Dictatorship in a Single Export Crop Economy

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Abstract

Is it a matter of pure altruism or shortsightedness when a dictator spends an increasing amount of his revenues for the population, while cutting on own consumption? In order to be able to consume, the dictator first has to stay in power. We present a formal model of a power maximizing dictator. His revenues depend on the exports of a single crop. With the export earnings the dictator buys loyalty from the producers of the export crop by setting the domestic producer price. Revenues resulting from the difference between the international and the domestic price of the crop are used to finance a repressive apparatus. We characterize the optimal trade-off between buying more loyalty and adapting the level of repression. The model is illustrated with a case study of Rwanda under president Habyarimana (1973-94).
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1   Introduction

Recently, economists and political scientists have narrowed the gap between their disciplines by articulating the interdependence of economic development and political power. Economists realize that development does not take place in a political vacuum. And political power cannot be studied without regard to the economy (Acemoglu and Robinson, 2001). The interdependence between economics and politics is particularly striking in economies that depend for their foreign exchange earnings on the export of one or a few primary commodities. According to the Food and Agricultural Organization (FAO, 2002), 43 countries earn more then 50% of their total agricultural export revenue from one agricultural commodity. They include Rwanda and Burundi (coffee), Ethiopia (coffee), Uganda (coffee), Ivory Coast (cocoa), Malawi (tobacco), Mali (cotton), Kenya (tea), Ghana (cocoa) in Africa and the coffee producing Latin-American countries Honduras, Nicaragua, Guatemala and Columbia. A number of these countries have been ruled by authoritarian or undemocratic regimes during most of the post-independence era. To give some examples: in Ethiopia, a communist one-party regime ruled the country after the demise of emperor Haile Selassie, until 1991; Uganda has seen a succession of dictatorships in the seventies and eighties ; in Burundi the *coup d'états* in 1966 and 1976 brought to power authoritarian rulers; Rwanda was governed between 1973 and 1994 by a dictatorial regime.

The conditions under which political elites in such regimes prey on the citizenry or, inversely, promote economic development, are the object of recent work in political economy. Lam and Wantchekon (1999) claim that resource abundance exacerbates the power asymmetry between the populace and the political elites. The position of the political elites is based on their control of the process of rent distribution. Other authors (Sachs and Warner, 1995) have provided empirical evidence of the adverse effects of resource abundance on economic growth. Robinson (1997) argues that political elites in undemocratic states do not promote development when they fear that this development will undermine the political status quo and will ultimately deprive them of their power.

Should we regard dictators as power maximizing or revenue maximizing persons? Bayart, Ellis and Hibou (1999) contend that political elites in many African countries are mere networks for rent distribution that thrive on the export of primary commodities, on drugs trafficking or on smuggling various kinds of goods. These elites care for their personal wealth. But these money making networks can only be maintained when the group of profiteers, often identified by kinship or ethnic ties, stays in power. This is in line with Tullock (1987) and Wintrobe (1998) who argue that, while some dictators care for personal

wealth, all dictators must care for power.

In this paper, we present a political economy model of dictatorship in which we account for the link between political power and economic activity. We rely upon a model of power maximizing dictatorship developed by Wintrobe (1990, 1998). In this model, repression and loyalty form the inputs in a production function for power. The dictator relies on the loyalty of the population, but he also uses repression to stay in power. Loyal citizens expect a return from their loyalty. A specific feature of Wintrobe's model is the dictator's power to influence the level of his own budget: the more power he has, the higher the budget he can command via taxation and expropriation.

In our model, the dictator's budget depends on the value of his country's export crop on the world market. With the export earnings, the dictator buys political loyalty from the population and finances repression. When the export earnings of an economy depend on the produce of a large group of smallholders, such as coffee producers in Rwanda, the dictator needs the loyalty of that group to stay in power[1]. He will therefore try to offer the smallholding producers a favourable price. But this may become difficult if the world price of the export crop falls.

In section 2, we reinterpret the Wintrobe power objective function as a power preference function, rather than a power production function: it expresses the relative willingness of a specific dictator to use repression rather loyalty, or *vice versa*, to obtain a certain level of power. We are thus able to obtain a classification of possible reactions of power maximizing dictators to changes in the world market price of the export crop, in terms of a trade-off between buying loyalty and the level of repression. We then apply the insights of the model to the case of Rwanda, more specifically to the regime of Juvénal Habyarimana, who ruled the country from 1973 to 1994 (section 3).

2   A political economy model

In the present section, we present a political economy model which allows a characterization of dictatorial behaviour in a single crop economy, when confronted with variations in the international price of that crop. The economy is characterized by a single export crop,

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[1]The incentive to "care" for a large group of farmer-producers is largely absent in an economy endowed with minerals or fuels. Once the dictator controls the mines or wells, he has few incentives to care for the welfare of the large part of the population that is not involved in the mining activity. As long as he pays the workers in the extracting industries a decent wage and uses the export earnings for his repressive apparatus, he can stay in power.

say coffee[2], which is produced by farmers-cultivators. Exports are under full control of the dictator. He obtains the (exogenous[3]) world price p_m per unit of coffee exported. Farmers' production behaviour is determined by the price, p_p, they obtain from the dictator when selling the harvest to him, and the repressive means, R, the dictator uses, among other things, to enforce coffee production, such as the legal prohibition to uproot coffee trees. Total coffee output, C, is therefore assumed to be positively related to both the price farmers obtain, p_p, and to the level of repression, R, applied by the dictator. Formally, we model this type of behaviour by a reduced form aggregative production function:

$$C = K(p_p, R) \qquad \text{with:} \quad \frac{\partial K}{\partial p_p} > 0, \ \frac{\partial K}{\partial R} > 0, \tag{1}$$

where K is assumed to be twice continuously differentiable and concave. Let $K(0,0) = 0$. Influencing the output of coffee by repressive means is however not without cost and has to be financed from the dictator's budget. The latter is composed of the (possibly negative[4]) net returns from coffee exports, $(p_m - p_p)C$, and other financial means, M, $e.g$ tax revenues, foreign loans or aid. Marketing costs could be included by subtracting a constant term from p_m. For simplicity and without loss of generality, we do not do this. Financial costs associated with the level of repression, R, are denoted by $p_R R$, where p_R is the cost of an additional unit of repression[5]. Putting things together, we obtain the following expression for the dictator's budget constraint:

$$M + (p_m - p_p)C = p_R R. \tag{2}$$

Together with the production function (1), the budget constraint (2) constitutes the constraints on the dictator's objective, which is to maximize his power[6]. For future reference,

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[2]Coffee is the single export crop in the case of Rwanda. But the model is more generally applicable, we believe. It can also be applied to an economy with a single labour intensive export *industry*. In that case, the price farmers obtain should be replaced by the (fixed) wage paid by the national authorities to the workers in that industry.

[3]The dictatorship economy is assumed to be a price taker on a world scale.

[4]Occasionally, the dictator can decide to subsidize coffee production by paying a price p_p to the farmers which exceeds the international price level p_m.

[5]The cost of repression is kept fixed throughout the analysis and could be normalized to 1. Only the unit repression cost *relative* to international and domestic coffee prices matters. But we feel the exposition below becomes more transparent when expressing everything in 'common' monetary units.

[6]Wintrobe (1998) indicates that dictatorial behaviour is most often a combination of trying to remain in power and rent seeking (tin pot dictatorship). However, we believe that the objective of staying in power reveals more about the decisions dictators in many African countries make, when faced with the choice between promoting loyalty and using repression.

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we will put both constraints together in the following expression:

$$M + (p_m - p_p)K(p_p, R) = p_R R. \tag{3}$$

Notice that this is a nonlinear constraint[7] in the instruments of the dictator to realize his objective, *i.e.* the coffee price, p_p, and the level of repression, R.

It is useful to introduce the so-called *shadow cost* or *virtual price* of both instruments for the dictator. These reflect the true cost to the dictator of raising the coffee price, p_p, and the level repression, R, by one unit. It contains a direct effect: raising the coffee price at given production level C, raises the cost by C units, while the direct cost effect of raising the level of repression, R, with one unit equals its unit cost, p_R. But, contrary to the usual linear case, there is an indirect effect too, which runs through the (positive) effect of both instruments on production. As long as the international price p_m exceeds the price paid to coffee growers, p_p, this indirect effect *reduces* the shadow cost: the dictator earns back part of the additional costs resulting from a higher domestic coffee price, for example, through the increased revenues from the additional exports which become available as the result of the higher domestic coffee price. That gain is formally equal to $(p_m - p_p)\frac{\partial K}{\partial p_p}$. An analogous argument applies to an increase in the level of repression. Formally, these shadow costs, denoted by v_1 for the domestic coffee price, and v_2 for repression, are defined by means of a first order Taylor approximation of the budget constraint, $M \cong v_1 p_p + v_2 R$. Carrying out the necessary calculations then gives:

$$v_1 \equiv K(p_p, R) - (p_m - p_p)\frac{\partial K}{\partial p_p}, \tag{4.1}$$

$$v_2 \equiv p_R - (p_m - p_p)\frac{\partial K}{\partial R}. \tag{4.2}$$

In order to guarantee the existence of an internal optimum for the maximization problem below, we assume that both v_1 and v_2 are positive, for any relevant realization of R and p_p.

