IMPACTS OF EXCHANGE RATE DEVALUATIONS ON THE COFFEE PRODUCTION RELATIONS[1]

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ABSTRACT

The objective of this paper is to determine the changes deriving from exchange devaluation shocks in coffee product and factors markets. Substitutability among factors is examined by applying the dual properties of the translog cost function. Coffee grains data were obtained in the area of Viçosa/MG between September/1988 and May/1998. Two scenarios of exchange devaluation are examined and the results show increases in factors'demand, specially land. The increase in the demand of imported input would be equivalent to the applied shock. Coffee production rises 26.14% with a 30% exchange devaluation, and 43.57% with a 50% shock. This increase would determine a larger pressure in the use of land, changing the estimated cost shares.

Key words: duality, foreign exchange, translog functions

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1. Introduction

The process of international economic integration in the last decades has changed the way of managing Brazilian economic policies reducing protectionist tariffs in international trade.

The "Real" stabilization plan, based essentially on an overestimated exchange rate, has handicapped the access of Brazilian products to the international market, especially the agricultural products, that make up about 31% of the total exports.

Policies and actions are required in order to cope with the persistent national public deficit of about 4% of GDP, thus, increasing positive results in trade relations and the external capital flows into Brazilian productive sectors. Devaluation of the foreign exchange rate and reduction in the protectionism are some ways of increasing exports and decreasing imports, therefore, obtaining better results in the trade balance.

The objective of this work is to determine the effects of an exchange rate intervention over production and factors, besides evaluating the substitutability among factors.

2. Methodology

In recent years, production functions studies have been common, due to the need of understanding the relationship among several factors and resulting products. This knowledge enables us to evaluate the effects of a market shock over the entire system.

Duality theory shows the relation between profit maximization and cost minimization. This theory has given a great contribution for it makes the capture of all production technology out of the cost function possible, without working directly with the production function, in a competitive framework with no risks. We only need to suppose the semicontinuity of the production function, the concavity of the cost function, linear homogeneity in inputs, and semicontinuity in the product vector (Alves, 1996).

Working with an average linearly homogeneous cost function, the relevant variables are the inputs prices, which are easily collected in the market. In the profit function there is a need for prices and quantities of inputs and outputs (Reis and Teixeira, 1995).

One way of dealing with production, cost, or profit functions, is using the translog function, with one or more inputs and outputs. This type of function has the advantage of being a flexible form with different substitution elasticities among factors and products without restrictions regarding any constant elasticity of substitution .

In a competitive market, a generic production function with n inputs is

$$Y = f(\mathbf{x})$$

where **x** is the input vector $(x_1, x_2, \ldots, x_n)$.

Let a production function with a constant return to scale. According to the dual relation, a linear homogeneous average cost function can be

$$\ln c(w) = \beta_0 + \sum_i \beta_i \ln w_i + \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln w_i \ln w_j \qquad (1),$$

where $c(w)$ is the indirect average cost function; w is the factors prices vector; i e j are factors; β' s are the parameters; and ln is the natural logarithm. The function is referred to as indirect in order to describe it as having only input prices as arguments instead of prices and quantities.

Using Shephard's Lemma in the indirect average cost function, and imposing symmetry and homogeneity restictions, cost shares equations are: $s_i = \beta_i + \beta_{ii} \ln w_i + \sum_{j \neq i} \beta_{ij} \ln w_j \qquad (2),$

where s is the cost share of the i factor[5].

Symmetry and homogeneity imply:

$$\beta_{ij} = \beta_{ji}; \qquad \sum_i s_i = 1; \qquad \sum_i \beta_i = 1; \qquad \sum_i \beta_{ij} = 0.$$

The direct price-elasticity relation of factor i (η_{ii}) demand is:

$$\eta_{ii} = \frac{\partial \ln x_i}{\partial \ln w_i} = \frac{\beta_{ii}}{s_i} + s_i - 1. \qquad (3),$$

Allen's substitution elasticity (σ_{ii}) is:

$$\sigma_{ii} = \frac{\beta_{ii}}{s_i^2} - \frac{1}{s_i} + 1. \qquad (4),$$

The advantage to obtain Allen's substitution elasticity is its symmetry characteristic.

