption

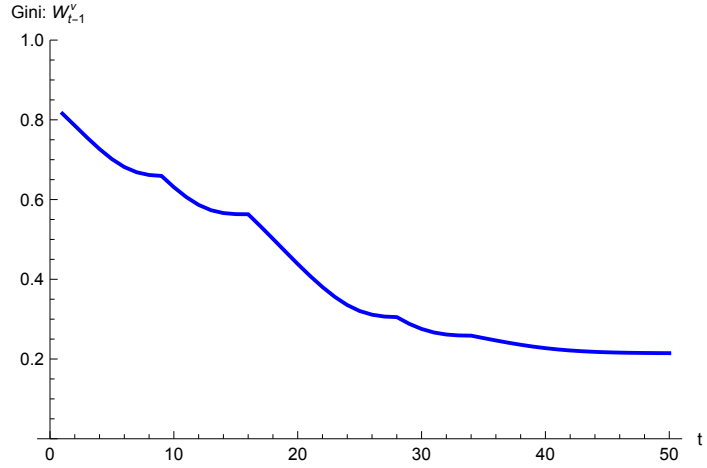
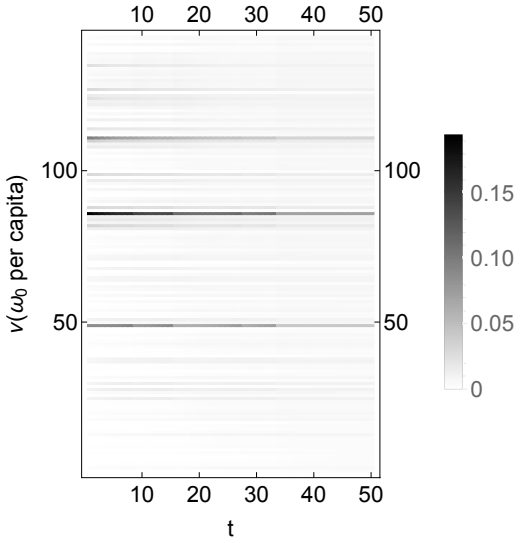
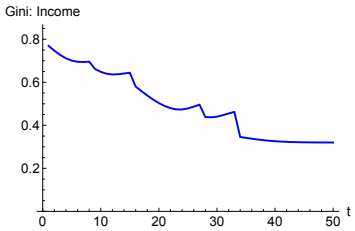


Figure 45: Distribution of Income - Model with standard of living consumption

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



4.5 Version 5

This subsection shows results for the case of:

$$D_t^\nu = b_t \Lambda_t^\nu + \max\left\{0, \min\left\{\frac{r_t \omega_{t-1}^\nu - b_t \Lambda_t^\nu}{r_t \omega_0^* - b_t \Lambda_1^\nu}, 1\right\}\right\} r_t \omega_{t-1}^\nu, \tag{5}$$

where ω_0^* is a reference capital stock set at the 91st percentile of the initial world capital stock and Λ_1^ν is the initial effective labour performed by a country.

Figure 46 shows the summary results of the simulation. Figure 47 shows the technology (A_t, L_t) and labour values over t.

Figure 48 shows the composition of exploitation and class status over the course of the simulation. Figures 49(a) and 49(b) show, respectively, the distribution of e_t^ν and the Gini coefficient of the distribution of e_t^ν over t.

Figures 50-52 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited.

Tables 9 and 10 report e_t^ν for countries that begin the simulation as exploiters and exploited, respectively, for the same select t as figures 50-52.

Figures 53 and 54 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 46: Summary results - Model with standard of living consumption

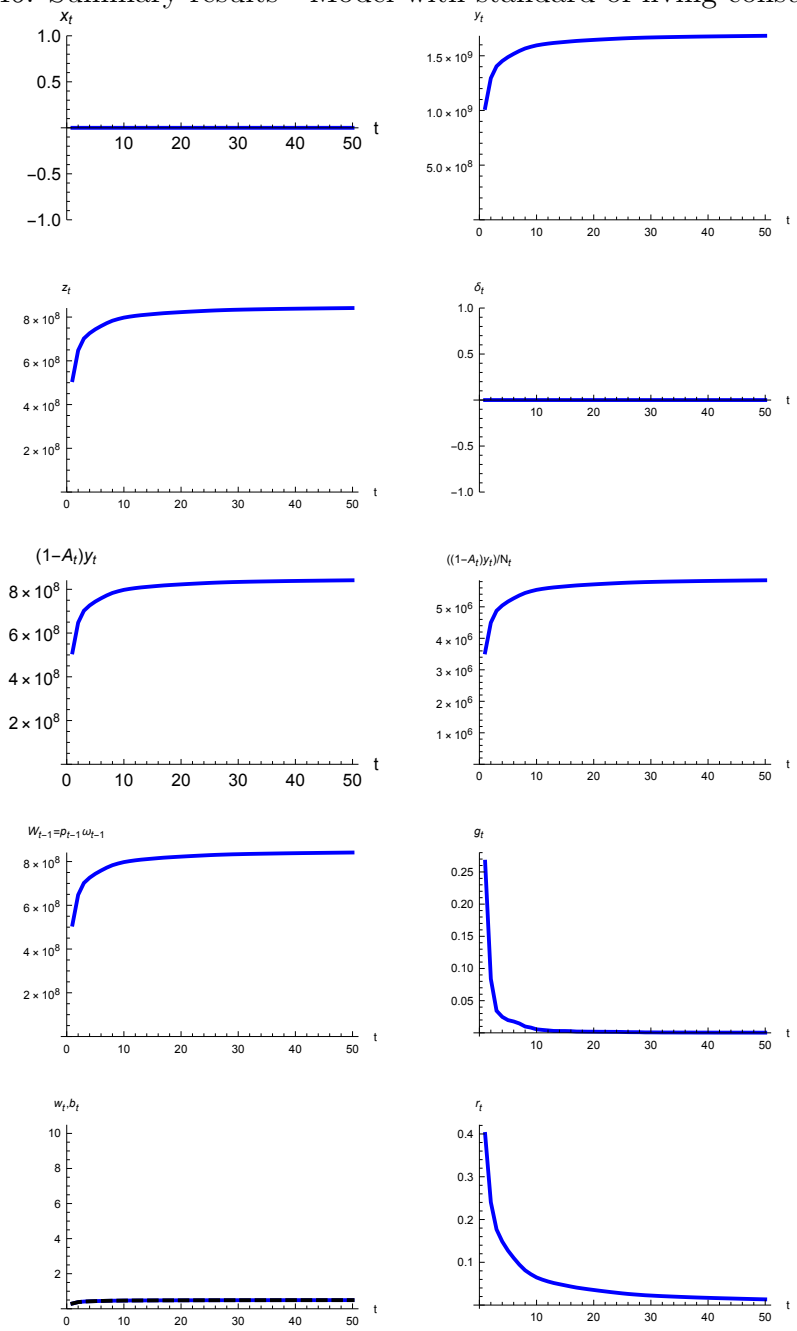


Figure 47: A_t, L_t, and labour values - Model with standard of living consumption

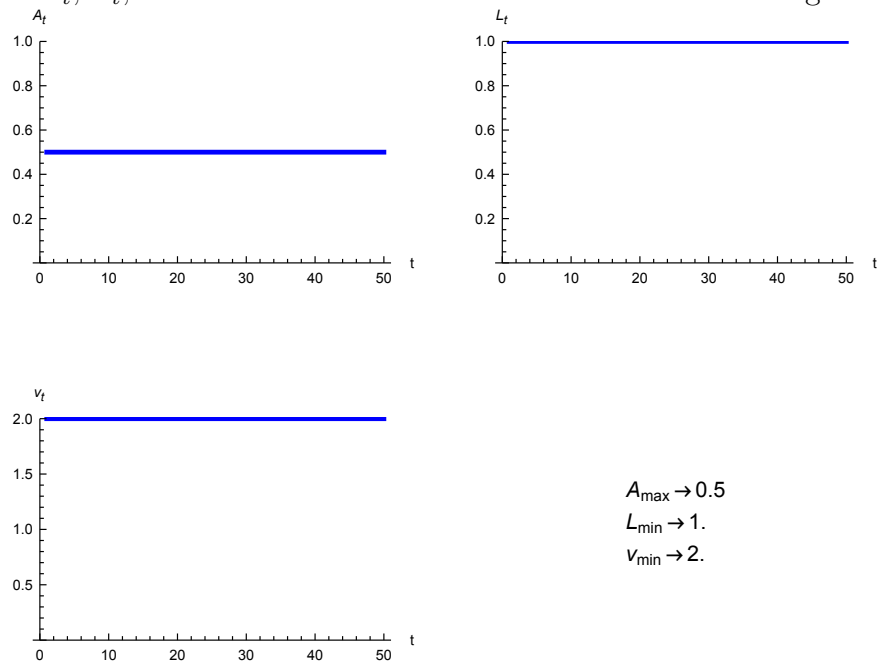
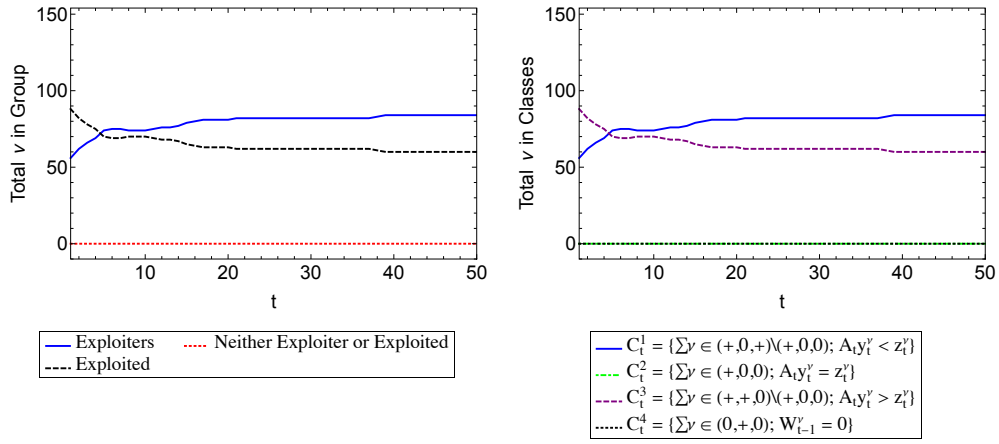


Figure 48: Class and exploitation status - Model with standard of living consumption

(a) Exploitation status

(b) Class status



(c) CECP

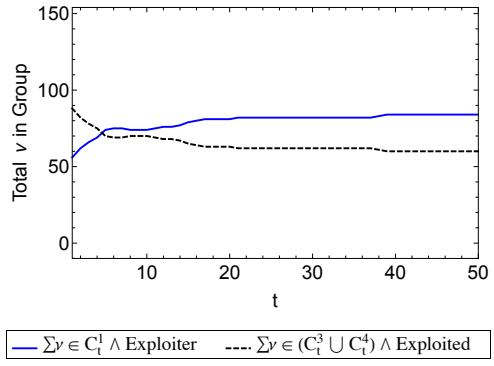
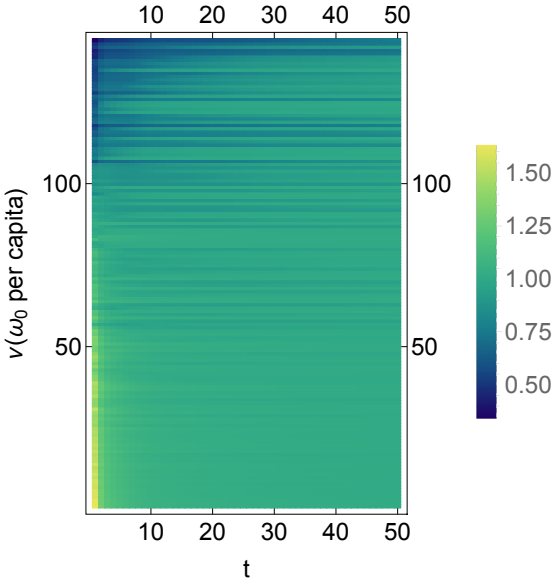


Figure 49: Exploitation intensity index - Model with standard of living consumption

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^{ν}

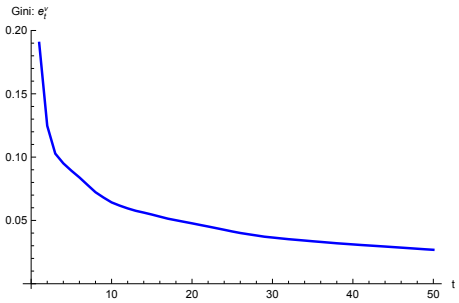
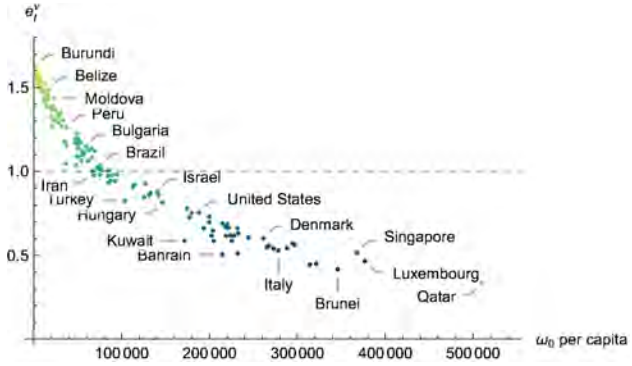
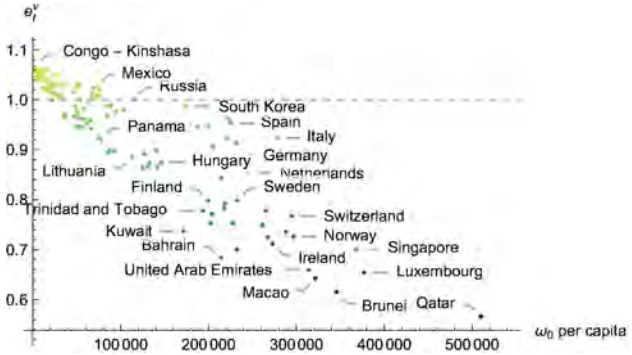


Figure 50: Worldwide Exploitation Intensity - Model with standard of living consumption

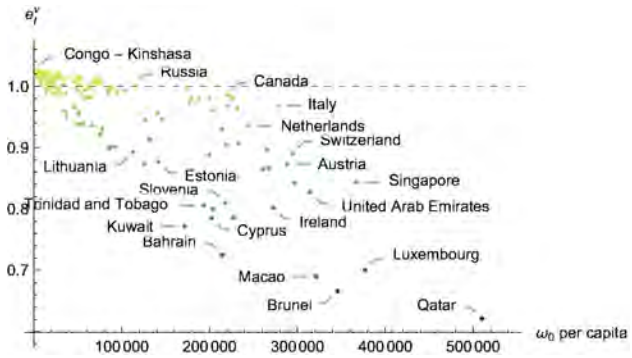
(a) $t = 1$



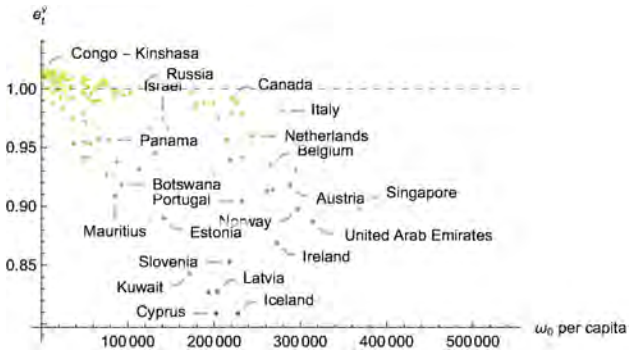
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

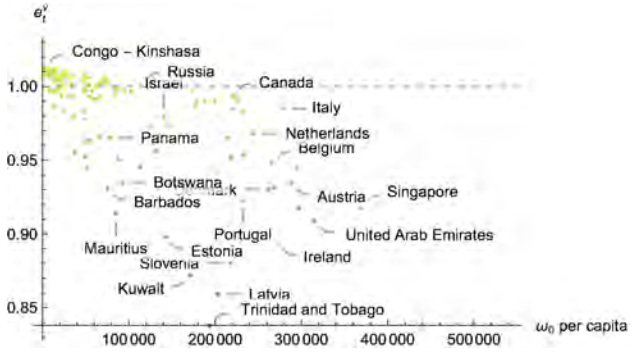
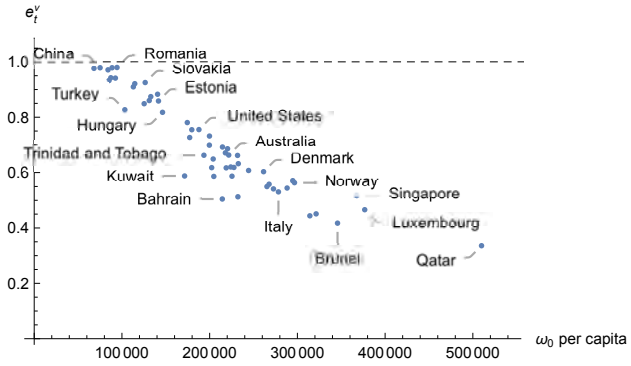
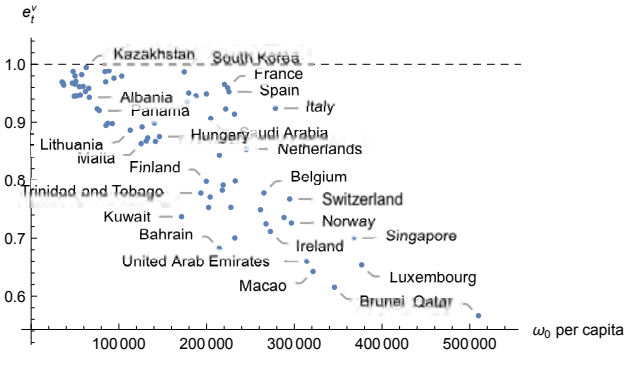


Figure 51: Exploiter Countries - Model with standard of living consumption

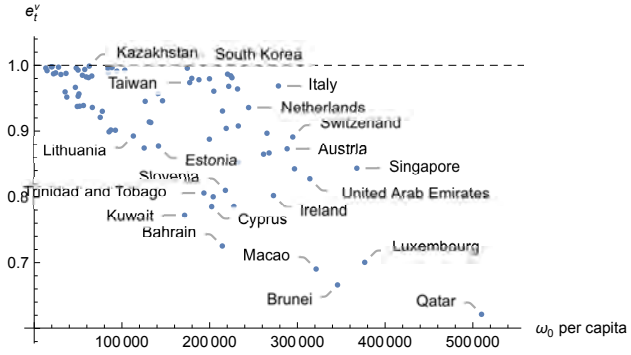
(a) $t = 1$



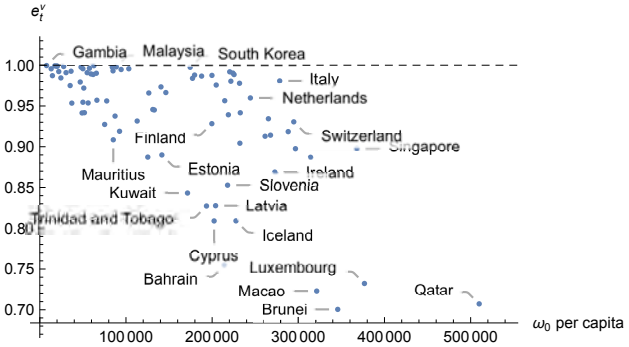
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

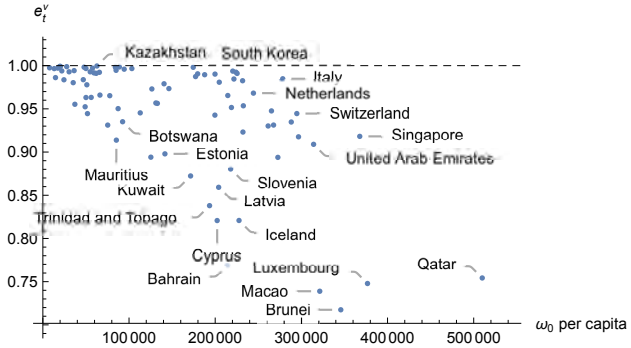
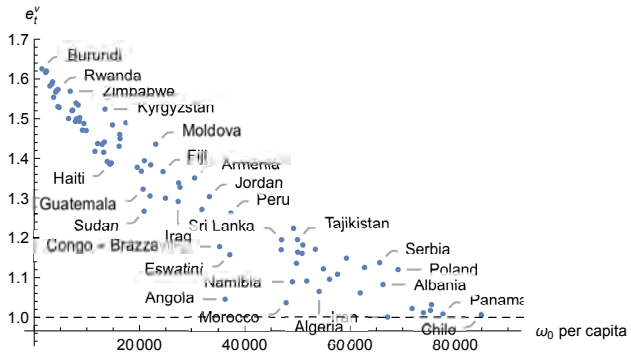
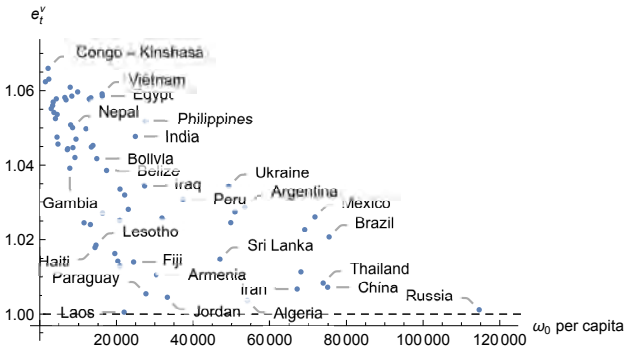


Figure 52: Exploited Countries - Model with standard of living consumption

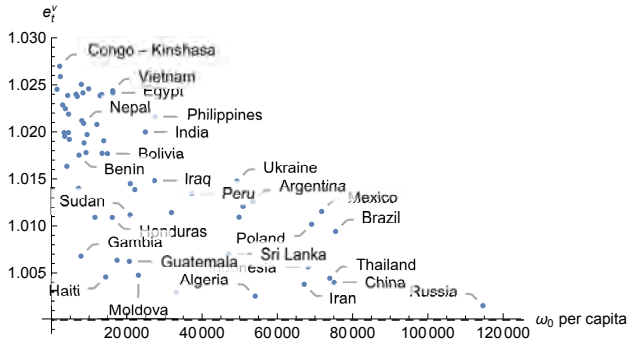
(a) $t = 1$



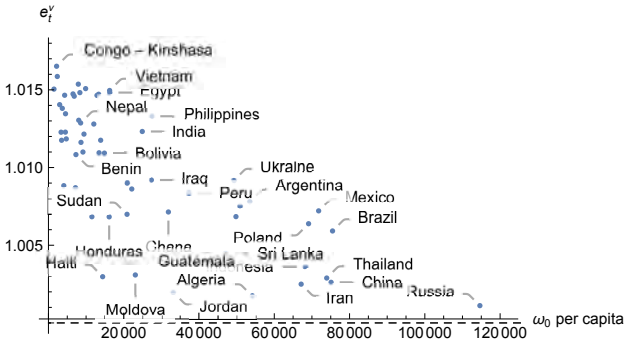
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

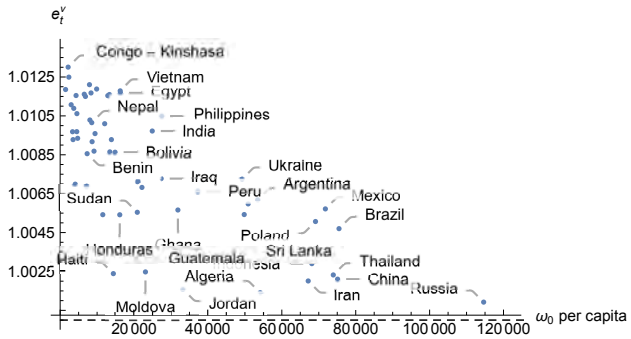


Table 9: Exploitation Intensity for Exploiter Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.97654	1.01134	1.00565	1.00363	1.00290
China	0.97865	1.00722	1.00398	1.00261	1.00210
Venezuela	0.97116	0.98745	0.99589	0.99766	0.99820
Mauritius	0.93254	0.89459	0.89890	0.90853	0.91378
Uruguay	0.94257	0.89813	0.90163	0.93760	0.95026
Malaysia	0.97870	0.98884	0.99646	0.99801	0.99848
Botswana	0.94131	0.89769	0.90129	0.91892	0.93510
Romania	0.97962	0.97609	0.99115	0.99474	0.99591
Turkey	0.82697	0.97968	0.99265	0.99567	0.99664
Lithuania	0.90969	0.88634	0.89250	0.93153	0.94535
Russia	0.92117	1.00117	1.00152	1.00111	1.00092
Malta	0.84880	0.86304	0.87428	0.88729	0.89406
Slovakia	0.92534	0.89202	0.94522	0.96593	0.97303
New Zealand	0.86020	0.86756	0.91391	0.94568	0.95678
Croatia	0.87438	0.87308	0.91306	0.94512	0.95633
Israel	0.88300	0.89864	0.95702	0.97343	0.97901
Estonia	0.85859	0.86692	0.87733	0.88993	0.89792
Hungary	0.81771	0.87525	0.94605	0.96646	0.97345
Kuwait	0.58765	0.73719	0.77195	0.84321	0.87235
South Korea	0.78071	0.98684	0.99563	0.99750	0.99808
Taiwan	0.72654	0.93560	0.97371	0.98393	0.98735
Japan	0.75478	0.95037	0.98017	0.98795	0.99054
United States	0.75529	0.94555	0.97808	0.98665	0.98951
Trinidad and Tobago	0.66270	0.77792	0.80581	0.82729	0.83797
Finland	0.69912	0.79821	0.88766	0.92830	0.94272
United Kingdom	0.73185	0.94884	0.97951	0.98754	0.99021
Cyprus	0.61782	0.75304	0.78521	0.80897	0.82072
Latvia	0.64914	0.77101	0.80012	0.82767	0.85921
Saudi Arabia	0.58610	0.90646	0.96062	0.97571	0.98082
Bahrain	0.50463	0.68251	0.72531	0.75495	0.76955
Czech Republic	0.69253	0.84318	0.93047	0.95645	0.96544
Slovenia	0.67142	0.78290	0.80990	0.85281	0.88042
Greece	0.61708	0.79182	0.90410	0.93922	0.95157
Canada	0.68624	0.96527	0.98657	0.99192	0.99367
Australia	0.66340	0.92284	0.96804	0.98038	0.98453
France	0.62024	0.95935	0.98404	0.99035	0.99244
Spain	0.58686	0.95258	0.98113	0.98855	0.99101
Iceland	0.61854	0.75317	0.78532	0.80907	0.82082
Germany	0.66211	0.91396	0.96404	0.97786	0.98253
Portugal	0.51266	0.70034	0.85231	0.90430	0.92314
Sweden	0.63217	0.79882	0.90780	0.94167	0.95355
Netherlands	0.60760	0.85396	0.93578	0.95988	0.96819
Denmark	0.60321	0.74908	0.86486	0.91290	0.93018
Belgium	0.54963	0.77804	0.89671	0.93433	0.94762
Hong Kong	0.55816	0.72472	0.86677	0.91420	0.93124
Ireland	0.54117	0.71157	0.80193	0.86888	0.89385
Italy	0.53033	0.92410	0.96860	0.98073	0.98481
Austria	0.54431	0.73571	0.87312	0.91851	0.93476
Switzerland	0.57071	0.76759	0.89102	0.93054	0.94454
Norway	0.56370	0.72619	0.84260	0.89759	0.91763
United Arab Emirates	0.44385	0.66048	0.82755	0.88707	0.90895
Macao	0.45091	0.64251	0.69030	0.72286	0.73892
Brunei	0.41733	0.61539	0.66612	0.70047	0.71745
Singapore	0.51707	0.70117	0.84351	0.89822	0.91815
Luxembourg	0.46594	0.65404	0.70047	0.73222	0.74787
Qatar	0.33588	0.56632	0.62145	0.70726	0.75427

Table 10: Exploitation Intensity for Exploited Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.62537	1.06239	1.02452	1.01505	1.01186	Laos	1.30558	1.00052	0.98708	0.99223	0.99392
Congo - Kinshasa	1.61626	1.06599	1.02698	1.01652	1.01301	Zambia	1.38382	1.03198	1.01386	1.00862	1.00682
Malawi	1.61990	1.06309	1.02588	1.01586	1.01249	Moldova	1.43585	1.02813	1.00476	1.00309	1.00248
Mali	1.58243	1.05517	1.02286	1.01405	1.01107	Fiji	1.36694	1.01399	0.98856	0.98441	0.98364
Sierra Leone	1.58735	1.05601	1.01991	1.01227	1.00969	India	1.30003	1.04771	1.01999	1.01232	1.00972
Liberia	1.59286	1.05695	1.01952	1.01176	1.00928	Iraq	1.29168	1.03442	1.01482	1.00920	1.00728
Mozambique	1.55384	1.05414	1.02247	1.01381	1.01089	Philippines	1.33840	1.05193	1.02162	1.01330	1.01049
Central African Republic	1.56698	1.05249	1.01634	1.00883	1.00699	Paraguay	1.32761	1.00546	0.99720	0.99846	0.99884
Madagascar	1.57139	1.05780	1.02387	1.01465	1.01155	Armenia	1.35084	1.01054	0.98604	0.99091	0.99287
Niger	1.53038	1.04753	1.01992	1.01228	1.00969	Ghana	1.27164	1.02580	1.01142	1.00714	1.00566
Rwanda	1.57342	1.05361	1.02189	1.01346	1.01062	Jordan	1.30397	1.00452	1.00289	1.00195	1.00158
Burkina Faso	1.52846	1.04566	1.01920	1.01184	1.00935	Congo - Brazzaville	1.17809	0.96947	0.95958	0.97505	0.98030
Ethiopia	1.50038	1.05817	1.02401	1.01474	1.01161	Angola	1.04566	0.96797	0.98772	0.99263	0.99424
Zimbabwe	1.56922	1.05753	1.02376	1.01459	1.01150	Eswatini	1.15767	0.96406	0.95172	0.95351	0.95530
Togo	1.52021	1.04416	1.01400	1.00870	1.00689	Peru	1.26243	1.03098	1.01347	1.00838	1.00663
Benin	1.52162	1.04442	1.01753	1.01083	1.00856	Costa Rica	1.17031	0.96742	0.96648	0.97940	0.98376
Gambia	1.49320	1.03917	1.00678	0.99957	0.99748	Sri Lanka	1.19538	1.01474	1.00701	1.00446	1.00356
Kenya	1.53937	1.06092	1.02506	1.01537	1.01211	Morocco	1.03688	0.98760	0.99595	0.99770	0.99823
Yemen	1.49963	1.05082	1.02119	1.01304	1.01029	Namibia	1.08955	0.94506	0.93745	0.94144	0.95240
Uganda	1.53425	1.05854	1.02415	1.01482	1.01168	Ukraine	1.22398	1.03427	1.01476	1.00916	1.00725
Nepal	1.49334	1.05007	1.02090	1.01287	1.01015	Colombia	1.13610	1.02456	1.01093	1.00684	1.00543
Cambodia	1.50258	1.04470	1.01883	1.01162	1.00917	Tajikistan	1.19568	0.97989	0.99274	0.99572	0.99668
Ivory Coast	1.47120	1.04205	1.01780	1.01100	1.00869	Gabon	1.16401	0.96575	0.95298	0.95457	0.96314
Cameroon	1.48808	1.04698	1.01971	1.01215	1.00959	South Africa	1.16125	1.02747	1.01208	1.00754	1.00598
Pakistan	1.47011	1.05967	1.02458	1.01508	1.01188	Mongolia	1.18218	0.97053	0.95655	0.97198	0.97785
Senegal	1.41778	1.02452	1.01092	1.00683	1.00542	Maldives	1.09138	0.94559	0.93785	0.94178	0.94450
Myanmar	1.43757	1.04977	1.02079	1.01280	1.01010	Argentina	1.17143	1.02862	1.01254	1.00782	1.00619
Nigeria	1.43552	1.05776	1.02385	1.01464	1.01154	Algeria	1.06517	1.00366	1.00254	1.00173	1.00141
Mauritania	1.41544	1.02405	0.99586	0.99561	0.99658	Dominican Republic	1.12206	0.96127	0.98486	0.99086	0.99284
Bangladesh	1.44134	1.05809	1.02398	1.01472	1.01160	Jamaica	1.09606	0.94694	0.93887	0.95371	0.96324
Kyrgyzstan	1.52408	1.04486	1.01772	1.01095	1.00865	Ecuador	1.10854	0.98211	0.99367	0.99629	0.99713
Tanzania	1.39213	1.04529	1.01906	1.01176	1.00928	Bulgaria	1.14899	0.96173	0.98240	0.98934	0.99163
Haiti	1.38536	1.01787	1.00458	1.00298	1.00239	Tunisia	1.06162	0.95301	0.98131	0.98866	0.99110
Lesotho	1.38850	1.01853	0.99185	0.98716	0.98615	Kazakhstan	1.12552	0.99449	0.99879	0.99944	0.99961
Bolivia	1.48442	1.04175	1.01768	1.01093	1.00863	Serbia	1.13767	0.95864	0.98374	0.99017	0.99229
Honduras	1.43062	1.02710	1.01091	1.00683	1.00541	Albania	1.08267	0.94305	0.93594	0.95706	0.96593
Vietnam	1.46041	1.05914	1.02438	1.01496	1.01179	Iran	1.00070	1.00674	1.00379	1.00249	1.00201
Egypt	1.44971	1.05855	1.02415	1.01482	1.01168	Poland	1.12024	1.02266	1.01018	1.00639	1.00507
Belize	1.48999	1.03857	1.00635	0.99921	0.99715	Mexico	1.02233	1.02610	1.01154	1.00721	1.00572
Nicaragua	1.37767	1.01626	0.99784	0.99886	0.99915	Thailand	1.01167	1.00833	1.00443	1.00289	1.00232
El Salvador	1.36790	1.01420	0.99783	0.99885	0.99914	Barbados	1.01769	0.92322	0.92089	0.92735	0.93119
Guatemala	1.32265	1.01279	1.00623	1.00398	1.00318	Brazil	1.03206	1.02073	1.00941	1.00592	1.00470
Sudan	1.26715	1.02518	1.01118	1.00699	1.00554	Panama	1.00832	0.92022	0.93006	0.95619	0.96523
Syria	1.39429	1.03357	1.01449	1.00900	1.00712	Chile	1.00589	0.96970	0.98845	0.99308	0.99459

Figure 53: Distribution of wealth - Model with standard of living consumption

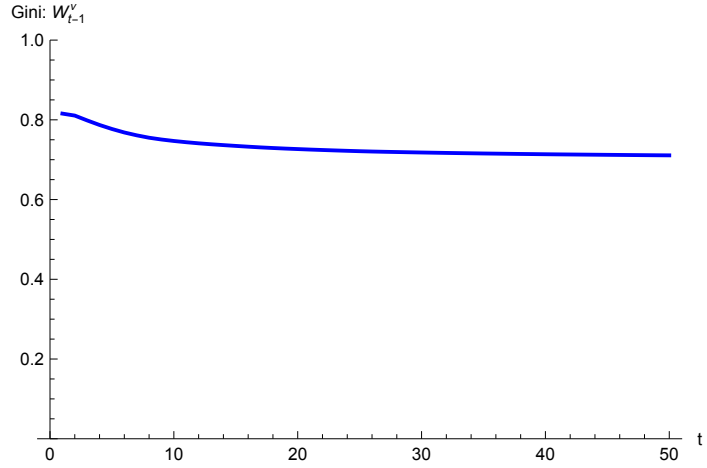
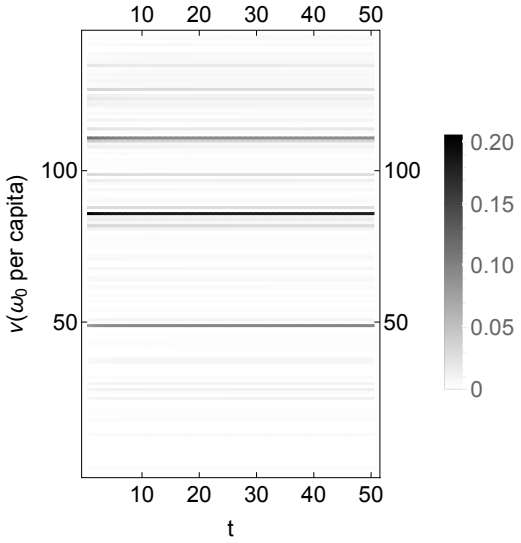
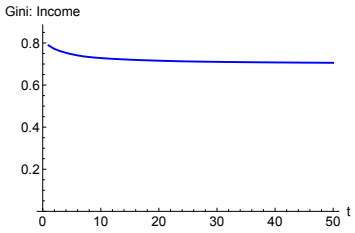


Figure 54: Distribution of Income - Model with standard of living consumption

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



4.6 Version 6

This subsection shows results for the case of:

$$D_t^\nu = \begin{cases} b_t \Lambda_t^\nu + \min\left\{\frac{r_t \omega_{t-1}^\nu}{r_1 \omega_0^*}, 1\right\} r_t \omega_{t-1}^\nu & \text{if } r_t \omega_{t-1}^\nu - b_t \Lambda_t^\nu > 0 \\ b_t \Lambda_t^\nu & \text{otherwise} \end{cases}, \tag{6}$$

where ω_0^* is a reference capital stock set at the 91st percentile of the initial world capital stock.