The dictator's objective to maximize his power critically depends on the amount of loyalty he can buy from his subjects, and the level of repression he applies. Buying loyalty is accomplished by setting the price p_p paid to the farmers for coffee: the higher the price the lower the probability that people will start grumbling, and for a high enough price,

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[7]Concavity of K guarantees convexity of the constraint set as long as $p_m \geq p_p$. If the latter condition is not satisfied, there might be non-convexities in the constraint set. However, this will not affect the analysis below, as long as the optimum lies in the interior of the constraint set. One should merely check whether the second order conditions for a maximum are satisfied.

they will be supportive of 'their' dictator. Repression, on the other hand, is interpreted here as the set of all independent measures a dictator can take to force his subjects into a behaviour which increases his power, or refrain them from acts of opposition, which would lead to the contrary[8]. Formally, the dictator's objective can therefore be represented by a function π depending positively on the coffee price, p_p, and on the level of repression applied by the dictator, R:

$$\Pi = \pi(p_p, R) \qquad \text{with:} \quad \frac{\partial \pi}{\partial p_p} > 0, \; \frac{\partial \pi}{\partial R} > 0. \tag{5}$$

In the sequel, first and second partial derivatives of π, will be written as π_{p_p}, π_R and $\pi_{p_p p_p}, \pi_{p_p R}, \pi_{R p_p}$ and π_{RR}.

We want to stress that the function π is not a purely technical one, reflecting which combinations of the coffee price and repression give a certain level of power, irrespective of the dictator's personality. On the contrary, the slope of the indifference curve (representing the couples (p_p, R) which result in a given level of power) reflects the type of dictator the people are confronted with. Flatter indifference curves in the (p_p, R)-plane, reveal that a dictator is more eager to use repression to stay in power than a colleague with steeper indifference curves. Because of this preference aspect associated with the power function, we feel justified to make the regularity assumptions which are familiar from preference characterizations: twice continuous differentiability and strong quasi-concavity. A formal definition of the latter property can be found in the appendix.

The dictator is assumed to maximize his power using his two instruments, the domestic coffee price, p_p, and repression, R, subject to the budget and coffee production constraints, summarized in equation (3). Formally the dictator's problem is:

$$\begin{aligned} \max_{p_p, R} \quad & \pi(p_p, R) \\ \text{s.t.} \quad & M + (p_m - p_p)K(p_p, R) = p_R R. \end{aligned} \tag{max}$$

We denote the Lagrange multiplier associated with the constraint in this maximization problem as λ.

The first order *necessary* conditions for an interior optimum are:

$$\pi_{p_p} - \lambda v_1 = 0, \tag{6.a}$$

$$\pi_R - \lambda v_2 = 0, \tag{6.b}$$

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[8]Since it includes repressive measures to increase coffee production, the level of repression, R, also appears as an argument in the coffee production function, K.

and the constraint set characterized by equation (3).

The dictator's equilibrium should therefore satisfy:

$$\frac{\pi_{p_p}}{\pi_R} = \frac{v_1}{v_2}, \tag{7}$$

stating that for a dictator to maximize his power, the ratio of the marginal contribution to his power of one dollar spent on loyalty by raising the purchasing price of coffee to the marginal contribution to power of one additional unit of repression, should equal the *ratio* of their respective shadow costs.

In the remainder of this section, we construct a typology of dictatorial behaviour engendered by the model just presented. We therefore concentrate on the reactions a dictator can exhibit in the optimal mix of buying loyalty and repression to stay in power, to changes in the world market price, p_m. In the appendix we derive, by means of a standard comparative statics procedure, the following results:

$$\frac{\partial p_p}{\partial p_m} = \left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}} K(p_p, R) + \left.\frac{\partial p_p}{\partial v_1}\right|_{\bar{\Pi}} \frac{\partial v_1}{\partial p_m} + \left.\frac{\partial p_p}{\partial v_2}\right|_{\bar{\Pi}} \frac{\partial v_2}{\partial p_m} + w_1, \tag{8}$$

$$\frac{\partial R}{\partial p_m} = \left.\frac{\partial R}{\partial M}\right|_{\bar{C}} K(p_p, R) + \left.\frac{\partial R}{\partial v_2}\right|_{\bar{\Pi}} \frac{\partial v_2}{\partial p_m} + \left.\frac{\partial R}{\partial v_1}\right|_{\bar{\Pi}} \frac{\partial v_1}{\partial p_m} + w_2. \tag{9}$$

A changing world price in the first place generates a direct income effect on the optimal domestic coffee price and the – from the dictator's point of view – optimal level of repression. This direct income effect is represented by the first terms at the RHS of respectively equations (8) and (9). Indeed, the budget equation (2) shows that an increase in the world price of coffee makes additional revenues available that can be spent on buying additional loyalty or repression. In the sequel we will maintain the assumption that both the coffee price and repression are normal 'goods', meaning that these variables will increase if the dictator's budget increases for whatever reason: $\left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}}, \left.\frac{\partial R}{\partial M}\right|_{\bar{C}} > 0$. These income effects are measured without taking into account the effect of income, M, on coffee production, C, which explains the notation $\left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}}$, *i.e.* the income effect is measured while keeping the coffee production constant.

The second and third terms at the RHS of equations (8) and (9) reflect the impact of a change in the international coffee price through its effect on the relative shadow cost of coffee and repression. Indeed, a change in the world coffee price affects the slope of the budget equation, because the shadow cost of buying additional loyalty through raising the producer price relative to the shadow cost of repression has changed. This change in the relative shadow cost, in its turn, causes substitution effects (*e.g.* the change of p_p due to

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a change in the virtual price v_i, keeping the dictator's level of power constant), reflected by the terms $\frac{\partial R}{\partial v_i}\big|_{\bar{\Pi}}$ and $\frac{\partial p_p}{\partial v_i}\big|_{\bar{\Pi}}$, $i = 1, 2$. In the appendix we show that the classical results on the negative sign of own substitution effects hold true in this model: $\frac{\partial p_p}{\partial v_1}\big|_{\bar{\Pi}}, \frac{\partial R}{\partial v_2}\big|_{\bar{\Pi}} < 0$. Furthermore, we show in the appendix that the cross substitution effects are necessarily positive. Repression and buying loyalty are said to be substitutes: an increase in the shadow cost of repression leads to a substitution of loyalty for repression, while keeping the power level constant, in the optimum. Formally, this means: $\frac{\partial p_p}{\partial v_2}\big|_{\bar{\Pi}}, \frac{\partial R}{\partial v_1}\big|_{\bar{\Pi}} > 0$. These substitution effects are combined with the change in the shadow cost of loyalty through changes in the domestic coffee price and in the level of repression, which can be calculated from equations (4.1) and (4.2):

$$\frac{\partial v_1}{\partial p_m} = -\frac{\partial K}{\partial p_p} < 0, \tag{10.1}$$

$$\frac{\partial v_2}{\partial p_m} = -\frac{\partial K}{\partial R} < 0. \tag{10.2}$$

Consequently, the global own substitution effects (the second terms at the RHS of equations 8 and 9) of an increase in the world coffee price, p_m, on p_p and R are *positive*, while the cross effects (the third terms at the RHS of equations 8 and 9) are negative.

Finally, the terms w_1 and w_2 reflect second round effects on the shape of the boundary of the constraint set, which act through the change in the slope of the production frontier (1) resulting from a change in domestic coffee price and the level of repression during the first round. We assume that these effects, which depend on first and second derivatives of the reduced form production function, K, will never be dominant. By this we mean that the following implications are satisfied:

$$\frac{\partial p_p}{\partial M}\Big|_{\bar{C}} K(p_p, R) + \frac{\partial p_p}{\partial v_1}\Big|_{\bar{\Pi}} \frac{\partial v_1}{\partial p_m} \quad > (<) \quad -\frac{\partial p_p}{\partial v_2}\Big|_{\bar{\Pi}} \frac{\partial v_2}{\partial p_m} \quad \Rightarrow \quad \frac{\partial p_p}{\partial p_m} \geq (\leq) \quad 0, \tag{11.1}$$

$$\frac{\partial R}{\partial M}\Big|_{\bar{C}} K(p_p, R) + \frac{\partial R}{\partial v_2}\Big|_{\bar{\Pi}} \frac{\partial v_2}{\partial p_m} \quad > (<) \quad -\frac{\partial R}{\partial v_1}\Big|_{\bar{\Pi}} \frac{\partial v_1}{\partial p_m} \quad \Rightarrow \quad \frac{\partial R}{\partial p_m} \geq (\leq) \quad 0. \tag{11.2}$$

The single direction of the implication and the switch between strong and weak inequalities give more content to the meaning of the non-dominant character of the production side effects, w_1 and w_2: these are assumed to be small enough in absolute value not to cause a switch in sign of the effect of a changing international coffee price on the optimal domestic price and the optimal level of repression.

