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The Elimination of Madagascar's Vanilla Marketing Board, Ten Years On[1]

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Abstract

This paper explores how the elimination of Madagascar's Marketing Board (MB) in 1995 affected prices paid to farmers, incentives, and regional indicators of poverty and inequality. After steadily losing market share, Madagascar has been able to regain some of the lost ground since the mid-1990s. Margins between FOB and farmgate prices have spectacularly narrowed down, but this effect is dwarfed by that of world-price volatility. A counterfactual analysis based on a model of Cournot competition between vanilla traders suggests that whatever limited competition there is among them has contributed to raise purchase prices and the cash income of vanilla farmers. However the effect on farmers' consumption remains small because a large part of it is self-consumed. The effect on aggregate measures of poverty and inequality is even smaller, even at the regional level. After taking into account the reduction in Madagascar's monopoly power on the world vanilla market implied by the elimination of the MB, the induced rise in producer prices is estimated to have lifted about 20,000 individuals out of poverty.

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1. Introduction

In most low-income countries and particularly in Sub-Saharan Africa (SSA), poverty is above all a rural phenomenon. Thus, reducing poverty means first and foremost raising the incomes of farmers. Although all farmers should ultimately benefit from pro-market reforms, those engaged in the production of cash crops, in particular export ones, are most susceptible to be reached by the trade reforms adopted by many SSA countries since the 1990s. However, although the failure of pre-reform policies is by now well documented, much uncertainty remains on the effect of those reforms.

The wave of pro-market reforms of the 1990s appeared against a backdrop of widespread failure in government intervention. Although sometimes justified on theoretical grounds (as in the case of vanilla), marketing boards and stabilization funds led to ill-fated outcomes documented in a growing body of well-documented case studies (see e.g. Krueger, Schiff and Valdes, 1988; Schiff and Valdes, 1992; Jaffee and Morton, 1995, McMillan et al. 2003, Baffes, 2005). Reasons behind the failures are multiple. Export crops are often extracted from a narrow geographic and economic base, meaning few supplier countries and often, also, few intermediaries in the export trade. Those situations had a high potential for strategic interaction over the appropriation of rents. Typically, particularly in SSA after independence, government intervention in the form of marketing boards ostensibly meant to exploit monopoly power externally and shelter farmer incomes from world-price volatility internally. However, weak public institutions associated with the failure of farmers to organize for the defense of their interests meant a widening wedge between FOB and farmgate prices, the difference being appropriated by various combinations of organized groups. In particular, export structures specialized in "point-source" (as opposed to diffuse) natural resources such as vanilla proved strongly associated with weak public institutions and low growth (see Isham et al., 2005).

Throughout the 1990s, along with complementary sectoral reforms (e.g. privatization of processing, removal of price controls and taxes), marketing boards and stabilization funds were largely eliminated throughout SSA, as was the case for vanilla. In retrospect, those reforms have met with varying degrees of success. If reform appraisal is sometimes complicated by the policies of importing countries (as in the case of cotton), domestic reforms deemed necessary have often been either slow, as in the case of the four major West African cotton producers (see Baffes, 2005), or controversial, as in the case of

cashew nuts in Mozambique (McMillan et al. 2003). Lacking the necessary household surveys before and after the reforms, it is hard to know how rural poverty has been affected by these reforms. With household surveys straddling the reform period during which the marketing board was eliminated, however, Madagascar's vanilla reform is an exception.

Madagascar's vanilla policy since independence is in many ways typical of a pattern common to large parts of SSA, having gone through three successive phases. Throughout the colonial period, the vanilla market had been marred by price instability, low farmgate prices, and collusion among traders. Right after independence, the Government of President Tsiranana intervened in a bid to bring more stability and equity in the distribution of the gains from the vanilla trade (sound economic arguments could also be invoked in favor of public intervention in the market). A vanilla stabilization fund was created, prices were guaranteed, and a cartel was formed in 1962 with the Comores and the Réunion, with the objective of taking advantage of the region's market power over the world's second most expensive spice. Government intervention initially brought about positive results, with exports up by a factor of five in the 15 years following independence (Blarel and Dolinsky, 1995).