Figure 55 shows the summary results of the simulation. Figure 56 shows the technology (A_t, L_t) and labour values over t.

Figure 57 shows the composition of exploitation and class status over the course of the simulation. Figures 58(a) and 58(b) show, respectively, the distribution of e_t^ν and the Gini coefficient of the distribution of e_t^ν over t.

Figures 59-61 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited.

Tables 11 and 12 report e_t^ν for countries that begin the simulation as exploiters and exploited, respectively, for the same select t as figures 59-61.

Figures 62 and 63 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 55: Summary results - Model with standard of living consumption

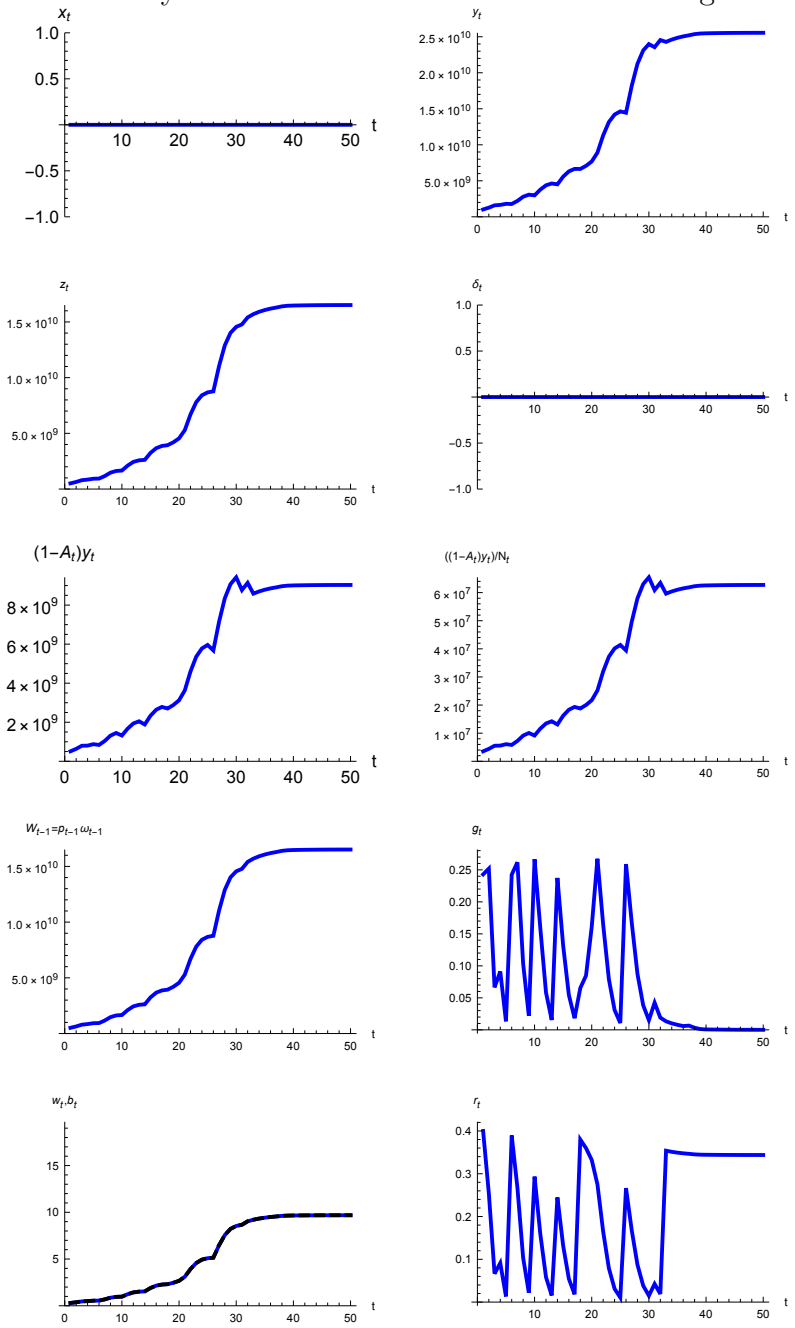


Figure 56: A_t, L_t, and labour values - Model with standard of living consumption

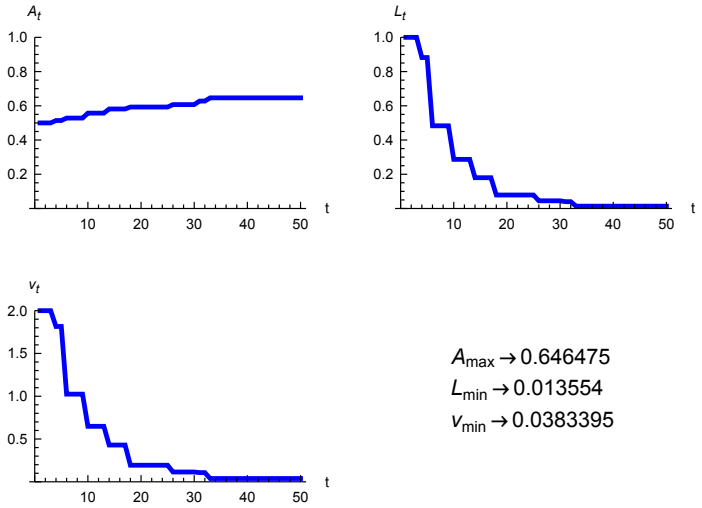
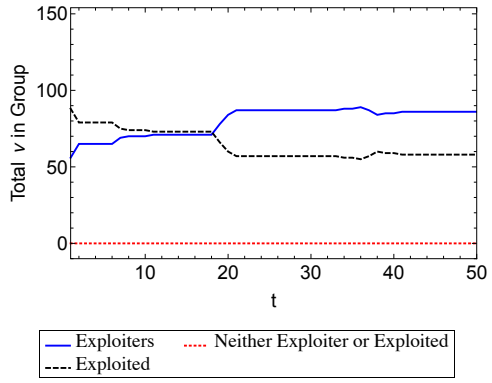
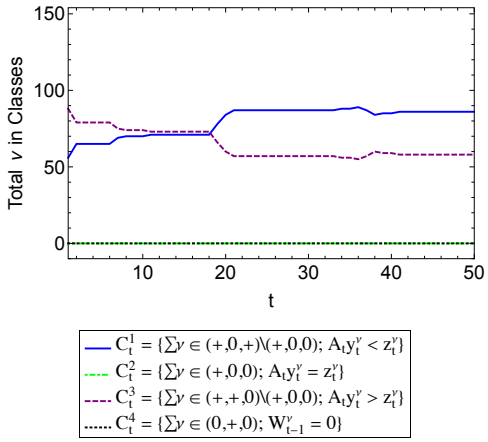


Figure 57: Class and exploitation status - Model with standard of living consumption

(a) Exploitation status



(b) Class status



(c) CECP

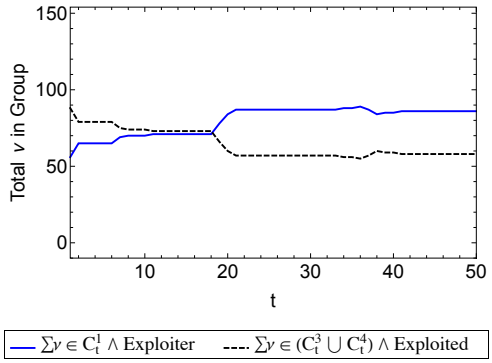


Figure 58: Exploitation intensity index - Model with standard of living consumption

(a) Exploitation intensity index across agents

(b) Gini coefficient of e_t^{ν}

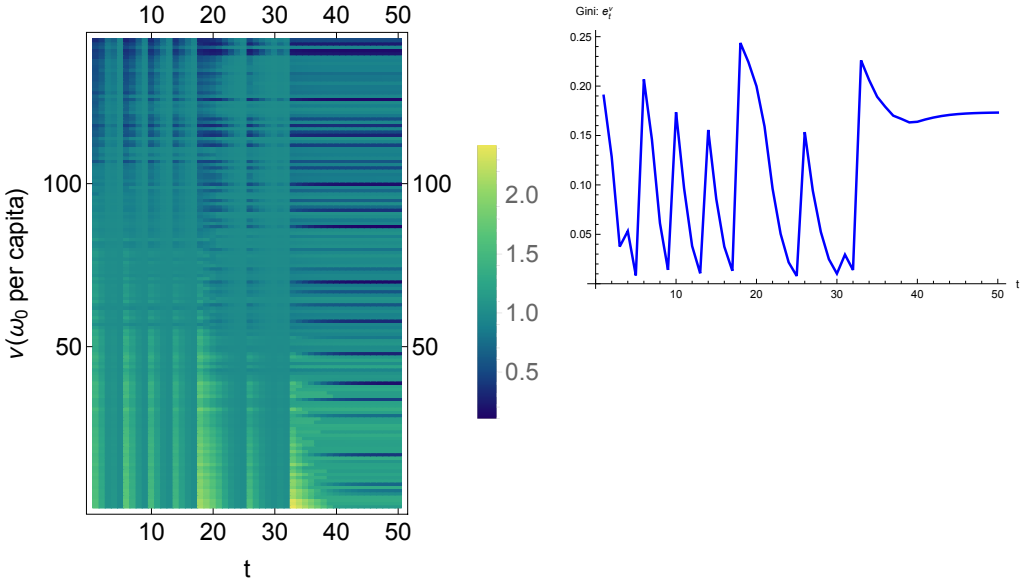
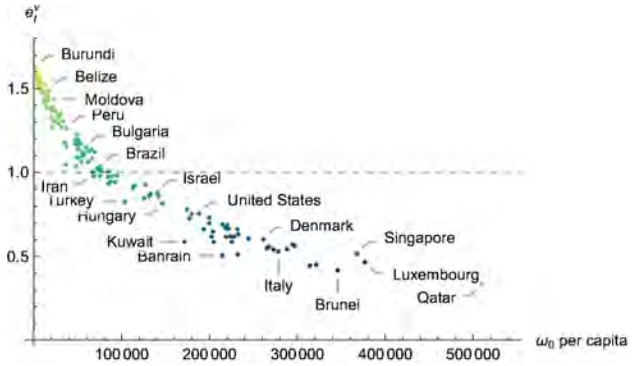
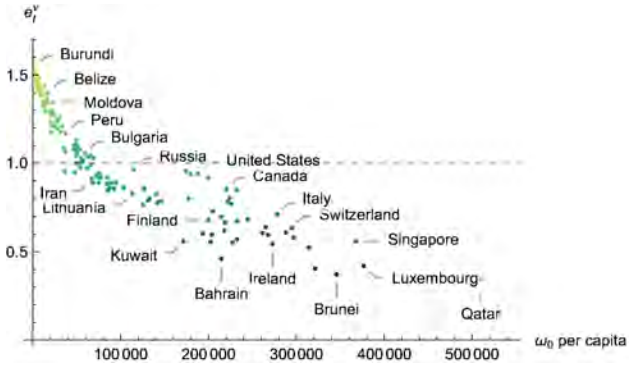


Figure 59: Worldwide Exploitation Intensity - Model with standard of living consumption

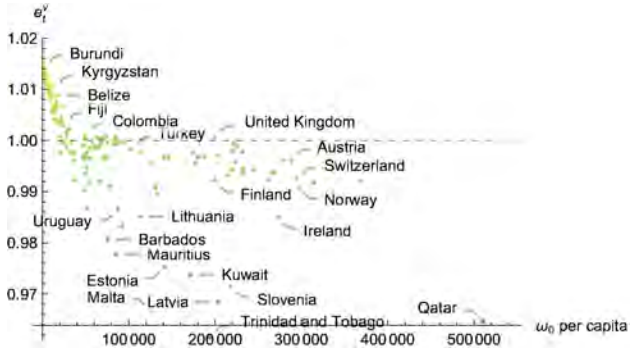
(a) $t = 1$



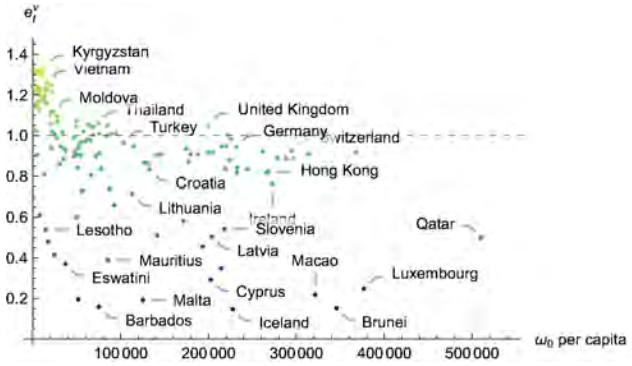
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

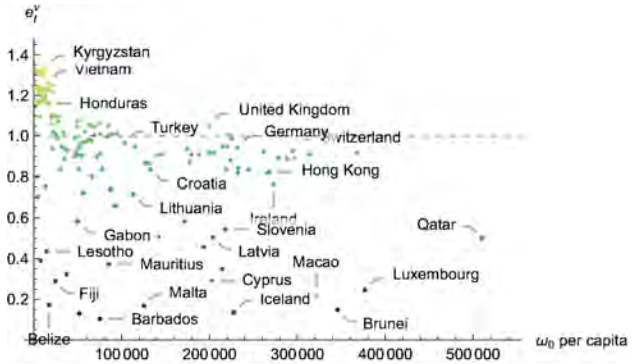
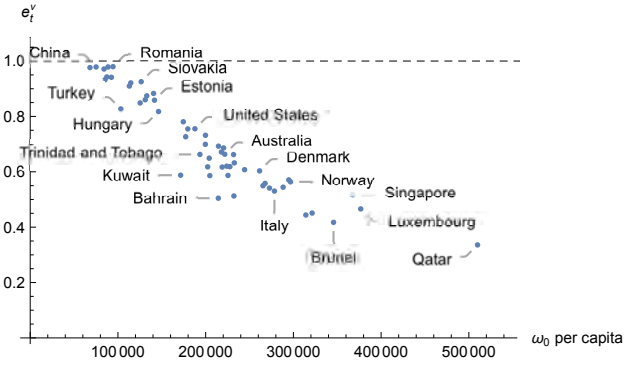
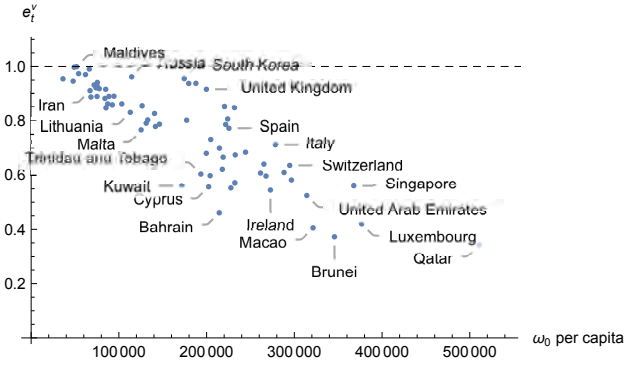


Figure 60: Exploiter Countries - Model with standard of living consumption

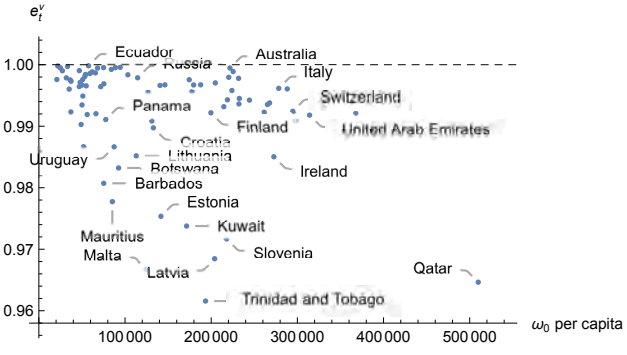
(a) $t = 1$



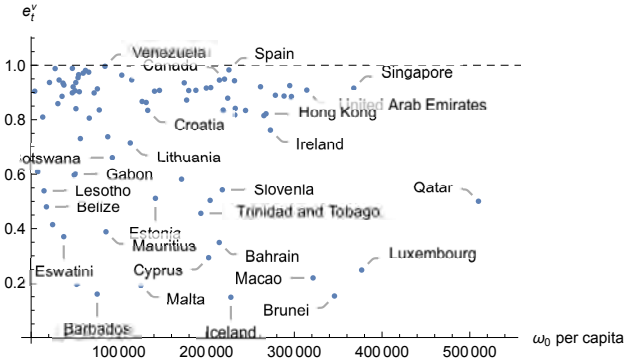
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

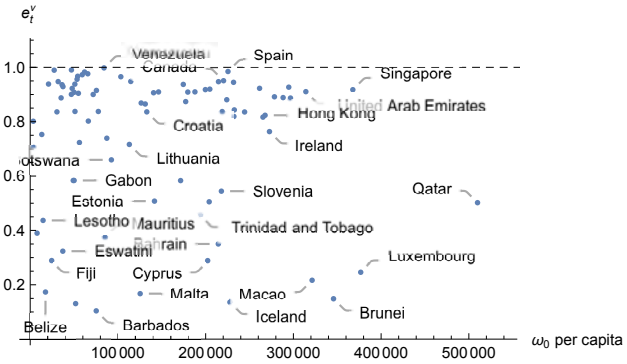
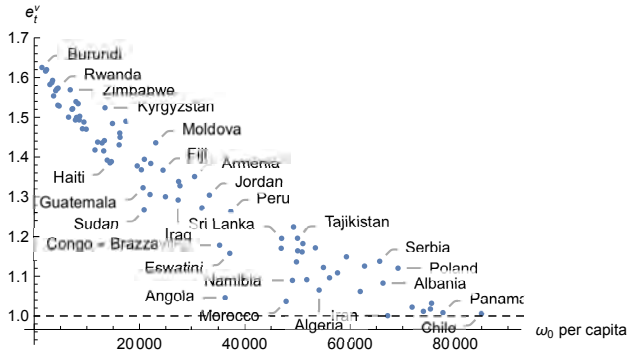
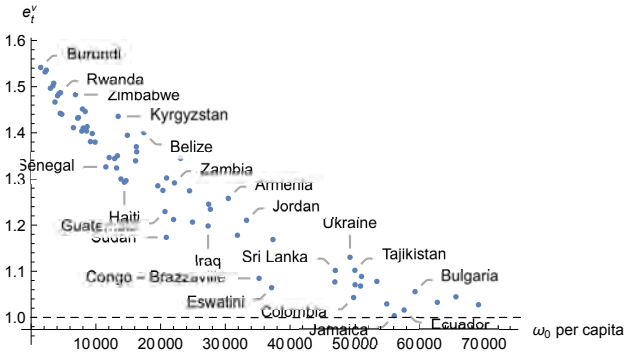


Figure 61: Exploited Countries - Model with standard of living consumption

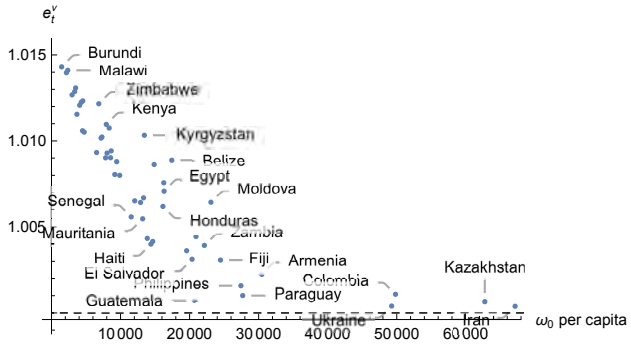
(a) $t = 1$



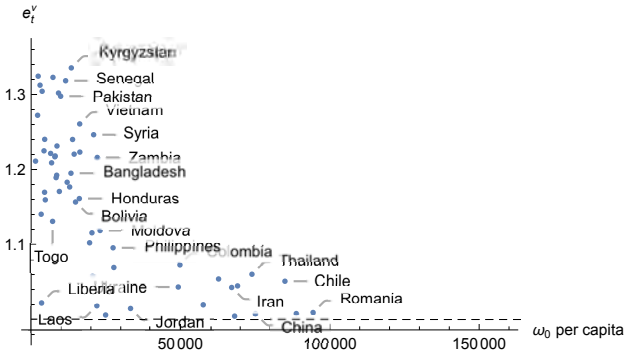
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

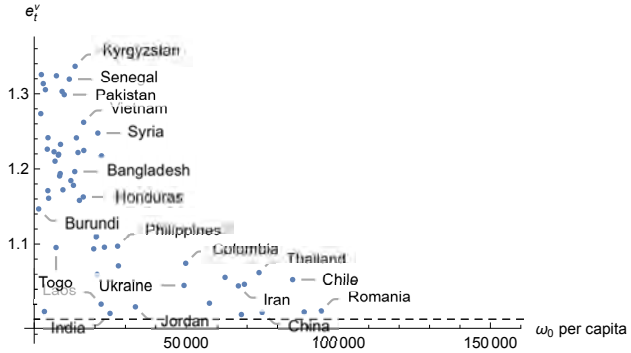


Table 11: Exploitation Intensity for Exploiter Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.97654	0.88740	0.99945	1.00453	1.00622
China	0.97865	0.88944	0.99953	1.00782	1.00950
Venezuela	0.97116	0.88220	0.99923	0.99616	0.99785
Mauritius	0.93254	0.84762	0.97774	0.38840	0.37476
Uruguay	0.94257	0.86196	0.98665	0.73743	0.73918
Malaysia	0.97870	0.88949	0.99954	1.00791	1.00959
Botswana	0.94131	0.85857	0.98322	0.66044	0.65960
Romania	0.97962	0.89038	0.99957	1.00935	1.01103
Turkey	0.82697	0.86180	0.99836	0.96368	0.96539
Lithuania	0.90969	0.83106	0.98519	0.71458	0.71632
Russia	0.92117	0.96183	0.99788	0.94630	0.94803
Malta	0.84880	0.76632	0.96673	0.19231	0.16726
Slovakia	0.92534	0.85503	0.99540	0.86695	0.86872
New Zealand	0.86020	0.79105	0.99085	0.86339	0.86515
Croatia	0.87438	0.80305	0.98974	0.83436	0.83612
Israel	0.88300	0.82688	0.99663	0.90473	0.90648
Estonia	0.85859	0.77883	0.97536	0.51130	0.50773
Hungary	0.81771	0.78747	0.99672	0.90771	0.90946
Kuwait	0.58765	0.55917	0.97377	0.58170	0.58331
South Korea	0.78071	0.95514	0.99756	0.93547	0.93720
Taiwan	0.72654	0.80205	0.99558	0.87211	0.87387
Japan	0.75478	0.93738	0.99671	0.90721	0.90896
United States	0.75529	0.93785	0.99673	0.90795	0.90970
Trinidad and Tobago	0.66270	0.60355	0.96158	0.45614	0.45755
Finland	0.69912	0.68025	0.99218	0.91626	0.91801
United Kingdom	0.73185	0.91595	1.00059	1.05128	1.05292
Cyprus	0.61782	0.55714	0.94712	0.29331	0.28883
Latvia	0.64914	0.59746	0.96846	0.50375	0.50525
Saudi Arabia	0.58610	0.73064	0.99704	0.91798	0.91972
Bahrain	0.50463	0.46090	0.94172	0.34896	0.35014
Czech Republic	0.69253	0.69916	0.99318	0.94549	0.94722
Slovenia	0.67142	0.62120	0.97167	0.54279	0.54435
Greece	0.61708	0.66588	0.99429	0.83547	0.83724
Canada	0.68624	0.85247	0.99795	0.94904	0.95077
Australia	0.66340	0.78635	0.99947	1.00517	1.00686
France	0.62024	0.80670	0.99581	0.87906	0.88082
Spain	0.58686	0.77234	0.99889	0.98297	0.98468
Iceland	0.61854	0.55310	0.93615	0.14794	0.13585
Germany	0.66211	0.84867	0.99778	0.94312	0.94485
Portugal	0.51266	0.57116	0.99363	0.81758	0.81935
Sweden	0.63217	0.67433	0.99452	0.84161	0.84338
Netherlands	0.60760	0.68425	0.99424	0.83403	0.83580
Denmark	0.60321	0.60726	0.99227	0.92103	0.92277
Belgium	0.54963	0.64016	0.99353	0.81498	0.81674
Hong Kong	0.55816	0.59620	0.99379	0.82189	0.82366
Ireland	0.54117	0.54513	0.98504	0.76176	0.76351
Italy	0.53033	0.71225	0.99616	0.88985	0.89160
Austria	0.54431	0.60950	0.99606	0.88691	0.88867
Switzerland	0.57071	0.63540	0.99243	0.92524	0.92698
Norway	0.56370	0.58138	0.99087	0.88524	0.88700
United Arab Emirates	0.44385	0.52466	0.99180	0.90874	0.91049
Macao	0.45091	0.40554	0.91586	0.21893	0.21662
Brunei	0.41733	0.37251	0.89821	0.15249	0.14855
Singapore	0.51707	0.56110	0.99208	0.91594	0.91768
Luxembourg	0.46594	0.42027	0.92249	0.24789	0.24605
Qatar	0.33588	0.34383	0.96465	0.50055	0.50204

Table 12: Exploitation Intensity for Exploited Countries at select t - Model with standard of living consumption

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.62537	1.54150	1.01431	1.21115	1.14676	Laos	1.30558	1.21213	0.99980	1.01838	1.02005
Congo - Kinshasa	1.61626	1.53193	1.01397	1.27232	1.27357	Zambia	1.38382	1.29143	1.00393	1.21606	1.21744
Malawi	1.61990	1.53575	1.01411	1.32438	1.32551	Moldova	1.43585	1.34461	1.00644	1.11874	1.09583
Mali	1.58243	1.49646	1.01268	1.31243	1.31359	Fiji	1.36694	1.27424	1.00307	0.41464	0.28906
Sierra Leone	1.58735	1.50161	1.01287	1.14036	1.01023	India	1.30003	1.20653	0.99949	1.00603	1.00771
Liberia	1.59286	1.50738	1.01308	1.02205	0.80157	Iraq	1.29168	1.19812	0.99902	0.98781	0.98951
Mozambique	1.55384	1.46660	1.01155	1.30428	1.30546	Philippines	1.33840	1.24529	1.00158	1.09562	1.09720
Central African Republic	1.56698	1.48032	1.01207	0.90464	0.70525	Paraguay	1.32761	1.23437	1.00101	1.06939	1.07101
Madagascar	1.57139	1.48492	1.01225	1.22490	1.22626	Armenia	1.35084	1.25789	1.00224	0.85902	0.83615
Niger	1.53038	1.44220	1.01059	1.16963	1.17109	Ghana	1.27164	1.17798	0.99786	0.94581	0.94754
Rwanda	1.57342	1.48704	1.01233	1.24021	1.24154	Jordan	1.30397	1.21050	0.99971	1.01478	1.01645
Burkina Faso	1.52846	1.44020	1.01051	1.15951	1.16099	Congo - Brazzaville	1.17809	1.08466	0.99603	0.88585	0.88761
Ethiopia	1.50038	1.41109	1.00933	1.22144	1.22281	Angola	1.04566	0.95447	0.99753	0.93439	0.93613
Zimbabwe	1.56922	1.48265	1.01216	1.20890	1.21029	Eswatini	1.15767	1.06443	0.99232	0.37041	0.32353
Togo	1.52021	1.43164	1.01017	1.13085	1.09541	Peru	1.26243	1.16874	0.99732	0.92726	0.92900
Benin	1.52162	1.43310	1.01023	1.32282	1.32395	Costa Rica	1.17031	1.07694	0.99645	0.89882	0.90057
Gambia	1.49320	1.40367	1.00902	0.60991	0.38992	Sri Lanka	1.19538	1.10181	0.99904	0.98866	0.99035
Kenya	1.53937	1.45155	1.01096	1.21697	1.21834	Morocco	1.03688	0.94591	0.99712	0.92070	0.92244
Yemen	1.49963	1.41032	1.00929	1.21809	1.21946	Namibia	1.08955	0.99737	0.99028	0.59742	0.58366
Uganda	1.53425	1.44622	1.01075	1.18918	1.19061	Ukraine	1.22398	1.13029	1.00040	1.04331	1.04495
Nepal	1.49334	1.40381	1.00902	1.19237	1.19379	Colombia	1.13610	1.04313	1.00108	1.07281	1.07442
Cambodia	1.50258	1.41337	1.00942	1.23134	1.23268	Tajikistan	1.19568	1.10211	0.99668	0.90633	0.90808
Ivory Coast	1.47120	1.38097	1.00805	1.30192	1.30310	Gabon	1.16401	1.07070	0.99346	0.60069	0.58379
Cameroon	1.48808	1.39837	1.00879	1.17073	1.17219	South Africa	1.16125	1.06797	0.99759	0.93647	0.93820
Pakistan	1.47011	1.37984	1.00800	1.29765	1.29885	Mongolia	1.18218	1.08870	0.99491	0.84049	0.83765
Senegal	1.41778	1.32610	1.00558	1.31833	1.31947	Maldives	1.09138	0.99916	0.98667	0.19528	0.13072
Myanmar	1.43757	1.34638	1.00652	1.18301	1.18445	Argentina	1.17143	1.07805	0.99810	0.95433	0.95606
Nigeria	1.43552	1.34427	1.00642	1.17671	1.17816	Algeria	1.06517	0.97350	0.99841	0.96542	0.96714
Mauritania	1.41544	1.32371	1.00547	0.80972	0.75299	Dominican Republic	1.12206	1.02930	0.99657	0.90271	0.90446
Bangladesh	1.44134	1.35025	1.00669	1.19503	1.19645	Jamaica	1.09606	1.00375	0.99190	0.73065	0.72325
Kyrgyzstan	1.52408	1.43566	1.01033	1.33546	1.33656	Ecuador	1.10854	1.01600	0.99983	1.01960	1.02127
Tanzania	1.39213	1.29990	1.00434	1.24004	1.24136	Bulgaria	1.14899	1.05585	0.99857	0.97104	0.97275
Haiti	1.38536	1.29300	1.00400	1.22046	1.22183	Tunisia	1.06162	0.97004	0.99884	0.98106	0.98277
Lesotho	1.38850	1.29620	1.00416	0.53883	0.43679	Kazakhstan	1.12552	1.03271	1.00065	1.05407	1.05570
Bolivia	1.48442	1.39460	1.00863	1.15665	1.15814	Serbia	1.13767	1.04468	0.99866	0.97459	0.97630
Honduras	1.43062	1.33925	1.00619	1.16121	1.16269	Albania	1.08267	0.99063	0.99203	0.80581	0.80220
Vietnam	1.46041	1.36985	1.00756	1.26076	1.26204	Iran	1.00070	0.91077	1.00039	1.04271	1.04435
Egypt	1.44971	1.35885	1.00708	1.22320	1.22456	Poland	1.12024	1.02751	1.00044	1.04481	1.04646
Belize	1.48999	1.40035	1.00888	0.48006	0.17323	Mexico	1.02233	0.93176	0.99643	0.89840	0.90015
Nicaragua	1.37767	1.28516	1.00362	1.10231	1.09364	Thailand	1.01167	0.92141	1.00080	1.06038	1.06200
El Salvador	1.36790	1.27522	1.00312	1.11566	1.10956	Barbados	1.01769	0.92725	0.98072	0.15952	0.10401
Guatemala	1.32265	1.22935	1.00074	1.05761	1.05924	Brazil	1.03206	0.94122	0.99690	0.91326	0.91501
Sudan	1.26715	1.17348	0.99760	0.93672	0.93845	Panama	1.00832	0.91816	0.99109	0.83580	0.83757
Syria	1.39429	1.30210	1.00444	1.24637	1.24769	Chile	1.00589	0.91580	1.00058	1.05104	1.05267

Figure 62: Distribution of wealth - Model with standard of living consumption

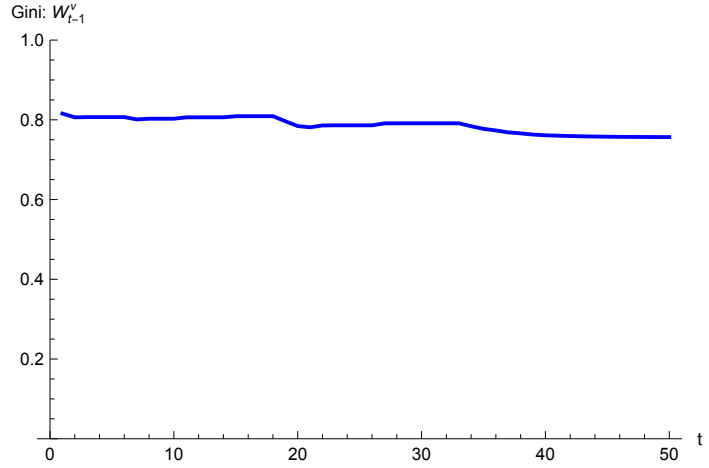
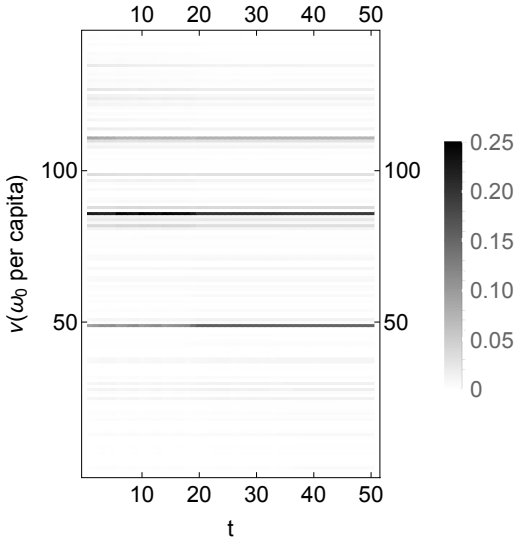
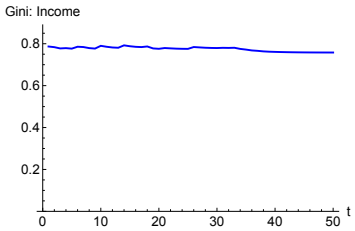


Figure 63: Distribution of Income - Model with standard of living consumption

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



5 Alternative Analysis of Technical Change

In this section, we analyse a variant of the model with exogenous labour-saving technical change and endogenous subsistence. This version of the basic model, starting in a capital-constrained state, incorporates an exogenous, constant rate of technological progress and endogenously determined subsistence. Technological progress is such that A_t remains constant and L_t decreases by two percent during each t. Subsistence b_t grows at the same rate as the aggregate endowment. The number of agents, the initial distribution of endowments, and all other parameters are handled as in the paper.

The results of the simulation are presented in Figures 64-72(b). Figure 64 presents the summary results. The simulation remains capital constrained for all t, thus $\widehat{w}_t = b_t$ for all t. Figure 65 shows L_t and labour values over the course of the simulation.

Figure 66 shows the exploitation and class status of the agents over the course of the simulation. Both the basic structure of exploitation relations. Because the simulation remains capital constrained, exploitation and classes persist, and, because $L_t y_t$ remains constant for all t, the class structure remains stable over the simulation.

Figure 67(a) shows the stable distribution of e_t^ν across agents for all t. Figure 67(b) shows that the Gini coefficient of e_t^ν quickly settles to a stable level over the simulation.