We are now able to characterize the dictator's optimal behaviour as follows:

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Proposition *Assume that both the domestic coffee price paid to producers, p_p, and repression, R, are normal goods, and the effects of p_p and R on coffee production, C, are relatively small. Then,*

1. *if it is optimal for the dictator to react to a decreasing world price of coffee, p_m, by increasing the domestic coffee price, p_p, he cannot simultaneously raise the level of repression, R.*

2. *if it is optimal for the dictator to react to a decreasing world price of coffee, p_m, by increasing the level of repression, R, he cannot simultaneously raise the domestic coffee price, p_p.*

3. *if a decreasing world price of coffee, p_m, leads to a decrease in the domestic coffee price, p_p, in the dictator's optimum, it might be optimal to increase or decrease the level of repression, R, depending on the structure of the power function π.*

Proof: *see appendix.*

This proposition allows us to provide a typology of dictatorial behaviour along the lines represented in table 1 below. A few words on how to read this table. One always starts from a strict inequality. Take *e.g.* column 2: if, following an increase of the world price, the dictator raises the domestic coffee price, either repression is not increased simultaneously (upper case of column 2), in which case we have a dictator who relies on benevolent means (buying loyalty) to stay in power, or the dictator increases also the level of repression (lower case of column 2), in which case the dictator combines buying more loyalty with more repression. We label the latter as a 'totalitarian dictatorship'. Note that a benevolent dictator trades off loyalty for more repression when the international price *de*creases. We call this the 'bad side' of the benevolent dictator. We continue the discussion of benevolent dictatorship assuming a fall of the world price of coffee as this will be the case in large parts of the empirical application in section 3. The reasoning can easily be adapted for the case that the international price rises. We turn now to the definition of *constrained* benevolent dictatorship (upper case of column 2 with brackets). As suggested we start reading from the strict inequality, *in casu* the dictator chooses to raise the level of repression following a decrease in the international coffee price. Conditional upon his choice to use more repression when the international price decreases, he can no longer choose to increase the domestic price. Otherwise, he would end up in the upper left part of the table which is

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Table 1: Typology of dictatorial behaviour

	$\frac{\partial p_p}{\partial p_m} \leq (<)0$	$\frac{\partial p_p}{\partial p_m} > (\geq)0$
$\frac{\partial R}{\partial p_m} \leq (<)0$	–	**(constrained)** **benevolent dictatorship**
$\frac{\partial R}{\partial p_m} > (\geq)0$	**(constrained)** **tyrannic dictatorship**	**totalitarian dictatorship**

The label 'constrained' corresponds to brackets in row and column headings.

not a viable strategy for the dictator according to our model. Therefore his benevolent behaviour is said to be constrained. In other words, the constrained benevolent dictator uses more repression when the world coffee price declines, which, because of budgetary reasons, necessarily *implies* that the domestic price paid to the producers will not rise[9].

Turn now to the first column of table 1. We have shown that, if the dictator maximizes his power, he cannot simultaneously decrease the domestic coffee price and the level of repression, when the international price rises (upper part). So, suppose we observe an increased level of repression when the world coffee price rises. If the dictator does not simultaneously increase the domestic price, we say he is a tyrant (lower part of the first column). If he would raise the domestic coffee price, we end up again in the totalitarian case (using both more repression and buying more loyalty). Finally, when we observe a decrease in the domestic price following an increase in the international coffee price, the dictator cannot choose to decrease repression, and therefore we say he is constrained to be a tyrant[10].

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[9]The difference between the behaviour of constrained benevolent and benevolent dictators can be observed if a decreasing world price is accompanied by a *constant* repression level and a decreasing domestic price. In that case, the behaviour of a benevolent dictator (keeping repression constant while lowering the domestic prices, following a decrease in international prices) is not the same as the behaviour of a constrained benevolent dictator, who would *raise* the level of repression while not increasing the domestic price. Constrained benevolence applies for sure if we observe a decreasing international price combined with an increase in the level of repression and no change at all in the domestic prices.

[10]Similarly to the case of constrained *versus* ordinary benevolence, constrained tyrannic behaviour can be distinguished from ordinary tyranny only if we observe a constant repression level and a decreasing domestic price when the world coffee price rises (constrained tyranny) or a constant domestic price level

Again, a *fall* of the world coffee price would induce a tyrant to substitute loyalty for repression, rather than the other way around. When tides are bad, the tyrant shows his 'good' side. The assumption of twice continuous differentiability of π does not allow for a-symmetric reactions on international price changes. For example, within the framework of this model it is impossible to meet a dictator who increases repression both when international prices decline and increase, starting from a given level of other financial means, M, and of the international coffee price, p_m. Nevertheless the latter behaviour might resemble closer the use of the term 'tyrant' in ordinary language.

But remark that benevolence and tyrannic dictatorship, as characterized here, are local properties. This means that a dictator can behave as a tyrant starting from a given combination (M, p_m) and as a benevolent dictator starting from another combination (M', p_m'). The classification of dictatorial behaviour into tyranny, totalitarian or benevolent dictatorship can therefore depend on the policy environment, *i.e.* the level of the world coffee price and the availability of other revenues.

3 Case study: coffee and power in Rwanda

3.1 Dictatorship and the coffee economy in Rwanda

In the present section we investigate whether the model developed in section 2 can shed some light on the strategic choices of the Habyarimana dictatorship (1973-1994) in Rwanda between buying loyalty, by increasing the domestic coffee paid to the farmers, and the implementation of repressive policies in order to stay in power, during an era of declining international coffee prices starting around 1978.

The Rwandese economy certainly fits in the picture of a single export crop economy. Coffee exports during the Habyarimana regime (1973-1994) accounted for 60 to 80% of export revenues, depending on annual output and world market prices. The leading members of the inner circle around the president (they were called *Akazu*) were in charge of OCIR-café, the state-run coffee agency. During the years when the regime had to establish its power (1974-1977), the world market price for coffee was relatively high, with a peak in 1977. The Habyarimana regime could afford to pay a relatively high producer price to the farmers, without affecting its revenues. The difference between the domestic price paid to the peasants and the world market price was substantial and the regime, by means

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and an increased level of repression (ordinary tyranny).

of the monopoly coffee marketing board, OCIR-café, derived large amounts of budgetary resources from coffee exports.

During the first half of the eighties (1981-1985) the international coffee price expressed in US dollar cents remained relatively stable, and this was, apparently, mirrored in a constant nominal coffee price paid to the producers, without major changes in the level of repression during that era. At the end of the eighties and during the early nineties (1988-1993) the Habyarimana dictatorship came under a double pressure. Firstly, the collapse of world market prices in 1987 and 1989 induced the regime to lower the domestic price paid to the farmers. This loss hit the farmers hard since they were already paying a number of taxes and retributions such as water taxes, health taxes, school fees. Secondly, political opposition to the regime got more organized. This coincided with the invasion of the Rwandese Patriotic Front (RPF) in October 1990. The question how to stay in power, therefore, became one of the central issues of the Habyarimana regime. This issue deserves more attention than the trade-off between consumption and power, or the pure rent seeking model of dictatorship (Wintrobe, 1998) in order to gain a better understanding of what happened at the end of Habyarimana's regime[11].

We will argue that the Habyarimana regime fits by and large the picture of a benevolent dictatorship that shows its bad side: increasing the level repression while cutting on the peasants' budget was a crucial feature of the way in which Habyarimana faced this double pressure during the late eighties and early nineties. The picture of a benevolent dictator who relies on buying loyalty rather than repression when he can afford it, is well in line with the peasant ideology which was developed by Habyarimana to justify his regime, as was analysed by one of us (Verwimp, 2000). But despite this ideology, it should be borne in mind that the benevolent dictator will substitute repression for loyalty when the world price of the country's export crop declines. There is also *prima facie* evidence for the argument that the benevolent character of Habyarimana's dictatorship developed only over the years. At the very beginning of his regime, when he had to establish his rule, Habyarimana exhibited rather totalitarian characteristics. Finally, there are some exceptional years (1981, 1984, 1988, 1991 and 1993) during which tyrannical traits emerge

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[11]In Wintrobe's classification, totalitarian dictatorship is characterized by trying to maximize both own consumption and power simultaneously, in contrast with a dictator who substitutes power for consumption, or the reverse. Verwimp (2003) adapted the Wintrobe reduced form model of totalitarian dictatorship to investigate the coffee policy under the Habyarimana regime. In the present paper, we single out the power maximizing objective from the Verwimp model, which allows to get a more detailed picture of the strategic choice between loyalty and repression to obtain power.

in Habyarimana's behaviour.

3.2 A short analysis of the coffee price evolution

It should be stressed that the model of section 2 does not satisfy homogeneity: converting all prices into a different monetary unit would not be neutral for the results. Some care should therefore be taken in deciding what is the appropriate unit for analysing the data. The central issue in the model of the previous section was the trade-off between the level of repression and of loyalty in order to maximize power. Loyalty was bought by means of providing the peasants with purchasing power. Furthermore, the means used by the Habyarimana regime to execute its repressive policy were mainly domestic. Even the genocide was in the first place executed with domestic sources, to wit the physical power of young males armed with farming equipment. Therefore – and in line with standard microeconomic models – monetary units should be expressed in constant domestic prices. Indeed, the dollar value which the dictator obtains through coffee exports should be expressed in terms of the amount of loyalty (peasant's purchasing power) and repression he can afford with those revenues.

There are three factors which explain variations in the world coffee price[12] expressed in constant Rwandese francs (RWF): changes in the dollar price on the international coffee market, variations in the bilateral exchange rate between the dollar and the Rwandese franc and the evolution of the Rwandese domestic price level (consumer price index, CPI). Notice that a depreciation of the Rwandese franc implies, in the short run, an increase in revenues for the dictator. He can be considered as an exporter who purchases power in terms of loyalty and repression on the domestic market. The inflationary effects of depreciations on the domestic markets are taken into account by considering also the evolution of the general domestic price level in the comparisons below.

The evolution of the main determinants to convert the world coffee price in terms of purchasing power can be found in columns 2 (the nominal coffee price on the world market in dollar cents), 3 (the exchange rate) and 4 (the consumer price index), of table 2, for the period 1985-1993.

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[12] All coffee prices are expressed per kg 'other mild Arabica', the standard reference for Rwandese coffee.