However things turned for the worse in the mid-1970s after the Socialist revolution of President Didier Ratsiraka. Policy capture, rent-seeking, inefficiency, and corruption were the hallmarks of this era, in Madagascar as in so many other SSA countries at the time. Export taxation became confiscatory, with farmers receiving less than 8% of vanilla's FOB price. On the world market, the cartel's overpricing policy encouraged Indonesia's successful entry. By the early 1990s, the golden-egg goose had been all but killed, and in 1995 the government finally adopted the reforms long advocated by donors: elimination of the stabilization fund, phasing out of the export tax, and limitation of public intervention to coordination and non-intrusive forms of quality control. The ten years since reform have featured renewed turbulence on the market and changes in the distribution of the gains from trade, which this paper purports to study.

Vanilla in Madagascar is a particularly interesting case to study the hurdles that reforms must overcome to be successful. The characteristics of the vanilla market and of vanilla preparation suggest significant externalities and market failures (e.g. asymmetric quality information) that justify intervention of the type that was initially set up. So if opportunistic behavior could be controlled, cooperation among agents involved in the value chain leading to export would be optimal

both to overcome market failures and to exploit its monopoly power on high-quality ("Bourbon") vanilla.

Thus, put in historical perspective the argument for reform was not a welfare one, as transparent cooperation between all domestic agents would have been —taking the market-failure arguments at face value and putting the political environment's realities aside— Madagascar's first best. Instead, the argument was essentially (i) a comparison of second-bests and (ii) of a distributional nature.

It was a comparison of second-bests because the pre-reform state of play was very far from the cooperative optimum, as the marketing board simultaneously expropriated vanilla farmers through very low farmgate prices while setting the FOB price substantially above even the static revenue-maximizing level (de Melo et al., 2001). The marketing board's irrational behaviour implied that the argument for reform was to relace the unsustainable over-exploitation of a dwindling market power by its under-exploitation in an imperfect-competition equilibrium on the domestic intermediation market.

The distributional aspect of the argument involved the redistribution of rents from urban elites (intermediaries and political beneficiaries) toward farmers. However even at this high level of simplicity the argument was less than straightforward as vanilla-growing farmers, although poor in absolute terms, were relatively high up in the distribution of rural incomes. So ironically reform, if successful, had the potential to *widen* rural income inequality (although, according to our results, it did not).

We attempt in this paper to trace the reform's effects on rural incomes through a two-pronged strategy. First, we look at price, quantity and income-distribution statistics in the vanilla region. It turns out that the statistically traceable impact is negligible for several reasons. First, the data is obviously spotty and the sample of vanilla farmers is small. Second, volatility in world prices is so large that it drowns the faint signal from the reform.

This observation prompted us to complement the household-based appraisal with a counterfactual experiment in which we compare the current equilibrium with what would be obtained, ceteris paribus, with current market conditions but under the old export-monopoly-cum-export-tax regime. For this, we use a simple simulation model of the vanilla market in which two countries (Madagascar and

Indonesia) with atomistic suppliers and imperfectly-competitive domestic traders adjust to policy changes, in this case the resuscitation of Madagascar's marketing board and export tax. Comparing the two outcomes (actual and simulated) plausibly establish that farmgate prices got a substantial boost from the elimination of the export monopoly and tax. Once re-injected into estimates of the distribution of income, however, the induced producer-price changes failed to generate large effects. The reason, in our view, is simply that cash income is small in the overall consumption of rural households, so price changes can only have small effects unless implausibly large quantity reactions are assumed.

Section 2 describes and analyzes the evolution of the vanilla market in light of Madagascar's policies. We start by describing the market failures and externalities that justify intervention (section 2.1) then recall the different phases in Madagascar's policies (section 2.2). Section 3 turns to an assessment of the reforms' effects. Section 3.1 analyzes evidence from Madagascar's four household surveys, while Section 3.2 presents the results from the simulation analysis. Section 4 concludes.