Figures 68-70 show exploitation intensity versus initial wealth for all countries for select t to provide a sense of how countries fall into being exploiters or exploited.

Tables 13 and 14 report e_t^ν for exploiter and exploited countries, respectively, for the same select t as figures 68-70.

Figure 64: Summary results - Model with exogenous technical change

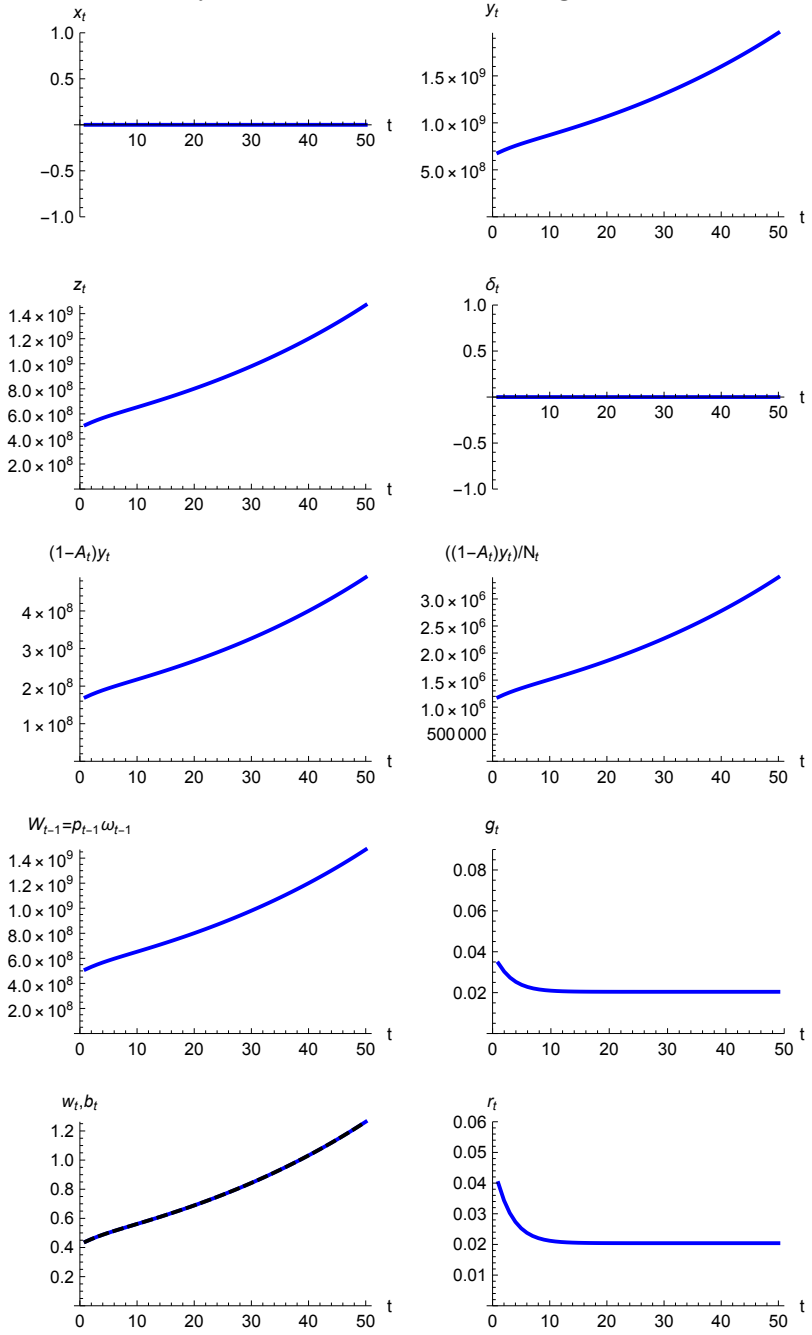


Figure 65: L_t and labour values - Model with exogenous technical change

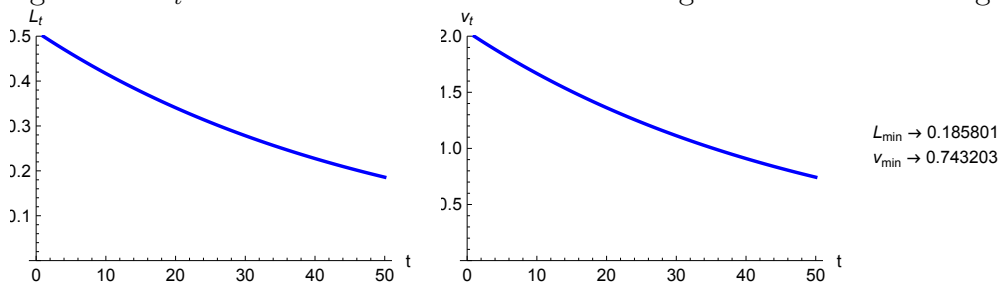
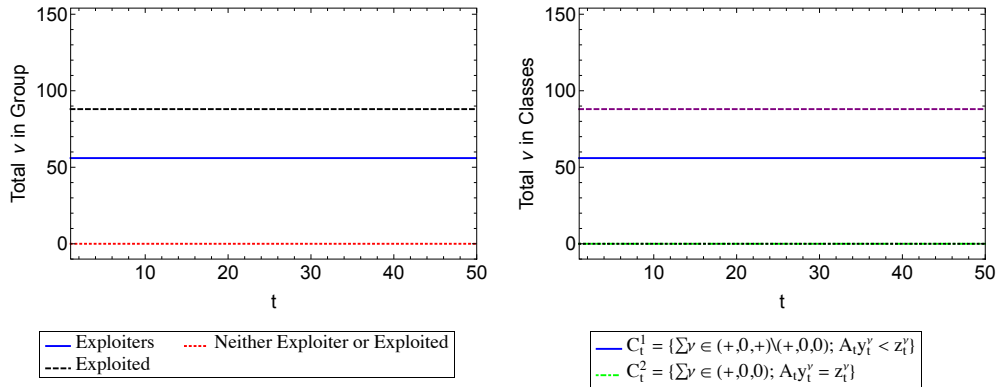


Figure 66: Class and exploitation status - Model with exogenous technical change

(a) Exploitation status

(b) Class status



(c) CECP

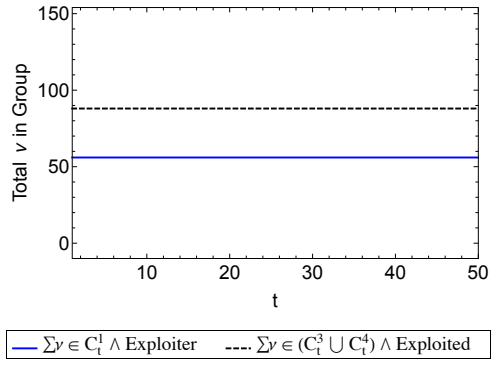


Figure 67: Exploitation intensity index - Model with exogenous technical change

(a) Exploitation intensity index across agents

(b) Gini coefficient of e_t^{ν}

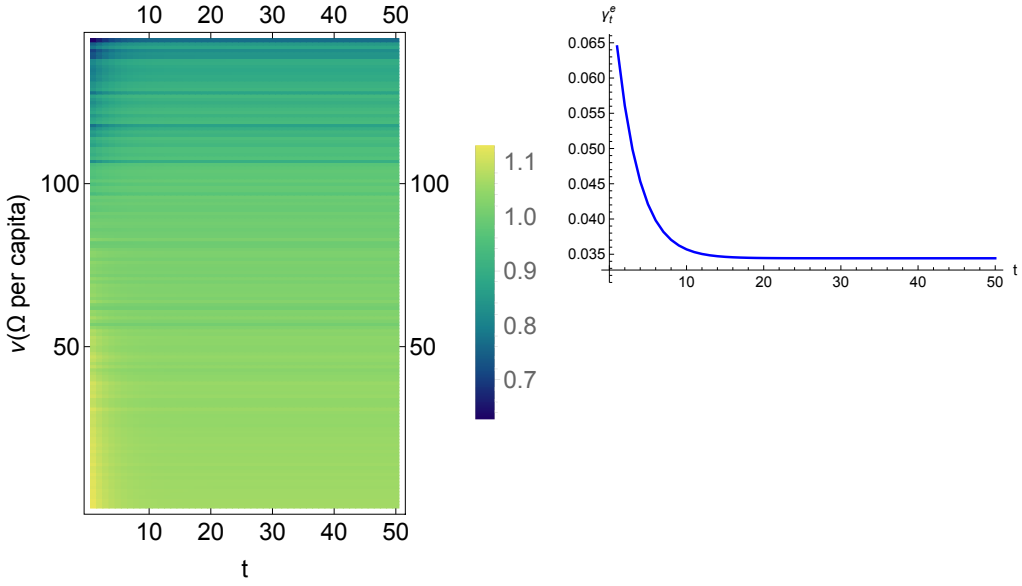
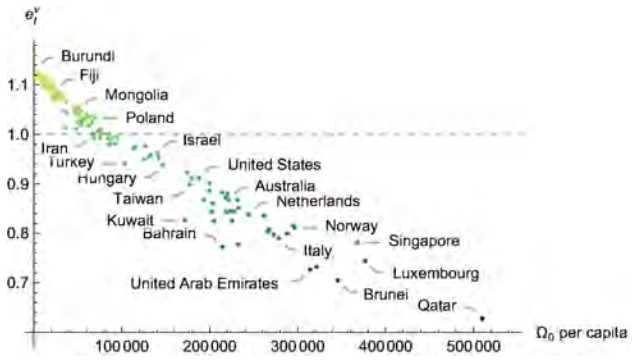
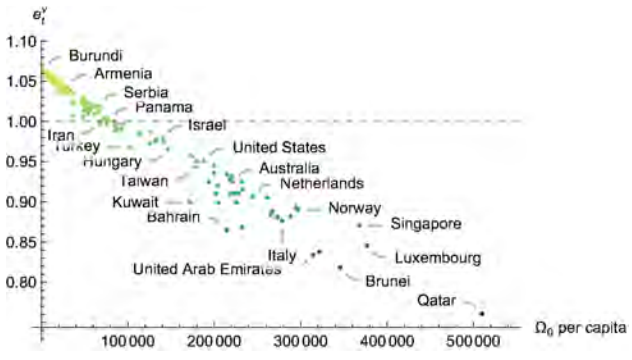


Figure 68: Worldwide Exploitation Intensity - Model with exogenous technical change

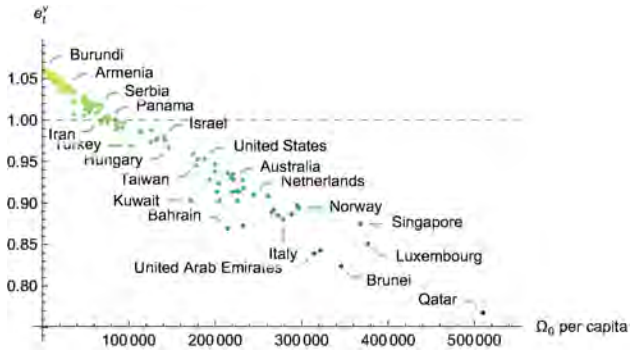
(a) $t = 1$



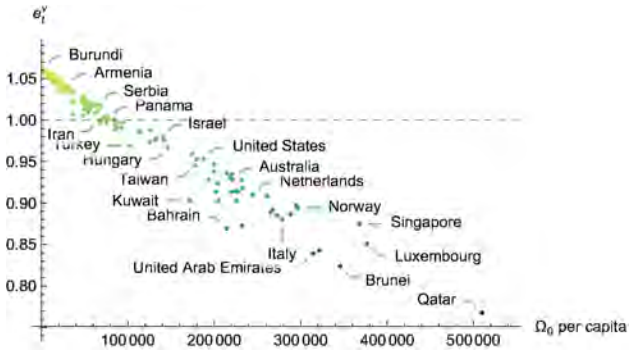
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

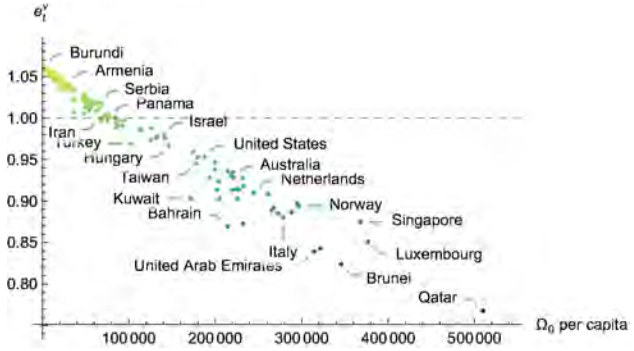
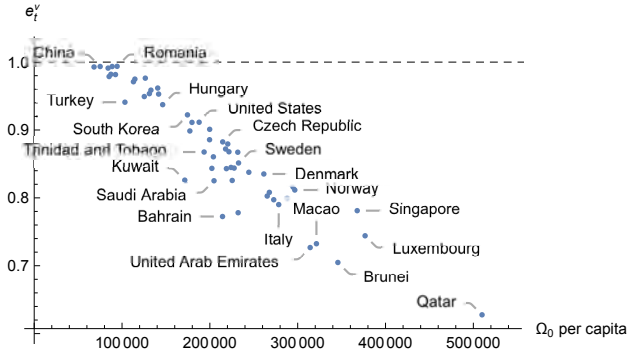
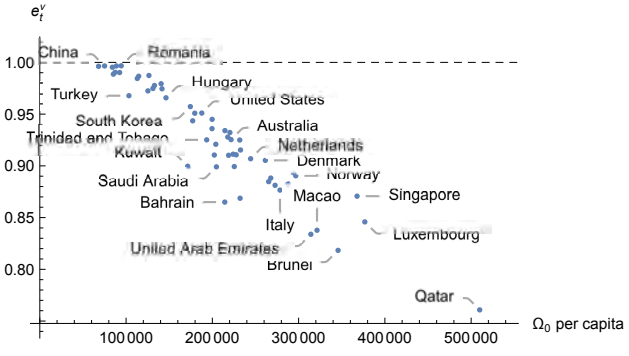


Figure 69: Exploiter Countries - Model with exogenous technical change

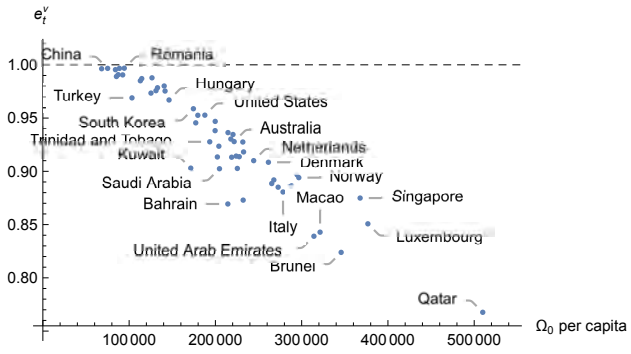
(a) $t = 1$



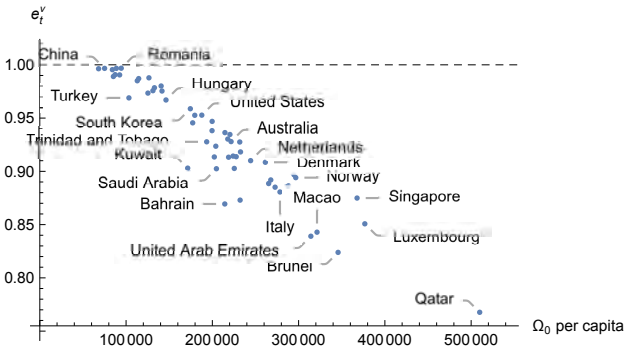
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

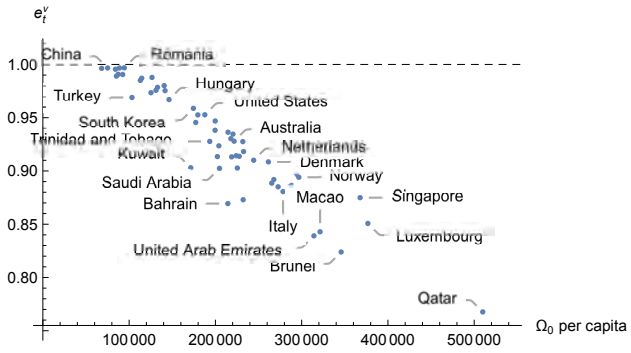
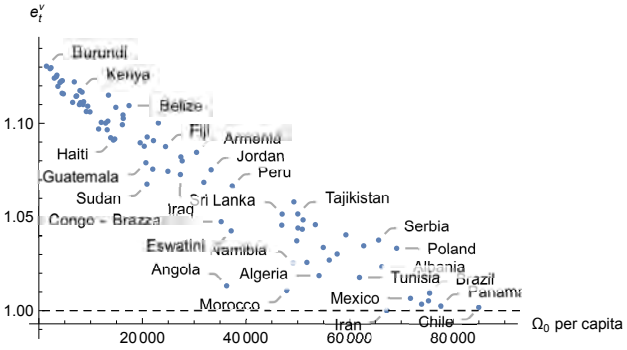
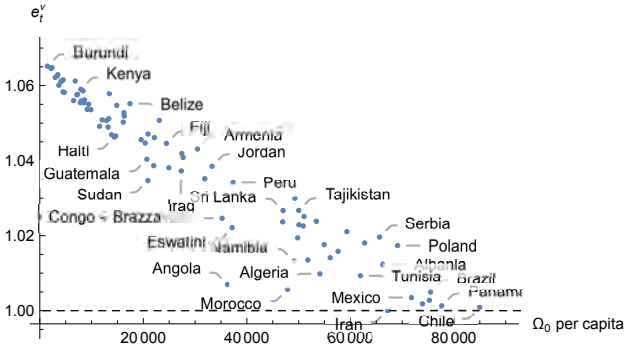


Figure 70: Exploited Countries - Model with exogenous technical change

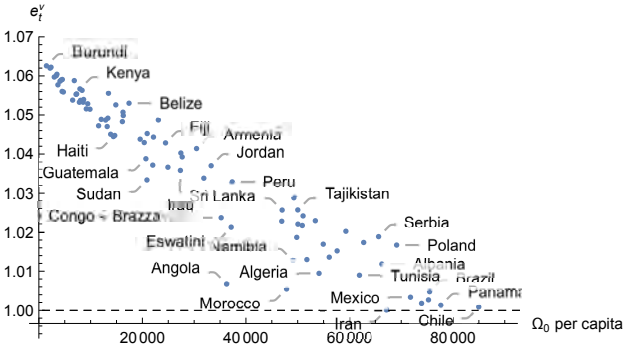
(a) $t = 1$



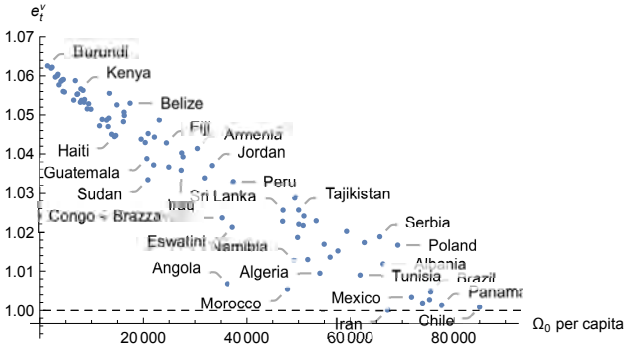
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

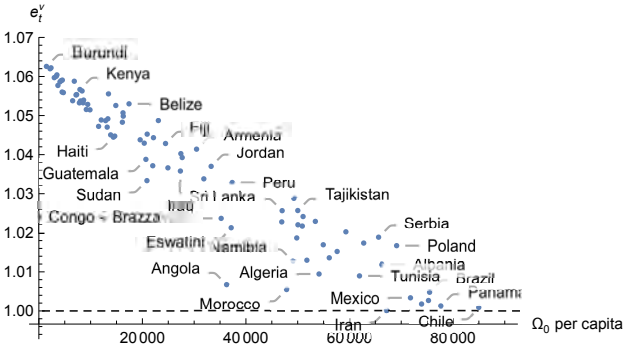


Table 13: Exploitation Intensity for Exploiter Countries at select t - Model with exogenous technical change

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Indonesia	0.9928	0.9962	0.9963	0.9963	0.9963
China	0.9935	0.9965	0.9967	0.9967	0.9967
Venezuela	0.9912	0.9953	0.9955	0.9955	0.9955
Mauritius	0.9788	0.9886	0.9890	0.9890	0.9890
Uruguay	0.9820	0.9904	0.9908	0.9908	0.9908
Malaysia	0.9935	0.9966	0.9967	0.9967	0.9967
Botswana	0.9816	0.9902	0.9905	0.9905	0.9905
Romania	0.9938	0.9967	0.9968	0.9968	0.9968
Turkey	0.9409	0.9678	0.9690	0.9690	0.9690
Lithuania	0.9711	0.9845	0.9850	0.9850	0.9850
Russia	0.9750	0.9866	0.9871	0.9871	0.9871
Malta	0.9493	0.9725	0.9735	0.9735	0.9735
Slovakia	0.9764	0.9873	0.9878	0.9878	0.9878
New Zealand	0.9535	0.9748	0.9757	0.9757	0.9757
Croatia	0.9587	0.9777	0.9785	0.9785	0.9785
Israel	0.9618	0.9794	0.9801	0.9801	0.9801
Estonia	0.9529	0.9745	0.9754	0.9754	0.9754
Hungary	0.9373	0.9658	0.9670	0.9670	0.9670
Kuwait	0.8261	0.8996	0.9030	0.9030	0.9030
South Korea	0.9223	0.9572	0.9588	0.9588	0.9588
Taiwan	0.8985	0.9435	0.9455	0.9455	0.9455
Japan	0.9112	0.9509	0.9526	0.9526	0.9526
United States	0.9114	0.9510	0.9527	0.9528	0.9528
Trinidad and Tobago	0.8675	0.9251	0.9277	0.9277	0.9277
Finland	0.8857	0.9360	0.9382	0.9382	0.9382
United Kingdom	0.9010	0.9449	0.9469	0.9469	0.9469
Cyprus	0.8435	0.9104	0.9135	0.9135	0.9135
Latvia	0.8605	0.9209	0.9236	0.9236	0.9236
Saudi Arabia	0.8252	0.8990	0.9024	0.9025	0.9025
Bahrain	0.7725	0.8650	0.8694	0.8694	0.8694
Czech Republic	0.8825	0.9341	0.9364	0.9364	0.9364
Slovenia	0.8720	0.9278	0.9303	0.9303	0.9303
Greece	0.8431	0.9102	0.9132	0.9133	0.9133
Canada	0.8794	0.9322	0.9346	0.9346	0.9346
Australia	0.8679	0.9253	0.9279	0.9279	0.9279
France	0.8448	0.9113	0.9143	0.9143	0.9143
Spain	0.8256	0.8993	0.9027	0.9027	0.9027
Iceland	0.8439	0.9107	0.9137	0.9137	0.9137
Germany	0.8672	0.9249	0.9275	0.9275	0.9275
Portugal	0.7781	0.8687	0.8730	0.8730	0.8730
Sweden	0.8514	0.9153	0.9182	0.9182	0.9182
Netherlands	0.8377	0.9069	0.9100	0.9100	0.9100
Denmark	0.8352	0.9053	0.9085	0.9085	0.9085
Belgium	0.8027	0.8847	0.8885	0.8886	0.8886
Hong Kong	0.8081	0.8882	0.8919	0.8919	0.8919
Ireland	0.7972	0.8812	0.8851	0.8851	0.8851
Italy	0.7901	0.8766	0.8806	0.8806	0.8806
Austria	0.7993	0.8825	0.8864	0.8864	0.8864
Switzerland	0.8159	0.8932	0.8967	0.8968	0.8968
Norway	0.8116	0.8904	0.8941	0.8941	0.8941
United Arab Emirates	0.7268	0.8339	0.8391	0.8391	0.8391
Macao	0.7324	0.8378	0.8429	0.8429	0.8429
Brunei	0.7048	0.8183	0.8239	0.8239	0.8239
Singapore	0.7811	0.8707	0.8749	0.8749	0.8749
Luxembourg	0.7441	0.8458	0.8507	0.8507	0.8507
Qatar	0.6277	0.7608	0.7676	0.7677	0.7677

Table 14: Exploitation Intensity for Exploited Countries at select t - Model with exogenous technical change

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.1305	1.0652	1.0626	1.0626	1.0626	Laos	1.0755	1.0387	1.0372	1.0372	1.0372
Congo - Kinshasa	1.1292	1.0645	1.0620	1.0620	1.0620	Zambia	1.0908	1.0461	1.0443	1.0443	1.0443
Malawi	1.1297	1.0648	1.0622	1.0622	1.0622	Moldova	1.1002	1.0507	1.0487	1.0487	1.0487
Mali	1.1241	1.0622	1.0597	1.0597	1.0597	Fiji	1.0876	1.0446	1.0429	1.0428	1.0428
Sierra Leone	1.1249	1.0625	1.0600	1.0600	1.0600	India	1.0744	1.0381	1.0366	1.0366	1.0366
Liberia	1.1257	1.0629	1.0604	1.0604	1.0604	Iraq	1.0727	1.0372	1.0358	1.0358	1.0358
Mozambique	1.1197	1.0601	1.0577	1.0577	1.0577	Philippines	1.0821	1.0419	1.0403	1.0403	1.0403
Central African Republic	1.1218	1.0610	1.0586	1.0586	1.0586	Paraguay	1.0799	1.0408	1.0393	1.0393	1.0393
Madagascar	1.1224	1.0614	1.0589	1.0589	1.0589	Armenia	1.0845	1.0431	1.0414	1.0414	1.0414
Niger	1.1160	1.0583	1.0560	1.0560	1.0560	Ghana	1.0685	1.0352	1.0338	1.0338	1.0338
Rwanda	1.1228	1.0615	1.0591	1.0591	1.0591	Jordan	1.0752	1.0385	1.0370	1.0370	1.0370
Burkina Faso	1.1157	1.0582	1.0559	1.0559	1.0559	Congo - Brazzaville	1.0475	1.0246	1.0237	1.0237	1.0237
Ethiopia	1.1112	1.0560	1.0538	1.0538	1.0538	Angola	1.0133	1.0070	1.0067	1.0067	1.0067
Zimbabwe	1.1221	1.0612	1.0588	1.0588	1.0588	Eswatini	1.0426	1.0221	1.0213	1.0213	1.0213
Togo	1.1144	1.0575	1.0553	1.0553	1.0553	Peru	1.0665	1.0342	1.0329	1.0329	1.0329
Benin	1.1146	1.0577	1.0554	1.0554	1.0554	Costa Rica	1.0456	1.0237	1.0228	1.0228	1.0228
Gambia	1.1100	1.0554	1.0533	1.0532	1.0532	Sri Lanka	1.0516	1.0267	1.0257	1.0257	1.0257
Kenya	1.1175	1.0590	1.0567	1.0567	1.0567	Morocco	1.0108	1.0057	1.0055	1.0055	1.0055
Yemen	1.1110	1.0559	1.0537	1.0537	1.0537	Namibia	1.0253	1.0132	1.0127	1.0127	1.0127
Uganda	1.1167	1.0586	1.0563	1.0563	1.0563	Ukraine	1.0581	1.0300	1.0288	1.0288	1.0288
Nepal	1.1100	1.0554	1.0533	1.0533	1.0533	Colombia	1.0373	1.0194	1.0187	1.0187	1.0187
Cambodia	1.1115	1.0562	1.0540	1.0540	1.0540	Tajikistan	1.0516	1.0267	1.0257	1.0257	1.0257
Ivory Coast	1.1063	1.0537	1.0516	1.0516	1.0516	Gabon	1.0441	1.0229	1.0220	1.0220	1.0220
Cameroon	1.1091	1.0550	1.0529	1.0529	1.0529	South Africa	1.0435	1.0226	1.0217	1.0217	1.0217
Pakistan	1.1061	1.0536	1.0515	1.0515	1.0515	Mongolia	1.0485	1.0251	1.0242	1.0242	1.0242
Senegal	1.0970	1.0492	1.0472	1.0472	1.0472	Maldives	1.0258	1.0135	1.0130	1.0130	1.0130
Myanmar	1.1005	1.0509	1.0489	1.0489	1.0489	Argentina	1.0459	1.0238	1.0229	1.0229	1.0229
Nigeria	1.1001	1.0507	1.0487	1.0487	1.0487	Algeria	1.0187	1.0098	1.0095	1.0095	1.0095
Mauritania	1.0966	1.0490	1.0470	1.0470	1.0470	Dominican Republic	1.0337	1.0176	1.0169	1.0169	1.0169
Bangladesh	1.1012	1.0512	1.0492	1.0492	1.0492	Jamaica	1.0270	1.0141	1.0136	1.0136	1.0136
Kyrgyzstan	1.1150	1.0578	1.0556	1.0556	1.0556	Ecuador	1.0303	1.0158	1.0152	1.0152	1.0152
Tanzania	1.0923	1.0469	1.0451	1.0451	1.0451	Bulgaria	1.0405	1.0211	1.0203	1.0202	1.0202
Haiti	1.0910	1.0463	1.0445	1.0445	1.0445	Tunisia	1.0177	1.0093	1.0090	1.0090	1.0090
Lesotho	1.0916	1.0466	1.0448	1.0447	1.0447	Kazakhstan	1.0346	1.0181	1.0174	1.0174	1.0174
Bolivia	1.1085	1.0547	1.0526	1.0526	1.0526	Serbia	1.0377	1.0196	1.0189	1.0189	1.0189
Honduras	1.0993	1.0503	1.0483	1.0483	1.0483	Albania	1.0234	1.0123	1.0118	1.0118	1.0118
Vietnam	1.1045	1.0528	1.0507	1.0507	1.0507	Iran	1.0002	1.0001	1.0001	1.0001	1.0001
Egypt	1.1026	1.0519	1.0499	1.0498	1.0498	Poland	1.0333	1.0174	1.0167	1.0167	1.0167
Belize	1.1095	1.0552	1.0530	1.0530	1.0530	Mexico	1.0066	1.0035	1.0034	1.0034	1.0034
Nicaragua	1.0896	1.0456	1.0438	1.0438	1.0438	Thailand	1.0035	1.0018	1.0018	1.0018	1.0018
El Salvador	1.0878	1.0447	1.0429	1.0429	1.0429	Barbados	1.0052	1.0028	1.0027	1.0027	1.0027
Guatemala	1.0790	1.0404	1.0388	1.0388	1.0388	Brazil	1.0094	1.0050	1.0048	1.0048	1.0048
Sudan	1.0675	1.0347	1.0334	1.0333	1.0333	Panama	1.0025	1.0013	1.0013	1.0013	1.0013
Syria	1.0927	1.0471	1.0453	1.0452	1.0452	Chile	1.0018	1.0009	1.0009	1.0009	1.0009

Figures 71 and 72 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 71: Distribution of wealth - Model with exogenous technical change

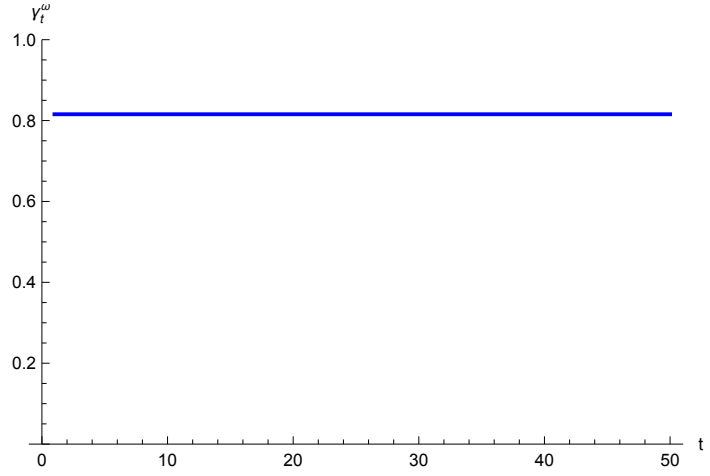
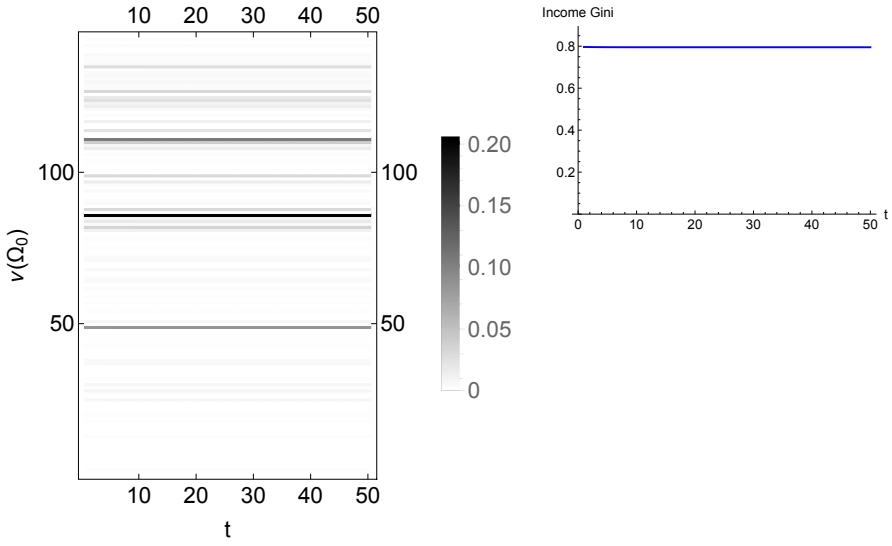


Figure 72: Distribution of Income - Model with exogenous technical change

(a) Distribution of Income Shares

(b) Gini Coefficient of Income



6 Proxies for Human Capital

This section presents simulations using proxies for human capital for those countries without a measurement of human capital in the Penn World Table [2]. Countries with no data on human capital are assigned a proxy value of one and labour endowments are then specified as in the simulations reported in the paper. This expands the population of countries to $N = 180$, and all other parameters are the same as in the simulations of the main paper. The simulations with proxies for human capital are run for the basic scenario and the model with technical change in the main paper.

6.1 Proxies for Human Capital - Basic Model

Figure 73 reports the summary results.

Figure 74 shows the exploitation and class status of the agents over the course of the simulation.

Figure 75(a) shows the distribution of e_t^ν across agents for all t. Figure 75(b) shows that the Gini coefficient of e_t^ν.

Figures 76-78 show exploitation intensity versus initial wealth for all countries for $t = 1$ to provide a sense of how countries fall into being exploiters or exploited. As in the basic model in the main simulations, countries' positions in the hierarchy of exploitation status do not change over t.

Tables 15 and 16 report e_t^ν for exploiter and exploited countries, respectively, for $t = 1$, as in figures 76-78.