Table 2: Volume of coffee produced, prices and subsidies

Year	p_p RWF per kg	p_m US \$ cent per kg	exchange rate[a] $\frac{\text{RWF}}{\$}$	consumer price index (CPI)[b]	p_p in constant 1975 RWF per kg	p_m in constant 1975 RWF per kg	p_p in RWF as % of p_m in RWF	volume produced (in tons)	subsidies to coffee sector (billion RWF)
1985	120.0	319.0	101.26	234.40	51.19	137.81	37.15	43000	0.0
1986	122.5	413.0	87.64	231.78	52.85	156.16	33.84	41384	0.0
1987	125.0	246.0	79.67	241.36	51.79	81.20	63.78	41797	3.0
1988	125.0	292.0	76.44	248.55	50.29	89.81	56.00	42666	1.6
1989	125.0	187.0	79.98	251.06	49.79	59.57	83.58	30591	2.1
1990	100.0	178.0	82.60	261.57	38.23	56.21	68.02	34680	4.2
1991	115.0	169.0	125.14	312.94	36.75	67.58	54.38	29131	1.0
1992	115.0	116.0	133.35	342.86	33.54	45.12	74.34	38824	2.0
1993	115.0	129.0	144.31	385.21	29.85	48.33	61.78	27510	1.0

[a] A devaluation of 40% took place in November 1990 and of 15% in June 1992. These devaluations did not affect that years coffee harvest (April to June of each year).
[b] 1975=100.

Sources: domestic and international coffee prices stem from Uwezeyimana (1996): 85-85-86 and Rwalinda *et al.* (1992): 6. Subsidies to the coffee sector: Tardif-Douglin *et al.* (1993): 8. Production volume: agricultural statistics of the FAO statistical databases (FAOSTAT), which can be found on `www.fao.org/waicent/portal/statistics_en.asp`. Local exchange rate and CPI stem from the World Development Indicators data-bank (`www.worldbank.org/data/wdi2003/`). Other figures are own calculations on the base of these data.

International coffee prices expressed in US dollars declined throughout the period, with the exceptions of 1986 and 1988, when the world price increased due to bad harvests in Brazil, and a relatively small upshot at the end of the observation period, in 1993. The steady increase of the domestic price level aggravated the negative repercussions of the falling international coffee price on the dictator's budget. The mild depreciation of the Rwandese franc *vis-à-vis* the dollar towards the end of the eighties, and the considerable devaluations of 1990 and 1992 could not reverse the global downward tendency of the world coffee price expressed in constant RWF (column 6 of table 2): while the price per kg in 1985 amounted to 138 constant 1975 RWF, it declined to a meagre 48 constant 1975 RWF in 1993, despite the relatively small upshots, also in real terms, in 1986, 1988, 1991 and 1993. The latter two were caused by the devaluations of 1990 and 1992 and the higher world price in dollars in 1993.

In nominal terms, the domestic producer price (see column 1 of table 2) was raised from 120 RWF in 1985 to 125 RWF in 1987. However, in real terms, the domestic prices continued to decline almost without any interruption over the whole period 1985-1993, from 51 constant 1975 RWF in 1985 to 30 constant 1975 RWF in 1993 (see column 5 of table 2). The only exception was the year 1986, when the increase in the domestic price exceeded inflation.

The global picture therefore suggests that the international and the domestic coffee price are positively associated. The regime was confronted with a declining revenue from coffee and reacted by price cuts, thereby buying less loyalty. As a consequence, the production of coffee became less attractive and the volume of coffee produced steadily declined (column 8 of table 2). Many farmers were not anymore interested in growing coffee. Some farmers preferred to grow other crops, *e.g.* bananas. Bananas and especially banana beer are important sources of peasant income (see Bart, 1993). Compared to coffee, bananas are a source of income the whole year round, with a dense local market for banana beer. Survey research in 1992 suggested that a minimum price of 120 RWF/kg was necessary for farmers to continue cultivation. At 115 RWF, 5 percent of the farmers stated that they would stop coffee cultivation. At 100 RWF, 10 percent would do so (Tardif-Douglin *et al.*, 1993).

Tardif-Douglin *et al.* (1993) write that a bag of coffee would buy the Rwandese farmer in 1991 only half the goods it bought in 1980. This figure was confirmed by our own calculations, which indicate a drop from 70 constant 1975 RWF in 1980 to 37 constant 1975 RWF in 1991. It was this drop in the real price of coffee that made its cultivation not anymore interesting to the farmer. The negative evolution of coffee production was exacerbated by

the crop failure in the southern prefectures of Gikongoro and Butare in 1989, due to plant disease and drought, with, as a consequence, a serious dip in the coffee production during that year.

The downward trend in both real world and domestic coffee prices seemed to have been ongoing already quite a while, be it less pronounced. From the same sources as those used for table 1, we constructed a time series of constant 1975 RWF world and domestic coffee prices going back to 1975, thus covering almost the whole period of the Habyarimana regime. These series are plotted in figure 1. We fitted a 3rd degree polynomial trend through both series. For the estimated coefficients, see the appendix.

Figure 1 permits three observations. First, the polynomial for the domestic coffee price, which is reasonably well estimated given the limited number of observations ($n = 19$), reaches its local maximum just before the fifth period of observation (1979) and its local minimum at about the eighteenth observation period (1992). So, the real domestic coffee price had a downward trend from the late seventies onward up to almost the very end of the Habyarimana regime. The international price trend, for which the estimate admittedly was much less precise, declined throughout the observation period, up to 1992. So, overall we observe a declining trend of the real world prices and the real producer price for coffee in Rwanda since 1979.

Secondly, the gap between the international and domestic coffee price is strongly reduced towards the end of the observation period. This could also be seen from column 7 of table 2, where we calculated the percentage of the world price which goes to the farmers. From a ratio which roughly reached 40% in the early eighties, it suddenly rose to 60% and more, with a maximum of 84% in 1989. This forced the regime into subsidizing the coffee sector from the second half of the eighties onwards (see the last column of table 2). Part of these subsidies presumably have been financed by foreign aid and soft loans, the level of which started to increase in that period. The World Development Indicators database for Rwanda reveals that the official development assistance (ODA) rose from 208 million US dollars in 1986 to 356 million US dollars in 1993[13]. In real terms, this meant an increase of resources by 91%, from 6969 constant 1975 RWF in 1986 to 13336 constant 1975 RWF

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[13]These figures stem from www.worldbank.org/data/wdi2003/. ODA comprises actual international transfers of financial resources or of goods and services. It contains grants by official agencies of the Development Assistance Committee members (22 major donor countries plus the European Commission) and loans with a grant element of at least 25%. These are net figures: any repayments of principals have been subtracted. The figures might give a slightly exaggerated picture, since grants in kind are expressed at cost for the donor.

Figure 1: International coffee price and price paid to producers (constant RWF)
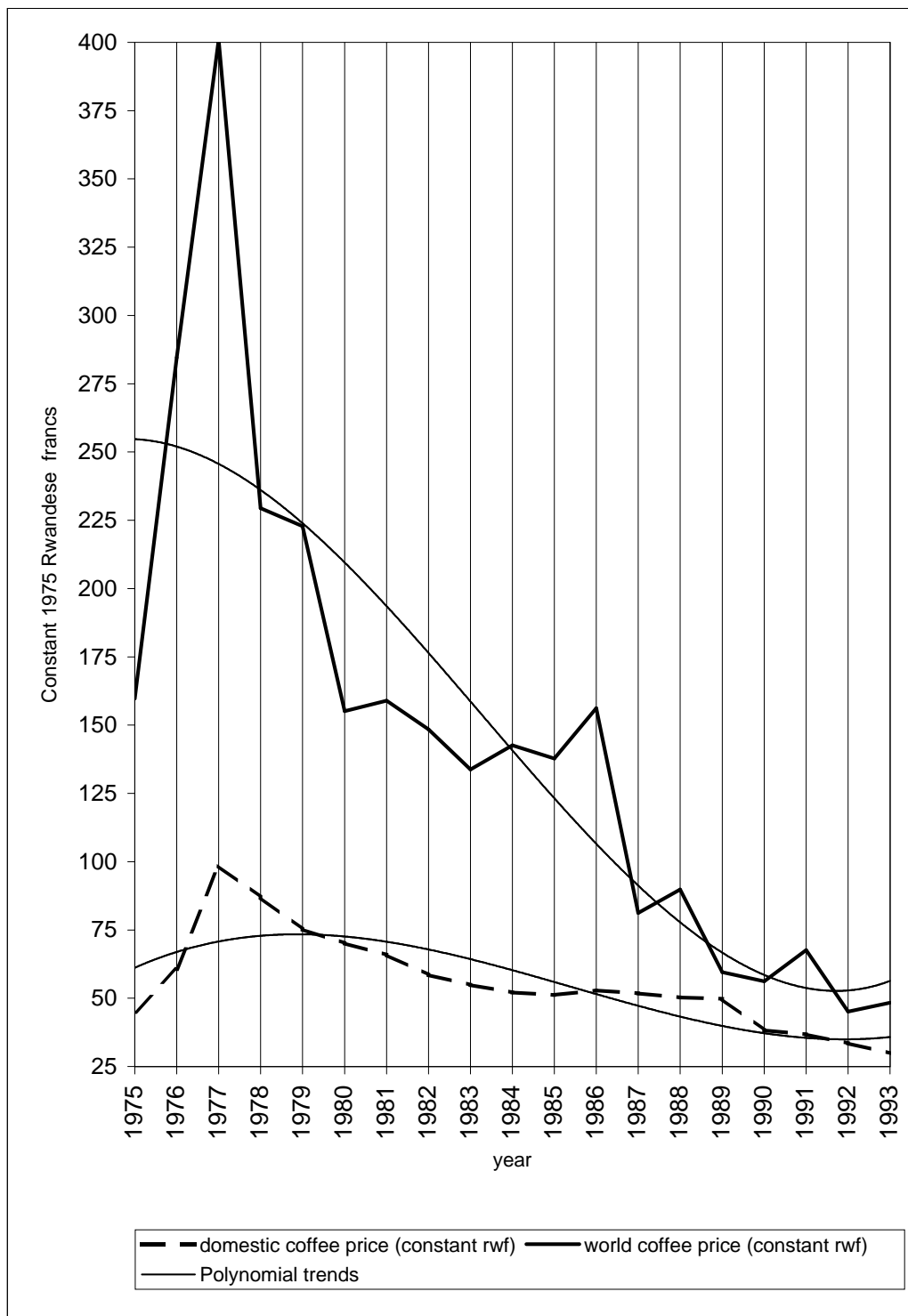

Sources: see table 2.

in 1993.