Cross price elasticities of demand (η_{ij}) are obtained by

$$\eta_{ij} = \frac{\partial \ln x_i}{\partial \ln w_j} = \frac{\beta_{ij}}{s_i} + s_j. \qquad (5),$$

Allen's cross substitution elasticity (σ_{ij}) will be

$$\sigma_{ij} = \frac{\eta_{ij}}{s_j} = \frac{\beta_{ij}}{s_i s_j} + 1. \qquad (6),$$

5 Other detais can be obtained at ZYLBERSZTAJN and JOHNSON (1985), BERNDT (1991), GREENE (1997), REIS and TEIXEIRA (1995).

After evaluating the cost shares and the substitution elasticities, price distortion effects can be evaluated[6]. Zylberstajn and Johnson (1985) show two types of factor market distortions. First, there is the effect of changes in the market exchange rate away from the equilibrium rate; second, there is the effect related to price differences of a factor i between domestic and foreign markets, caused by trade distortions.

Let us consider a nation where the suplus is exported at foreign price. It is possible to show domestic demand and supply curves at Figure 1(a), and exports demand and supply curves at Figure 1(b).

In Figure 1 (b), $D_{exp}(e_0)$ is the exports demand curve faced by the country at domestic prices, and a function of the exchange rate *e*, overvalued at time 0. For a country playing as a residual participant in the market, $D_{exp}(e_0)$ will be perfectly elastic. For a big country that can affect international prices, exports demand will be D_{exp}.

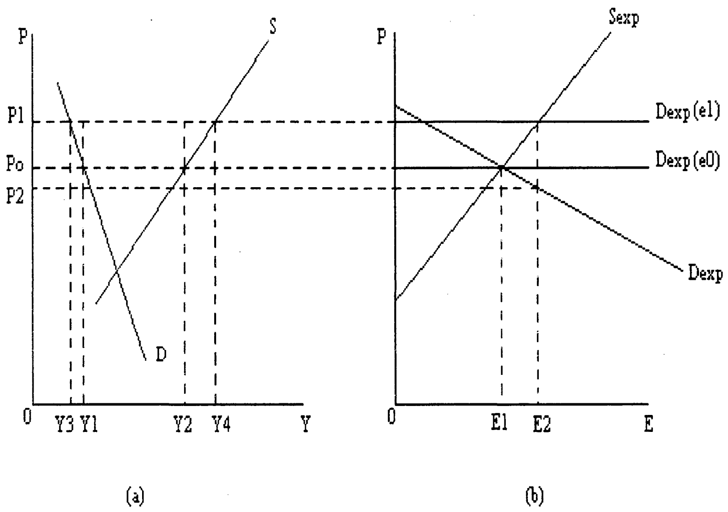

Figure 1. Market for an exported product.

6 Specifically, the agricultural market of products and inputs is emphasized in this article.

Defining the exchange rate as $e = P/P^*$, the ratio between domestic and international prices in terms of relative changes would be:

$$EP = Ee + EP^*$$

where E is the relative change($E\xi = d\ln\xi$); P is domestic price; and P* is the international price. If P* has no change, exchange rate changes will directly reflect on domestic prices.

Figure 1 shows that at prices P_0, the production will be y_2 with a demand y_1. Then, (y_2-y_1) will be exported (E_1) at an exchange rate e_0. In the domestic point of view, a devaluation of the currency to e_1 will change the exports demand curve from $D_{exp}(e_0)$ to $D_{exp}(e_1)$, increasing domestic prices and reducing domestic demand and, as a consequence, allowing a greater exports surplus. The new export equilibrium will be $E_2 = (y_4-y_3)$. This change would have the same result as an export subsidy of (P_1-P_0). If the country is big enough to influence foreign prices, then the increase in exports will make lower foreign prices. Brazil is the world's biggest coffee producer and in 1998/99 took in almost 22% of global exports, while in 1997/98 this share was about 18%. The extent of the country's influence on foreign prices is questionable, but this consideration will not affect the model as it is formulated in this work.

The previous model considers only the production market, apart from the devaluation effects over inputs market. Brazilian agriculture uses a huge quantity of imported inputs, so changes in the exchange rate will affect not only the products market but also the inputs market.

Figure 2 shows the market for an imported input. Domestic factor supply and demand are shown in Figure 2(a) and imports supply and demand in Figure 2(b).