Figures 79 and 80 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 73: Summary results - Basic model with proxies for human capital

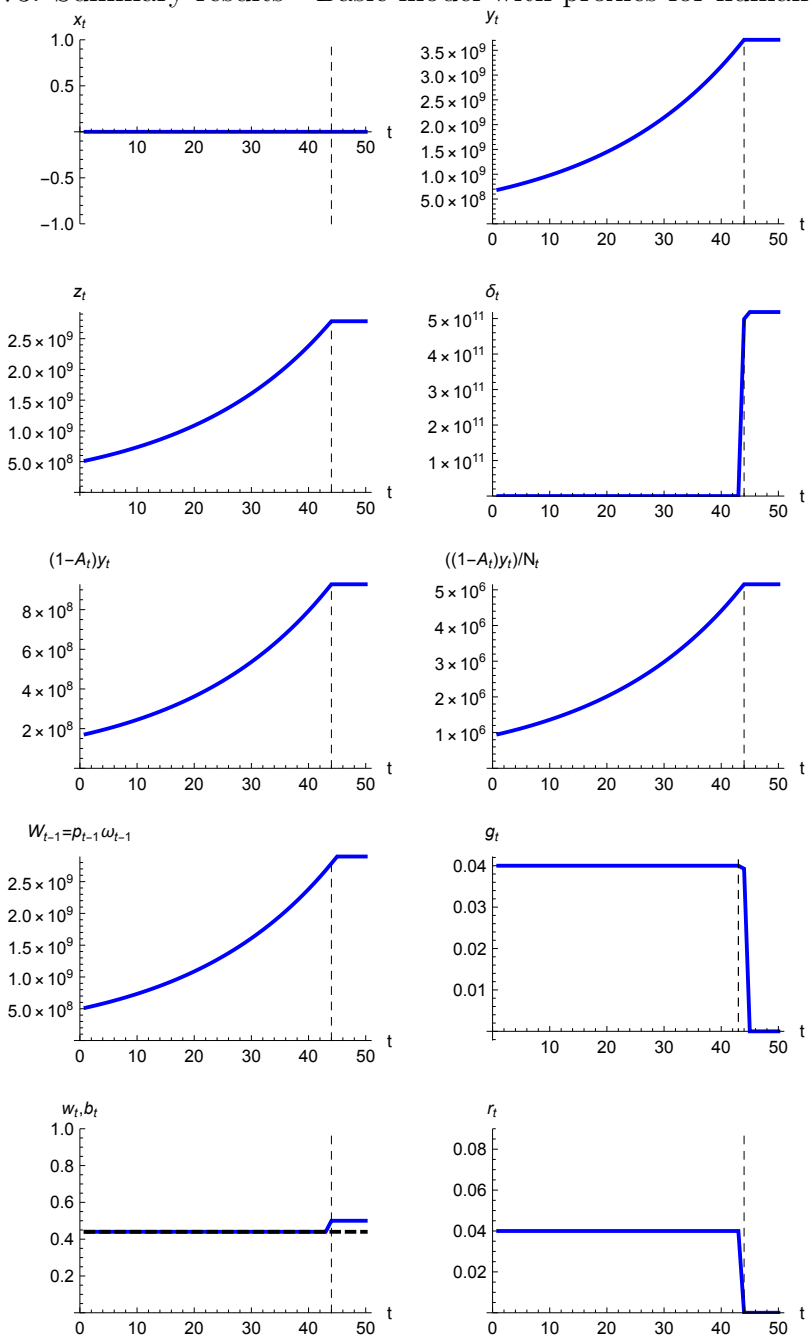
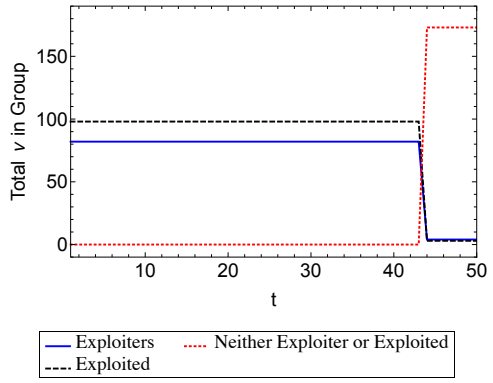
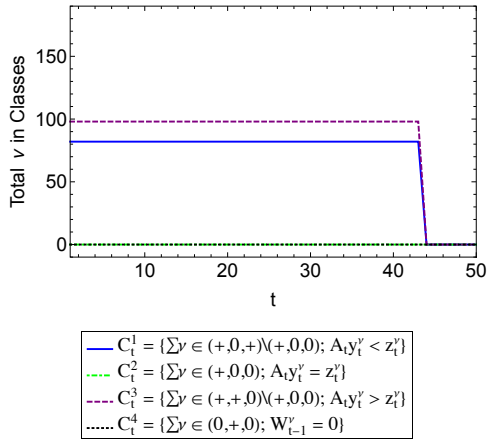


Figure 74: Class and exploitation status - Basic model with proxies for human capital

(a) Exploitation status



(b) Class status



(c) CECP

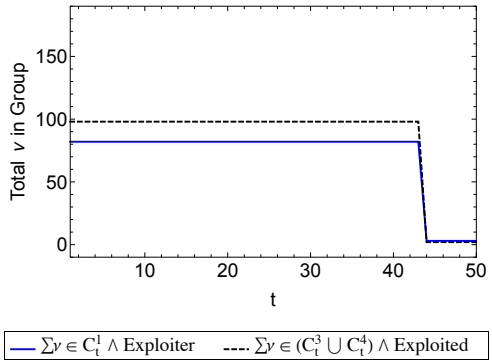
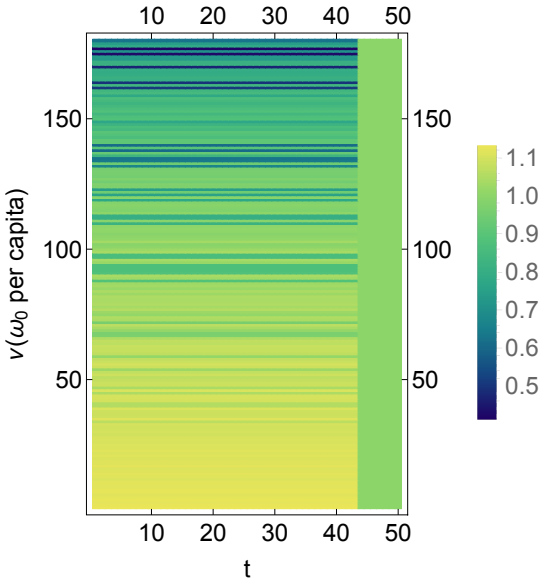


Figure 75: Exploitation intensity index - Basic model with proxies for human capital

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^ν

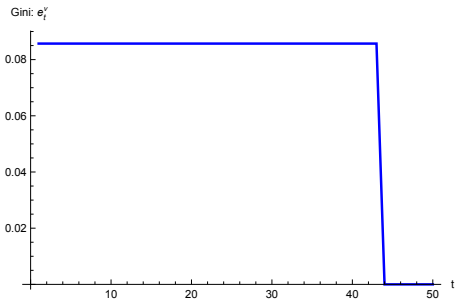


Figure 76: Worldwide Exploitation Intensity - Basic model with proxies for human capital

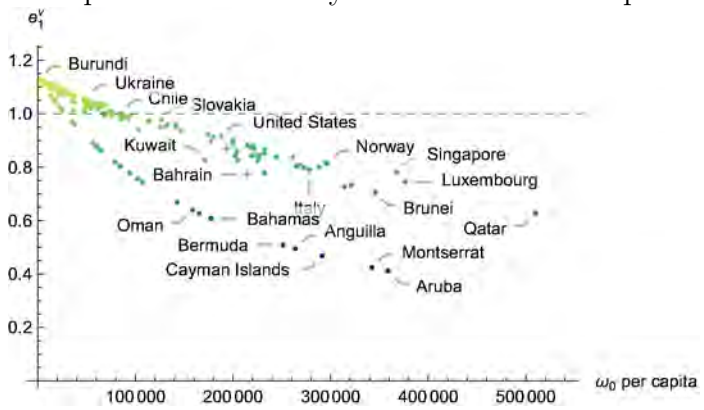


Figure 77: Exploiter Countries -Basic model with proxies for human capital

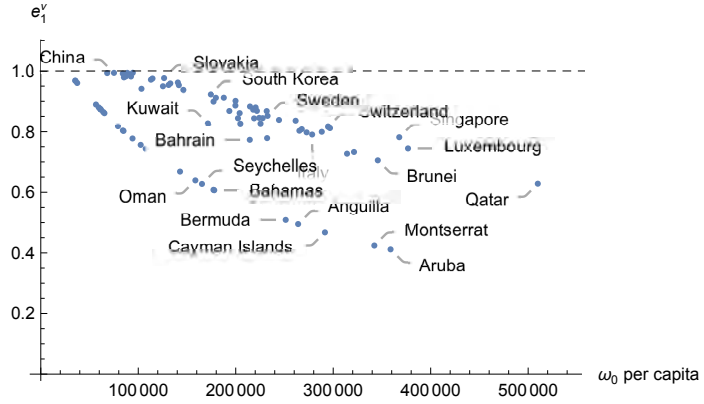


Figure 78: Exploited Countries - Basic model with proxies for human capital

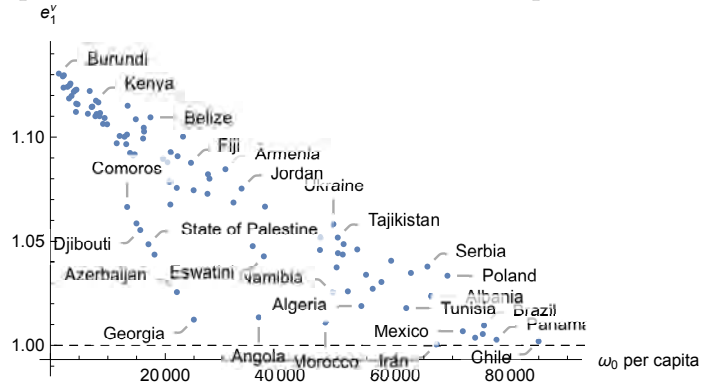


Table 15: Exploitation Intensity for Exploiter Countries at $t = 1$ - Basic model with proxies

	e_1^ν		e_1^ν
Cape Verde	0.9686	Bahamas	0.6067
Bosnia and Herzegovina	0.9672	Japan	0.9115
Dominica	0.9603	United States	0.9117
North Macedonia	0.8893	Trinidad and Tobago	0.8679
Bhutan	0.8797	Finland	0.8860
Saint Lucia	0.8744	United Kingdom	0.9013
Belarus	0.8739	Cyprus	0.8438
Montenegro	0.8727	Latvia	0.8608
Grenada	0.8646	Saudi Arabia	0.8256
Turks and Caicos Islands	0.8606	Bahrain	0.7729
Indonesia	0.9931	Czech Republic	0.8828
China	0.9937	Slovenia	0.8723
Lebanon	0.8184	Greece	0.8434
Venezuela	0.9914	Canada	0.8797
Suriname	0.8040	Australia	0.8682
Saint Vincent and the Grenadines	0.8023	France	0.8452
Mauritius	0.9790	Spain	0.8260
Uruguay	0.9823	Iceland	0.8442
Malaysia	0.9937	Germany	0.8676
Botswana	0.9819	Portugal	0.7785
British Virgin Islands	0.7774	Sweden	0.8517
Romania	0.9940	Netherlands	0.8381
Equatorial Guinea	0.7561	Bermuda	0.5090
Turkey	0.9412	Denmark	0.8356
Turkmenistan	0.7436	Anguilla	0.4951
Lithuania	0.9713	Belgium	0.8031
Russia	0.9752	Hong Kong	0.8085
Malta	0.9495	Ireland	0.7976
Slovakia	0.9766	Italy	0.7905
New Zealand	0.9538	Austria	0.7997
Croatia	0.9589	Cayman Islands	0.4676
Israel	0.9620	Switzerland	0.8163
Estonia	0.9532	Norway	0.8119
Antigua and Barbuda	0.6681	United Arab Emirates	0.7272
Hungary	0.9376	Macao	0.7329
Oman	0.6391	Montserrat	0.4242
Seychelles	0.6274	Brunei	0.7052
Kuwait	0.8265	Aruba	0.4116
South Korea	0.9226	Singapore	0.7815
Saint Kitts and Nevis	0.6079	Luxembourg	0.7446
Taiwan	0.8989	Qatar	0.6282

Table 16: Exploitation Intensity for Exploited Countries at $t = 1$ - Basic model with proxies

	e_1^ν		e_1^ν
Burundi	1.130497649	Guatemala	1.079052335
Congo - Kinshasa	1.129172375	Sudan	1.067628848
Chad	1.123765872	Syria	1.092772492
Malawi	1.129703812	Laos	1.075617117
Mali	1.124144443	Azerbaijan	1.025571464
Guinea-Bissau	1.118555806	Zambia	1.090835628
Sierra Leone	1.124886251	Moldova	1.100247277
Liberia	1.125712662	Fiji	1.087663101
Mozambique	1.119759996	India	1.074484892
Central African Republic	1.121791572	Georgia	1.012343153
Madagascar	1.122466382	Iraq	1.07276808
Guinea	1.112104168	Philippines	1.082164302
Niger	1.116068795	Paraguay	1.080038555
Rwanda	1.1227766	Armenia	1.084582481
Burkina Faso	1.115762119	Ghana	1.068580426
Ethiopia	1.1112151	Jordan	1.075289487
Zimbabwe	1.12213401	Congo - Brazzaville	1.04764434
Togo	1.114439541	Angola	1.013460273
Benin	1.114666782	Eswatini	1.042744206
Gambia	1.110031993	Peru	1.066621607
Kenya	1.11749419	Costa Rica	1.045790749
Yemen	1.111091403	Sri Lanka	1.051693674
Uganda	1.116683303	Morocco	1.010973618
Nepal	1.110054337	Namibia	1.0254509
Cambodia	1.111576087	Ukraine	1.058209246
Ivory Coast	1.106348501	Colombia	1.037430481
Cameroon	1.109180919	Tajikistan	1.05176452
Pakistan	1.106162956	Gabon	1.044278111
Senegal	1.097038319	South Africa	1.043611951
Myanmar	1.100549599	Mongolia	1.048608605
Nigeria	1.100188675	Maldives	1.025934306
Mauritania	1.096618621	Argentina	1.046058821
Bangladesh	1.101209786	Algeria	1.0188761
Comoros	1.066454955	Dominican Republic	1.033893123
Kyrgyzstan	1.115061899	Jamaica	1.027170282
Tanzania	1.092374908	Ecuador	1.030425765
Haiti	1.091122097	Bulgaria	1.040624462
Lesotho	1.091704448	Tunisia	1.017900887
Bolivia	1.108571388	Kazakhstan	1.034772215
Uzbekistan	1.058560068	Serbia	1.037823157
Djibouti	1.05536158	Albania	1.023616825
Honduras	1.099325526	Iran	1.000411939
Vietnam	1.104509529	Poland	1.033430455
Egypt	1.102666935	Mexico	1.006789747
State of Palestine	1.048550356	Thailand	1.003671058
Belize	1.10949844	Barbados	1.005437756
Sao Tome and Principe	1.043575289	Brazil	1.009596858
Nicaragua	1.08968593	Panama	1.002679977
El Salvador	1.087845842	Chile	1.00195937

Figure 79: Distribution of wealth - Basic model with proxies for human capital

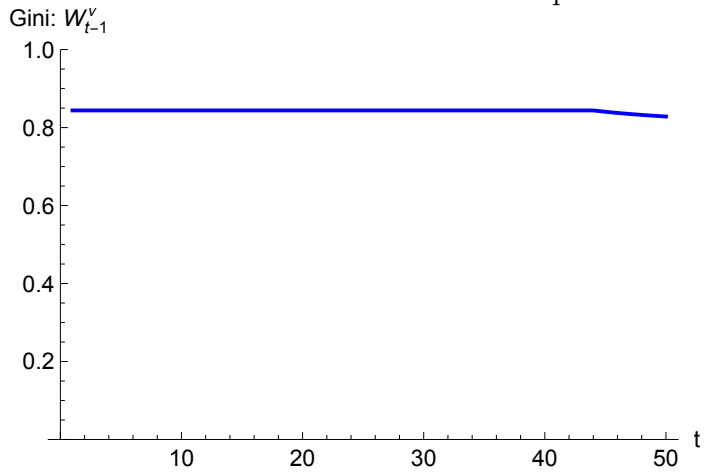
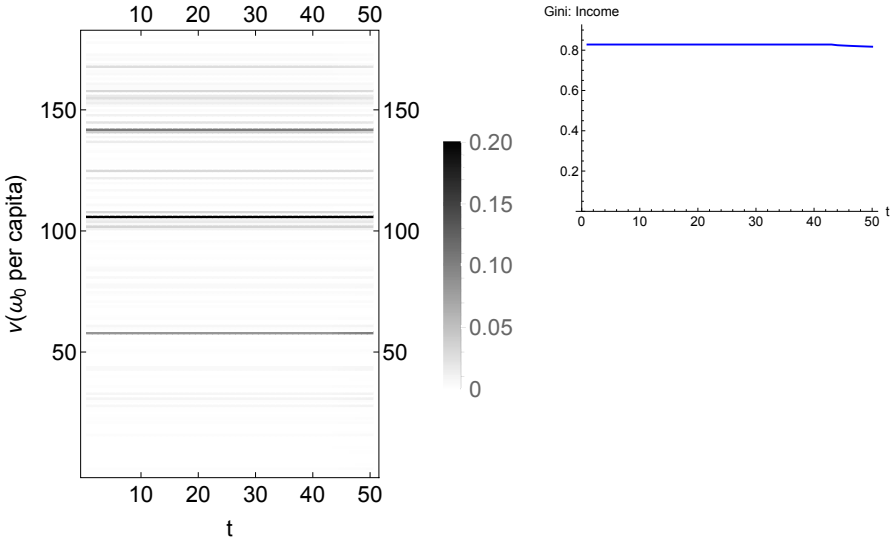


Figure 80: Distribution of Income - Basic model with proxies for human capital

(a) Distribution of Income Shares

(b) Gini Coefficient of Income



6.2 Proxies for Human Capital - Model with exogenous technical change and endogenous consumption

This subsection presents results for the simulation with proxies for human capital and exogenous technical change and endogenous consumption.

Figure 83 shows the exploitation and class status of the agents over the course of the simulation.

Figure 84(a) shows the distribution of e_t^ν across agents for all t. Figure 84(b) shows the Gini coefficient of e_t^ν.

Figures 85-87 show exploitation intensity versus initial wealth for all countries for select t.

Tables 17 and 18 report e_t^ν for exploiter and exploited countries, respectively, for the same select t as figures 85-87.

Figure 81: Summary results - Model with exogenous technical change using proxies for human capital

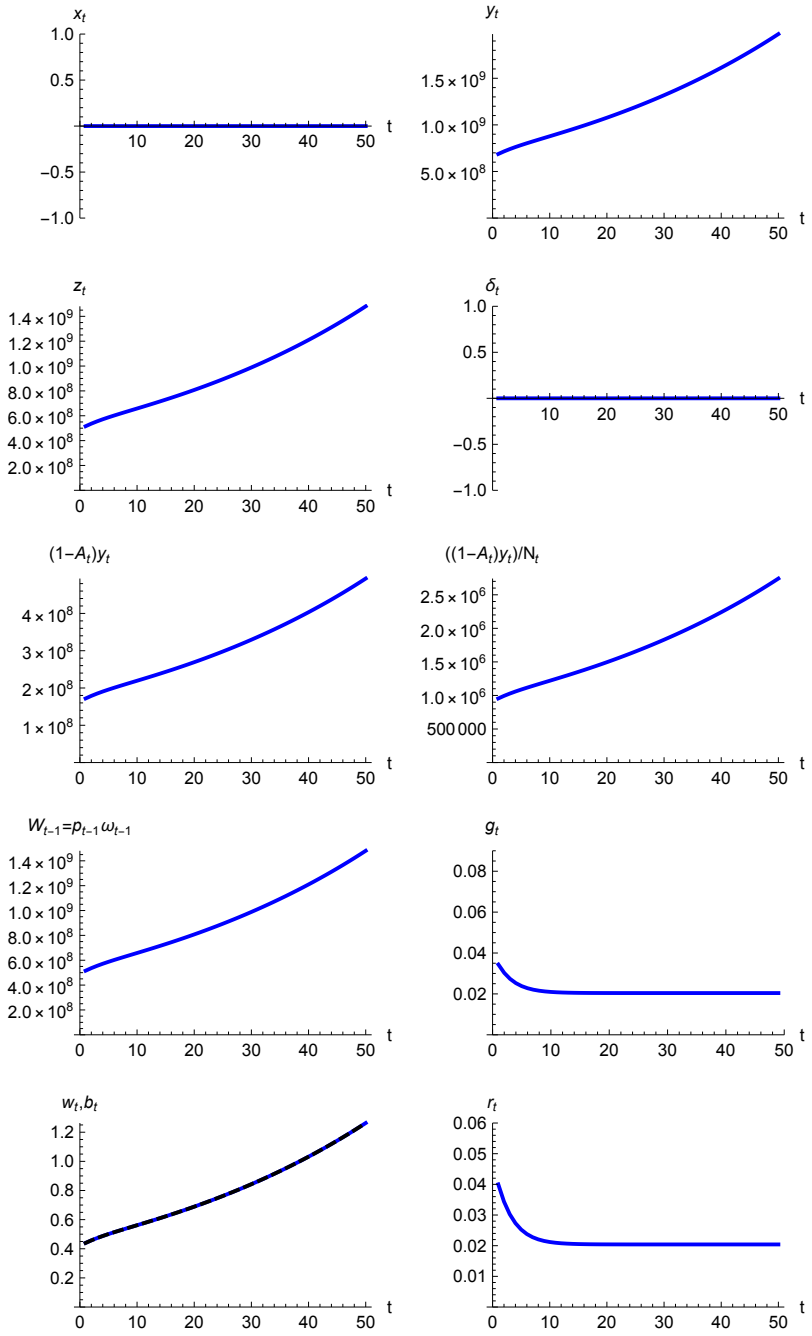


Figure 82: L_t and labour values - Model with exogenous technical change using proxies for human capital

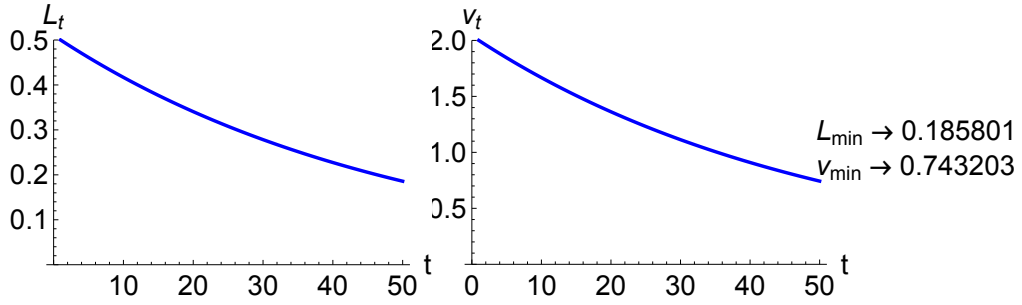
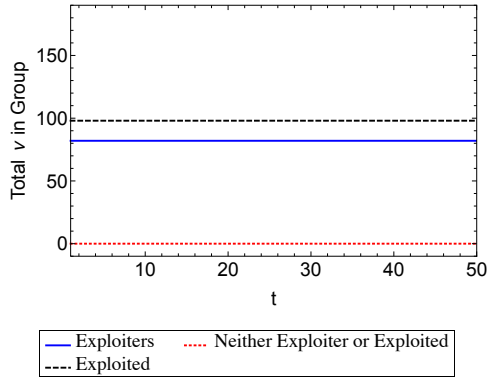
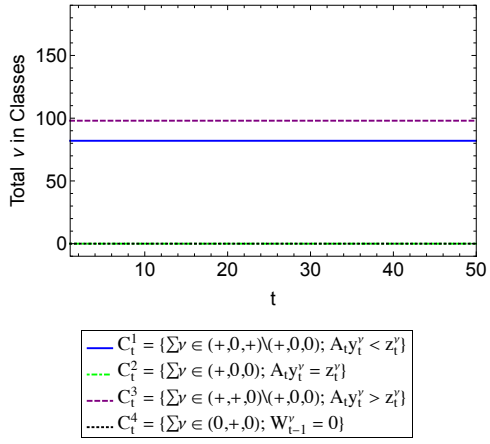


Figure 83: Class and exploitation status - Model with exogenous technical change using proxies for human capital

(a) Exploitation status



(b) Class status



(c) CECP

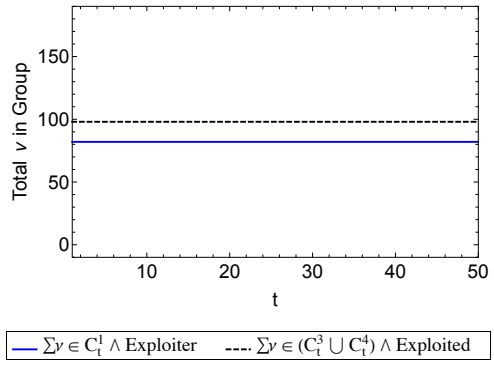


Figure 84: Exploitation intensity index - Model with exogenous technical change using proxies for human capital

(a) Exploitation intensity index across agents

(b) Gini coefficient of e_t^{ν}

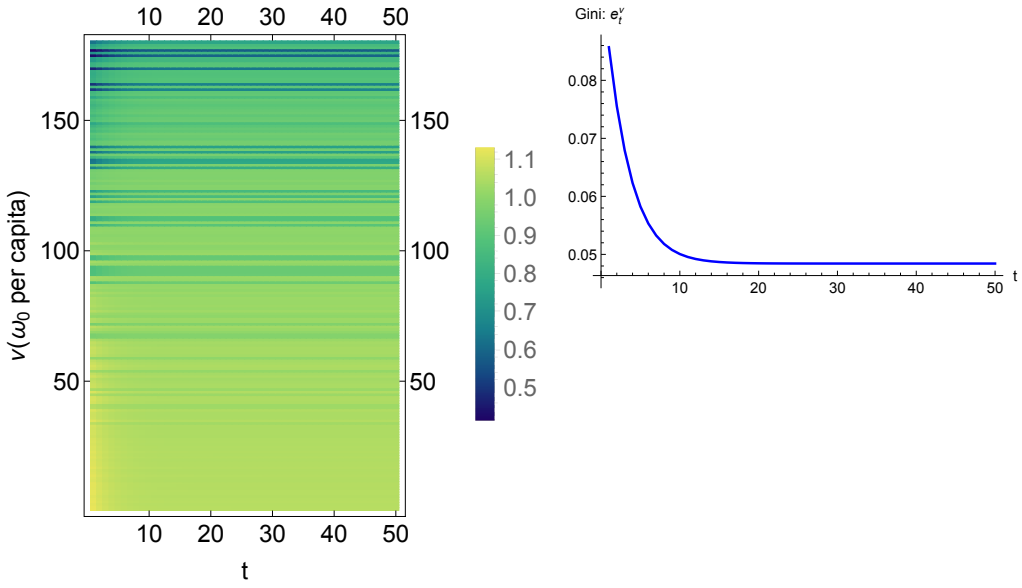
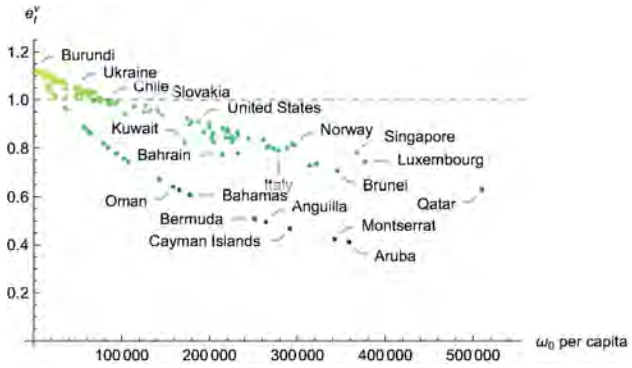
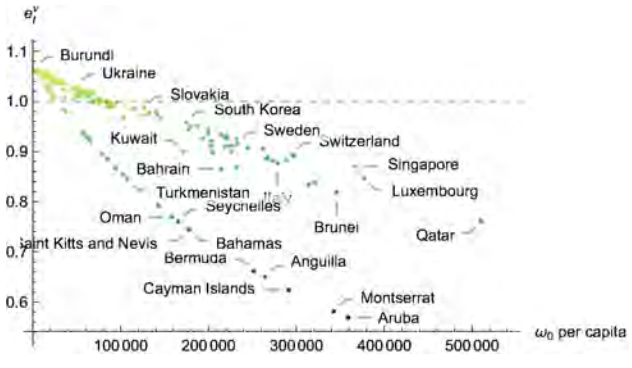


Figure 85: Worldwide Exploitation Intensity - Model with exogenous technical change using proxies for human capital

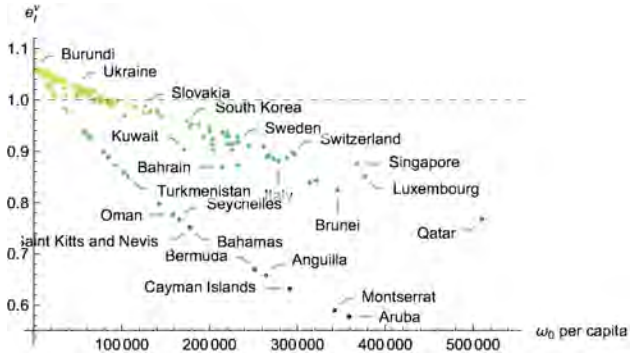
(a) $t = 1$



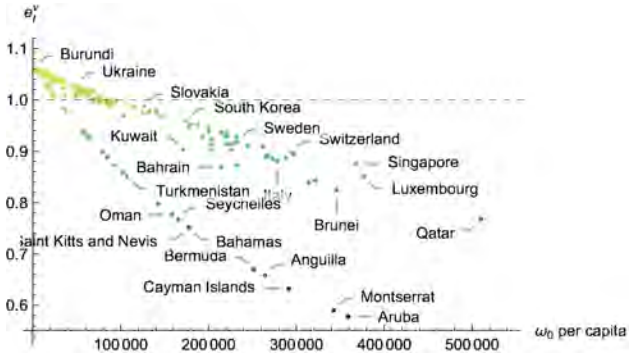
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

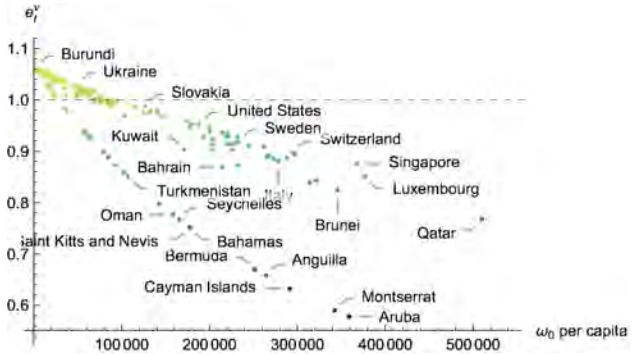
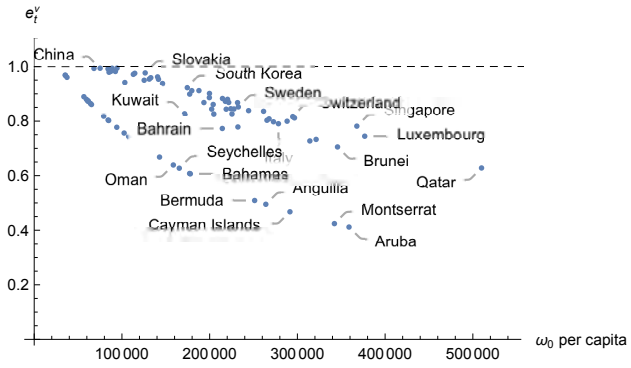
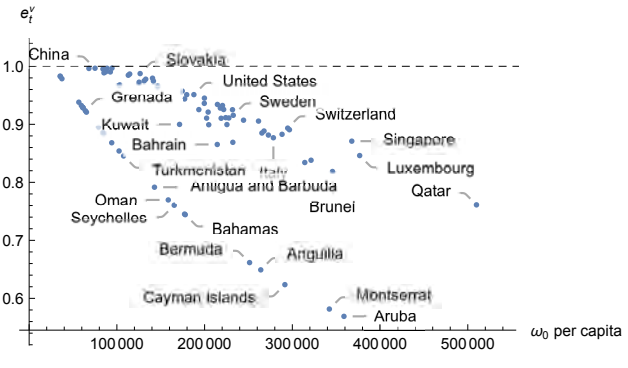


Figure 86: Exploiter Countries - Model with exogenous technical change using proxies for human capital

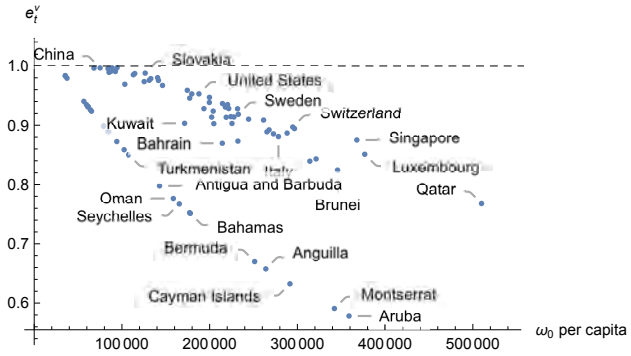
(a) $t = 1$



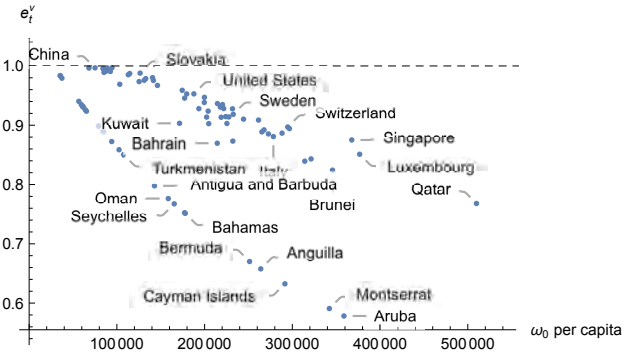
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

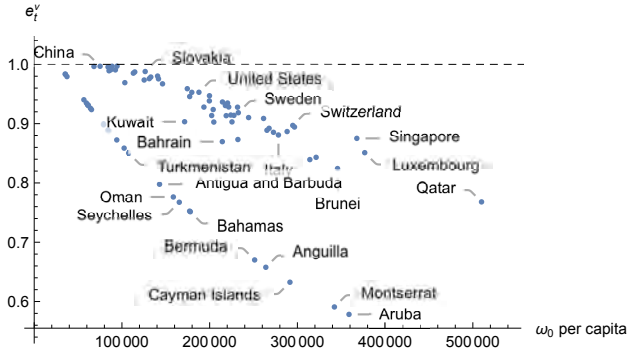
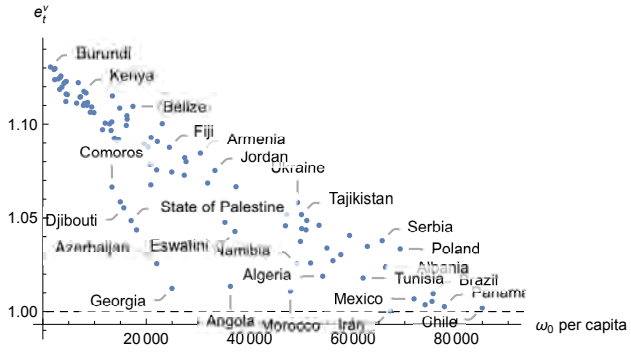
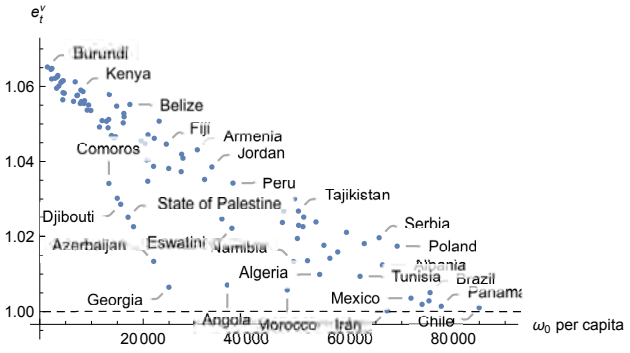


Figure 87: Exploited Countries - Model with exogenous technical change using proxies for human capital

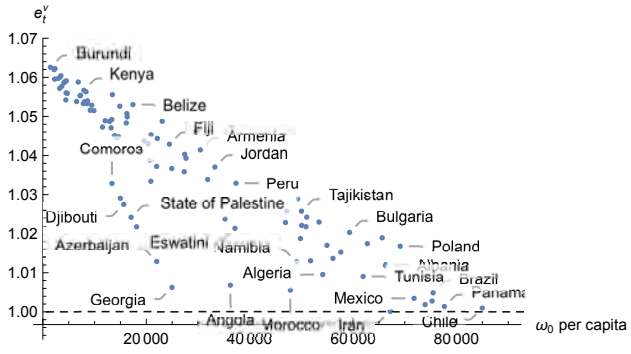
(a) $t = 1$



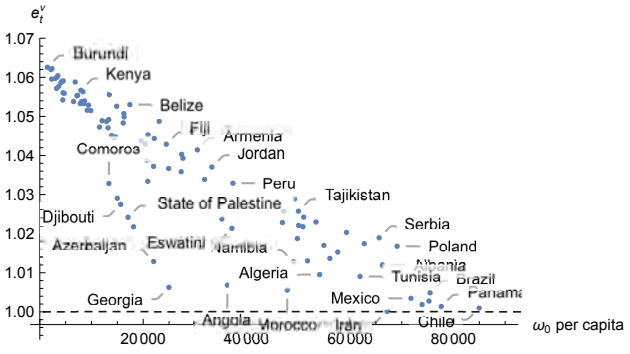
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