Thirdly, we observe that the trend lines confirm the suggestion made earlier that world and domestic coffee prices are positively associated. In terms of our model, the dictator buys more loyalty to increase his power in budgetary favourable times, but he cuts his expenditures on loyalty when his revenue is imploding, which was generally speaking the case in Rwanda between 1979 and 1993. During the years 1975-1978 the raw data suggest a positive association between real world and domestic prices, but the trend lines are negatively correlated until 1979.

To investigate this relation further, we performed a nonparametric regression of the real domestic on real international coffee price[14]. The result is represented in figure 2. For the sake of facilitating the interpretation, we added the real observation points to the graph. The positive relation throughout the range of values that the international price level assumes from 1979 onwards is confirmed. Contrary to what the negative correlation of the trend lines during the early observation period suggested, this positive relation seems to hold also for higher values of the international price, as, for example, those values observed during that period (1975-1978). There is indeed a negative kink in the regression curve for values of the international price level between 246 and 308 constant 1975 RWF. This can be explained empirically, by the observation that the real international coffee price declined from 285 constant 1975 RWF in 1976, to 229 constant 1975 RWF in 1978, while the real domestic price rose during the same period from 61 to 87 constant 1975 RWF. But this negative part of the graph is statistically not very reliable. Increasing the bandwidth of the regression would eliminate the negative part from the graph and reveal a persistent positive association throughout the observation period. We could have expected this, since the ratio of *yearly* first differences of real domestic to real international price is positive for 1976-1975 through 1980-1979, including the observations for 1978-1977 and 1977-1976. We can conclude that there is statistical evidence for a positive sign of the derivative of the real domestic price w.r.t. the real world price of coffee, in Rwanda during the Habyarimana regime.

Some point observations (revert to figure 1) do not fit with the global picture of a positive association between world and domestic coffee prices. These are all situated in

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[14]One-dimensional nonparametric regression is a technique which allows for testing the sign of association between two variables in a functionally independent way. Admittedly, the technique is designed in the first place for analysis of larger data-sets. So the present regression should be interpreted with care. Technicalities can be found in Härdle (1990). We used a bandwidth of $\frac{.75}{\sqrt[5]{n}}$ times the (estimated) standard deviation of the world price in constant 1975 RWF.

Figure 2: Nonparametric regression of domestic on world coffee price
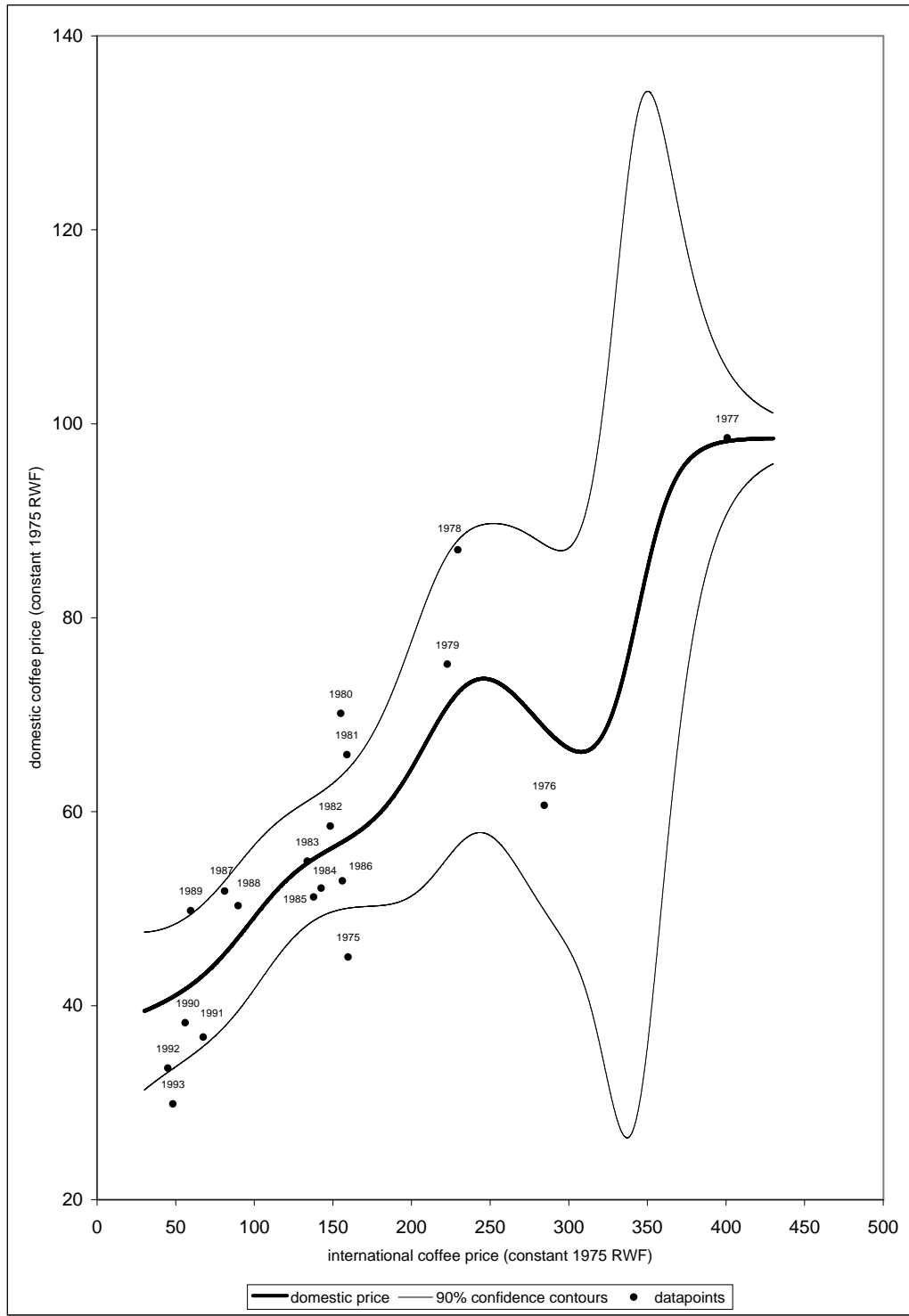
years of small upshots in the international price expressed in real terms (1981, 1984, 1988, 1991, 1993), while the global trend is already declining, from 1978 onwards. Apparently, these did not suffice to convince the regime to raise simultaneously the farmers' purchasing power. Only the peak in 1986, during the Brazil crisis, was passed on, be it only partly, to the farmers. We interpret the exceptions as stochastic deviations from the global picture. Possibly, the regime's economic policy makers did expect that these upshots in the price were only temporarily and therefore did not adapt the domestic price simultaneously.

In terms of our model, the globally positive association between world and domestic coffee prices during the reign of the Habyarimana regime corresponds to what is described in the second column of table 1 as either benevolent or totalitarian dictatorship. In the next subsection, we will give some empirical evidence on the evolution of the level of repression during the observation period, to determine which of both types of dictatorship best characterizes the behaviour of the regime. In the meantime, we feel that the small elasticity of the domestic coffee price with respect to the world price, alluded to earlier as the second lesson from figure 1, gives at least an intuitive indication that buying loyalty, or attempts to limit the decrease of the farmers' purchasing power, was an important concern for the Habyarimana regime.

3.3 Repression as a manifestation of benevolent dictatorship?

During the early years (1973-1979), the Habyarimana regime still had to establish itself among the peasant masses (Uwezeyimana, 1996). Some classical dictatorial policy measures were taken. In 1975, Habyarimana abolished all political parties and made all Rwandans members of the MRND (Mouvement Révolutionaire National pour le Développement), the single party. From then onwards, the MRND would be used as a vehicle for distributing political rents and to build mass loyalty. At least during the very first years of our observation period, from 1975 to 1977, this coincided with a rise in the real international and domestic coffee price. In our typology, such a dictator, who buys more loyalty as well as more repression when the price of the export crop rises, was said to be totalitarian.

Towards the end of the seventies, the first signs of repressive policies regarding the coffee sector appeared (Little and Horowitz, 1987)[15]. The 1978 law on coffee cultivation, for example, made the neglect of coffee trees punishable and provided every commune

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[15]There is some discussion on the degree of force used by the authorities to promote coffee cultivation. For this discussion, the reader can consult the comment by Robins and Ndoreyaho (1988) and Little and Horowitz's reply (1988).

with a monitor to advise farmers and control their coffee cultivation. At that moment the real international coffee price started to decline already, so that these measures can be interpreted as some preliminary evidence on the emergence of a benevolent type of dictatorship.