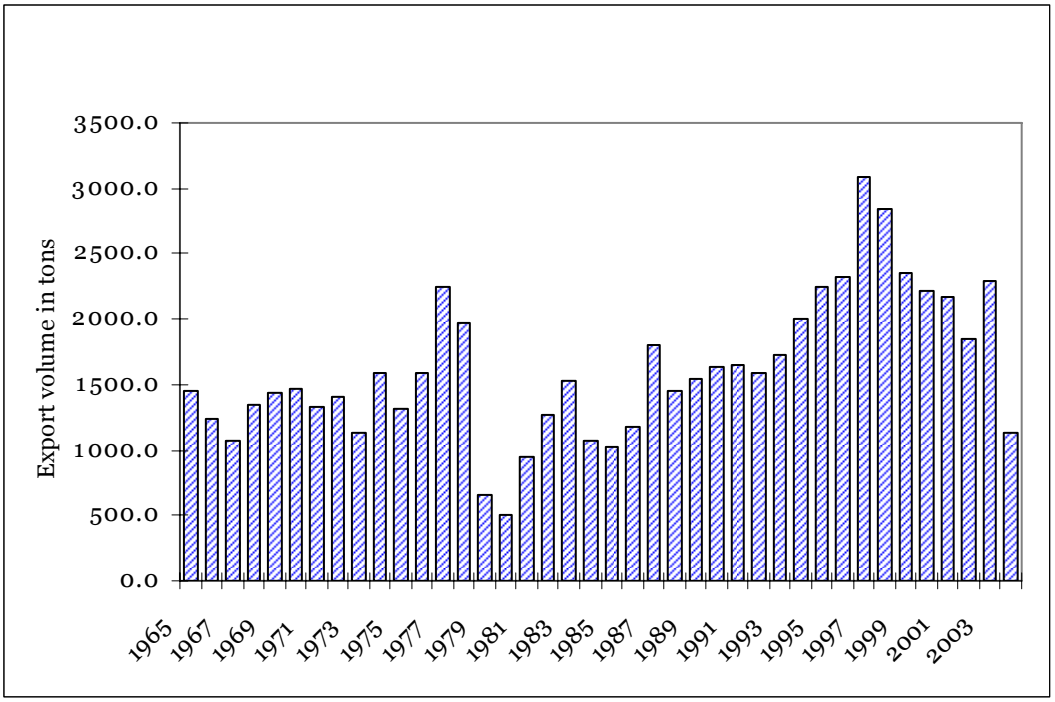
2. Madagascar's vanilla market

Smuggled out of Mexico by Cortes in 1520, vanilla was introduced to the Réunion, then called Ile Bourbon, around 1793, but without the complementary bee that carried out the pollination. Vanilla production had to wait for the discovery of hand pollination in 1836. From then on, its cultivation for export to the Metropole was encouraged by colonial authorities, although for technical reasons, unlike other tropical crops its production could never be carried out in large plantations.

Low in bulkiness, vanilla has a high unit value and is highly differentiated across origins. Madagascar's vanilla is considered high-quality because of its high vanillin content (1.5% to 2%), and substitutability is low between beans of different origins ("Bourbon", which denotes beans from Madagascar, Comoros and Réunion, vs. the Mexican, Java, and Bali's "Bourbon-like" quality). Vanilla is the only spice that benefits from a "Standard of Identity" helping to shield it from competition by substitutes. Synthetic vanilla, which is cheaper than the natural one, accounts for the bulk of the overall vanilla market (about 20'000 tons per year, of which natural accounts for 10-15%). Tonnages on the natural vanilla

market have hovered between 1'500 and 2'500 tons per year worldwide with no clear trend (Figure 1).[2]

Figure 1
Worldwide natural vanilla export tonnage



Source: Blarel and Dolinsky, COMTRADE.

2.1 The vanilla sector: stylized facts[3]

2.1.1 Organization and market structure

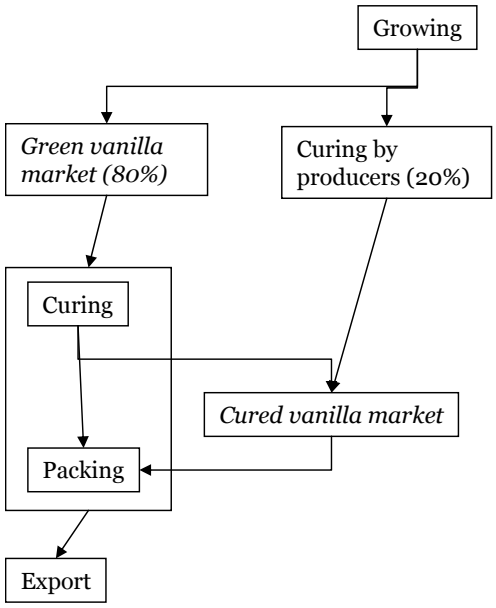
Figure 2 shows that the production of vanilla beans consists of three stages: (i) vanilla growing, which produces the "green" beans; (ii) curing, the stage at which

[2] Like other primary products, natural vanilla faces a constant threat from technical change. For instance, a German flavor and biotech company, Symrise, was recently reported to have made advances in the development of natural vanillin by fermentation with genetically modified bacteria of Eugenol, the conventional (and cheap) source of artificial vanillin. Although European hostility toward GMOs has convinced Symrise's management to put its GM vanillin project temporarily on hold, once on the market, this technology could increase competition for natural vanilla (see www.genet-info.org).