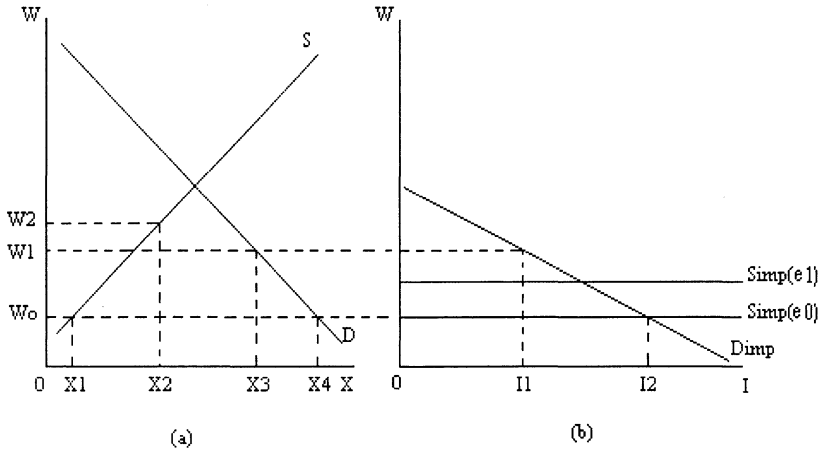

Figure 2. Market for an imported factor.

In Figure 2(b), D_{imp} is the import demand and $S_{imp}(e_0)$ is the import supply as a function of the exchange rate *e*, appreciated at time 0, supposing that the country faces a perfect elastic import supply curve.

The factor market is subject to different influences, and two of them are related to the protection of the domestic industry and the exchange rate.

Supposing that different protectionist measures can be represented as an import quota (x_2), that guarantees a share of the production to be traded inside the country, then the input industry will produce x_2, and the price will be W_2 (Figure 2(a)).

As the international price is $W_0 < W_2$, then the farmer will demand the domestic quota of the production plus an imported share ($I_1=x_3-x_2$). The effective price paid by the farmer (W_1) will be a weighted price between W_0 and W_2.

The effect of the overvalued exchange rate in the imported inputs market is the reduction of prices, allowing for higher imports (x_4-x_1). Protectionism will increase domestic production and domestic prices, whereas reducing domestic demand.

An exchange rate devaluation would move the imports supply curve up ($S_{imp}(e_1)$), increasing W_0 and W_1 and changing the protection level. This devaluation would also move domestic inputs supply, if imported inputs are used in their production (for example, fertilizers that use microelements in its production).

Figure 3 shows the effects of distortions in the final product supply curve, supposing that the input industry is protected and that the exchange rate is overvalued. Product domestic supply (S) and demand (D) are shown in Figure 3(a).

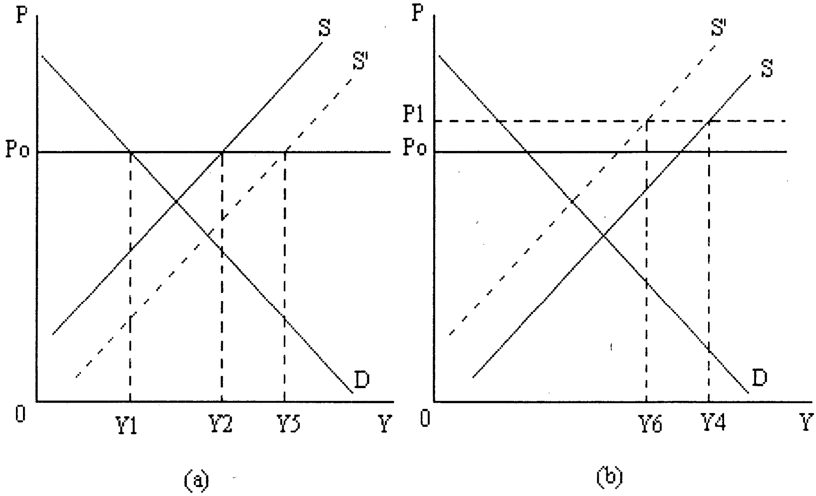

Figure 3. Distortions effects in final product supply curve.

The elimination of microelements imports quotas has the effect of moving product supply to S', increasing exports surplus from (y_2-y_1) to (y_5-y_1), at prices P_0.