During the early eighties, there was however little pressure to apply these laws in practice. From 1980 to 1985 the fall of the international coffee prices in real terms was mild. As there was little political upheaval during that period, the regime exhibited a tendency to cut its expenditures on loyalty, by letting the real prices decrease slightly, without feeling the need to increase simultaneously the level of repression. This also fits into the picture of the behaviour of a benevolent dictator when tides are worsening. After abandoning the fixed exchange rate between the dollar and the RWF in 1983, a depreciation of the Rwandese franc followed so that the real producer price could be kept relatively stable, without a major impact on the government budget.

The picture started changing after 1986, when the world price in real terms collapsed. However, as we noticed from figure 1 and column 7 of table 2, the elasticity of the domestic price with respect to the international coffee price is small. Therefore, unless for other, exogenous shocks, changes in the level of repression due to international price movements can be expected to be very moderate or *quasi* nil. Some qualitative evidence suggests an increase in the level of repression towards the end of the eighties[16]. We give a short overview.

The reaction of the government to the crop failure in Gikongoro and Butare (1989) can be seen as illustrative. The government, which had proclaimed food-self-sufficiency to be its prime policy objective, refused to recognize the existence of a famine. It tried to impose a press black out (Prunier (1995): 87-88) and heavily criticized the journal *Kinyamateka* for publishing photos of starving people.

In September 1990 three journalists and the editor of the same journal *Kinyamateka*

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[16]Quantified measures of the political and civil rights status of countries were too rough to register these micro changes. Moreover the results of those quantifications are sometimes questionable. On the seven point scale for the civil right index distributed by the Freedom House (available from www.freedomhouse.org/research/freeworld/FHSCORES.xls) Rwanda scored 6 (7 is the worst case) over the whole period from 1979 till 1992. Surprisingly, an *improvement* to score 5 is registered from 1992 to 1993, while this index comprises, amongst other things, the occurrence of war and insurgencies. Possibly, the Arusha agreements might have influenced the score. Their political right index, which comprises minority rights, remained constant, at the high level of 6, throughout the period 1979-1993 despite ample documentation by now of liquidations of Tutsi after the invasion of the RPF in October 1990 (cf. note 18 below).

were brought before a court by the state for publishing a series of articles on the diversion of public funds for food relief by government authorities in the second half of 1989, but they were finally acquitted due to massive support of local people and international rights organizations. During the the publication of the articles there was a lot of pressure on the journalists (Amnesty International, 1990 and Sibomana, 1999)[17]. All this happened in a climate of an officially announced political democratization of the regime. The regime abandoned the one party state in June 1990. This fact could, at first sight, be interpreted as counter evidence of constant or increasing repression. But the decision to democratize was taken under international pressure of some major donors, amongst them France, and the regime was dependent on their aid to face the coffee crisis. Moreover, this decision did not prevent the regime from increasing repression in the economic sector, and from obstructing a free press and political opposition.

The situation became critical between 1988 and 1990, when the real world price declined from 90 to 56 constant 1975 RWF. As a consequence, the regime lowered the domestic price in 1990 from 125 to 100 RWF in nominal terms. This meant a decline to a level at which 10% of the farmers reported that they would rather destroy their coffee trees (*cf. supra* and Tardif-Douglin, 1993), even though this was, strictly speaking, legally prohibited according to the 1978 law. Some authors report that farmers actually did uproot their coffee trees, in spite of the penalties (Uvin 1998, Willame 1995). Given the legal restrictions, the percentage of farmers who would have uprooted their coffee trees in a less repressive environment surely would have been higher.

Because of the farmers' increasing reluctance in the late eighties to continue participating in *umuganda* – the unpaid communal labour duties which every adult had to perform once a week – local party and state officials were driven to raise pressure in order to be able to meet the national *umuganda* objectives stated by the regime's central authority (Guichaoua, (1991): 562). Prunier (1995: 87) claims that the number of *umuganda*

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[17]The editor comments on the events as follows: *"I knew that I was taking a risk by publishing these articles. It was at that time that Father Sylvio Sindambiwe was killed and it was difficult not to make a linked between these two events. I also knew that I was exposing the whole editorial team to possible retaliation. We accepted these risks."* (Sibomana, (1999): 25). Sylvio Sindambiwe was a former editor in chief of that newspaper, who had to resign in December 1985 under pressure of Archbishop Nsengiyumva, who was closely related to the Habyarimana regime, after he was directing the newspaper to adopt a critical line towards the Habyarimana regime. He escaped two earlier assassination attempts since then, and died in a suspect traffic accident on November 7th 1989. Another suspect death in a 'traffic accident' in August of the same year, of a member of parliament known for her open criticism of those corrupt government practices was reported by Prunier (1995: 89)

tasks were also increased by the regime during that period.

The coercive policy measures as a means to safeguard power while the loyalty from the peasantry began to fade due to the lowering of the domestic price (see previous subsection), could be interpreted as the reaction of a benevolent dictator to the disadvantageous economic environment in the late eighties, when the world coffee prices were falling. It is impossible to distinguish empirically for that period between constrained and pure benevolence (see note 9).

Finally, the repression got into a new phase after the civil war started with the invasion of the RPF in October 1990. The regime tried to reassure support by stirring up nationalist feelings and deviating attention from unfavourable economic conditions. As a part of the programme to stimulate hostile feelings against Tutsi, the training of unemployed youth as militias started. The increase in *political* repression is amply documented by the 1993 report of the international inquiry commission on the violations of human rights in Rwanda: arbitrary arrest, killing of opposition members by government agents, several massacres against Tutsi, confiscation of property, rape, etc.[18]

What is less known, but can be derived from the figures, is that the repressive policies of the early nineties have been financed at least partly by the successive devaluations of 1990 and 1992. The years following the devaluations (1991 and 1993) were indeed exceptional in that an increase in the international coffee price expressed in constant 1975 RWF due to the devaluation was followed by an increase in the level of repression combined with a continued

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[18]Several reports were written on gross human rights violations in Rwanda during the 1990-93 period. All these reports implicated the national and local authorities in the organization of the killings of Tutsi. (1) International Commission on Human Rights Violations in Rwanda since October 1st 1990 (Féderation Internationale des Droits de l'Homme (FIDH), *et al.*, March 1993). This report implicates the highest authorities in the organization of the killing of 2.000 Tutsi in several locations throughout Rwanda. The report also observes that Léon Mugesera, a close friend of Habyarimana and one of the ideologists of the genocide, was the instigator of this first massacre (FIDH, *et al.*, (1993): 21). Two years later, in 1992, Mugesera would make a racist speech inciting his audience to kill Tutsi.
(2) The US Department of State (February, 1993) published a report detailing the massacres of Tutsi in Bugesera (March 1992) and Bagogwe, a Tutsi subgroup (January 1991). In March 1991 the US Department of State had already published a report on the January 1991 massacre.
(3) In December 1992 and December 1993, the Rwandese human rights group ADL (Association rwandaise pour la défense des Droits de la personne et des Libertés publiques) published reports detailing massacres and human rights violations against Tutsi.
(4) The UN special rapporteur's report on Rwanda was released in August 1993. It says that massacres fall under the treaty definition of genocide.

reduction of the real domestic coffee price, be it at a lower rate than before[19]. In those exceptional years, the Habyarimana regime exhibited tyrannical traits. But these point observations can of course not overrule the global picture which is the one of a benevolent dictatorship. Recall that benevolent dictators substitute loyalty by repression when their revenues from exports are falling due to international price declines. The situation seemed to have been exacerbated by the success of the regime in obtaining external financial means (soft loans and aid) till its very end. This engendered positive income effects and made it therefore possible to raise the level of repression, while letting the real domestic price fall less rapidly than the world price.

4   Conclusion

We presented a political economy model of dictatorship in a single export crop economy. With the export earnings, the dictator buys the loyalty of the farmers-producers of the export crop by setting the price paid to producers. The difference between this price and the world market price, the revenue of the dictator, is used to pay for a repressive apparatus. Foreign aid or debt financing provide additional budgetary resources. Changes in the world market price of the crop affect the producer price and the level of repression. The sign of these effects depends on the magnitude of the income and substitution effects of the producer price and repression in the production of power and on their effect on the volume of coffee produced.

The model suggests a taxonomy of dictatorial behaviour. A benevolent dictator, for example, relies on buying more loyalty and substituting repression by loyalty to stay in power, when the international price of the export crop increases. The reverse or 'bad' side of a benevolent dictator pops up when he faces worsening economic circumstances: the level of repression is (weakly) increased, and he reduces his expenditures on loyalty by reducing the producer price.

We used our model to explain the political economy of coffee in Rwanda under Habyarimana who ruled the country from 1973 to 1994. The observed facts on the evolution of the international coffee price, the domestic coffee price and the level of repression in Rwanda illustrate the functioning of the model. What we have analyzed here is the behaviour of a dictator who tried to found his power on the loyalty of the peasant population. He had

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[19]In 1991 the government increased the nominal price from 100 to 115 RWF, but this could not compensate for the inflation rate of 19.6%.

to conduct this policy in an era when the world coffee price was declining. The logic of benevolent dictatorship led him to cut on expenditures on loyalty and, eventually, to turn to an increase in the level of repression from the end of the eighties onwards. The success of the regime to raise alternative revenues in the form of foreign aid and soft loans allowed it to raise the repression, and to mitigate the negative pressure on the domestic price.