[3] This section draws from de Melo et al. (2000) and Blarel and Dolinsky (1995). Ecott (2005) narrates the fascination with vanilla since the time when the Aztecs demanded vanilla as a tax from the people of the central and high plateaus of the country we now call Mexico. In addition to a history of vanilla's origins and its development, his book describes in great details the organization of vanilla production and its use by the flavoring industry (see the narrative of his visit to the Nielsen-Massey factory (Ecott 2004, pp. 11-19).

it develops its quality (flavor profile and natural vanillin content); (iii) packing (sorting, grading, and tying in small homogenous bunches). Each stage requires specific skills.

Figure 2
Organization of the Vanilla Sector in Madagascar



Growing is highly labor-intensive, as crop husbandry requires 260 man-days per hectare during the first year and about 460 during the 4 to 8 years where plants reach maturity. Pruning and weeding are then supplemented by hand-pollination —which means that each flower on the vine has to be pollinated by hand and at different times— and harvesting. With few purchased inputs, entry and exit costs are low although plants require over three years to become productive and rather exacting growing conditions (small tracts of rich soil under the shade of trees).

Curing entails dipping beans in near-boiling water, then triggering an enzymatic reaction by alternate heating and "sweating", which means boxing the beans and exposing them to sunlight. The process is repeated 10 to 20 times before the beans are left to dry outdoors for 2-3 months. By then, they possess a uniform dark color and strongly smell of vanilla.

Once cured, vanilla beans are prepared, packed and stored in order to keep their flavor, a stage that is peculiar to Indian-Ocean producers. The storage process, which can last up to two years, is risky, as vanilla can mold and weekly inspections are required. The required expertise creates a barrier to entry

compounded by the cost of maintaining a high-value stock. Though it need not be the case, packers often export, and importers from the three main importing countries —the USA, France, and Germany— keep close and lasting marketing contacts with exporters.

Several of a bean's quality characteristics are unobservable and largely determined by growing conditions, time of harvest, and the curing process. This asymmetric information can make it tempting for individual growers and/or curers to free-ride, in particular by early harvest, giving rise to a prisoner's dilemma.[4] The resulting market failure could in principle be addressed by a variety of market mechanisms, including vertical integration, branding, or industry standards.

As a matter of fact, vertical integration between farming and processing is virtually nonexistent. If incentives to vertically integrate between curers and packers are stronger to overcome information asymmetries, they are still limited because the activities require specific skills. In the absence of vertical integration, the industry has developed weaker mechanisms to alleviate adverse-selection issues, such as the introduction of identification marks that remain visible after curing.

Virtually all packers have traditionally been Malagasy companies, some owned by ethnic Chinese. Although in the mid-1990s there were about 45 packers, five of them largely controlled the business (Blarel and Dolinsky, 1995), and the top three exporters accounted for two thirds of Madagascar's exports. This high concentration arguably resulted as much from government policies and rent-seeking as from economic rationality (marketing externalities and the like).

2.1.2 Vanilla farming

We now turn to a characterization of vanilla farms on the basis of Madagascar's four household surveys (EPM under their French acronym standinf for "*Enquêtes Permanentes de Ménages*"): 1993, 1997, 1999 and 2001. Although they are not

[4] Five months after flowering, vanilla beans have reached their optimal size but contain less than 1% of vanillin. In order to reach a vanillin content of around 2% (the norm for Bourbon vanilla) the beans must be harvested at least eight months after flowering. Fringe traders can thus be tempted to compete on collection dates. That is, if trader *i* collects at date *t*, trader *j* has an incentive to collect at date *t-1*. Depending on his discount rate, the farmer can be induced, in equilibrium, to sell his vanilla too early—though this competition can only take place over a short period-- leading to rent dissipation pretty much like in patent races.

strictly comparable because of differences in coverage, information from those surveys is helpful to identify correlates of vanilla farming that can help understand who the vanilla farmers are. Up to 200 vanilla-growing households were included in each survey.