There are two effects of the exchange rate devaluation in Figure 3(b): a change of the product supply curve to the left due to the increase of input costs; and an increase of the supply curve due to the higher prices that result from the increase in exports demand, as showed in Figure 1(b).

As it was shown, the elimination of imports quotas and the exchange rate devaluation have opposite effects in product supply and input prices. If these distortions act simultaneously the final result will be a combination of the partial effects. So, it is possible that a protectionist policy applied to the input industry reduce agricultural production, or that an exchange rate devaluation doesn't increase production, since these effects depend on the supply price elasticity of the product and of the inputs. They also depend on factors' partials elasticity of substitution.

Using a similar model as Zylbersztajn and Johnson (1985), it is possible to quantify the effects of protection elimination and of an exchange rate devaluation. The model is described through the use Shephard's Lemma. This Lemma implies that the product compensated input demand can be obtained by[7],

$$\frac{\partial\, c(w,y)}{\partial\, w_i} = u_i(w,y). \qquad (7),$$

In the situation where the price of the product is equal to the marginal cost of production, in a competitive equilibrium, with a linear homogeneous average cost function, we have

$$\frac{\partial\, yc(w)}{\partial\, y} = c(w) = P_y \qquad (8),$$

where Py is the product price.

[7] See HERTEL (1984).

Differentiating equation (8) in factor prices, substituting (7) in the results and arranging terms, the equation of relative product price changes ($E\text{p}_y$) is obtained:

$$E_{P_y} = \sum_i s_i E_{w_i} \qquad (9),$$

where s_i is the cost share of factor i; E_{wi} is the relative change in factor price; E is the relative change operator $(E\xi = \text{dln}\xi)$.

Totally differentiating equation (7) and using the concept of Allen's partial elasticity, the expression of relative change in factor quantities ($E\text{x}_i$) is obtained:

$$E_{x_i} = \sum_j \sigma_{ij} s_j E_{w_j} + E_y \qquad (10),$$

where E_y is the relative change in product quantity.

The relative change in product prices ($E\text{p}_y$) and in factor prices ($E\text{w}_i$), like in Zylbersztajn and Johnson (1985), are

$$E_{Py} = \left(\frac{1}{\eta}\right) E_y + Ty \qquad (11),$$

$$E_{w_i} = \left(\frac{1}{\varepsilon_i}\right) E_{x_i} + Tx \qquad (12),$$

where η is the price elasticity of demand of the final product; ε_i is the partial price elasticity of supply of factor i to its own price; Tx and Ty are vertical shifters of factor supply and product demand curves, expressed in percentage changes.

The model used by Zylbersztajn and Johnson (1985) links the factor market to the production with Ew, Ex and Ey as endogenous variables.

Matrices of price elasticity of factor supply (Γ) and of factor demand (Φ), and also a cost shares vector (S) are constructed, so that the effects on production and factors, from exogenous changes in Tx and Ty, can be calculated, and the effects of exchange market interventions can be determined. In matrix notation, relative changes in production are calculated by

$$E_y = \left[S'(\Gamma - \Phi)^{-1}\gamma\right]^{-1} Ty - \left[S'(\Gamma - \Phi)^{-1}\gamma\right]^{-1}\left[S'(\Gamma - \Phi)^{-1}\right]\delta\, Tx \qquad (13),$$

where $(\Gamma - \Phi)^{-1} = \left(I - \Gamma^{-1}\Phi\right)^{-1}\Gamma^{-1}$; δ is a vector of zeros and ones that makes possible to put a price shock in any factor; and γ is a unitary column vector.

Relative changes in factor prices are expressed by:

$$E_w = (\Gamma - \Phi)^{-1}\gamma\, D^{-1} Ty + \left\{\left[I - (\Gamma - \Phi)^{-1}\gamma\, D^{-1} S'\right](\Gamma - \Phi)^{-1}\Gamma\right\}\delta\, Tx \qquad (14),$$

where $D = S'(\Gamma - \Phi)^{-1}\gamma$.