Appendix

Comparative statics

Differentiation of the system of first order conditions (6.a), (6.b) and the budget constraint (3), repeated here in full form as:

$$\begin{aligned}
\pi_{p_p} - \lambda\left(K(p_p, R) - (p_m - p_p)\frac{\partial K}{\partial p_p}\right) &= 0, \\
\pi_R - \lambda\left(p_R - (p_m - p_p)\frac{\partial K}{\partial R}\right) &= 0, \\
p_R R - (p_m - p_p)K(p_p, R) - M &= 0,
\end{aligned} \tag{A.1}$$

with respect to p_m and M, yields:

$$(H(\pi) - \lambda H(v_1, v_2))) \begin{bmatrix} \frac{\partial p_p}{\partial p_m} & \frac{\partial p_p}{\partial M} \\ \frac{\partial R}{\partial p_m} & \frac{\partial R}{\partial M} \\ -\frac{\partial \lambda}{\partial p_m} & -\frac{\partial \lambda}{\partial M} \end{bmatrix} = \begin{bmatrix} \lambda\frac{\partial v_1}{\partial p_m} & 0 \\ \lambda\frac{\partial v_2}{\partial p_m} & 0 \\ K(p_p, R) & 1 \end{bmatrix} = \begin{bmatrix} -\lambda\frac{\partial K}{\partial p_p} & 0 \\ -\lambda\frac{\partial K}{\partial R} & 0 \\ K(p_p, R) & 1 \end{bmatrix}, \tag{A.2}$$

where v_1 and v_2 are the virtual costs or shadow prices of p_p and R respectively, defined in equation (4.1) and (4.2) of the main text. $H(\pi)$ is the bordered Hessian of π:

$$H(\pi) \equiv \begin{bmatrix} \pi_{p_p p_p} & \pi_{p_p R} & v_1 \\ \pi_{R p_p} & \pi_{RR} & v_2 \\ v_1 & v_2 & 0 \end{bmatrix}, \tag{A.3}$$

and $H(v_1, v_2)$, the Hessian of (v_1, v_2) bordered by a column and row of zeros:

$$\begin{aligned}
H(v_1, v_2) &\equiv \begin{bmatrix} \frac{\partial v_1}{\partial p_p} & \frac{\partial v_1}{\partial R} & 0 \\ \frac{\partial v_2}{\partial p_p} & \frac{\partial v_2}{\partial R} & 0 \\ 0 & 0 & 0 \end{bmatrix} \\
&= \begin{bmatrix} 2\frac{\partial K}{\partial p_p} - (p_m - p_p)\frac{\partial^2 K}{(\partial p_p)^2} & \frac{\partial K}{\partial R} - (p_m - p_p)\frac{\partial^2 K}{\partial p_p \partial R} & 0 \\ \frac{\partial K}{\partial R} - (p_m - p_p)\frac{\partial^2 K}{\partial R \partial p_p} & -(p_m - p_p)\frac{\partial^2 K}{(\partial R)^2} & 0 \\ 0 & 0 & 0 \end{bmatrix}.
\end{aligned} \tag{A.4}$$

All functions of p_p and R are evaluated in the optimal point (the solution to the system of equations A.1).

In the sequel, the matrix $-H(v_1, v_2))$ will be abbreviated by the expression $\mathbf{U}$. Hence, the solution of the matrix equation (A.2) yields:

$$\begin{bmatrix} \frac{\partial p_p}{\partial p_m} & \frac{\partial p_p}{\partial M} \\ \frac{\partial R}{\partial p_m} & \frac{\partial R}{\partial M} \\ -\frac{\partial \lambda}{\partial p_m} & -\frac{\partial \lambda}{\partial M} \end{bmatrix} = (H(\pi) + \lambda\mathbf{U})^{-1} \begin{bmatrix} -\lambda\frac{\partial K}{\partial p_p} & 0 \\ -\lambda\frac{\partial K}{\partial R} & 0 \\ K(p_p, R) & 1 \end{bmatrix}. \tag{A.5}$$

Using the formulas for an inverse of the sum of two matrices (see f.e. Henderson and Searle, 1981, formula 2), we are able to derive that:

$$(H(\pi) + \lambda \mathbf{U})^{-1} = (H(\pi))^{-1} - \lambda (H(\pi))^{-1} \mathbf{U} \left(\mathbf{I}_3 + \lambda (H(\pi))^{-1} \mathbf{U}\right)^{-1} (H(\pi))^{-1}, \quad (A.6)$$

with $\mathbf{I}_3$, the 3-dimensional unit matrix.

We first consider the matrix $(H(\pi))^{-1}$, which we write as:

$$(H(\pi))^{-1} \equiv \begin{bmatrix} Z_{11} & Z_{12} & z_1 \\ Z_{21} & Z_{22} & z_2 \\ z_1 & z_2 & \xi \end{bmatrix}. \quad (A.7)$$

By definition, we have:

$$(H(\pi))^{-1} H(\pi) = \mathbf{I}_3, \quad (A.8)$$

from which it follows that:

$$Z_{11}v_1 + Z_{12}v_2 = 0, \quad (A.9a)$$
$$Z_{21}v_1 + Z_{22}v_2 = 0. \quad (A.9b)$$

These are known in consumer theory as the *homogeneity conditions* (see *e.g.* Barten and Böhm, 1982), and are used in the proof of the proposition below. It can furthermore be shown that $Z_{11}, Z_{22} < 0$ and $Z_{12} = Z_{21} > 0$. The symmetry ($Z_{12} = Z_{21}$) follows from the assumption of twice continuous differentiability of π, which implies that $H(\pi)$ is symmetric, and so is its inverse. Consequently, from the homogeneity conditions (A.9a) and (A.9b) it follows that $Z_{11}v_1 + Z_{21}v_2 = 0$ and $Z_{12}v_1 + Z_{22}v_2 = 0$ also hold. The sign of the Z_{ij}'s then follows from the strong quasi-concavity assumption on π which is defined as:

$$\mathbf{x}' \begin{bmatrix} \pi_{p_p p_p} & \pi_{p_p R} \\ \pi_{R p_p} & \pi_{RR} \end{bmatrix} \mathbf{x} < 0 \qquad \forall \mathbf{x} \in \mathbb{R}^2 : (v_1, v_2) \cdot \mathbf{x} = 0 \text{ and } \mathbf{x} \neq \mathbf{0}, \text{ (strong quasi-concavity)}.$$

From equation (A.8), symmetry and homogeneity, it follows that:

$$\begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} \pi_{p_p p_p} & \pi_{p_p R} \\ \pi_{R p_p} & \pi_{RR} \end{bmatrix} \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}.$$

Hence,

$$\forall \mathbf{y} \in \mathbb{R}^2 : \mathbf{y} \neq \alpha(v_1, v_2), \alpha \in \mathbb{R} :$$
$$\mathbf{y}' \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \mathbf{y} = \mathbf{y}' \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} \pi_{p_p p_p} & \pi_{p_p R} \\ \pi_{R p_p} & \pi_{RR} \end{bmatrix} \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \mathbf{y} < 0,$$

where the inequality follows from the fact that

$$
\begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}
$$ is symmetric due to twice continuous differentiability of π,

and homogeneity then implies:

$$
(v_1, v_2) \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \mathbf{y} = 0.
$$

Positivity of Z_{12} and Z_{21} follows then from homogeneity and positivity of the shadow costs.

Furthermore, from general consumer theory (Barten and Böhm, 1982), it is possible to derive that the elements λZ_{ij}, $i, j \in \{1, 2\}$ are equal to pure substitution effects, while the z_i's represent income effects, for an optimization problem in which the virtual prices, v_1 and v_2, and the global budget $B \equiv M + p_m K(p_p, R)$ are considered to be parametric. By the latter we mean the following problem:

$$
\begin{aligned}
\max_{p_p, R} \quad & \pi(p_p, R) \\
\text{s.t.} \quad & B = v_1 p_p + v_2 R.
\end{aligned}
\tag{max'}
$$

Then it follows that:

$$
\begin{bmatrix} \lambda Z_{11} & \lambda Z_{12} & z_1 \\ \lambda Z_{21} & \lambda Z_{22} & z_2 \end{bmatrix} = \begin{bmatrix} \left.\frac{\partial p_p}{\partial v_1}\right|_{\bar{\Pi}} & \left.\frac{\partial p_p}{\partial v_2}\right|_{\bar{\Pi}} & \frac{\partial p_p}{\partial B} \\ \left.\frac{\partial R}{\partial v_1}\right|_{\bar{\Pi}} & \left.\frac{\partial R}{\partial v_2}\right|_{\bar{\Pi}} & \frac{\partial R}{\partial B} \end{bmatrix}.
\tag{A.10}
$$

We now concentrate first on the structure of the solution of our own problem for the income effects (the partial derivatives of p_p and R w.r.t. M). Since it was shown that the inverse of $H(\pi) + \lambda \mathbf{U}$ could be written as a sum of $(H(\pi))^{-1}$ and another matrix, the elements of which will be denoted as follows:

$$
-\lambda \left(H(\pi)\right)^{-1} \mathbf{U} \left(\mathbf{I}_3 + \lambda \left(H(\pi)\right)^{-1} \mathbf{U}\right)^{-1} \left(H(\pi)\right)^{-1} \equiv \begin{bmatrix} Q_{11} & Q_{12} & q_1 \\ Q_{21} & Q_{22} & q_2 \\ q_1 & q_2 & \zeta \end{bmatrix},
\tag{A.11}
$$

we are now able to establish that:

$$
\frac{\partial p_p}{\partial M} = \frac{\partial p_p}{\partial B} + q_1,
\tag{A.12a}
$$

$$
\frac{\partial R}{\partial M} = \frac{\partial R}{\partial B} + q_2.
\tag{A.12b}
$$

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That is, the income effect can be split up in two parts: the first is the classical income effect from consumer theory, and an indirect effect, which takes into account that the reaction of p_p and R due to an increase in M, induces an additional income effect because of the associated change in coffee production, which alters the budget constraint through the term $p_m K(p_p, R)$. This allows the notation:

$$\frac{\partial p_p}{\partial B} = \left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}}, \tag{A.13a}$$

$$\frac{\partial R}{\partial B} = \left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}}. \tag{A.13b}$$

That is, the traditional income effect equals the effect of a change in the budget on p_p and R, keeping coffee production constant. We will make the assumption of bi-normality (cf. Moulin, 1995, p.357), which states that this direct income effect is positive, both for p_p and R. The terms q_1 and q_2 then capture the additional, indirect, income effect that works through $p_m K(p_p, R)$.