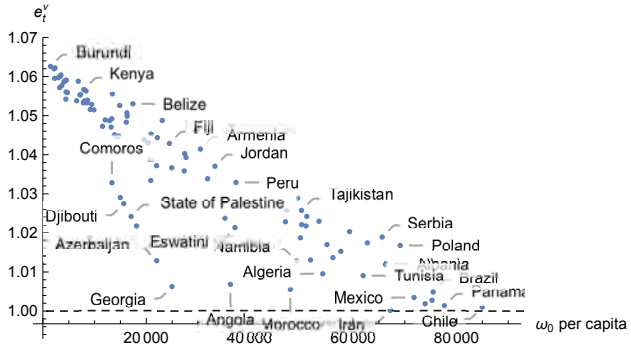


Table 17: Exploitation Intensity for Exploiter Countries at select t - Model with exogenous technical change using proxies for human capital

	e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}		e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}
Cape Verde	0.9686	0.9831	0.9837	0.9837	0.9837	Bahamas	0.6067	0.7443	0.7514	0.7514	0.7514
Bosnia and Herzegovina	0.9672	0.9824	0.9830	0.9830	0.9830	Japan	0.9115	0.9511	0.9528	0.9528	0.9528
Dominica	0.9603	0.9786	0.9794	0.9794	0.9794	United States	0.9117	0.9512	0.9529	0.9529	0.9529
North Macedonia	0.8893	0.9381	0.9403	0.9403	0.9403	Trinidad and Tobago	0.8679	0.9253	0.9279	0.9279	0.9279
Bhutan	0.8797	0.9324	0.9348	0.9348	0.9348	Finland	0.8860	0.9361	0.9384	0.9384	0.9384
Saint Lucia	0.8744	0.9292	0.9317	0.9317	0.9317	United Kingdom	0.9013	0.9451	0.9471	0.9471	0.9471
Belarus	0.8739	0.9290	0.9314	0.9314	0.9314	Cyprus	0.8438	0.9107	0.9137	0.9137	0.9137
Montenegro	0.8727	0.9283	0.9307	0.9308	0.9308	Latvia	0.8608	0.9211	0.9238	0.9238	0.9238
Grenada	0.8646	0.9234	0.9260	0.9260	0.9260	Saudi Arabia	0.8256	0.8993	0.9027	0.9027	0.9027
Turks and Caicos Islands	0.8606	0.9210	0.9237	0.9237	0.9237	Bahrain	0.7729	0.8653	0.8696	0.8696	0.8696
Indonesia	0.9931	0.9963	0.9964	0.9964	0.9964	Czech Republic	0.8828	0.9343	0.9365	0.9366	0.9366
China	0.9937	0.9967	0.9968	0.9968	0.9968	Slovenia	0.8723	0.9280	0.9305	0.9305	0.9305
Lebanon	0.8184	0.8948	0.8983	0.8983	0.8983	Greece	0.8434	0.9104	0.9135	0.9135	0.9135
Venezuela	0.9914	0.9954	0.9956	0.9956	0.9956	Canada	0.8797	0.9324	0.9348	0.9348	0.9348
Suriname	0.8040	0.8856	0.8894	0.8894	0.8894	Australia	0.8682	0.9256	0.9281	0.9281	0.9281
Saint Vincent and the Grenadines	0.8023	0.8845	0.8883	0.8883	0.8883	France	0.8452	0.9115	0.9145	0.9145	0.9145
Mauritius	0.9790	0.9888	0.9892	0.9892	0.9892	Spain	0.8260	0.8996	0.9029	0.9030	0.9030
Uruguay	0.9823	0.9905	0.9909	0.9909	0.9909	Iceland	0.8442	0.9109	0.9140	0.9140	0.9140
Malaysia	0.9937	0.9967	0.9968	0.9968	0.9968	Germany	0.8676	0.9252	0.9277	0.9277	0.9277
Botswana	0.9819	0.9903	0.9907	0.9907	0.9907	Portugal	0.7785	0.8690	0.8732	0.8732	0.8732
British Virgin Islands	0.7774	0.8682	0.8725	0.8725	0.8725	Sweden	0.8517	0.9155	0.9184	0.9184	0.9184
Romania	0.9940	0.9968	0.9969	0.9969	0.9969	Netherlands	0.8381	0.9071	0.9103	0.9103	0.9103
Equatorial Guinea	0.7561	0.8540	0.8587	0.8587	0.8587	Bermuda	0.5090	0.6616	0.6701	0.6701	0.6701
Turkey	0.9412	0.9680	0.9691	0.9691	0.9691	Denmark	0.8356	0.9055	0.9087	0.9088	0.9088
Turkmenistan	0.7436	0.8455	0.8503	0.8504	0.8504	Anguilla	0.4951	0.6491	0.6577	0.6578	0.6578
Lithuania	0.9713	0.9846	0.9852	0.9852	0.9852	Belgium	0.8031	0.8850	0.8888	0.8888	0.8888
Russia	0.9752	0.9867	0.9872	0.9872	0.9872	Hong Kong	0.8085	0.8885	0.8922	0.8922	0.8922
Malta	0.9495	0.9726	0.9736	0.9736	0.9736	Ireland	0.7976	0.8815	0.8854	0.8854	0.8854
Slovakia	0.9766	0.9875	0.9879	0.9879	0.9879	Italy	0.7905	0.8768	0.8809	0.8809	0.8809
New Zealand	0.9538	0.9750	0.9759	0.9759	0.9759	Austria	0.7997	0.8828	0.8866	0.8867	0.8867
Croatia	0.9589	0.9778	0.9786	0.9786	0.9786	Cayman Islands	0.4676	0.6236	0.6325	0.6325	0.6325
Israel	0.9620	0.9795	0.9803	0.9803	0.9803	Switzerland	0.8163	0.8934	0.8970	0.8970	0.8970
Estonia	0.9532	0.9746	0.9755	0.9755	0.9755	Norway	0.8119	0.8907	0.8943	0.8943	0.8943
Antigua and Barbuda	0.6681	0.7916	0.7978	0.7978	0.7978	United Arab Emirates	0.7272	0.8342	0.8394	0.8394	0.8394
Hungary	0.9376	0.9659	0.9671	0.9672	0.9672	Macao	0.7329	0.8381	0.8432	0.8432	0.8432
Oman	0.6391	0.7696	0.7763	0.7763	0.7763	Montserrat	0.4242	0.5816	0.5908	0.5908	0.5908
Seychelles	0.6274	0.7606	0.7674	0.7674	0.7674	Brunei	0.7052	0.8186	0.8242	0.8242	0.8242
Kuwait	0.8265	0.8999	0.9032	0.9032	0.9032	Aruba	0.4116	0.5690	0.5783	0.5783	0.5783
South Korea	0.9226	0.9574	0.9589	0.9589	0.9589	Singapore	0.7815	0.8710	0.8752	0.8752	0.8752
Saint Kitts and Nevis	0.6079	0.7453	0.7524	0.7524	0.7524	Luxembourg	0.7446	0.8461	0.8510	0.8510	0.8510
Taiwan	0.8989	0.9437	0.9457	0.9457	0.9457	Qatar	0.6282	0.7612	0.7680	0.7680	0.7680

Table 18: Exploitation Intensity for Exploited Countries at select t - Model with exogenous technical change using proxies for human capital

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.1305	1.0652	1.0626	1.0626	1.0626	Guatemala	1.0791	1.0404	1.0388	1.0388	1.0388
Congo - Kinshasa	1.1292	1.0645	1.0620	1.0620	1.0620	Sudan	1.0676	1.0347	1.0334	1.0334	1.0334
Chad	1.1238	1.0620	1.0595	1.0595	1.0595	Syria	1.0928	1.0471	1.0453	1.0453	1.0453
Malawi	1.1297	1.0648	1.0622	1.0622	1.0622	Laos	1.0756	1.0387	1.0372	1.0372	1.0372
Mali	1.1241	1.0622	1.0597	1.0597	1.0597	Azerbaijan	1.0256	1.0134	1.0129	1.0129	1.0129
Guinea-Bissau	1.1186	1.0595	1.0572	1.0572	1.0572	Zambia	1.0908	1.0462	1.0444	1.0444	1.0444
Sierra Leone	1.1249	1.0625	1.0601	1.0600	1.0600	Moldova	1.1002	1.0507	1.0488	1.0488	1.0488
Liberia	1.1257	1.0629	1.0604	1.0604	1.0604	Fiji	1.0877	1.0446	1.0429	1.0429	1.0429
Mozambique	1.1198	1.0601	1.0577	1.0577	1.0577	India	1.0745	1.0381	1.0367	1.0367	1.0367
Central African Republic	1.1218	1.0611	1.0587	1.0586	1.0586	Georgia	1.0123	1.0065	1.0063	1.0063	1.0063
Madagascar	1.1225	1.0614	1.0590	1.0589	1.0589	Iraq	1.0728	1.0373	1.0359	1.0358	1.0358
Guinea	1.1121	1.0564	1.0542	1.0542	1.0542	Philippines	1.0822	1.0419	1.0403	1.0403	1.0403
Niger	1.1161	1.0583	1.0560	1.0560	1.0560	Paraguay	1.0800	1.0409	1.0393	1.0393	1.0393
Rwanda	1.1228	1.0615	1.0591	1.0591	1.0591	Armenia	1.0846	1.0431	1.0414	1.0414	1.0414
Burkina Faso	1.1158	1.0582	1.0559	1.0559	1.0559	Ghana	1.0686	1.0352	1.0339	1.0339	1.0339
Ethiopia	1.1112	1.0560	1.0538	1.0538	1.0538	Jordan	1.0753	1.0385	1.0371	1.0370	1.0370
Zimbabwe	1.1221	1.0612	1.0588	1.0588	1.0588	Congo - Brazzaville	1.0476	1.0247	1.0238	1.0238	1.0238
Togo	1.1144	1.0576	1.0553	1.0553	1.0553	Angola	1.0135	1.0071	1.0068	1.0068	1.0068
Benin	1.1147	1.0577	1.0554	1.0554	1.0554	Eswatini	1.0427	1.0222	1.0214	1.0214	1.0214
Gambia	1.1100	1.0555	1.0533	1.0533	1.0533	Peru	1.0666	1.0342	1.0329	1.0329	1.0329
Kenya	1.1175	1.0590	1.0567	1.0567	1.0567	Costa Rica	1.0458	1.0238	1.0229	1.0229	1.0229
Yemen	1.1111	1.0560	1.0538	1.0538	1.0538	Sri Lanka	1.0517	1.0267	1.0257	1.0257	1.0257
Uganda	1.1167	1.0586	1.0563	1.0563	1.0563	Morocco	1.0110	1.0058	1.0056	1.0056	1.0056
Nepal	1.1101	1.0555	1.0533	1.0533	1.0533	Namibia	1.0255	1.0133	1.0128	1.0128	1.0128
Cambodia	1.1116	1.0562	1.0540	1.0540	1.0540	Ukraine	1.0582	1.0300	1.0289	1.0289	1.0289
Ivory Coast	1.1063	1.0537	1.0516	1.0516	1.0516	Colombia	1.0374	1.0195	1.0188	1.0188	1.0188
Cameroon	1.1092	1.0550	1.0529	1.0529	1.0529	Tajikistan	1.0518	1.0268	1.0258	1.0258	1.0258
Pakistan	1.1062	1.0536	1.0515	1.0515	1.0515	Gabon	1.0443	1.0230	1.0221	1.0221	1.0221
Senegal	1.0970	1.0492	1.0473	1.0473	1.0473	South Africa	1.0436	1.0227	1.0218	1.0218	1.0218
Myanmar	1.1005	1.0509	1.0489	1.0489	1.0489	Mongolia	1.0486	1.0252	1.0242	1.0242	1.0242
Nigeria	1.1002	1.0507	1.0487	1.0487	1.0487	Maldives	1.0259	1.0136	1.0131	1.0131	1.0131
Mauritania	1.0966	1.0490	1.0471	1.0471	1.0471	Argentina	1.0461	1.0239	1.0230	1.0230	1.0230
Bangladesh	1.1012	1.0512	1.0492	1.0492	1.0492	Algeria	1.0189	1.0099	1.0095	1.0095	1.0095
Comoros	1.0665	1.0342	1.0328	1.0328	1.0328	Dominican Republic	1.0339	1.0177	1.0170	1.0170	1.0170
Kyrgyzstan	1.1151	1.0579	1.0556	1.0556	1.0556	Jamaica	1.0272	1.0142	1.0137	1.0137	1.0137
Tanzania	1.0924	1.0469	1.0451	1.0451	1.0451	Ecuador	1.0304	1.0159	1.0153	1.0153	1.0153
Haiti	1.0911	1.0463	1.0445	1.0445	1.0445	Bulgaria	1.0406	1.0211	1.0203	1.0203	1.0203
Lesotho	1.0917	1.0466	1.0448	1.0448	1.0448	Tunisia	1.0179	1.0094	1.0091	1.0091	1.0091
Bolivia	1.1086	1.0548	1.0526	1.0526	1.0526	Kazakhstan	1.0348	1.0181	1.0174	1.0174	1.0174
Uzbekistan	1.0586	1.0302	1.0290	1.0290	1.0290	Serbia	1.0378	1.0197	1.0189	1.0189	1.0189
Djibouti	1.0554	1.0286	1.0275	1.0275	1.0275	Albania	1.0236	1.0124	1.0119	1.0119	1.0119
Honduras	1.0993	1.0503	1.0483	1.0483	1.0483	Iran	1.0004	1.0002	1.0002	1.0002	1.0002
Vietnam	1.1045	1.0528	1.0507	1.0507	1.0507	Poland	1.0334	1.0174	1.0168	1.0168	1.0168
Egypt	1.1027	1.0519	1.0499	1.0499	1.0499	Mexico	1.0068	1.0036	1.0035	1.0035	1.0035
State of Palestine	1.0486	1.0252	1.0242	1.0242	1.0242	Thailand	1.0037	1.0019	1.0019	1.0019	1.0019
Belize	1.1095	1.0552	1.0530	1.0530	1.0530	Barbados	1.0054	1.0029	1.0028	1.0028	1.0028
Sao Tome and Principe	1.0436	1.0226	1.0218	1.0218	1.0218	Brazil	1.0096	1.0051	1.0049	1.0049	1.0049
Nicaragua	1.0897	1.0456	1.0438	1.0438	1.0438	Panama	1.0027	1.0014	1.0014	1.0014	1.0014
El Salvador	1.0878	1.0447	1.0430	1.0430	1.0430	Chile	1.0020	1.0010	1.0010	1.0010	1.0010

Figures 88 and 89 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 88: Distribution of wealth - Model with exogenous technical change using proxies for human capital

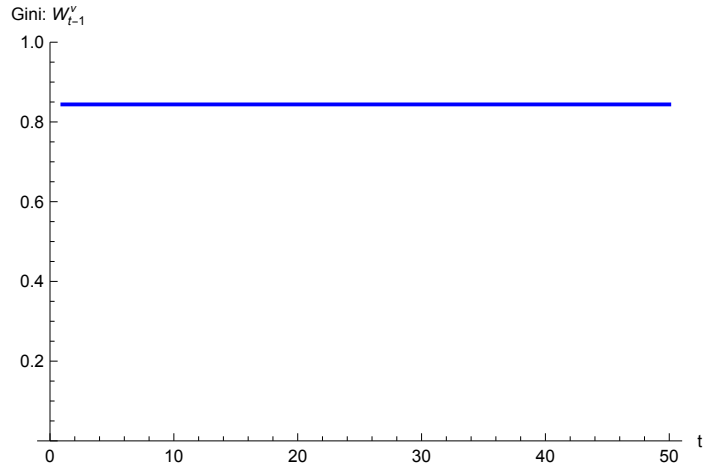
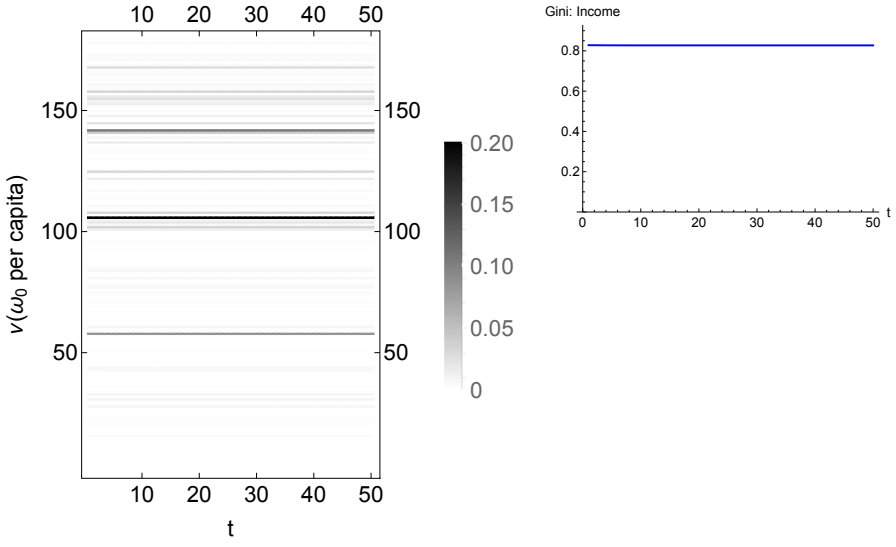


Figure 89: Distribution of Income - Model with exogenous technical change using proxies for human capital

(a) Distribution of Income Shares

(b) Gini Coefficient of Income



6.3 Proxies for Human Capital - Model with endogenous technical change and consumption

This subsection presents results for the simulation with proxies for human capital and endogenous technical change and consumption.

Figure 92 shows the exploitation and class status of the agents over the course of the simulation.

Figure 93(a) shows the distribution of e_t^ν across agents for all t. Figure 93(b) shows the Gini coefficient of e_t^ν.

Figures 94-96 show exploitation intensity versus initial wealth for all countries for select t.

Tables 19 and 20 report e_t^ν for exploiter and exploited countries, respectively, for the same select t as figures 94-96.

Figure 90: Summary results - Model with endogenous technical change and consumption using proxies for human capital

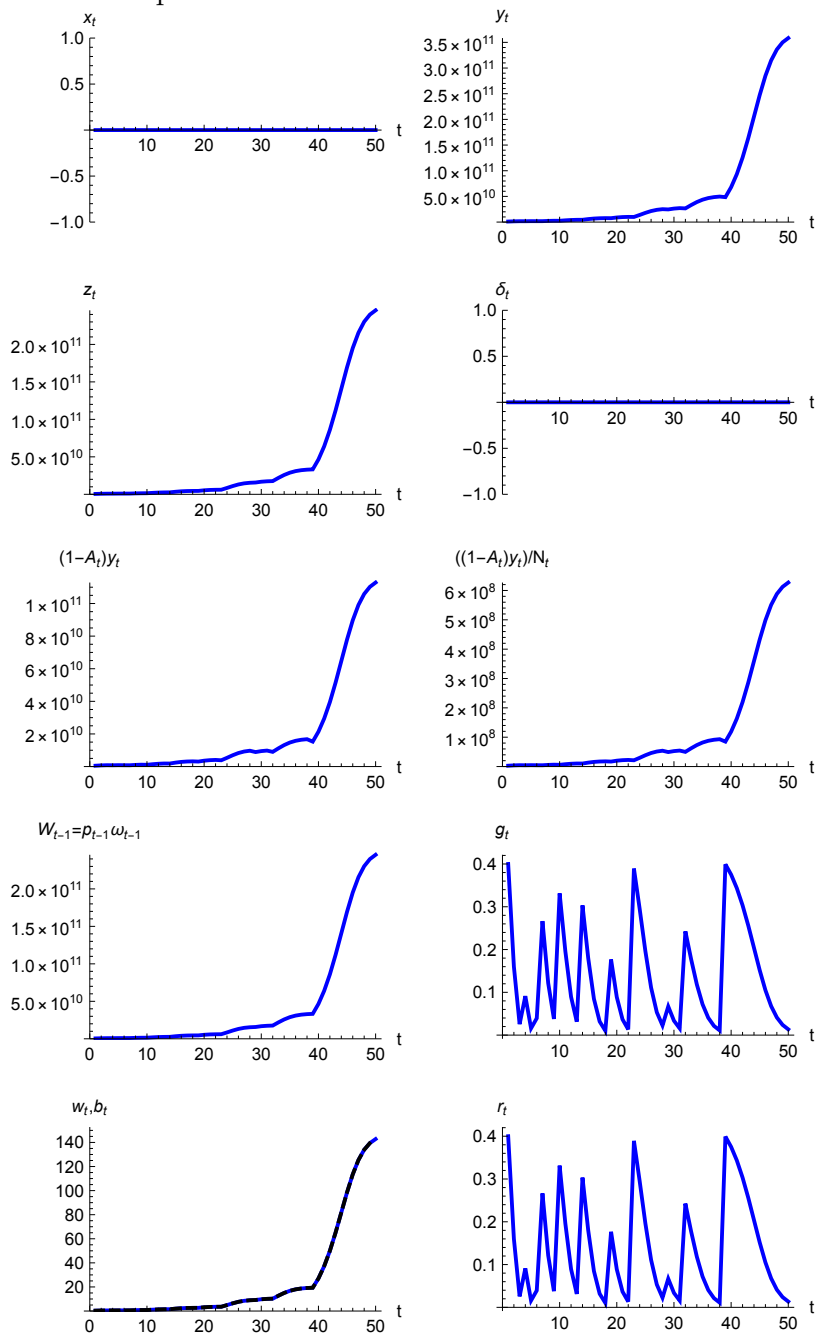


Figure 91: A_t, L_t, and labour values - Model with endogenous technical change and consumption using proxies for human capital

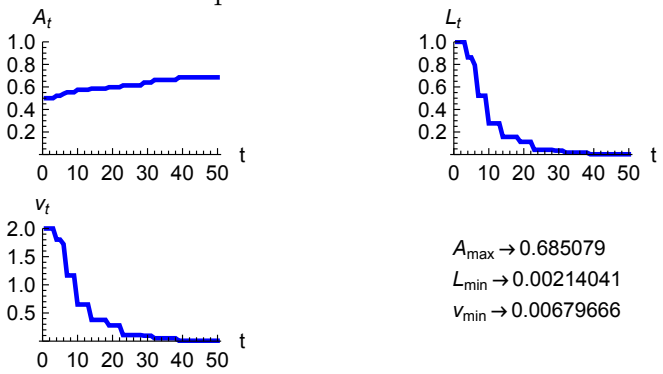
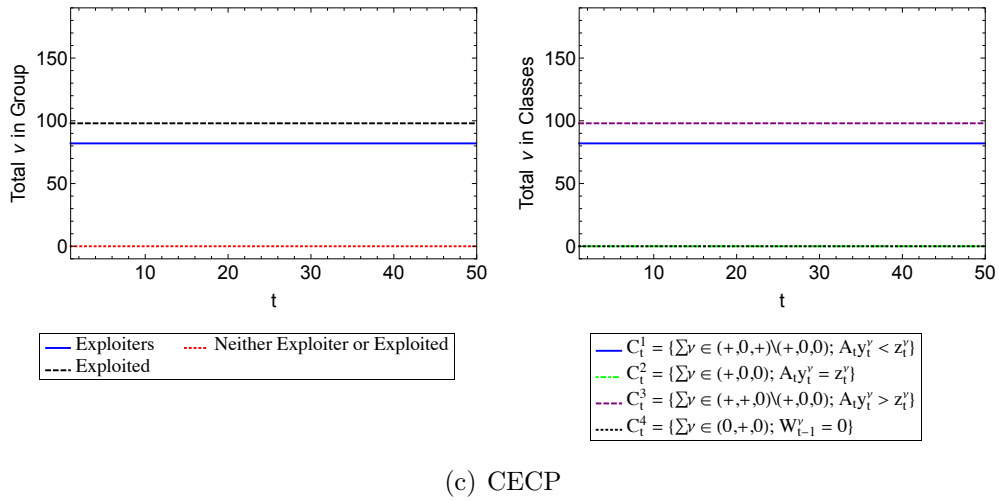


Figure 92: Class and exploitation status - Model with endogenous technical change and consumption using proxies for human capital

(a) Exploitation status

(b) Class status



(c) CECP

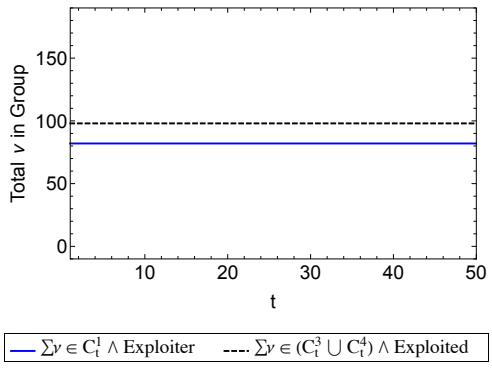
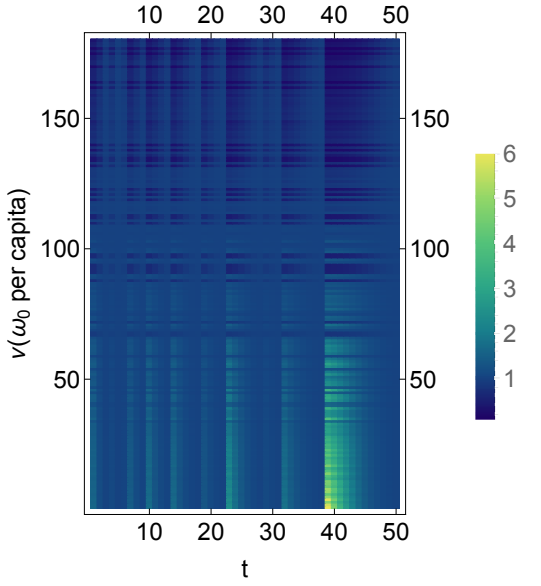


Figure 93: Exploitation intensity index - Model with endogenous technical change and consumption using proxies for human capital

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^{ν}

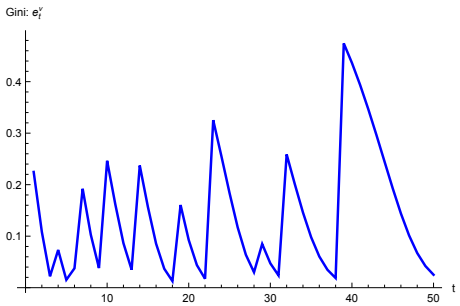
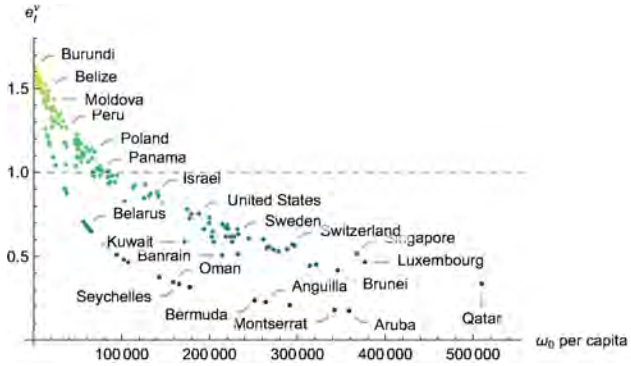
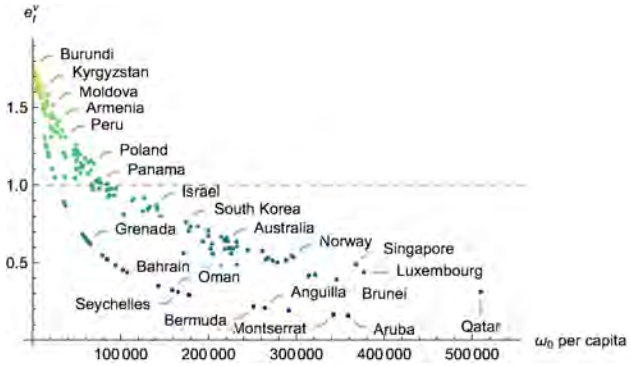


Figure 94: Worldwide Exploitation Intensity - Model with endogenous technical change and consumption using proxies for human capital

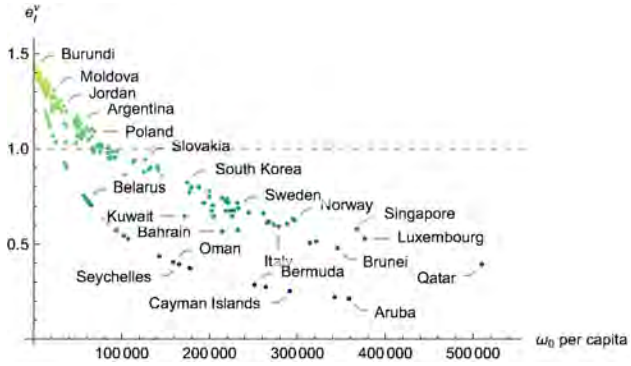
(a) $t = 1$



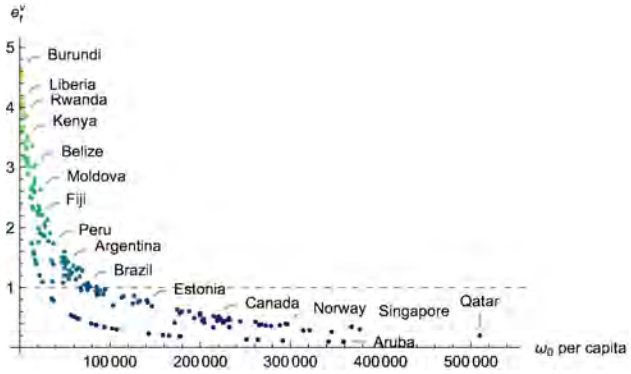
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

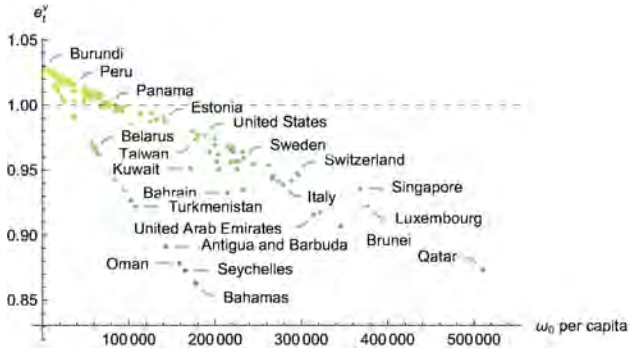
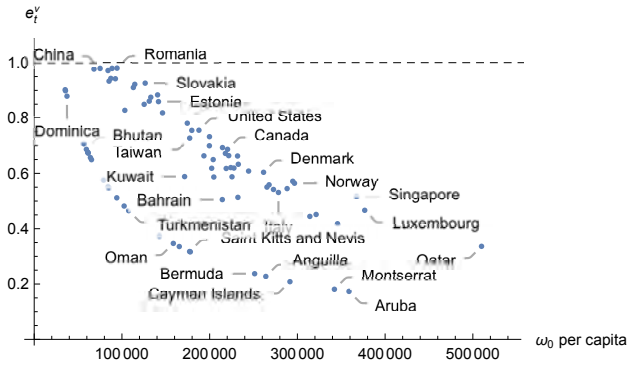
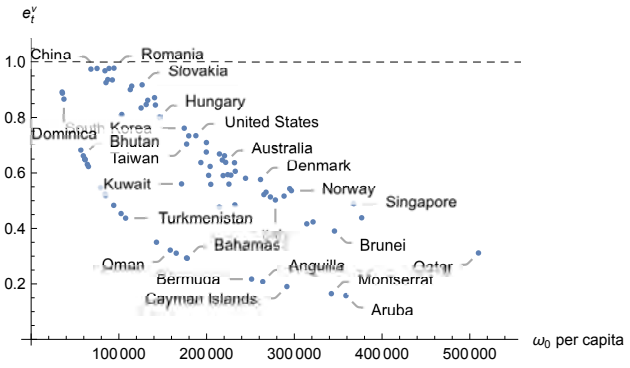


Figure 95: Exploiter Countries - Model with endogenous technical change and consumption using proxies for human capital

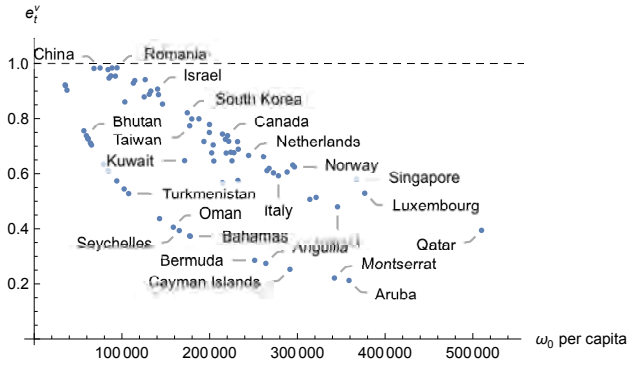
(a) $t = 1$



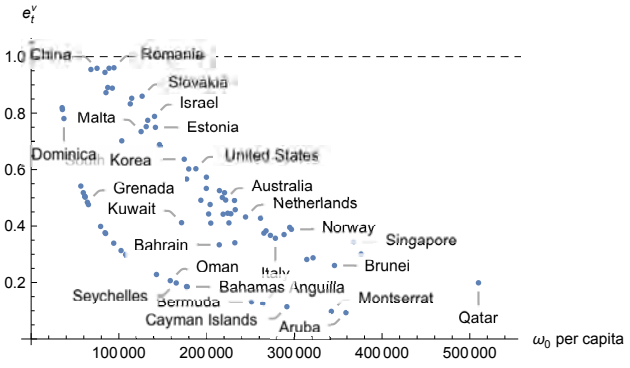
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

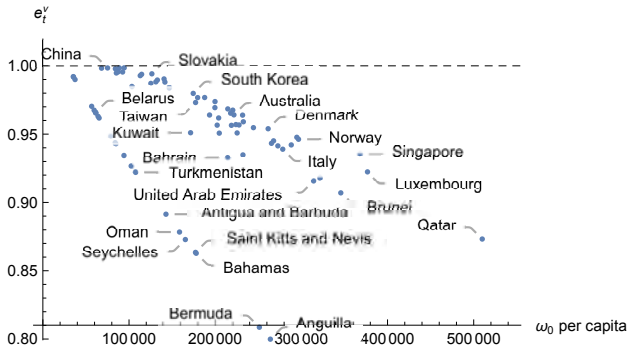
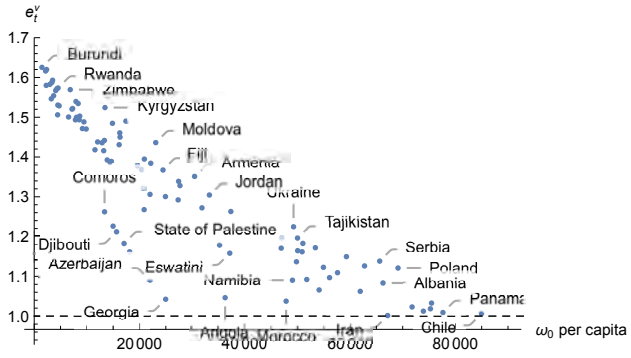
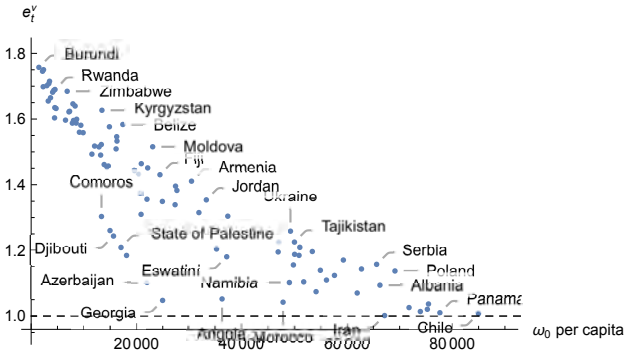


Figure 96: Exploited Countries - Model with endogenous technical change and consumption using proxies for human capital