The calculus of relative changes in factor quantities (Ex) is achieved by the expression:

$$E_x = \left[\Phi(\Gamma - \Phi)^{-1}\gamma\, D^{-1} + \gamma\, D^{-1}\right] Ty +$$

$$+ \left\{\Phi\left[I - (\Gamma - \Phi)^{-1}\gamma\, D^{-1} S'\right]\left[(\Gamma - \Phi)^{-1}\Gamma\right] - \gamma\, D^{-1}\left[S'(\Gamma - \Phi)^{-1}\Gamma\right]\right\}\delta\, T \qquad (15),$$

Relative changes in factor shares in total income (Es) are:

$$E_{S_j} = E_{w_j} + E_{x_j} - E_{P_y} - E_y \qquad (16),$$

3. Operationalizing the variables

This work studies coffee production in Viçosa/MG, between September/1988 and May/1998. The inputs are divided in labor (M), equipment (E), fertilizer (I), and land (T).

The previously related cost shares equations are estimated by seemingly unrelated regressions methods (Zellner's method), since cost share equations are linked by their disturbances. To operationalize the model, symmetry and homogeneity are imposed to deal with singularity difficulties of the covariance matrix of cost shares disturbances (Greene, 1997).

There will be (n-1) estimated cost shares equations and the remaining parameters will be obtained by difference in order to avoid a singular covariance matrix of disturbances (Berndt, 1991).

After defining cost shares equations for labor, equipment and fertilizer from (2) and imposing symmetry and homogeneity, the expressions were estimated as follows:

$$\begin{cases} S_M = \beta_M + \beta_{MM} \ln \frac{P_M}{P_T} + \beta_{ME} \ln \frac{P_E}{P_T} + \beta_{MI} \ln \frac{P_I}{P_T} \\ S_E = \beta_E + \beta_{EE} \ln \frac{P_E}{P_T} + \beta_{ME} \ln \frac{P_M}{P_T} + \beta_{EI} \ln \frac{P_I}{P_T} \\ S_I = \beta_I + \beta_{II} \ln \frac{P_I}{P_T} + \beta_{MI} \ln \frac{P_M}{P_T} + \beta_{EI} \ln \frac{P_E}{P_T} \end{cases} \quad (17).$$

where S_M, S_E e S_I are the cost shares of labor, equipment and fertilizer, respectively.

The parameters of the labor share equation are calculated using symmetry and homogeneity conditions, by difference.

Cost data for coffee produced in Viçosa-MG with monthly market prices were used. The data were collected by researchers from the

Agricultural Economics Department at the Federal University of Viçosa[8] considering all types of production costs. Production technology was detected by a local survey with producers at the beginning of the period and considered constant over the period of study.

Prices of equipment and labor were obtained directly from the cost sheets, with observed market prices, and are respectively equipment rents and the value of an eventual daily worker. The price of ammonium sulfate was used as a proxy for the fertilizer price, by the great number of inputs used in production. This proxy was obtained at IEA – São Paulo's Agricultural Secretary.

Monthly land costs were obtained by a linear interpolation of the semestrial values of crop land rents obtained at the Fundação Getúlio Vargas. The average productivity used in the unit conversion was forty 60-Kg bags per hectare.

All prices were deflated using IGP-DI index from the Fundação Getúlio Vargas at June-1998.

The devaluation model was operationalized from equations (13), (14), (15) e (16) where: S' is a vector (1x4) of the mean estimated cost share of each factor; Γ is a diagonal matrix (4x4) of the price elasticity of supply of each factor achieved by Lopes (1977) quoted by Zylbersztajn (1983), corresponding to 1.23; 0.50; infinite and 0.31, to labor, equipment, fertilizer and land, respectively; Φ is a matrix (4x4) of the price elasticity of factor demand, showed in Table 2 (in the results topic); δ is a vector of zeros and ones (4x1) where imported fertilizer is the only one affected by the exchange rate devaluation (the only one regarded as imported); γ is a unitary vector (4x1); Tx and Ty are the tariffs and exchange shocks vectors (1x1).

Two scenarios were constructed by applying a 30% and 50% exchange rate devaluation, and the results are in relative changes (Ewi,

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8 The authors thanks the researcher Ângelo Antônio Ferreira for the valuable collaboration on obtainment of the data.

Exi, Ey, Esi) for each factor i (labor - M, equipment –E, fertilizer – I, and land –T). The reference exchange rate is the effective one.