Putting things together, we can now calculate the complete effect of changing international coffee prices on domestic prices, p_p, and repression, R:

$$\frac{\partial p_p}{\partial p_m} = \left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}} K(p_p, R) + \left.\frac{\partial p_p}{\partial v_1}\right|_{\bar{\Pi}} \frac{\partial v_1}{\partial p_m} + \left.\frac{\partial p_p}{\partial v_2}\right|_{\bar{\Pi}} \frac{\partial v_2}{\partial p_m} + \\ \lambda Q_{11} \frac{\partial v_1}{\partial p_m} + \lambda Q_{12} \frac{\partial v_2}{\partial p_m} + q_1 K(p_p, R), \tag{A.14a}$$

$$\frac{\partial R}{\partial p_m} = \left.\frac{\partial R}{\partial M}\right|_{\bar{C}} K(p_p, R) + \left.\frac{\partial R}{\partial v_2}\right|_{\bar{\Pi}} \frac{\partial v_2}{\partial p_m} + \left.\frac{\partial R}{\partial v_1}\right|_{\bar{\Pi}} \frac{\partial v_1}{\partial p_m} + \\ \lambda Q_{21} \frac{\partial v_1}{\partial p_m} + \lambda Q_{22} \frac{\partial v_2}{\partial p_m} + q_2 K(p_p, R). \tag{A.14b}$$

An increase in the international coffee price provokes in the first place a direct income effect on both p_p and R. Indeed, it has the same effect as raising the other budgetary means M, through the term $p_m K(p_p, R)$. Under the assumption of bi-normality, these income effects are positive. From the expressions for the shadow cost of coffee price and repression, v_1 and v_2 (see equations 4.1 and 4.2 in the main text), it can be seen that a change in the international prices has also a direct negative effect on those shadow prices, since v_1 and v_2 are a function of p_m: we obtain that $\frac{\partial v_1}{\partial p_m} = -\frac{\partial K}{\partial p_p} < 0$ and $\frac{\partial v_2}{\partial p_m} = -\frac{\partial K}{\partial R} < 0$. This induces a double substitution effect. The first, 'own' substitution effects contain the effect on p_p, respectively R, of this decline in the own shadow cost, v_1, respectively v_2. This decline of shadow costs, when combined with the own substitution effects $\left.\frac{\partial p_p}{\partial v_1}\right|_{\bar{\Pi}} = \lambda Z_{11} < 0$ and $\left.\frac{\partial R}{\partial v_2}\right|_{\bar{\Pi}} = \lambda Z_{22} < 0$, which were shown to be negative, lead to an *increase* of both R and p_p. On the other hand the 'cross' substitution effects reflect the change in p_p, respectively R,

of the decline in the other shadow cost, v_2, respectively v_1. Since, $\left.\frac{\partial p_p}{\partial v_2}\right|_{\bar{\Pi}} = \lambda Z_{12} = \left.\frac{\partial R}{\partial v_1}\right|_{\bar{\Pi}} = \lambda Z_{21} > 0$, those cross substitution effects are *negative*. This means that the global effect of changing international prices on domestic price, p_p, and the level of repression, R, cannot be signed *a priori*. We classify the possible types of dictatorial behaviour the model allows in the main text.

Moreover, the shadow prices v_1, v_2 and the budgetary means are functions of the level of domestic coffee prices, p_p, and, repression, R. Consequently, the direct reaction in p_p and R to a change in international coffee prices, cause *second round effects*, which are reflected in the three last terms of both equations. The terms with Q_{ij} reflect the second round effects of changes in v_1 and v_2 due to variations in the first round of p_p and R. Secondly, the terms $q_i K(p_p, R)$ denote the indirect income effects, which act through a change in the coffee production $C = K(p_p, R)$, following the first round effects on p_p and R. We were not able to sign these effects. We assume that these are small in absolute value, in a sense specified more precisely in the main text (see equations (11.1) and (11.2) and the consequent comments). Therefore, we denote the sum of these indirect second round effects in a more condensed way by the symbols w_1, respectively w_2. After this substitution, equations (A.14a) and (A.14b) result in equations (8) and (9) of the main text. It can be seen from equation (A.6) that the non-dominating character of these terms will be satisfied, if the terms of the matrix **U** are small in absolute value. This will *mainly* be the case, when the effects of p_p and R on coffee production, reflected in the partial derivatives of the production function K, are small.

There are a number of arguments to support this assumption. It takes three to five years after planting before coffee trees reach full production. Regenerated coffee fields, also, do not reach full production in the year of regeneration. An increase in the price offered to producers may only result in an increase in the volume produced a few years later. Therefore, a government must be able to credibly commit itself that it will pay a higher price over a number of years. This is very difficult for a dictator who uses repression when he sees fit. Increased repression may uphold the volume of output for some time. It will also keep the dictator in power for some time, but it does not yield any additional income for the farmer-producers. This means that, in the end, the effect of p_p on C (the volume produced) depends on the credibility of a country's institutions to guarantee the income of farmer-producers. Given the knowledge and experience of producers that the dictator is willing and ready to use repression to reach his objectives, the credibility of a price policy for coffee under dictatorship is low and the assumption of small effects of p_p and R on C

is not unrealistic.

Proof of the proposition

Proof. Recall that $\frac{\partial p_p}{\partial p_m} < 0$ if:

$$\left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}} K(p_p, R) \leq \lambda Z_{11}\frac{\partial K}{\partial p_p} + \lambda Z_{12}\frac{\partial K}{\partial R}. \tag{A.15}$$

Use homogeneity ($Z_{11}v_1 + Z_{12}v_2 = 0$) to rewrite condition (A.15) as:

$$\left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}} K(p_p, R) \leq \lambda Z_{11}\left(\frac{\partial K}{\partial p_p} - \frac{v_1}{v_2}\frac{\partial K}{\partial R}\right). \tag{A.16}$$

Since it is assumed that $\left.\frac{\partial p_p}{\partial M}\right|_{\bar{C}} > 0$ and since $Z_{11} < 0$ this implies that:

$$\frac{\partial p_p}{\partial p_m} < 0 \Rightarrow \left(\frac{\partial K}{\partial p_p} - \frac{v_1}{v_2}\frac{\partial K}{\partial R}\right) \leq 0. \tag{A.16}$$

After rewriting the condition for $\frac{\partial R}{\partial p_m} \geq 0$ in a similar way as (use homogeneity condition $Z_{21}v_1 + Z_{22}v_2 = 0$):

$$\left.\frac{\partial R}{\partial M}\right|_{\bar{C}} K(p_p, R) \geq \lambda Z_{22}\left(\frac{\partial K}{\partial R} - \frac{v_2}{v_1}\frac{\partial K}{\partial p_p}\right). \tag{A.17}$$

Since $Z_{22} < 0$ and condition (A.16) implies that $\left(\frac{\partial K}{\partial R} - \frac{v_2}{v_1}\frac{\partial K}{\partial p_p}\right) \geq 0$, it follows, under the assumption that repression is a normal good, $\left.\frac{\partial R}{\partial M}\right|_{\bar{C}} > 0$, that

$$\frac{\partial R}{\partial p_m} \geq 0, \tag{A.18}$$

is always satisfied since the right hand side of condition (A.17) is non-positive, and the left hand side is positive.

Putting things together leads to the claim 1 of the proposition. The second and third claim are proven analogously. ∎

Polynomial trend equations

The estimates of the coefficients of the 3th degree polynomial trends represented in figure 1 are equal to (t-statistics between brackets):

$$
\begin{aligned}
\hat{p}_p &= \quad 0.035 \quad t^3 \quad - \quad 1.188 \quad t^2 \quad + \quad 9.113 \quad t \quad + \quad 53.196, \\
& \qquad (1.768) \qquad\quad (-1.990) \qquad\qquad (1.750) \qquad\qquad (4.311) \\
& \qquad\qquad\qquad\qquad\qquad\qquad\qquad R^2 = \quad 0.6821 \qquad \overline{R}^2 = \quad 0.6186,
\end{aligned} \tag{A.19}
$$

and:

$$\hat{p}_m = \begin{array}{cccccccc} 0.084 & t^3 & - & 2.336 & t^2 & + & 3.714 & t & + & 253.240, \\ (0.867) & & & (-0.795) & & & (0.145) & & & (4.168) \end{array} \quad \text{(A.20)}$$

$$R^2 = 0.7059 \qquad \overline{R}^2 = 0.6471.$$

The fit is reasonable for both equations, while the precision of the domestic price equation is acceptable, given the limited amount of observations ($n = 19$). The precision for the international price equation is however very poor. We therefore also estimated a 4th degree polynomial for the world coffee price. The fit increases significantly (in terms of adjusted R^2), and the precision amounts to the same level as for the 3-th degree equation for the domestic price. We nevertheless prefer the 3-th degree polynomial for interpretational purposes, since it performs better at the end of period, which is of most interest to us. Moreover, its results are more in line with the non-parametric regression in figure 2.

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