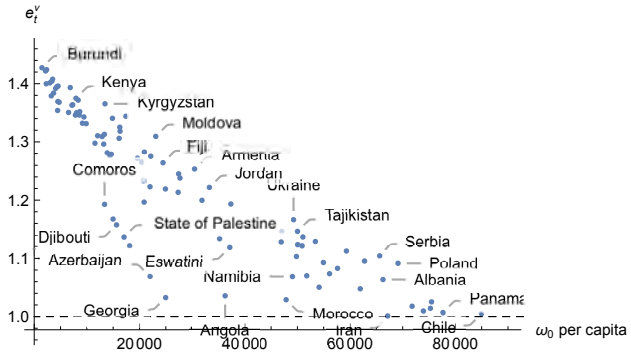
(a) $t = 1$



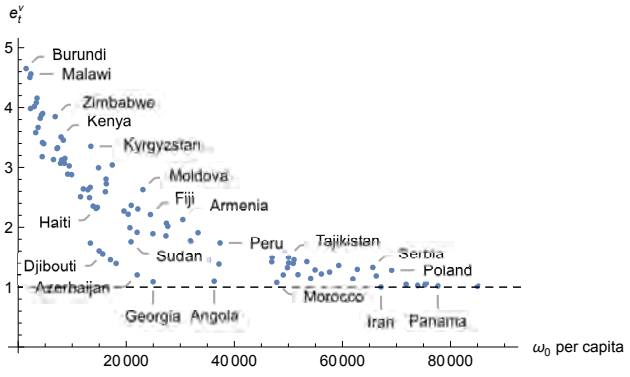
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

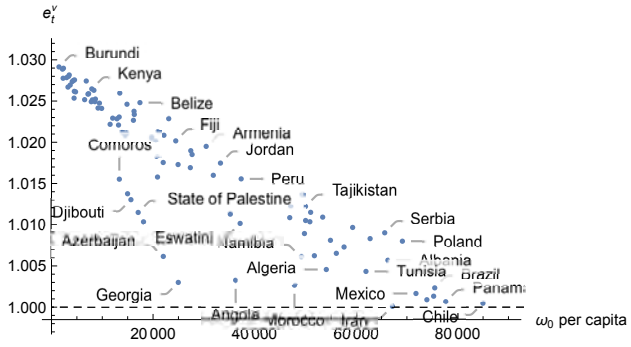


Table 19: Exploitation Intensity for Exploiter Countries at select t - Model with endogenous technical change and consumption using proxies for human capital

	e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}		e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}
Cape Verde	0.9024	0.8919	0.9224	0.8192	0.9921	Bahamas	0.3164	0.2924	0.3729	0.1849	0.8628
Bosnia and Herzegovina	0.8985	0.8877	0.9192	0.8127	0.9918	Japan	0.7555	0.7339	0.7988	0.6023	0.9767
Dominica	0.8790	0.8664	0.9032	0.7807	0.9900	United States	0.7560	0.7345	0.7993	0.6029	0.9768
North Macedonia	0.7068	0.6827	0.7560	0.5416	0.9704	Trinidad and Tobago	0.6634	0.6376	0.7169	0.4913	0.9640
Bhutan	0.6869	0.6620	0.7382	0.5182	0.9675	Finland	0.6998	0.6755	0.7497	0.5333	0.9694
Saint Lucia	0.6762	0.6509	0.7286	0.5058	0.9660	United Kingdom	0.7325	0.7097	0.7788	0.5731	0.9738
Belarus	0.6753	0.6499	0.7277	0.5048	0.9658	Cyprus	0.6185	0.5914	0.6757	0.4428	0.9566
Montenegro	0.6729	0.6475	0.7256	0.5021	0.9655	Latvia	0.6498	0.6236	0.7046	0.4763	0.9619
Grenada	0.6571	0.6311	0.7112	0.4843	0.9630	Saudi Arabia	0.5867	0.5590	0.6460	0.4103	0.9507
Turks and Caicos Islands	0.6495	0.6232	0.7042	0.4759	0.9618	Bahrain	0.5052	0.4769	0.5675	0.3336	0.9328
Indonesia	0.9772	0.9746	0.9822	0.9546	0.9983	Czech Republic	0.6932	0.6686	0.7438	0.5255	0.9685
China	0.9793	0.9769	0.9838	0.9587	0.9984	Slovenia	0.6721	0.6466	0.7248	0.5012	0.9653
Lebanon	0.5749	0.5470	0.6348	0.3986	0.9484	Greece	0.6177	0.5906	0.6750	0.4420	0.9564
Venezuela	0.9718	0.9686	0.9780	0.9442	0.9979	Canada	0.6869	0.6620	0.7382	0.5182	0.9675
Suriname	0.5517	0.5236	0.6127	0.3763	0.9436	Australia	0.6641	0.6383	0.7176	0.4921	0.9641
Saint Vincent and the Grenadines	0.5490	0.5208	0.6101	0.3737	0.9430	France	0.6209	0.5939	0.6779	0.4453	0.9570
Mauritius	0.9332	0.9258	0.9473	0.8726	0.9948	Spain	0.5875	0.5598	0.6467	0.4111	0.9509
Uruguay	0.9433	0.9369	0.9553	0.8907	0.9956	Iceland	0.6192	0.5921	0.6763	0.4435	0.9567
Malaysia	0.9794	0.9770	0.9839	0.9588	0.9985	Germany	0.6628	0.6370	0.7164	0.4907	0.9639
Botswana	0.9420	0.9355	0.9543	0.8884	0.9955	Portugal	0.5133	0.4849	0.5754	0.3407	0.9348
British Virgin Islands	0.5116	0.4833	0.5738	0.3393	0.9344	Sweden	0.6328	0.6061	0.6890	0.4579	0.9591
Romania	0.9803	0.9780	0.9846	0.9606	0.9985	Netherlands	0.6082	0.5809	0.6662	0.4321	0.9547
Equatorial Guinea	0.4819	0.4537	0.5445	0.3131	0.9267	Bermuda	0.2372	0.2173	0.2855	0.1323	0.8086
Turkey	0.8277	0.8109	0.8606	0.7019	0.9849	Denmark	0.6039	0.5764	0.6620	0.4276	0.9539
Turkmenistan	0.4652	0.4371	0.5278	0.2989	0.9220	Anguilla	0.2273	0.2080	0.2743	0.1260	0.7999
Lithuania	0.9104	0.9007	0.9289	0.8328	0.9928	Belgium	0.5503	0.5221	0.6112	0.3749	0.9433
Russia	0.9219	0.9133	0.9381	0.8526	0.9938	Hong Kong	0.5588	0.5307	0.6194	0.3830	0.9451
Malta	0.8495	0.8344	0.8788	0.7345	0.9871	Ireland	0.5418	0.5135	0.6031	0.3669	0.9414
Slovakia	0.9260	0.9179	0.9415	0.8599	0.9942	Italy	0.5309	0.5026	0.5926	0.3568	0.9390
New Zealand	0.8609	0.8468	0.8883	0.7521	0.9883	Austria	0.5449	0.5167	0.6061	0.3699	0.9421
Croatia	0.8751	0.8622	0.9000	0.7745	0.9896	Cayman Islands	0.2085	0.1904	0.2530	0.1144	0.7817
Israel	0.8837	0.8715	0.9071	0.7883	0.9904	Switzerland	0.5713	0.5434	0.6314	0.3952	0.9477
Estonia	0.8593	0.8450	0.8870	0.7496	0.9881	Norway	0.5643	0.5363	0.6247	0.3883	0.9462
Antigua and Barbuda	0.3765	0.3503	0.4370	0.2284	0.8914	United Arab Emirates	0.4444	0.4166	0.5069	0.2816	0.9158
Hungary	0.8184	0.8009	0.8528	0.6884	0.9839	Macao	0.4515	0.4236	0.5140	0.2875	0.9179
Oman	0.3469	0.3217	0.4057	0.2066	0.8783	Montserrat	0.1810	0.1648	0.2212	0.0977	0.7502
Seychelles	0.3356	0.3108	0.3936	0.1984	0.8728	Brunei	0.4179	0.3905	0.4798	0.2603	0.9070
Kuwait	0.5883	0.5606	0.6474	0.4119	0.9510	Aruba	0.1735	0.1578	0.2124	0.0933	0.7404
South Korea	0.7814	0.7614	0.8212	0.6366	0.9798	Singapore	0.5177	0.4893	0.5797	0.3447	0.9358
Saint Kitts and Nevis	0.3175	0.2934	0.3742	0.1857	0.8634	Luxembourg	0.4665	0.4384	0.5291	0.3000	0.9224
Taiwan	0.7272	0.7042	0.7741	0.5665	0.9731	Qatar	0.3363	0.3115	0.3944	0.1990	0.8732

Table 20: Exploitation Intensity for Exploited Countries at select t - Model with endogenous technical change and consumption using proxies for human capital

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.6254	1.7574	1.4274	4.6517	1.0291	Guatemala	1.3231	1.3765	1.2346	1.9929	1.0183
Congo - Kinshasa	1.6163	1.7456	1.4219	4.5038	1.0289	Sudan	1.2677	1.3098	1.1966	1.7568	1.0158
Chad	1.5801	1.6984	1.3999	3.9839	1.0278	Syria	1.3947	1.4641	1.2824	2.3660	1.0213
Malawi	1.6200	1.7503	1.4241	4.5620	1.0290	Laos	1.3061	1.3559	1.2230	1.9161	1.0175
Mali	1.5826	1.7016	1.4014	4.0165	1.0278	Azerbaijan	1.0906	1.1027	1.0691	1.2042	1.0062
Guinea-Bissau	1.5463	1.6549	1.3791	3.5817	1.0267	Zambia	1.3842	1.4512	1.2755	2.3057	1.0209
Sierra Leone	1.5875	1.7080	1.4044	4.0819	1.0280	Moldova	1.4362	1.5156	1.3095	2.6290	1.0229
Liberia	1.5930	1.7151	1.4078	4.1572	1.0282	Fiji	1.3674	1.4305	1.2643	2.2130	1.0202
Mozambique	1.5540	1.6648	1.3839	3.6676	1.0269	India	1.3005	1.3492	1.2192	1.8919	1.0173
Central African Republic	1.5671	1.6817	1.3920	3.8217	1.0274	Georgia	1.0424	1.0477	1.0327	1.0904	1.0030
Madagascar	1.5715	1.6874	1.3947	3.8757	1.0275	Iraq	1.2922	1.3392	1.2135	1.8563	1.0169
Guinea	1.5061	1.6035	1.3540	3.1800	1.0254	Philippines	1.3388	1.3956	1.2452	2.0676	1.0190
Niger	1.5306	1.6348	1.3694	3.4159	1.0262	Paraguay	1.3281	1.3825	1.2380	2.0160	1.0185
Rwanda	1.5736	1.6900	1.3959	3.9010	1.0276	Armenia	1.3513	1.4108	1.2536	2.1293	1.0195
Burkina Faso	1.5287	1.6323	1.3682	3.3965	1.0261	Ghana	1.2722	1.3151	1.1997	1.7745	1.0160
Ethiopia	1.5006	1.5966	1.3506	3.1312	1.0252	Jordan	1.3044	1.3540	1.2219	1.9090	1.0175
Zimbabwe	1.5694	1.6846	1.3933	3.8489	1.0274	Congo - Brazzaville	1.1787	1.2045	1.1337	1.4478	1.0113
Togo	1.5204	1.6218	1.3630	3.3150	1.0258	Angola	1.0463	1.0522	1.0357	1.0993	1.0033
Benin	1.5218	1.6236	1.3639	3.3288	1.0259	Eswatini	1.1583	1.1807	1.1190	1.3865	1.0102
Gambia	1.4935	1.5876	1.3461	3.0686	1.0249	Peru	1.2629	1.3041	1.1933	1.7384	1.0156
Kenya	1.5396	1.6463	1.3750	3.5091	1.0265	Costa Rica	1.1709	1.1954	1.1281	1.4240	1.0109
Yemen	1.4999	1.5957	1.3501	3.1246	1.0251	Sri Lanka	1.1959	1.2248	1.1461	1.5021	1.0122
Uganda	1.5345	1.6397	1.3718	3.4555	1.0263	Morocco	1.0375	1.0422	1.0290	1.0797	1.0027
Nepal	1.4936	1.5877	1.3462	3.0697	1.0249	Namibia	1.0902	1.1021	1.0688	1.2031	1.0061
Cambodia	1.5028	1.5994	1.3520	3.1508	1.0252	Ukraine	1.2245	1.2585	1.1664	1.5977	1.0137
Ivory Coast	1.4715	1.5598	1.3321	2.8878	1.0241	Colombia	1.1367	1.1557	1.1032	1.3251	1.0089
Cameroon	1.4883	1.5811	1.3428	3.0249	1.0247	Tajikistan	1.1963	1.2251	1.1463	1.5031	1.0122
Pakistan	1.4704	1.5585	1.3314	2.8792	1.0241	Gabon	1.1646	1.1881	1.1236	1.4052	1.0105
Senegal	1.4181	1.4931	1.2977	2.5097	1.0222	South Africa	1.1618	1.1849	1.1216	1.3970	1.0104
Myanmar	1.4379	1.5177	1.3106	2.6408	1.0229	Mongolia	1.1828	1.2093	1.1367	1.4604	1.0115
Nigeria	1.4359	1.5152	1.3092	2.6267	1.0228	Maldives	1.0920	1.1042	1.0702	1.2076	1.0062
Mauritania	1.4158	1.4902	1.2962	2.4949	1.0221	Argentina	1.1720	1.1967	1.1289	1.4274	1.0109
Bangladesh	1.4417	1.5224	1.3130	2.6669	1.0231	Algeria	1.0658	1.0743	1.0505	1.1442	1.0046
Comoros	1.2622	1.3032	1.1928	1.7354	1.0155	Dominican Republic	1.1227	1.1395	1.0929	1.2869	1.0081
Kyrgyzstan	1.5243	1.6267	1.3655	3.3529	1.0260	Jamaica	1.0967	1.1096	1.0737	1.2193	1.0065
Tanzania	1.3925	1.4614	1.2810	2.3534	1.0212	Ecuador	1.1092	1.1239	1.0829	1.2513	1.0073
Haiti	1.3858	1.4531	1.2765	2.3145	1.0209	Bulgaria	1.1496	1.1706	1.1127	1.3614	1.0097
Lesotho	1.3889	1.4569	1.2786	2.3324	1.0210	Tunisia	1.0623	1.0703	1.0478	1.1358	1.0043
Bolivia	1.4847	1.5765	1.3405	2.9944	1.0246	Kazakhstan	1.1261	1.1435	1.0955	1.2962	1.0083
Uzbekistan	1.2261	1.2603	1.1675	1.6031	1.0138	Serbia	1.1383	1.1575	1.1044	1.3295	1.0090
Djibouti	1.2119	1.2436	1.1575	1.5546	1.0130	Albania	1.0833	1.0943	1.0637	1.1861	1.0057
Honduras	1.4310	1.5091	1.3061	2.5937	1.0227	Iran	1.0014	1.0015	1.0011	1.0028	1.0001
Vietnam	1.4607	1.5463	1.3252	2.8049	1.0238	Poland	1.1209	1.1374	1.0916	1.2820	1.0080
Egypt	1.4500	1.5329	1.3184	2.7262	1.0234	Mexico	1.0230	1.0258	1.0178	1.0481	1.0017
State of Palestine	1.1825	1.2090	1.1365	1.4596	1.0115	Thailand	1.0123	1.0138	1.0096	1.0255	1.0009
Belize	1.4903	1.5835	1.3441	3.0411	1.0248	Barbados	1.0184	1.0206	1.0142	1.0382	1.0013
Sao Tome and Principe	1.1617	1.1847	1.1215	1.3966	1.0103	Brazil	1.0327	1.0368	1.0253	1.0691	1.0023
Nicaragua	1.3781	1.4436	1.2714	2.2713	1.0206	Panama	1.0090	1.0101	1.0070	1.0185	1.0007
El Salvador	1.3683	1.4316	1.2649	2.2181	1.0202	Chile	1.0066	1.0074	1.0051	1.0135	1.0005

Figures 97 and 98 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 97: Distribution of wealth - Model with endogenous technical change and consumption using proxies for human capital

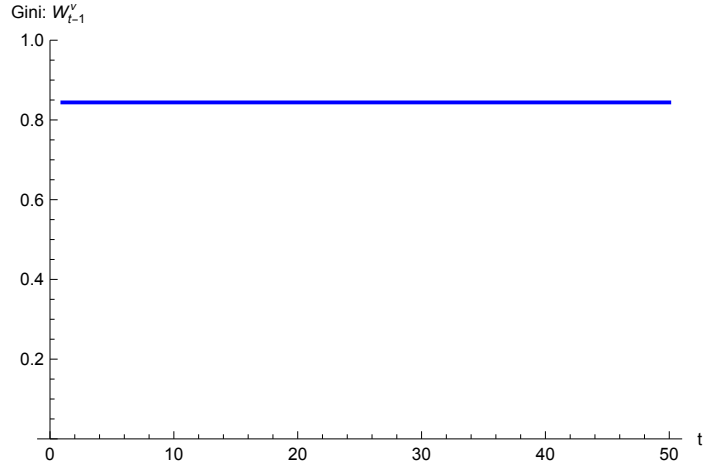
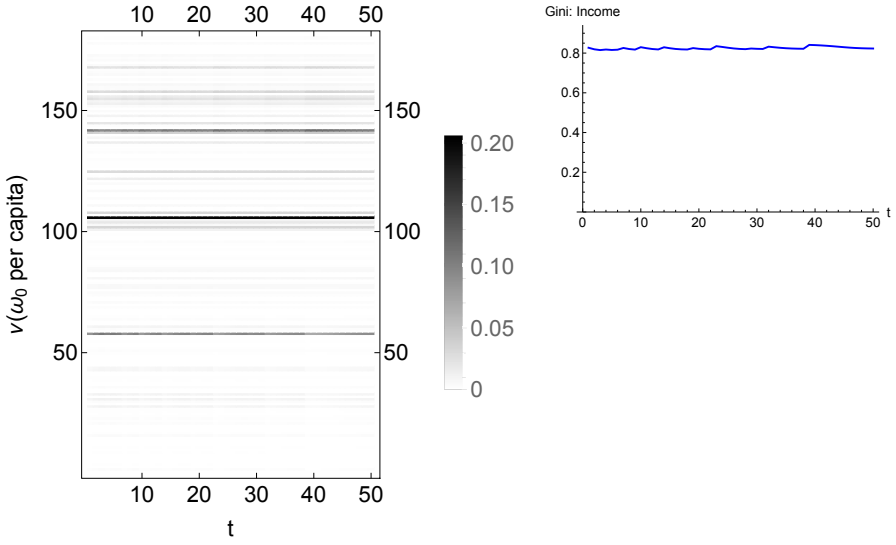


Figure 98: Distribution of Income - Model with endogenous technical change and consumption using proxies for human capital

(a) Distribution of Income Shares

(b) Gini Coefficient of Income



7 Persons Engaged

This section presents results for simulations that use the Penn World Table [2] data on persons engaged to determine countries' labour endowments rather than population. The persons engaged in each country is multiplied by 1,000,000 to scale labour capacities to ensure the simulations begin from a capital constrained state. With the available data $N = 171$ for this method of determining labour endowments. All other parameters are the same as the main simulations. This alternative specification of labour endowments is run for the basic model, the model with exogenous technical change and endogenous consumption, and the model with endogenous technical change and consumption.

7.1 Persons Engaged - Basic Model

Figure 99 reports the summary results.

Figure 100 shows the exploitation and class status of the agents over the course of the simulation.

Figure 101(a) shows the distribution of e_t^ν across agents for all t. Figure 101(b) shows that the Gini coefficient of e_t^ν.

Figures 102-104 show exploitation intensity versus initial wealth for all countries for $t = 1$ to provide a sense of how countries fall into being exploiters or exploited. As in the basic model in the main simulations, countries' positions in the hierarchy of exploitation status do not change over t.

Tables 21 and 22 report e_t^ν for exploiter and exploited countries, respectively, for $t = 1$, as in figures 102-104.

Figures 105 and 106 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 99: Summary results - Basic model using persons engaged

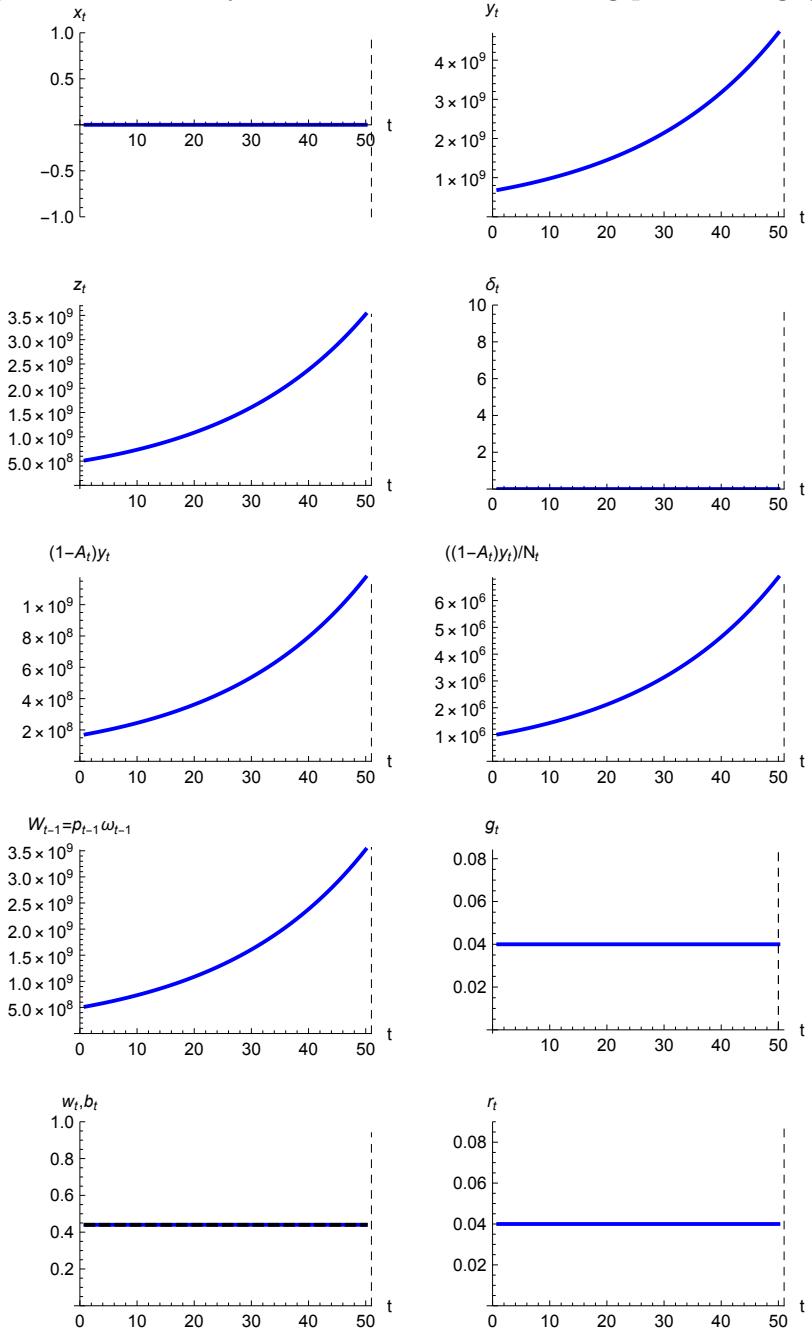
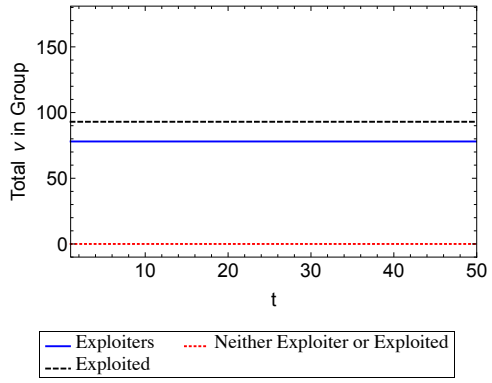
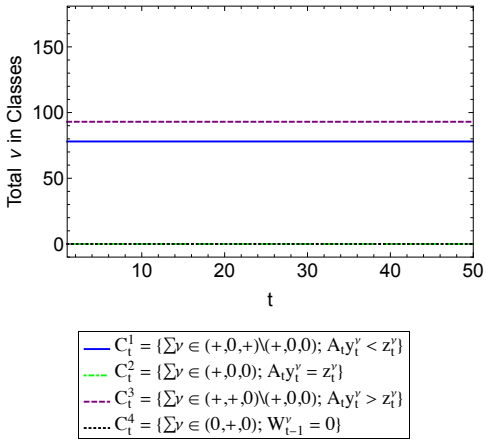


Figure 100: Class and exploitation status - Basic model using persons engaged

(a) Exploitation status



(b) Class status



(c) CECP

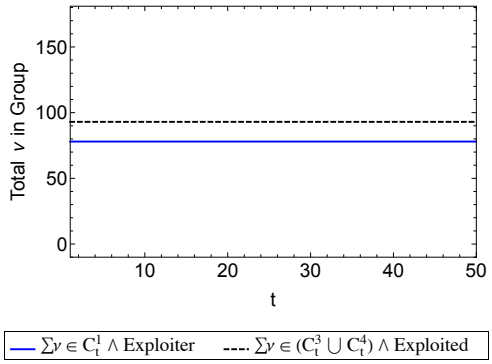
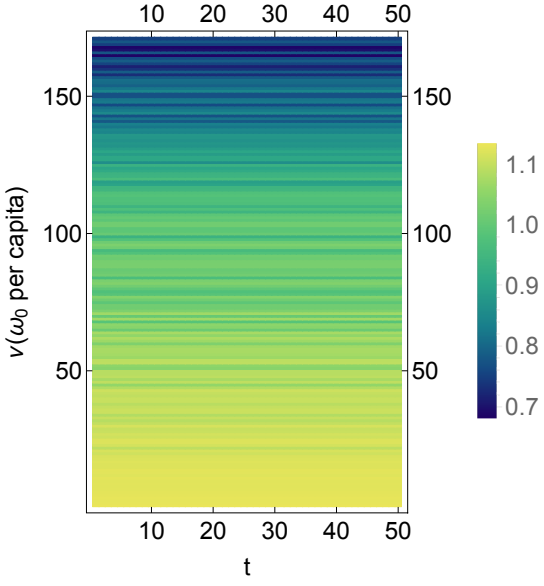


Figure 101: Exploitation intensity index - Basic model using persons engaged

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^ν

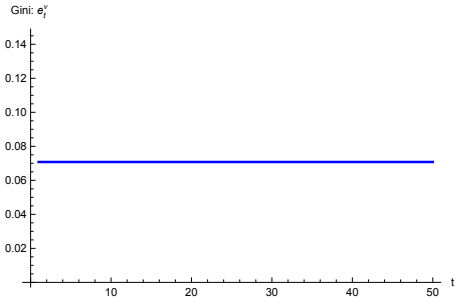


Figure 102: Worldwide Exploitation Intensity - Basic model using persons engaged

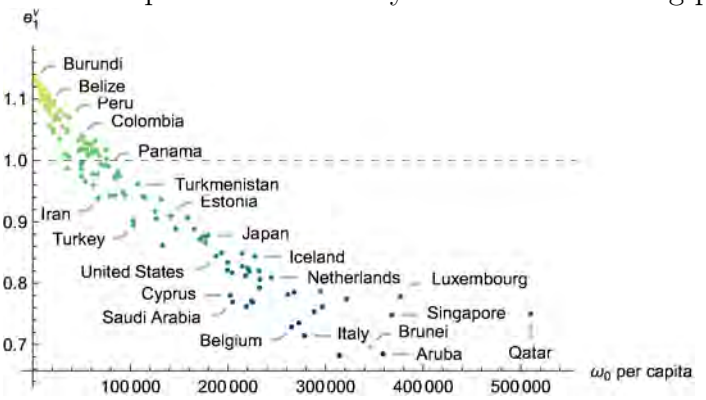


Figure 103: Exploiter Countries -Basic model using persons engaged

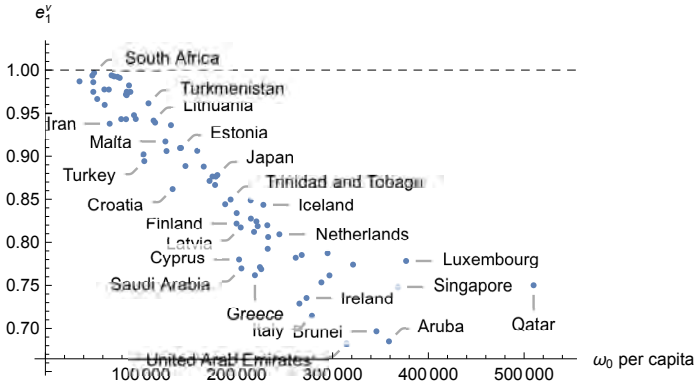


Figure 104: Exploited Countries - Basic model using persons engaged

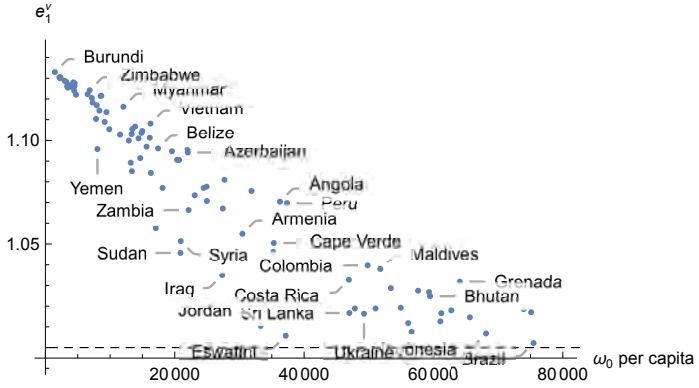


Table 21: Exploitation Intensity for Exploiter Countries at $t = 1$ - Basic model using persons engaged

	e_1^ν		e_1^ν
Bosnia and Herzegovina	0.9869	South Korea	0.8764
Namibia	0.9936	Taiwan	0.8666
Tajikistan	0.9860	Bahamas	0.8763
Gabon	0.9747	Japan	0.8781
South Africa	0.9968	United States	0.8442
Algeria	0.9664	Trinidad and Tobago	0.8497
Montenegro	0.9775	Finland	0.8218
Tunisia	0.9596	United Kingdom	0.8339
Albania	0.9774	Cyprus	0.7801
Iran	0.9377	Latvia	0.8173
Poland	0.9939	Saudi Arabia	0.7697
Mexico	0.9927	Bahrain	0.8488
Barbados	0.9922	Czech Republic	0.8275
Panama	0.9909	Slovenia	0.8121
Lebanon	0.9431	Greece	0.7618
Venezuela	0.9717	Canada	0.8243
Suriname	0.9430	Australia	0.8188
Saint Vincent and the Grenadines	0.9709	France	0.7712
Chile	0.9748	Spain	0.7688
Mauritius	0.9728	Iceland	0.8435
Uruguay	0.9822	Germany	0.8198
Malaysia	0.9747	Portugal	0.7925
Botswana	0.9476	Sweden	0.8062
Romania	0.9432	Netherlands	0.8093
Equatorial Guinea	0.9021	Denmark	0.7821
Turkey	0.8943	Belgium	0.7289
Turkmenistan	0.9614	Hong Kong	0.7853
Lithuania	0.9414	Ireland	0.7354
Russia	0.9390	Italy	0.7147
Malta	0.9171	Austria	0.7535
Slovakia	0.9060	Switzerland	0.7874
New Zealand	0.9360	Norway	0.7616
Croatia	0.8618	United Arab Emirates	0.6822
Israel	0.9095	Macao	0.7741
Estonia	0.9096	Brunei	0.6967
Hungary	0.8886	Aruba	0.6850
Oman	0.9062	Singapore	0.7482
Seychelles	0.8879	Luxembourg	0.7783
Kuwait	0.8713	Qatar	0.7502

Figure 105: Distribution of wealth - Basic model with using persons engaged

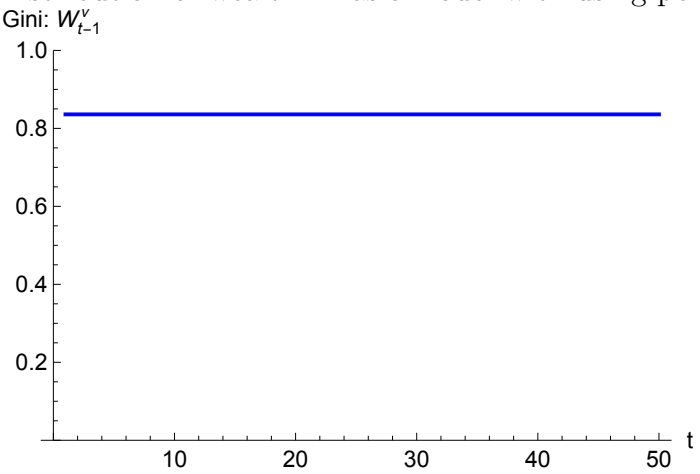
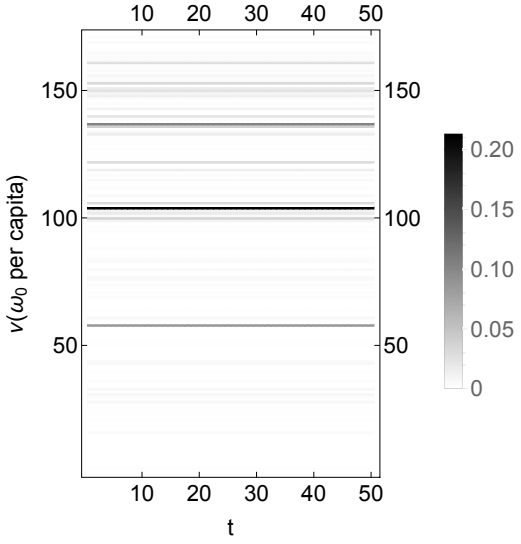


Table 22: Exploitation Intensity for Exploited Countries at $t = 1$ - Basic model using persons engaged

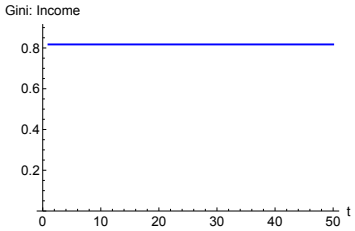
	e_1^ν		e_1^ν
Burundi	1.1329	Nicaragua	1.0948
Congo - Kinshasa	1.1305	El Salvador	1.0906
Chad	1.1300	Guatemala	1.0906
Malawi	1.1304	Sudan	1.0457
Mali	1.1288	Syria	1.0514
Guinea-Bissau	1.1282	Laos	1.0958
Sierra Leone	1.1260	Azerbaijan	1.0942
Liberia	1.1255	Zambia	1.0664
Mozambique	1.1266	Moldova	1.0735
Central African Republic	1.1258	Fiji	1.0771
Madagascar	1.1280	India	1.0777
Guinea	1.1240	Georgia	1.0708
Niger	1.1262	Iraq	1.0350
Rwanda	1.1276	Philippines	1.0671
Burkina Faso	1.1221	Paraguay	1.0810
Ethiopia	1.1223	Armenia	1.0549
Zimbabwe	1.1242	Ghana	1.0756
Togo	1.1205	Jordan	1.0104
Benin	1.1183	Congo - Brazzaville	1.0461
Gambia	1.1104	Cape Verde	1.0505
Kenya	1.1169	Angola	1.0705
Yemen	1.0958	Eswatini	1.0057
Uganda	1.1144	Peru	1.0697
Nepal	1.1215	Costa Rica	1.0328
Cambodia	1.1215	Sri Lanka	1.0167
Ivory Coast	1.1089	Morocco	1.0189
Cameroon	1.1136	Ukraine	1.0164
Pakistan	1.1054	Colombia	1.0397
Senegal	1.1028	Mongolia	1.0189
Myanmar	1.1162	Maldives	1.0380
Nigeria	1.0999	Argentina	1.0287
Mauritania	1.0892	Dominican Republic	1.0192
Bangladesh	1.1031	Jamaica	1.0118
Comoros	1.0851	North Macedonia	1.0076
Kyrgyzstan	1.1055	Ecuador	1.0274
Tanzania	1.1067	Bulgaria	1.0268
Haiti	1.1010	Bhutan	1.0248
Lesotho	1.0915	Saint Lucia	1.0127
Bolivia	1.1036	Belarus	1.0166
Uzbekistan	1.1045	Kazakhstan	1.0180
Djibouti	1.0970	Grenada	1.0318
Honduras	1.1013	Serbia	1.0146
Vietnam	1.1081	Indonesia	1.0068
Egypt	1.0843	Thailand	1.0185
State of Palestine	1.0577	China	1.0171
Belize	1.0961	Brazil	1.0022
Sao Tome and Principe	1.0771		

Figure 106: Distribution of Income - Basic model using persons engaged

(a) Distribution of Income Shares



(b) Gini Coefficient of Income



7.2 Persons Engaged - Model with Exogenous Technical Change and Endogenous Consumption

This subsection presents results for the simulation using persons engaged to determine labour endowments with exogenous technical change and endogenous consumption.