In this paper, the broader model is used, where devaluation shocks raise the relative price of imports and decrease those of exports, compared to international prices. The exchange rate devaluation will increase the cost of imported fertilizer and the revenue of exported products in domestic currency.

The protectionism was not evaluated, by making Tx = 0, supposing that there was no change in trade policy, but only an exchange devaluation shock.

4. Results and discussion

The translog model parameters were estimated using software EViews® and the seemingly unrelated regressions (SUR) method, and the results are in Table 1.

Table 1. Parameters estimates of factor cost shares in coffee production, Sept/1988-May/1998.

Parameter	Estimates	Standard Deviation
β_M	0,6713*	0,0487
β_{MM}	0,2078*	0,0076
β_{ME}	-0,0175**	0,0075
β_{MI}	-0,1143*	0,0067
β_{MT}	-0,0760	-
β_E	-0,0208 ns	0,0499
β_{EE}	0,0277*	0,0103
β_{EI}	-0,0016 ns	0,0072
β_{ET}	-0,0086	-
β_I	-0,5410*	0,0603
β_{II}	0,1652*	0,0094
β_{IT}	-0,0493	-
β_T	0,8905	-
β_{TT}	0,1339	-

Source: Research's data.
* Statistically significant at 1%; ** statistically significant at 5%; ns = non-significant; β_i is the intercept of the cost share equation of factor i; β_{ij} is the parameter of variable $\ln(Pj/P_T)$ in the cost share equation of factor i; i and j represents factors (M = labor; E = equipment; I = fertilizer; T = land); land parameters were obtained by difference.

The model had good estimates with a satisfactory behavior of the disturbances. There were only two non-significant parameters: the intercept β_E and the parameter β_{EI}. The parameters with no standard deviation are those obtained by difference, using the homogeneity conditions previously discussed.

The price elasticities of factors demand and the Allen's partial substitution elasticities were calculated using equations (3), (4), (5), and (6) and are shown in Tables 2 and 3.

In Table 2, the values of price elasticities of factor demand are statistically significant, except for the cross price elasticity between labor and equipment. The signs of the direct price elasticity of the demand agree with the theory, except for the land, which has a positive value. However, there is no information about the significance of this land direct price elasticity of the demand and a non-significance may be possible.

Table 2. Direct and cross price elasticities of the demand for coffee production factors Sept/1988-May/1998.[1]

Quantity	Price				
	Labor	Equipment	Fertilizer	Land	Σ of rows
Labor	-0.0883*	0.0091 ns	0.1186*	-0.0394	0.0000
	(0.0167)	(0.0166)	(0.0147)		
Equipment	0.0866 ns	-0.3705**	0.3367**	-0.0528	0.0000
	(0.1582)	(0.2163)	(0.1504)		
Fertilizer	0.1455*	0.0433**	-0.1836*	-0.0052	0.0000
	(0.0181)	(0.0193)	(0.0254)		
Land	-0.1400	-0.0196	-0.0152	0.1748	0.0000

Source: Research's data.
1. Values between brackets are standard deviations;* Significant at1%; **significant at 5%; ns = non-significant.

Table 3. Allen's elasticities of substitution between factors in coffee production, Sept/1988-May/1998.[1]

Quantity	Price			
	Labor	Equipment	Fertilizer	Land
Labor	-0.1944* (0.0368)	0.1912^{ns} (0.3483)	0.3203* (0.0398)	-0.3081
Equipment		-7.7836** (4.5401)	0.9093** (0.4061)	-0.4128
Fertilizer			-0.4958* (0.0686)	-0.0407
Land				1.3667

Source: Research's data.
1. Values between brackets are standard deviations;
* Significant at 1%;**significant at 5%; ns = non-significant.

The substitutability between factors can be analyzed in Tables 2 and 3. Labor, fertilizer and equipment have a substitution relationship. Land is complementary to other factors and these relationships show that more land requires more equipment, workmanship and fertilizers, as a characteristic of the Zona da Mata region - Minas Gerais. For a larger area of coffee, there will be a need for dryers, more labor in production and more fertilizers and herbicides.

The highest substitution degree seen in Allen's elasticities was between equipment and fertilizer and it was almost unitary. The substitution relationship between fertilizers and equipment was unexpected. As the ammonium sulfate's price was used as a proxy to the fertilizer's price, and the equipment and labor's prices were obtained directly from costs sheets observed at Viçosa's region, maybe a weighted index would be a better quality proxy to fertilizer's price.