Figure 109 shows the exploitation and class status of the agents over the course of the simulation.

Figure 110(a) shows the distribution of e_t^ν across agents for all t. Figure 110(b) shows the Gini coefficient of e_t^ν.

Figures 111-113 show exploitation intensity versus initial wealth for all countries for select t.

Tables 23 and 24 report e_t^ν for exploiter and exploited countries, respectively, for the same select t as figures 111-113.

Figure 107: Summary results - Model with exogenous technical change using persons engaged

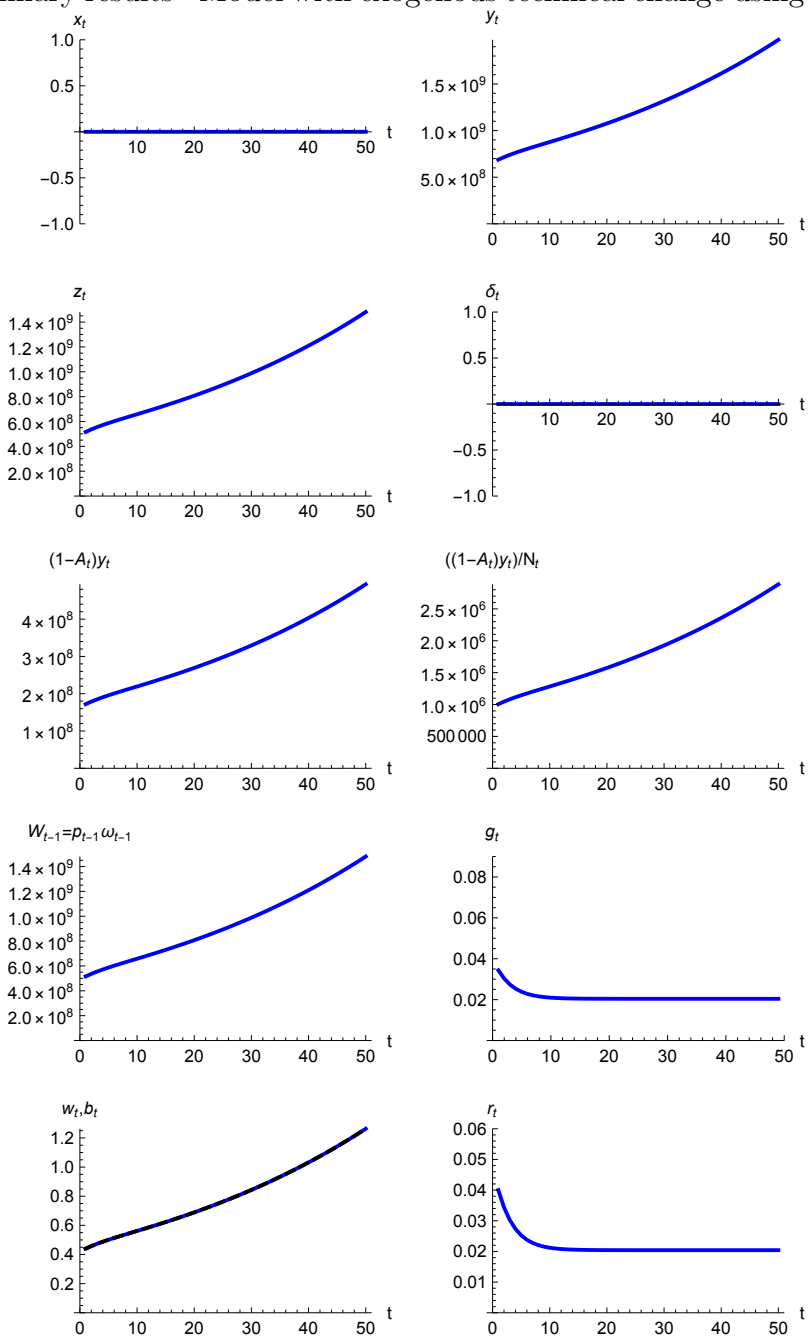


Figure 108: L_t and labour values - Model with exogenous technical change using persons engaged

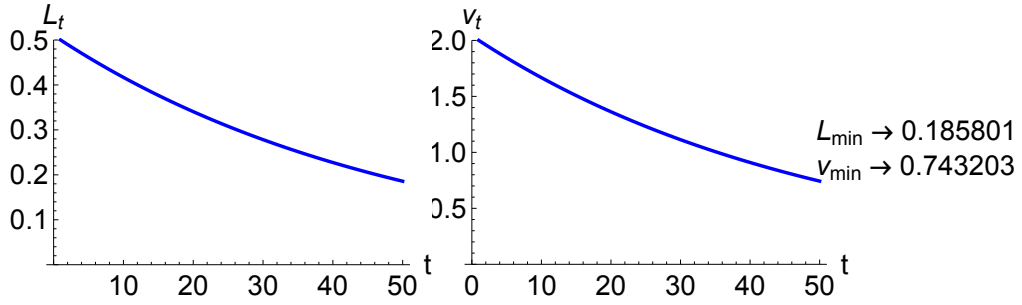
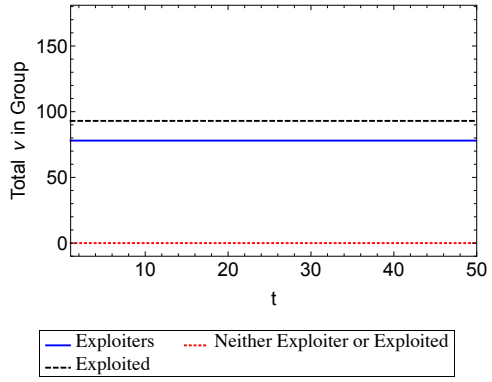
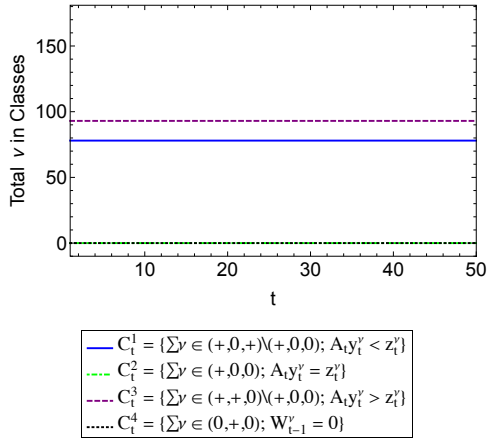


Figure 109: Class and exploitation status - Model with exogenous technical change using persons engaged

(a) Exploitation status



(b) Class status



(c) CECP

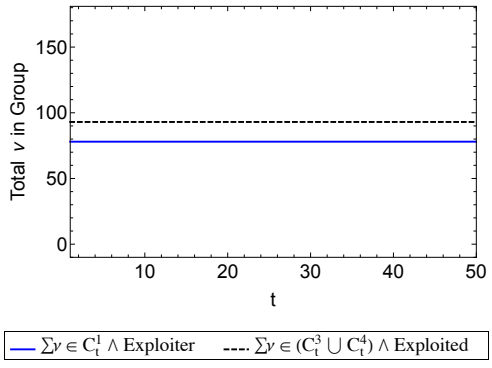
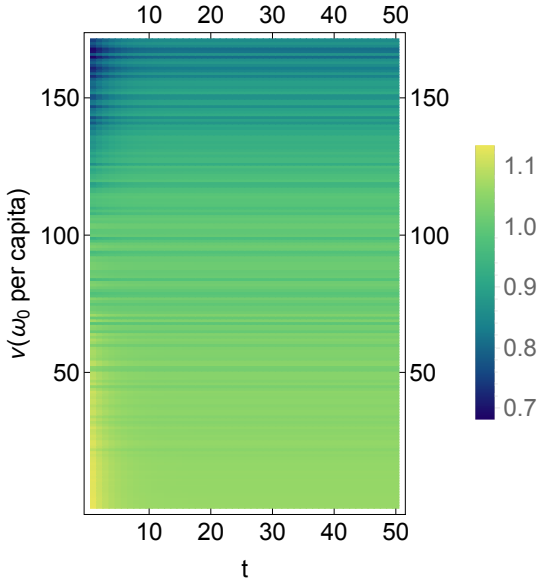


Figure 110: Exploitation intensity index - Model with exogenous technical change using persons engaged

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^{ν}

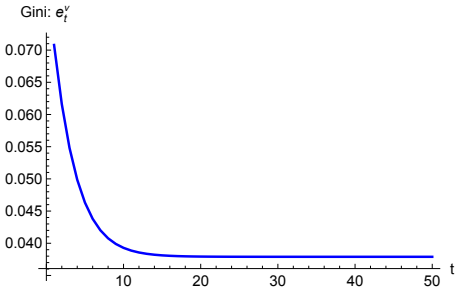
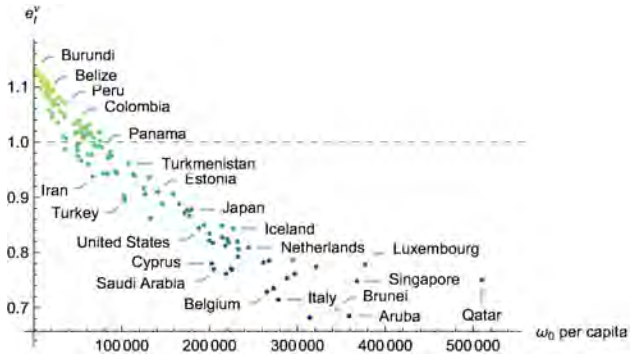
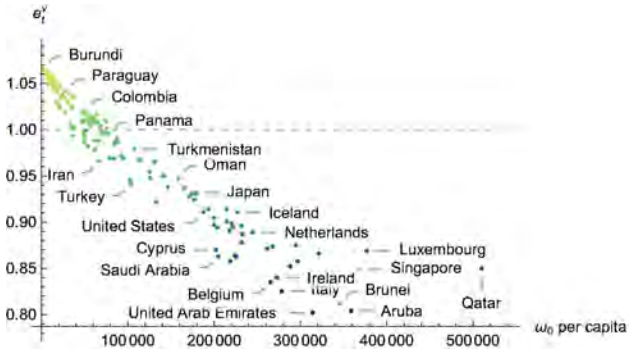


Figure 111: Worldwide Exploitation Intensity - Model with exogenous technical change using persons engaged

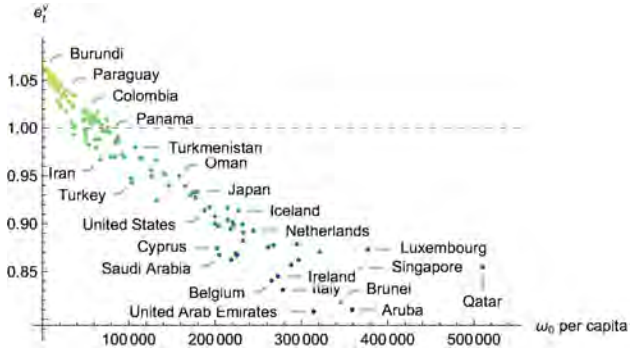
(a) $t = 1$



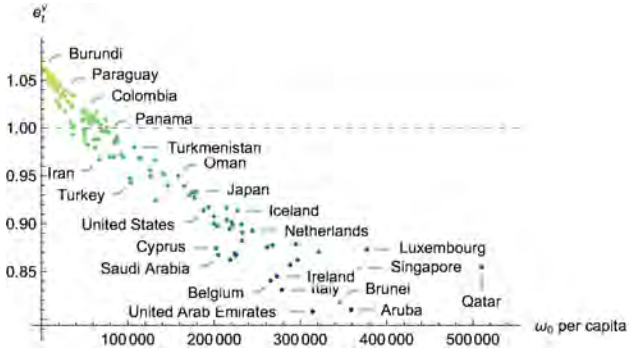
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

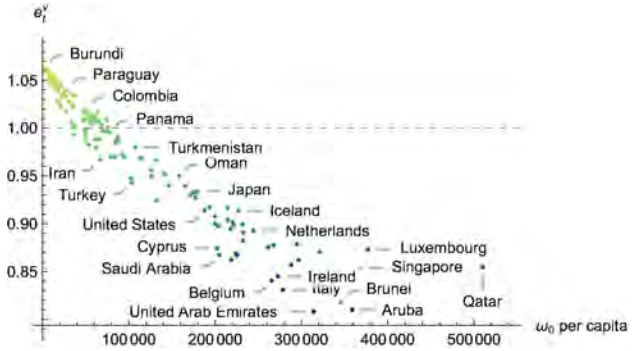
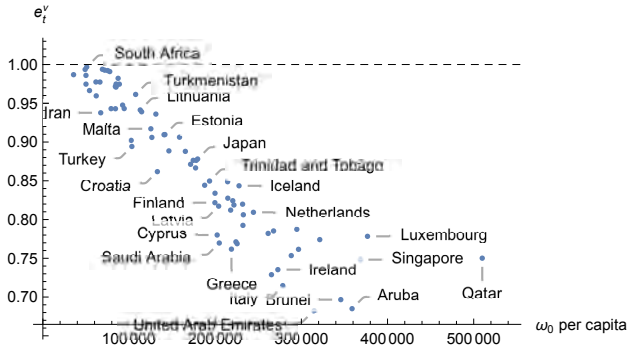
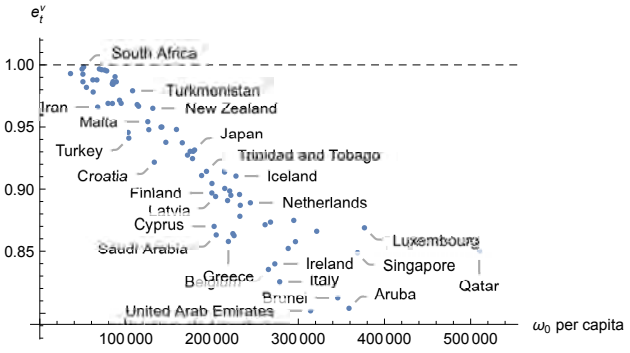


Figure 112: Exploiter Countries - Model with exogenous technical change using persons engaged

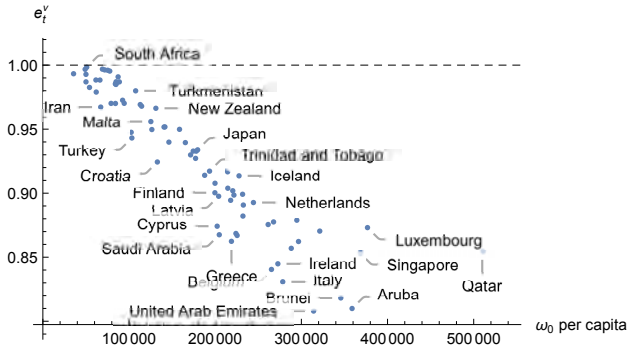
(a) $t = 1$



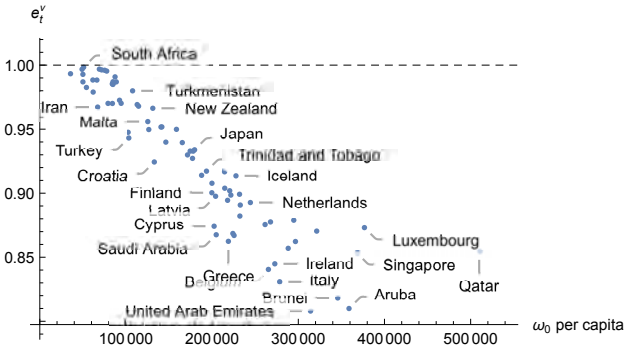
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

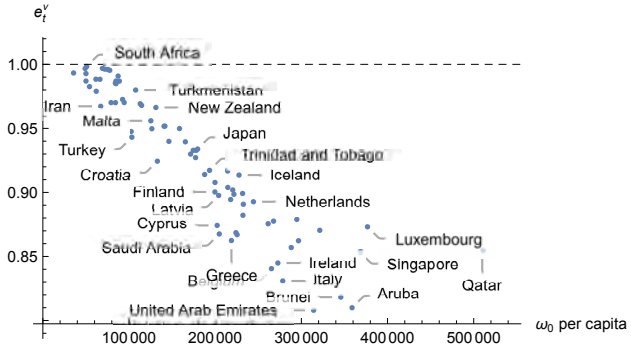
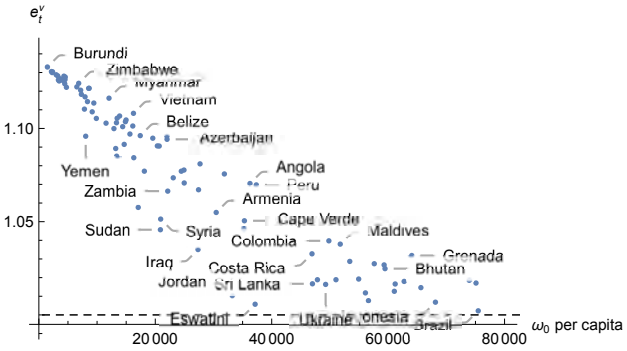
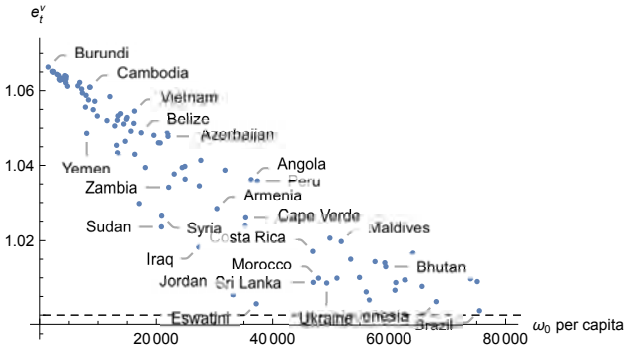


Figure 113: Exploited Countries - Model with exogenous technical change using persons engaged

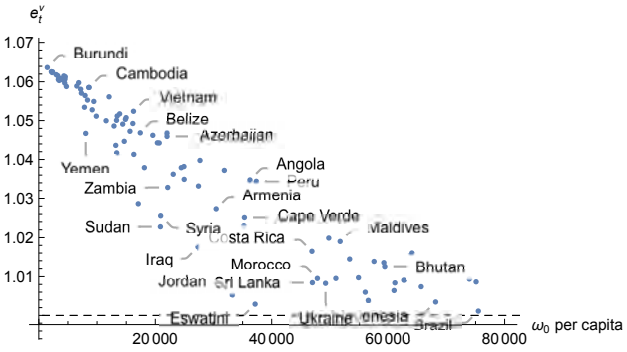
(a) $t = 1$



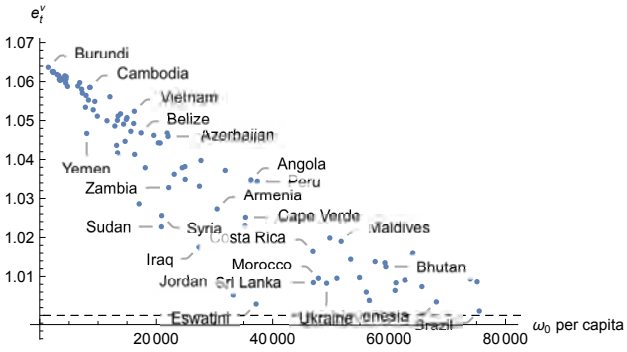
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

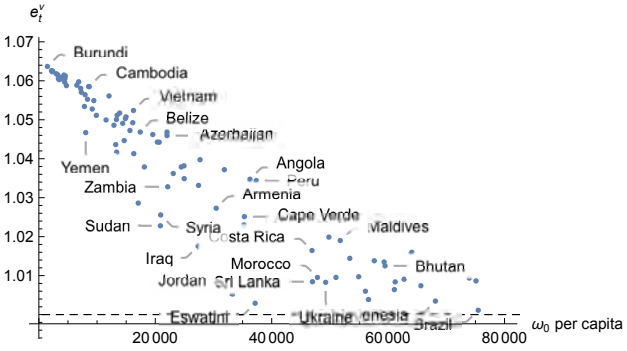


Table 23: Exploitation Intensity for Exploiter Countries at select t - Model with exogenous technical change using persons engaged

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Bosnia and Herzegovina	0.9869	0.9930	0.9933	0.9933	0.9933	South Korea	0.8764	0.9304	0.9329	0.9329	0.9329
Namibia	0.9936	0.9966	0.9967	0.9967	0.9967	Taiwan	0.8666	0.9246	0.9272	0.9272	0.9272
Tajikistan	0.9860	0.9925	0.9928	0.9928	0.9928	Bahamas	0.8763	0.9304	0.9328	0.9328	0.9328
Gabon	0.9747	0.9864	0.9869	0.9869	0.9869	Japan	0.8781	0.9315	0.9338	0.9339	0.9339
South Africa	0.9968	0.9983	0.9984	0.9984	0.9984	United States	0.8442	0.9109	0.9140	0.9140	0.9140
Algeria	0.9664	0.9819	0.9826	0.9826	0.9826	Trinidad and Tobago	0.8497	0.9143	0.9172	0.9172	0.9172
Montenegro	0.9775	0.9879	0.9884	0.9884	0.9884	Finland	0.8218	0.8969	0.9003	0.9004	0.9004
Tunisia	0.9596	0.9782	0.9790	0.9790	0.9790	United Kingdom	0.8339	0.9045	0.9078	0.9078	0.9078
Albania	0.9774	0.9879	0.9883	0.9883	0.9883	Cyprus	0.7801	0.8700	0.8742	0.8742	0.8742
Iran	0.9377	0.9660	0.9672	0.9672	0.9672	Latvia	0.8173	0.8940	0.8976	0.8976	0.8976
Poland	0.9939	0.9967	0.9969	0.9969	0.9969	Saudi Arabia	0.7697	0.8631	0.8675	0.8676	0.8676
Mexico	0.9927	0.9961	0.9963	0.9963	0.9963	Bahrain	0.8488	0.9137	0.9167	0.9167	0.9167
Barbados	0.9922	0.9958	0.9960	0.9960	0.9960	Czech Republic	0.8275	0.9005	0.9039	0.9039	0.9039
Panama	0.9909	0.9952	0.9954	0.9954	0.9954	Slovenia	0.8121	0.8908	0.8944	0.8944	0.8944
Lebanon	0.9431	0.9690	0.9701	0.9701	0.9701	Greece	0.7618	0.8578	0.8624	0.8624	0.8624
Venezuela	0.9717	0.9848	0.9854	0.9854	0.9854	Canada	0.8243	0.8985	0.9019	0.9019	0.9019
Suriname	0.9430	0.9689	0.9701	0.9701	0.9701	Australia	0.8188	0.8950	0.8985	0.8985	0.8985
Saint Vincent and the Grenadines	0.9709	0.9843	0.9849	0.9849	0.9849	France	0.7712	0.8641	0.8685	0.8686	0.8686
Chile	0.9748	0.9865	0.9870	0.9870	0.9870	Spain	0.7688	0.8625	0.8670	0.8670	0.8670
Mauritius	0.9728	0.9854	0.9859	0.9859	0.9859	Iceland	0.8435	0.9105	0.9135	0.9135	0.9135
Uruguay	0.9822	0.9905	0.9908	0.9908	0.9908	Germany	0.8198	0.8957	0.8992	0.8992	0.8992
Malaysia	0.9747	0.9864	0.9869	0.9869	0.9869	Portugal	0.7925	0.8781	0.8821	0.8821	0.8821
Botswana	0.9476	0.9715	0.9726	0.9726	0.9726	Sweden	0.8062	0.8870	0.8907	0.8907	0.8907
Romania	0.9432	0.9691	0.9702	0.9702	0.9702	Netherlands	0.8093	0.8890	0.8927	0.8927	0.8927
Equatorial Guinea	0.9021	0.9456	0.9476	0.9476	0.9476	Denmark	0.7821	0.8713	0.8755	0.8755	0.8755
Turkey	0.8943	0.9410	0.9431	0.9431	0.9431	Belgium	0.7289	0.8353	0.8405	0.8405	0.8405
Turkmenistan	0.9614	0.9792	0.9799	0.9799	0.9799	Hong Kong	0.7853	0.8734	0.8776	0.8776	0.8776
Lithuania	0.9414	0.9680	0.9692	0.9692	0.9692	Ireland	0.7354	0.8398	0.8449	0.8449	0.8449
Russia	0.9390	0.9667	0.9679	0.9679	0.9679	Italy	0.7147	0.8254	0.8308	0.8308	0.8308
Malta	0.9171	0.9543	0.9559	0.9559	0.9559	Austria	0.7535	0.8522	0.8569	0.8570	0.8570
Slovakia	0.9060	0.9479	0.9497	0.9497	0.9497	Switzerland	0.7874	0.8748	0.8789	0.8789	0.8789
New Zealand	0.9360	0.9651	0.9663	0.9663	0.9663	Norway	0.7616	0.8577	0.8623	0.8623	0.8623
Croatia	0.8618	0.9217	0.9244	0.9244	0.9244	United Arab Emirates	0.6822	0.8020	0.8080	0.8080	0.8080
Israel	0.9095	0.9499	0.9517	0.9517	0.9517	Macao	0.7741	0.8661	0.8704	0.8704	0.8704
Estonia	0.9096	0.9500	0.9518	0.9518	0.9518	Brunei	0.6967	0.8125	0.8182	0.8182	0.8182
Hungary	0.8886	0.9377	0.9399	0.9399	0.9399	Aruba	0.6850	0.8040	0.8099	0.8100	0.8100
Oman	0.9062	0.9480	0.9499	0.9499	0.9499	Singapore	0.7482	0.8487	0.8535	0.8535	0.8535
Seychelles	0.8879	0.9373	0.9395	0.9395	0.9395	Luxembourg	0.7783	0.8689	0.8731	0.8731	0.8731
Kuwait	0.8713	0.9274	0.9299	0.9299	0.9299	Qatar	0.7502	0.8500	0.8547	0.8548	0.8548

Table 24: Exploitation Intensity for Exploited Countries at select t - Model with exogenous technical change using persons engaged

	e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}		e^{ν}_{1}	e^{ν}_{10}	e^{ν}_{25}	e^{ν}_{40}	e^{ν}_{50}
Burundi	1.13294	1.06632	1.06369	1.06368	1.06368	Nicaragua	1.09477	1.04809	1.04621	1.04621	1.04621
Congo - Kinshasa	1.13052	1.06518	1.06260	1.06259	1.06259	El Salvador	1.09063	1.04608	1.04428	1.04428	1.04428
Chad	1.12996	1.06492	1.06235	1.06234	1.06234	Guatemala	1.09056	1.04604	1.04425	1.04424	1.04424
Malawi	1.13037	1.06511	1.06253	1.06252	1.06252	Sudan	1.04568	1.02370	1.02280	1.02280	1.02280
Mali	1.12879	1.06437	1.06182	1.06181	1.06181	Syria	1.05138	1.02659	1.02558	1.02557	1.02557
Guinea-Bissau	1.12820	1.06409	1.06155	1.06154	1.06154	Laos	1.09584	1.04861	1.04671	1.04671	1.04671
Sierra Leone	1.12602	1.06306	1.06057	1.06056	1.06056	Azerbaijan	1.09417	1.04780	1.04594	1.04593	1.04593
Liberia	1.12546	1.06279	1.06031	1.06030	1.06030	Zambia	1.06638	1.03412	1.03281	1.03280	1.03280
Mozambique	1.12662	1.06334	1.06084	1.06083	1.06083	Moldova	1.07353	1.03767	1.03622	1.03621	1.03621
Central African Republic	1.12582	1.06296	1.06048	1.06047	1.06047	Fiji	1.07707	1.03942	1.03790	1.03789	1.03789
Madagascar	1.12804	1.06401	1.06148	1.06147	1.06147	India	1.07769	1.03973	1.03819	1.03818	1.03818
Guinea	1.12399	1.06210	1.05965	1.05964	1.05964	Georgia	1.07075	1.03629	1.03489	1.03489	1.03489
Niger	1.12619	1.06314	1.06064	1.06063	1.06063	Iraq	1.03505	1.01828	1.01758	1.01758	1.01758
Rwanda	1.12756	1.06379	1.06126	1.06125	1.06125	Philippines	1.06712	1.03449	1.03316	1.03316	1.03316
Burkina Faso	1.12206	1.06119	1.05877	1.05876	1.05876	Paraguay	1.08100	1.04136	1.03976	1.03975	1.03975
Ethiopia	1.12229	1.06130	1.05888	1.05887	1.05887	Armenia	1.05494	1.02839	1.02730	1.02730	1.02730
Zimbabwe	1.12421	1.06221	1.05975	1.05974	1.05974	Ghana	1.07560	1.03869	1.03720	1.03719	1.03719
Togo	1.12049	1.06044	1.05806	1.05805	1.05805	Jordan	1.01038	1.00548	1.00527	1.00527	1.00527
Benin	1.11829	1.05940	1.05706	1.05705	1.05705	Congo - Brazzaville	1.04613	1.02393	1.02302	1.02302	1.02302
Gambia	1.11036	1.05561	1.05343	1.05342	1.05342	Cape Verde	1.05048	1.02614	1.02514	1.02514	1.02514
Kenya	1.11695	1.05876	1.05644	1.05643	1.05643	Angola	1.07046	1.03615	1.03475	1.03475	1.03475
Yemen	1.09583	1.04860	1.04671	1.04670	1.04670	Eswatini	1.00572	1.00303	1.00291	1.00291	1.00291
Uganda	1.11439	1.05754	1.05527	1.05527	1.05527	Peru	1.06972	1.03578	1.03440	1.03440	1.03440
Nepal	1.12150	1.06092	1.05852	1.05851	1.05851	Costa Rica	1.03276	1.01710	1.01645	1.01645	1.01645
Cambodia	1.12154	1.06094	1.05853	1.05852	1.05852	Sri Lanka	1.01669	1.00878	1.00845	1.00844	1.00844
Ivory Coast	1.10892	1.05492	1.05276	1.05276	1.05276	Morocco	1.01887	1.00991	1.00954	1.00954	1.00954
Cameroon	1.11362	1.05717	1.05492	1.05492	1.05492	Ukraine	1.01635	1.00860	1.00828	1.00828	1.00828
Pakistan	1.10537	1.05322	1.05113	1.05112	1.05112	Colombia	1.03973	1.02067	1.01989	1.01988	1.01988
Senegal	1.10283	1.05199	1.04996	1.04995	1.04995	Mongolia	1.01887	1.00992	1.00954	1.00954	1.00954
Myanmar	1.11624	1.05842	1.05612	1.05611	1.05611	Maldives	1.03796	1.01977	1.01902	1.01901	1.01901
Nigeria	1.09991	1.05058	1.04861	1.04860	1.04860	Argentina	1.02869	1.01500	1.01444	1.01444	1.01444
Mauritania	1.08924	1.04540	1.04363	1.04362	1.04362	Dominican Republic	1.01924	1.01011	1.00973	1.00972	1.00972
Bangladesh	1.10306	1.05210	1.05006	1.05006	1.05006	Jamaica	1.01181	1.00622	1.00599	1.00599	1.00599
Comoros	1.08512	1.04338	1.04170	1.04169	1.04169	North Macedonia	1.00763	1.00403	1.00388	1.00388	1.00388
Kyrgyzstan	1.10546	1.05326	1.05117	1.05116	1.05116	Ecuador	1.02744	1.01436	1.01382	1.01381	1.01381
Tanzania	1.10667	1.05384	1.05173	1.05172	1.05172	Bulgaria	1.02681	1.01403	1.01350	1.01350	1.01350
Haiti	1.10096	1.05109	1.04909	1.04908	1.04908	Bhutan	1.02482	1.01300	1.01251	1.01251	1.01251
Lesotho	1.09146	1.04648	1.04467	1.04466	1.04466	Saint Lucia	1.01266	1.00667	1.00642	1.00642	1.00642
Bolivia	1.10362	1.05237	1.05032	1.05031	1.05031	Belarus	1.01658	1.00872	1.00839	1.00839	1.00839
Uzbekistan	1.10454	1.05281	1.05075	1.05074	1.05074	Kazakhstan	1.01797	1.00944	1.00909	1.00909	1.00909
Djibouti	1.09700	1.04917	1.04725	1.04725	1.04725	Grenada	1.03185	1.01663	1.01600	1.01600	1.01600
Honduras	1.10131	1.05126	1.04925	1.04924	1.04924	Serbia	1.01463	1.00770	1.00741	1.00741	1.00741
Vietnam	1.10811	1.05453	1.05239	1.05239	1.05239	Indonesia	1.00682	1.00360	1.00347	1.00347	1.00347
Egypt	1.08430	1.04298	1.04131	1.04131	1.04131	Thailand	1.01854	1.00974	1.00938	1.00937	1.00937
State of Palestine	1.05765	1.02975	1.02861	1.02861	1.02861	China	1.01709	1.00899	1.00865	1.00865	1.00865
Belize	1.09614	1.04875	1.04685	1.04685	1.04685	Brazil	1.00219	1.00116	1.00112	1.00112	1.00112
Sao Tome and Principe	1.07708	1.03943	1.03790	1.03789	1.03789						

Figures 114 and 115 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 114: Distribution of wealth - Model with exogenous technical change using persons engaged

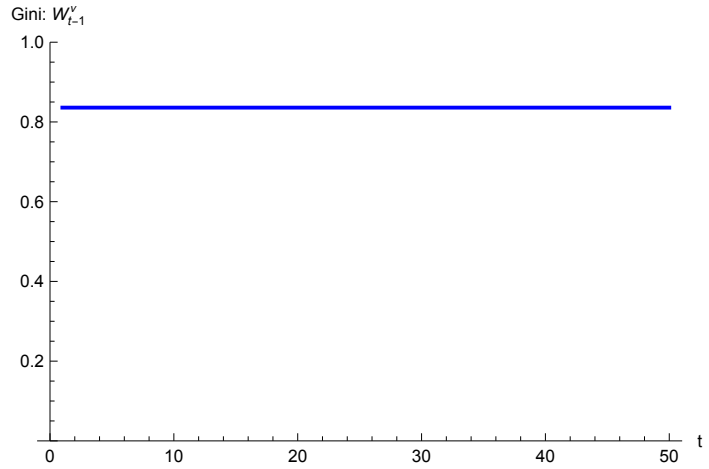
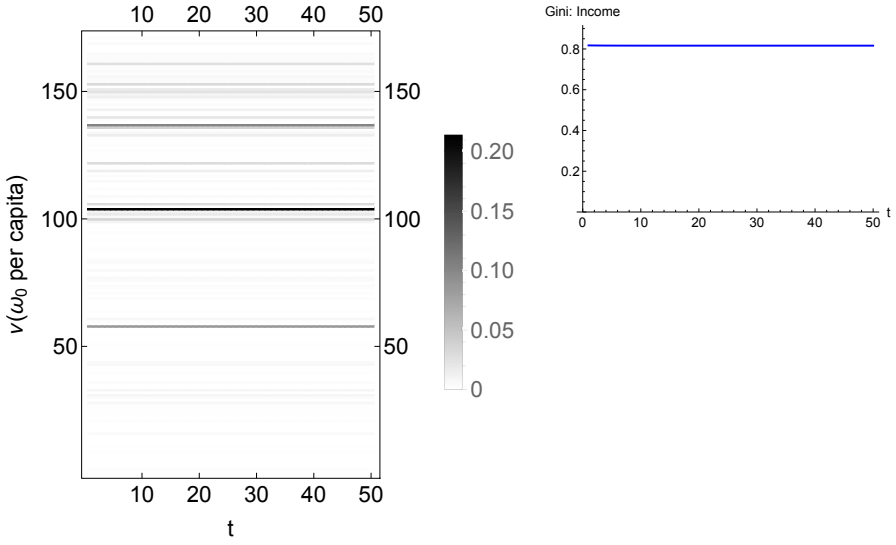


Figure 115: Distribution of Income - Model with exogenous technical change using persons engaged

(a) Distribution of Income Shares

(b) Gini Coefficient of Income



7.3 Persons Engaged - Model with endogenous technical change and consumption

This subsection presents results for the simulation using persons engaged to determine labour endowments with endogenous technical change and consumption.