Symmetry and homogeneity conditions were satisfied and they can be seen in Table 3 (by the Allen's elasticities of substitution), and by the sum of the partial elasticities of substitution rows (Table 2).

Monotonicity of the cost function was satisfied and all factors shares in cost are positive. Their average estimated values are 0.0476; 0.3703; 0.4542; and 0.1279, for equipment, fertilizer, labor and land, respectively. Fertilizers and labor account for most of the cost. Land cost share is 12.8% and equipment does not contribute significantly in cost (4.8%) for that given technology.

Results for exchange rate devaluation are shown in Table 4. Factor demands would have positive relative changes, with a higher change in land, followed by fertilizer and labor. Fertilizer's demand (E_{XI}), with a positive supply pressure, would increase by almost the same percentage of the shock applied. The small effect in the equipment's demand (E_{XE}) expected for this factor, has a small use in the coffee production technology of the studied region.

As expected, larger shocks enhance the effects in factors prices, changed from a 30% devaluation to a 50% one, with positive relative changes in domestic prices of labor (E_{WM}), equipment (E_{WE}) and land (E_{WT}). Land has significant changes in its prices, compared to the others, with an increase above the percentage of devaluation, in absolute values.

Table 4. Relative changes with exogenous exchange rate shocks.

Variable	Ty = 0.30	Ty = 0.50
E_{XM}	0.1817	0.3029
E_{XE}	0.1037	0.1728
E_{XI}	0.2830	0.4717
E_{XT}	0.5406	0.9010
E_{WM}	0.1477	0.2462
E_{WE}	0.2074	0.3456
E_{WI}	0.0000	0.0000
E_{WT}	1.7440	2.9066
E_{SM}	-0.2320	-0.3866
E_{SE}	-0.2504	-0.4173
E_{SI}	-0.2784	-0.4640
E_{ST}	1.7232	2.8719
E_Y	0.2614	0.4357

Source: Research's data.
* E_{Xi} are changes in factors quantities; E_{Wi} are changes in factors prices; E_{Si} are changes in factors shares in production value; i represents factor (M = labor; E = equipment; I = fertilizer; T = land); E_Y are changes in production; T_Y is the value of applied exchange rate devaluation (30% e 50%).

The null effect in fertilizers price (E_{WI}) was unexpected, because it is known that a devaluation of the currency does not change imported input prices in foreign currency, but increases its prices in the domestic currency. The result is obtained by the use of the infinite price elasticity of the supply of imported factors (Figure 2b). This infinite value in inverse matrices generates a null result and shows that the model requires improvement. This null relative change in imported factor price was also achieved by Zylbersztajn (1983) in a cotton and corn study for São Paulo (for Tx = 0 and Ty>0).

Although there has been positive changes in prices and in demanded quantities of all factors, relative changes in factor shares in production value are negative, exception to land (E_{ST}). This happens because there is a major increase in land prices and demands, that makes this factor more determinant in prod'iction value.

The relative change in production (E_Y) is high, with increases of 26.14% and 43.57% in 30% and 50% scenarios of devaluation respectively.

5. Conclusion

In this paper, the coffee production in Viçosa/MG, Zona da Mata region is studied between September-1988 and May-1998. There are two scenarios of exchange rate devaluation (30% and 50%), and there are increases in factors demand, especially land. Imported fertilizers would have an increase in demand by almost the percentage of the applied shock (30% and 50%).

Coffee production would increase the exchange devaluation scenarios by 26.14% and 43.57%, in 30% and 50%, respectively.

As expected, equipment has not shown to be an important factor in coffee production of the studied region, and labor would answer with increases in demand and in price of about half of the shock applied. So, an exchange rate devaluation would be useful to avoid unemployment, stimulating production but generating factors prices increases as a negative effect.

An observation must be made to remember that this study adopts an exogenous exchange rate shock and did not admit changes in trade policy. So, an anti-inflationary policy that modifies tariffs over imported factors may change the results.

Another limitation of this work is related to factors price elasticities of supply, that were based on Lopes (1977), quoted by Zylbersztajn (1983), in their intermediary levels and they may need to be updated.

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