Figure 118 shows the exploitation and class status of the agents over the course of the simulation.

Figure 119(a) shows the distribution of e_t^ν across agents for all t. Figure 119(b) shows the Gini coefficient of e_t^ν.

Figures 120-122 show exploitation intensity versus initial wealth for all countries for select t.

Tables 25 and 26 report e_t^ν for exploiter and exploited countries, respectively, for the same select t as figures 120-122.

Figure 116: Summary results - Model with endogenous technical change and consumption using persons engaged

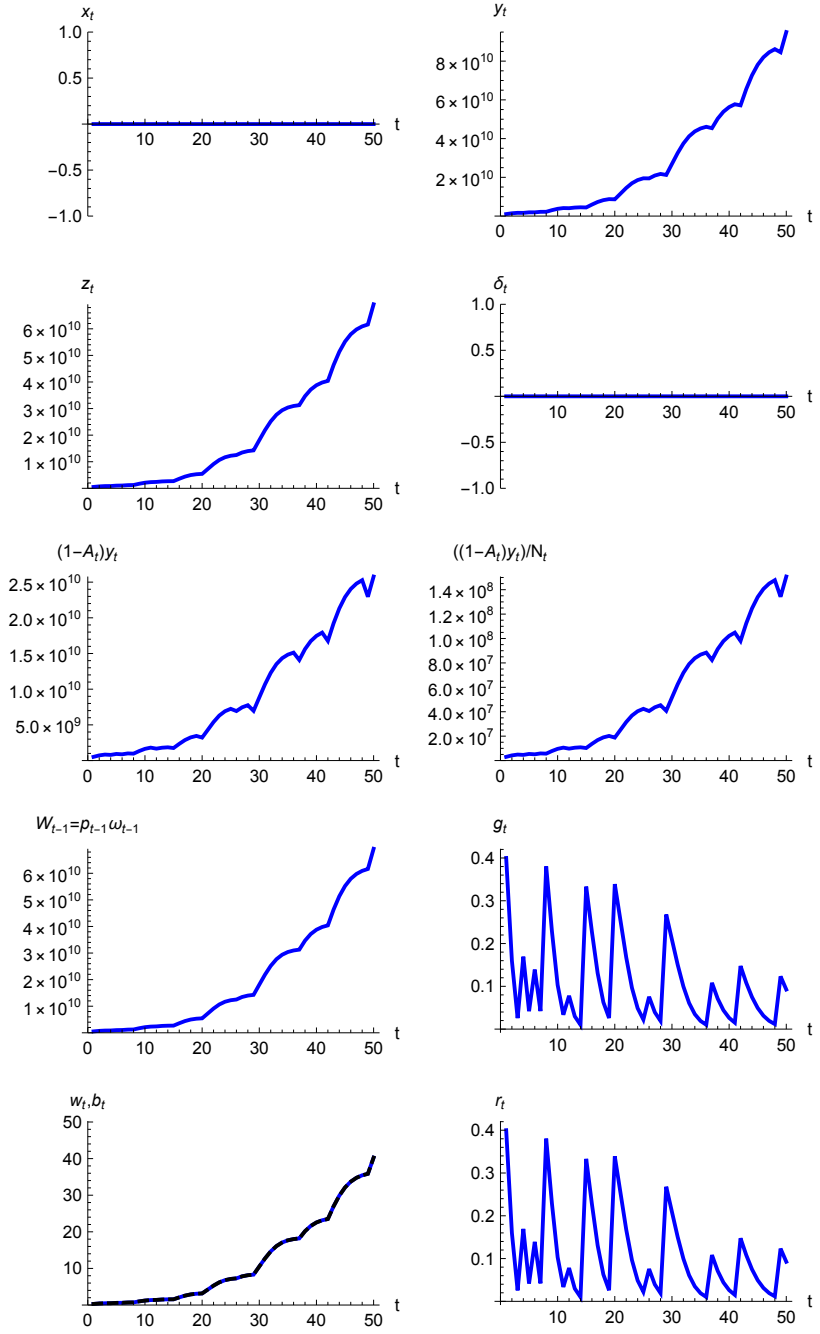


Figure 117: L_t and labour values - Model with endogenous technical change and consumption using persons engaged

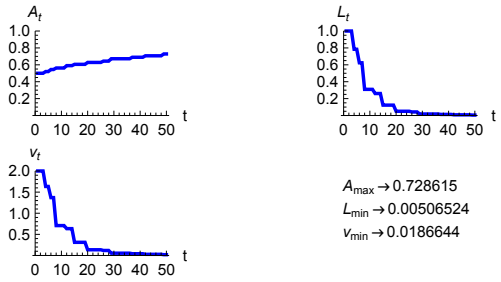
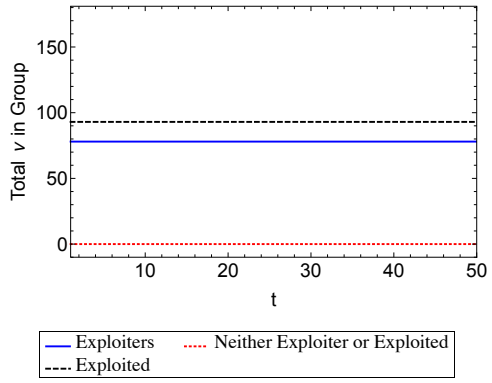
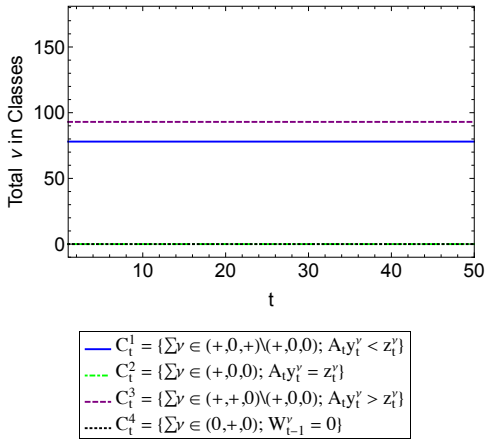


Figure 118: Class and exploitation status - Model with endogenous technical change and consumption using persons engaged

(a) Exploitation status



(b) Class status



(c) CECP

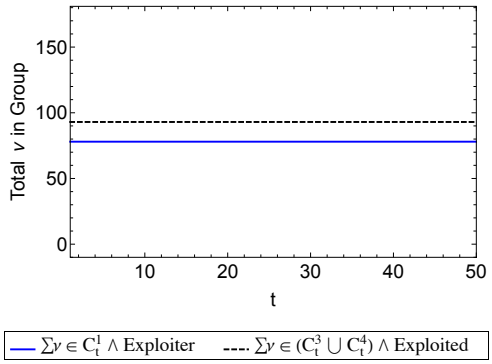
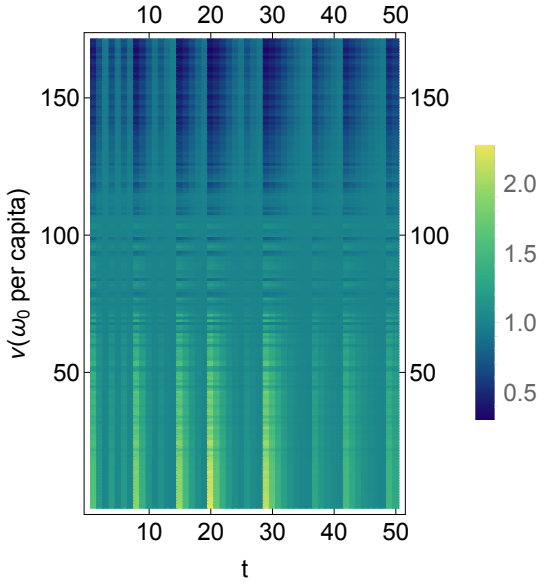


Figure 119: Exploitation intensity index - Model with endogenous technical change and consumption using persons engaged

(a) Exploitation intensity index across agents



(b) Gini coefficient of e_t^{ν}

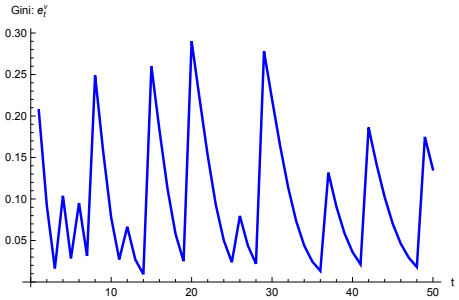
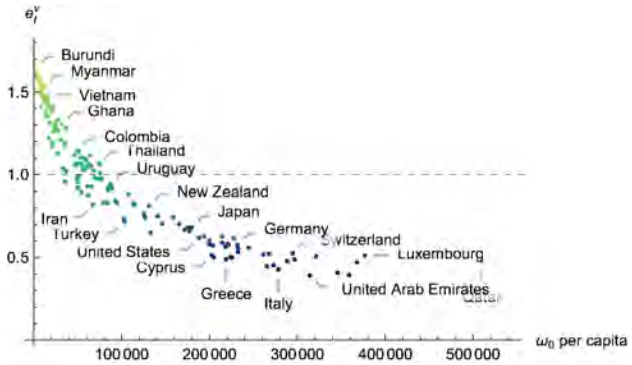
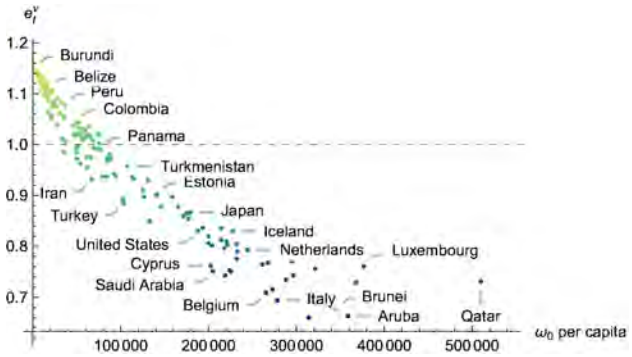


Figure 120: Worldwide Exploitation Intensity - Model with endogenous technical change and consumption using persons engaged

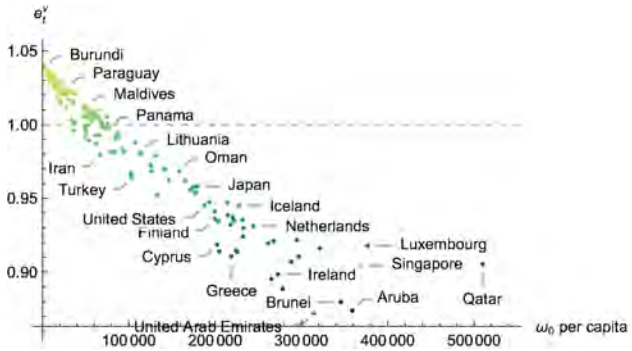
(a) $t = 1$



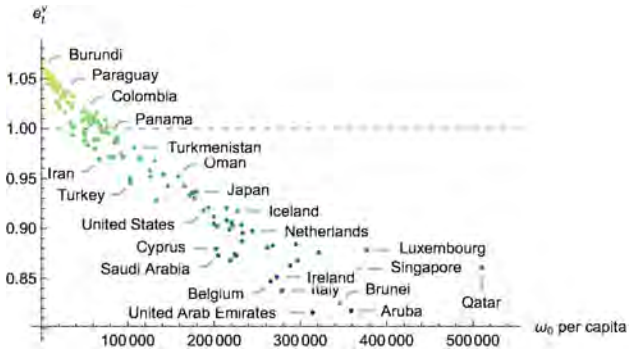
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

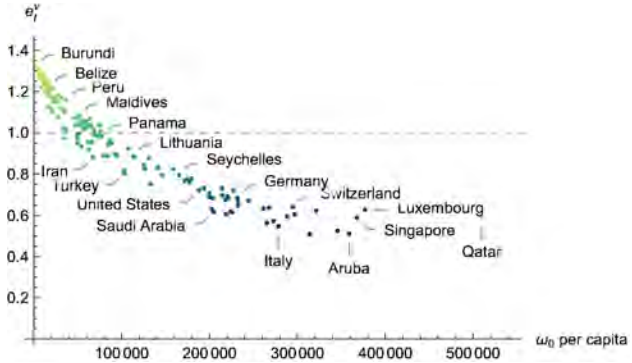
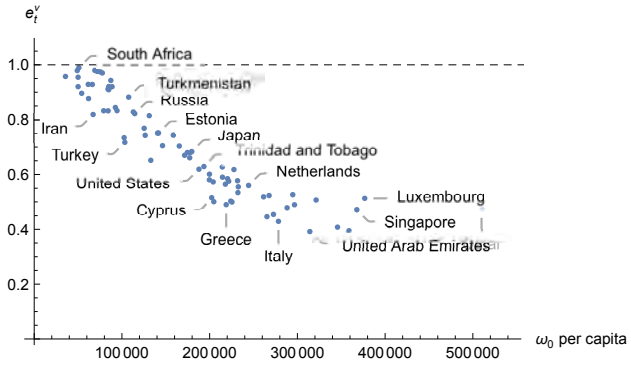
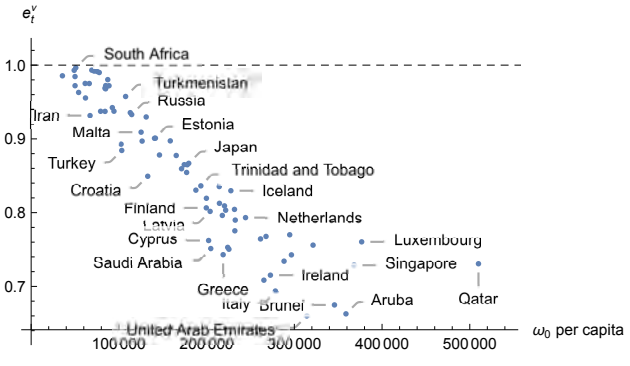


Figure 121: Exploiter Countries - Model with endogenous technical change and consumption using persons engaged

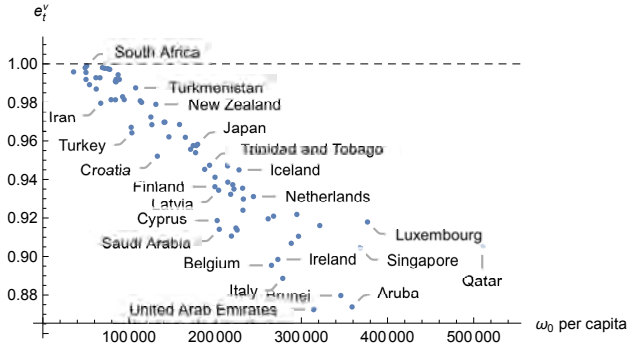
(a) $t = 1$



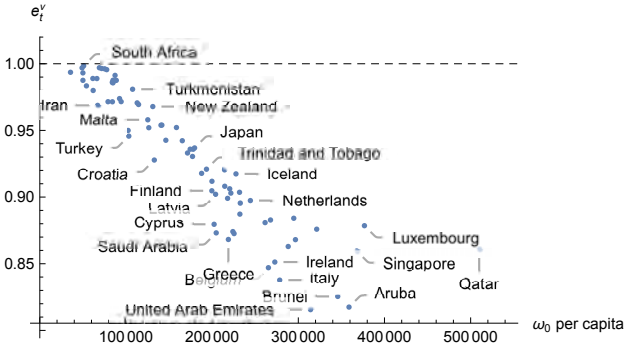
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

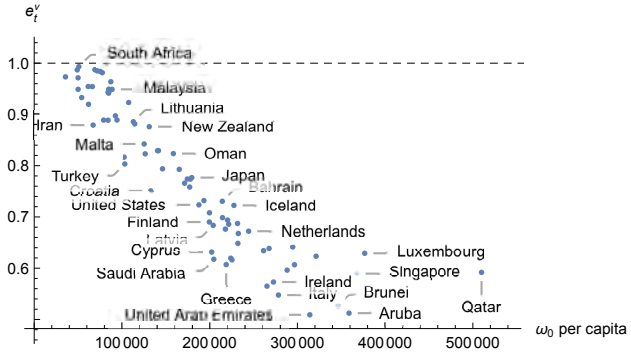
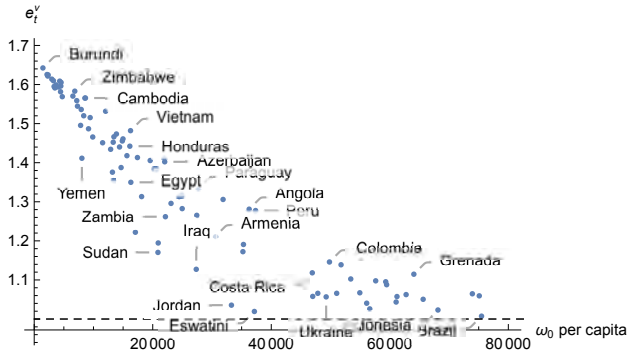
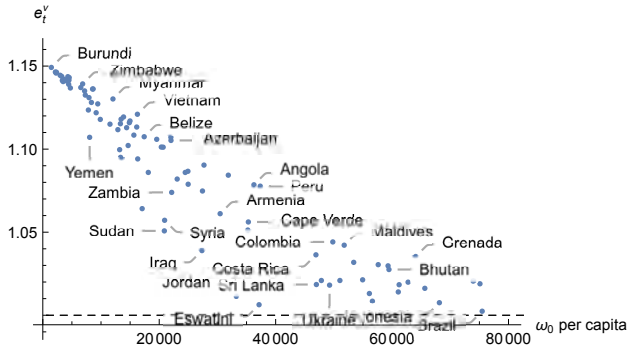


Figure 122: Exploited Countries - Model with endogenous technical change and consumption using persons engaged

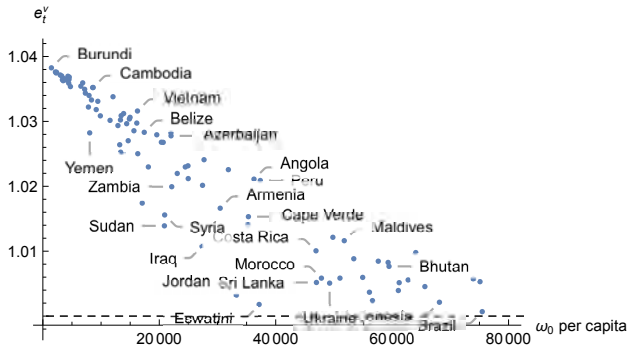
(a) $t = 1$



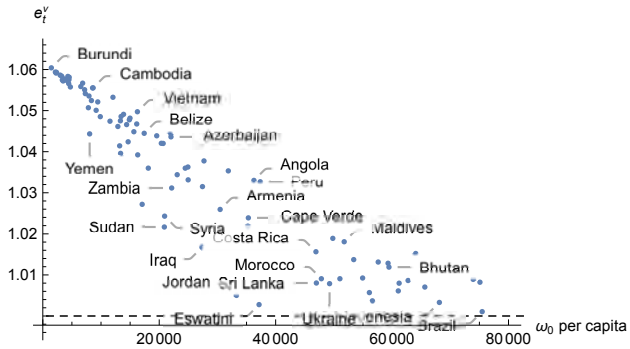
(b) $t = 10$



(c) $t = 25$



(d) $t = 40$



(e) $t = 50$

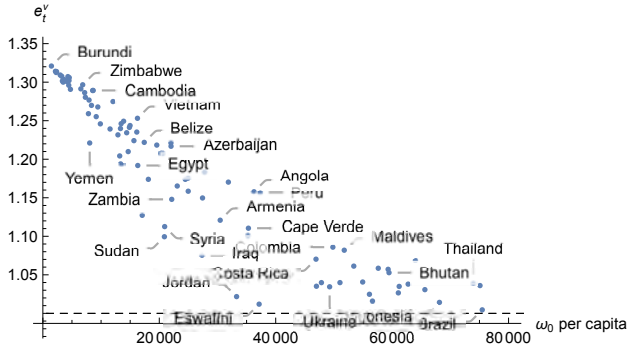


Table 25: Exploitation Intensity for Exploiter Countries at select t - Model with endogenous technical change and consumption using persons engaged

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Bosnia and Herzegovina	0.9576	0.9855	0.9958	0.9936	0.9732	South Korea	0.6802	0.8650	0.9576	0.9359	0.7740
Namibia	0.9791	0.9930	0.9980	0.9969	0.9869	Taiwan	0.6609	0.8545	0.9539	0.9305	0.7583
Tajikistan	0.9547	0.9845	0.9956	0.9931	0.9714	Bahamas	0.6801	0.8650	0.9576	0.9359	0.7739
Gabon	0.9204	0.9721	0.9919	0.9876	0.9490	Japan	0.6837	0.8669	0.9582	0.9369	0.7768
South Africa	0.9894	0.9964	0.9990	0.9984	0.9934	United States	0.6192	0.8305	0.9452	0.9178	0.7236
Algeria	0.8962	0.9630	0.9892	0.9834	0.9329	Trinidad and Tobago	0.6290	0.8363	0.9474	0.9209	0.7319
Montenegro	0.9287	0.9752	0.9928	0.9889	0.9545	Finland	0.5804	0.8065	0.9362	0.9047	0.6901
Tunisia	0.8769	0.9555	0.9869	0.9800	0.9198	United Kingdom	0.6011	0.8195	0.9412	0.9119	0.7081
Albania	0.9284	0.9751	0.9928	0.9889	0.9543	Cyprus	0.5155	0.7622	0.9187	0.8796	0.6314
Iran	0.8188	0.9316	0.9796	0.9688	0.8791	Latvia	0.5730	0.8017	0.9344	0.9021	0.6836
Poland	0.9798	0.9932	0.9981	0.9970	0.9874	Saudi Arabia	0.5007	0.7513	0.9141	0.8732	0.6175
Mexico	0.9761	0.9919	0.9977	0.9964	0.9850	Bahrain	0.6274	0.8354	0.9470	0.9204	0.7306
Barbados	0.9744	0.9914	0.9975	0.9962	0.9840	Czech Republic	0.5901	0.8126	0.9386	0.9081	0.6986
Panama	0.9704	0.9900	0.9971	0.9956	0.9814	Slovenia	0.5646	0.7962	0.9323	0.8990	0.6762
Lebanon	0.8325	0.9374	0.9814	0.9715	0.8889	Greece	0.4897	0.7430	0.9106	0.8682	0.6070
Venezuela	0.9115	0.9688	0.9909	0.9861	0.9431	Canada	0.5846	0.8092	0.9373	0.9062	0.6938
Suriname	0.8322	0.9373	0.9814	0.9715	0.8887	Australia	0.5754	0.8033	0.9350	0.9030	0.6857
Saint Vincent and the Grenadines	0.9091	0.9679	0.9907	0.9856	0.9415	France	0.5028	0.7529	0.9148	0.8741	0.6195
Chile	0.9208	0.9722	0.9920	0.9876	0.9493	Spain	0.4994	0.7504	0.9137	0.8726	0.6163
Mauritius	0.9148	0.9700	0.9913	0.9866	0.9453	Iceland	0.6179	0.8297	0.9450	0.9174	0.7225
Uruguay	0.9430	0.9803	0.9943	0.9913	0.9638	Germany	0.5772	0.8044	0.9354	0.9036	0.6873
Malaysia	0.9203	0.9721	0.9919	0.9875	0.9489	Portugal	0.5339	0.7754	0.9240	0.8872	0.6484
Botswana	0.8445	0.9424	0.9829	0.9739	0.8973	Sweden	0.5551	0.7899	0.9298	0.8955	0.6677
Romania	0.8328	0.9375	0.9814	0.9716	0.8891	Netherlands	0.5601	0.7932	0.9311	0.8974	0.6722
Equatorial Guinea	0.7345	0.8929	0.9671	0.9500	0.8166	Denmark	0.5185	0.7644	0.9196	0.8809	0.6342
Turkey	0.7173	0.8843	0.9642	0.9457	0.8034	Belgium	0.4464	0.7084	0.8954	0.8470	0.5649
Turkmenistan	0.8820	0.9575	0.9876	0.9809	0.9233	Hong Kong	0.5232	0.7677	0.9209	0.8828	0.6385
Lithuania	0.8281	0.9355	0.9808	0.9706	0.8858	Ireland	0.4546	0.7152	0.8985	0.8513	0.5730
Russia	0.8221	0.9330	0.9800	0.9694	0.8815	Italy	0.4291	0.6937	0.8886	0.8377	0.5475
Malta	0.7685	0.9091	0.9724	0.9580	0.8424	Austria	0.4783	0.7342	0.9068	0.8629	0.5962
Slovakia	0.7430	0.8970	0.9684	0.9520	0.8231	Switzerland	0.5263	0.7700	0.9218	0.8841	0.6414
New Zealand	0.8145	0.9297	0.9790	0.9679	0.8761	Norway	0.4894	0.7428	0.9105	0.8681	0.6067
Croatia	0.6517	0.8493	0.9521	0.9278	0.7508	United Arab Emirates	0.3918	0.6599	0.8724	0.8156	0.5091
Israel	0.7509	0.9008	0.9697	0.9539	0.8291	Macao	0.5069	0.7560	0.9161	0.8759	0.6234
Estonia	0.7512	0.9010	0.9697	0.9540	0.8294	Brunei	0.4079	0.6749	0.8797	0.8255	0.5259
Hungary	0.7052	0.8782	0.9621	0.9426	0.7939	Aruba	0.3948	0.6628	0.8738	0.8175	0.5123
Oman	0.7436	0.8973	0.9685	0.9522	0.8236	Singapore	0.4713	0.7287	0.9044	0.8596	0.5894
Seychelles	0.7039	0.8775	0.9619	0.9423	0.7929	Luxembourg	0.5130	0.7604	0.9179	0.8785	0.6291
Kuwait	0.6700	0.8595	0.9557	0.9331	0.7658	Qatar	0.4739	0.7307	0.9053	0.8608	0.5919

Table 26: Exploitation Intensity for Exploited Countries at select t - Model with endogenous technical change and consumption using persons engaged

	e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν		e_1^ν	e_{10}^ν	e_{25}^ν	e_{40}^ν	e_{50}^ν
Burundi	1.6424	1.1492	1.0383	1.0604	1.3209	Nicaragua	1.4056	1.1059	1.0279	1.0439	1.2184
Congo - Kinshasa	1.6256	1.1464	1.0376	1.0594	1.3141	El Salvador	1.3831	1.1012	1.0268	1.0420	1.2078
Chad	1.6218	1.1458	1.0375	1.0591	1.3126	Guatemala	1.3828	1.1012	1.0268	1.0420	1.2076
Malawi	1.6246	1.1463	1.0376	1.0593	1.3137	Sudan	1.1704	1.0508	1.0139	1.0217	1.0994
Mali	1.6137	1.1445	1.0372	1.0586	1.3093	Syria	1.1946	1.0572	1.0156	1.0243	1.1126
Guinea-Bissau	1.6097	1.1438	1.0370	1.0584	1.3076	Laos	1.4115	1.1071	1.0282	1.0443	1.2211
Sierra Leone	1.5950	1.1413	1.0364	1.0575	1.3016	Azerbaijan	1.4023	1.1052	1.0278	1.0436	1.2168
Liberia	1.5913	1.1407	1.0363	1.0572	1.3000	Zambia	1.2618	1.0740	1.0199	1.0312	1.1479
Mozambique	1.5990	1.1420	1.0366	1.0577	1.3032	Moldova	1.2958	1.0820	1.0220	1.0344	1.1652
Central African Republic	1.5937	1.1411	1.0364	1.0574	1.3010	Fiji	1.3132	1.0860	1.0230	1.0360	1.1739
Madagascar	1.6087	1.1436	1.0370	1.0583	1.3072	India	1.3163	1.0867	1.0232	1.0363	1.1754
Guinea	1.5815	1.1390	1.0359	1.0566	1.2960	Georgia	1.2825	1.0789	1.0212	1.0331	1.1585
Niger	1.5962	1.1415	1.0365	1.0575	1.3021	Iraq	1.1272	1.0389	1.0107	1.0167	1.0754
Rwanda	1.6054	1.1431	1.0368	1.0581	1.3059	Philippines	1.2653	1.0748	1.0201	1.0315	1.1497
Burkina Faso	1.5689	1.1368	1.0354	1.0558	1.2907	Paraguay	1.3329	1.0904	1.0241	1.0378	1.1836
Ethiopia	1.5704	1.1371	1.0354	1.0559	1.2913	Armenia	1.2101	1.0611	1.0166	1.0259	1.1209
Zimbabwe	1.5830	1.1393	1.0359	1.0567	1.2966	Ghana	1.3060	1.0843	1.0226	1.0353	1.1703
Togo	1.5587	1.1350	1.0349	1.0551	1.2864	Jordan	1.0355	1.0115	1.0032	1.0050	1.0217
Benin	1.5446	1.1325	1.0344	1.0541	1.2804	Congo - Brazzaville	1.1723	1.0513	1.0140	1.0219	1.1005
Gambia	1.4955	1.1235	1.0322	1.0507	1.2591	Cape Verde	1.1907	1.0562	1.0153	1.0239	1.1105
Kenya	1.5361	1.1310	1.0340	1.0536	1.2768	Angola	1.2811	1.0785	1.0211	1.0330	1.1578
Yemen	1.4114	1.1071	1.0282	1.0443	1.2211	Eswatini	1.0193	1.0063	1.0018	1.0028	1.0119
Uganda	1.5201	1.1281	1.0333	1.0524	1.2699	Peru	1.2776	1.0777	1.0209	1.0327	1.1560
Nepal	1.5653	1.1362	1.0352	1.0555	1.2892	Costa Rica	1.1182	1.0364	1.0101	1.0156	1.0703
Cambodia	1.5655	1.1362	1.0352	1.0555	1.2893	Sri Lanka	1.0579	1.0185	1.0052	1.0080	1.0352
Ivory Coast	1.4868	1.1219	1.0318	1.0501	1.2553	Morocco	1.0658	1.0209	1.0058	1.0091	1.0399
Cameroon	1.5154	1.1272	1.0331	1.0521	1.2678	Ukraine	1.0567	1.0181	1.0051	1.0079	1.0345
Pakistan	1.4658	1.1179	1.0309	1.0485	1.2459	Colombia	1.1460	1.0441	1.0121	1.0189	1.0859
Senegal	1.4510	1.1150	1.0302	1.0474	1.2392	Mongolia	1.0658	1.0209	1.0059	1.0091	1.0399
Myanmar	1.5316	1.1302	1.0338	1.0532	1.2749	Maldives	1.1388	1.0422	1.0116	1.0181	1.0819
Nigeria	1.4343	1.1117	1.0294	1.0461	1.2316	Argentina	1.1025	1.0318	1.0088	1.0137	1.0613
Mauritania	1.3757	1.0997	1.0264	1.0414	1.2043	Dominican Republic	1.0671	1.0213	1.0060	1.0092	1.0407
Bangladesh	1.4523	1.1153	1.0302	1.0475	1.2398	Jamaica	1.0405	1.0131	1.0037	1.0057	1.0248
Comoros	1.3541	1.0950	1.0253	1.0396	1.1939	North Macedonia	1.0259	1.0084	1.0024	1.0037	1.0159
Kyrgyzstan	1.4663	1.1180	1.0309	1.0486	1.2461	Ecuador	1.0977	1.0304	1.0085	1.0131	1.0585
Tanzania	1.4734	1.1194	1.0312	1.0491	1.2493	Bulgaria	1.0953	1.0297	1.0083	1.0128	1.0571
Haiti	1.4403	1.1129	1.0296	1.0466	1.2344	Bhutan	1.0878	1.0275	1.0077	1.0119	1.0528
Lesotho	1.3876	1.1022	1.0270	1.0424	1.2099	Saint Lucia	1.0435	1.0140	1.0039	1.0061	1.0266
Bolivia	1.4556	1.1159	1.0304	1.0478	1.2413	Belarus	1.0575	1.0184	1.0051	1.0080	1.0350
Uzbekistan	1.4609	1.1170	1.0306	1.0482	1.2437	Kazakhstan	1.0625	1.0199	1.0056	1.0086	1.0379
Djibouti	1.4179	1.1084	1.0286	1.0449	1.2241	Grenada	1.1147	1.0354	1.0098	1.0152	1.0683
Honduras	1.4422	1.1133	1.0297	1.0467	1.2353	Serbia	1.0505	1.0162	1.0045	1.0070	1.0308
Vietnam	1.4820	1.1210	1.0316	1.0497	1.2531	Indonesia	1.0231	1.0076	1.0021	1.0033	1.0142
Egypt	1.3498	1.0941	1.0250	1.0392	1.1919	Thailand	1.0646	1.0206	1.0057	1.0089	1.0392
State of Palestine	1.2221	1.0642	1.0174	1.0272	1.1272	China	1.0593	1.0189	1.0053	1.0082	1.0360
Belize	1.4131	1.1075	1.0283	1.0445	1.2219	Brazil	1.0073	1.0024	1.0007	1.0011	1.0045
Sao Tome and Principe	1.3133	1.0860	1.0230	1.0360	1.1739						

Figures 123 and 124 show the Gini coefficients of the distributions of wealth and income and the distribution of income shares over t.

Figure 123: Distribution of wealth - Model with endogenous technical change and consumption using persons engaged

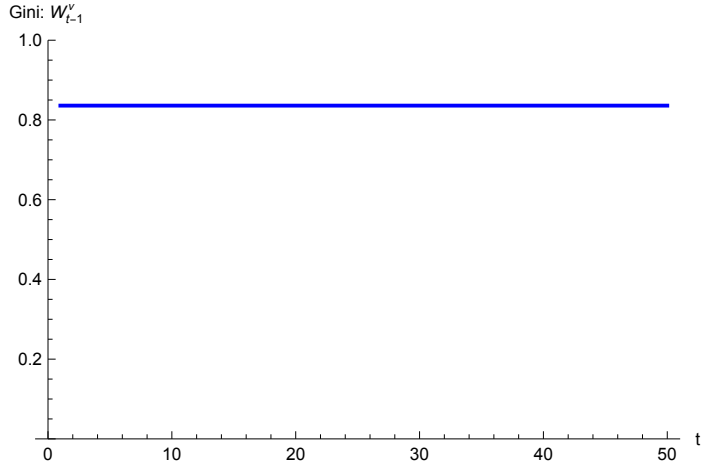
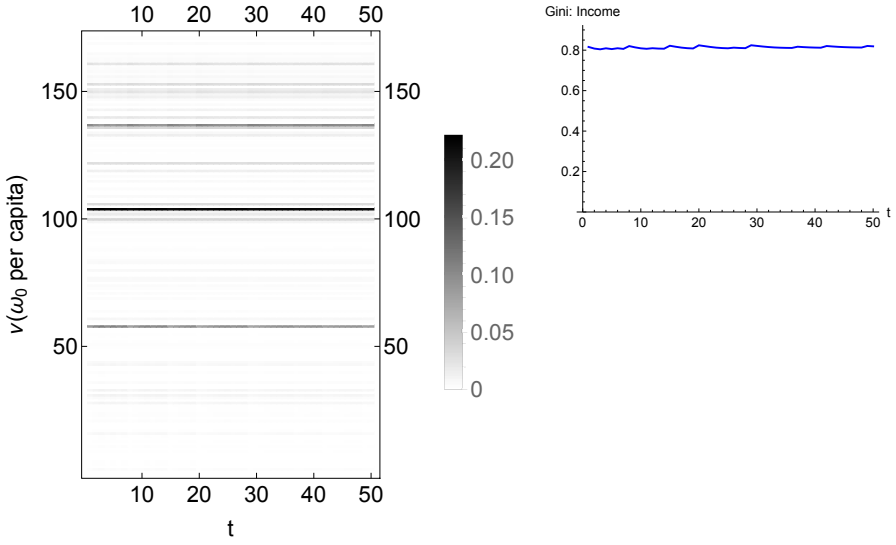


Figure 124: Distribution of Income - Model with endogenous technical change and consumption using persons engaged

(a) Distribution of Income Shares

(b) Gini Coefficient of Income



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