Table 1 describes the geographical distribution of farming activities. Vanilla farming is concentrated on about 30,000 ha of plantations in the so-called SAVA zone (Sambava, Antalaha, Vohémar and Andapa) in the North-Eastern province of Antsiranana, with smaller numbers in the Toamasina province.[5]

Table 1
Agricultural population by main crop and region, 1998

Crop/Region	Antananarivo	Mahajanga	Fianarantsoa	Toamasina	Antsiranana	Toliary	Number of Producers	Share in total (%)
	Share in Total Number of Producers (%)							
Rice	22.4	11.1	26.7	18.3	12.9	8.7	2,804,244	30.9
Other food crops	40.4	7.0	14.9	13.4	5.8	18.5	4,402,227	48.5
Sub-total food crops	33.4	8.6	19.5	15.3	8.6	14.7	7,206,471	79.5
Sugar cane	7.3	18.0	32.5	21.3	10.6	10.2	422,267	4.7
Cotton	0.0	25.0	0.0	8.2	4.1	62.7	20,783	0.2
Tobacco	22.6	24.0	33.4	5.0	2.2	12.8	82,244	0.9
Peanuts	27.0	8.7	30.4	5.9	2.0	26.1	575,794	6.3
Sub-total ind. crops	18.6	13.7	30.9	11.8	5.3	19.7	1,101,088	12.1
Coffee	1.2	3.2	41.2	32.8	19.9	1.6	480,897	5.3
Vanilla	0.0	3.4	0.5	17.1	79.0	0.0	93,796	1.0
Pepper	0.0	0.9	70.0	11.3	17.6	0.1	54,230	0.6
Cloves	0.0	3.7	7.3	80.6	8.4	0.0	127,908	1.4
Cocoa	0.0	1.2	0.0	3.9	94.9	0.0	5,883	0.1
Sub-total export crops	0.8	3.1	32.2	37.1	25.6	1.0	762,714	8.4
Total	28.9	8.7	22.0	16.7	9.6	14.1	9,070,273	100

Source: World Bank (2001)

Because of its labor-intensive characteristics, vanilla is ill-suited for large-scale plantations. The number of farms involved in vanilla production fluctuates between 50,000 and 100,000.[6] Interestingly, Figure 3 shows that, compared to the average across all agricultural activities, concentration in vanilla farming is less than the EPM's average (compare with annex table A1). This may be due to

[5] Press sources report that vanilla production has also recently started in the island's South-East region (Manakara, Vohipeno, Farafangana, Vangaindrano) as a response to the collapse of coffee prices, but is still embryonic at around 100 ha. See http://www3.clicanoo.com.

[6] Data from Madagascar's EPMs suggests a figure around 90'000 with a substantial error margin because of imperfect stratification. A producer organization quotes 70'000 farmers in 2004.

the fact that vanilla requires special conditions that may not apply to a farm's entire land, however small.

Figure 3
Specialization of Madagascar's vanilla farms

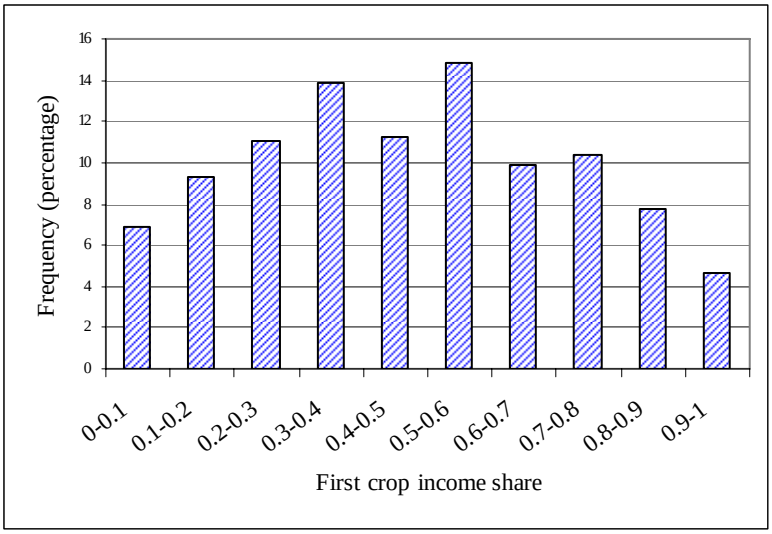


Table 2 shows descriptive statistics for vanilla farmers compared to the EPM's average which are given in annex table A1. It can be seen that most individual characteristics are close to nationwide averages except for a higher proportion in the "medium remoteness" category and, more importantly, for incomes which stands 15% higher. Given the very low nationwide average, this is not much, though it implies that improvements in producer prices received by vanilla farmers could contribute to widen rural inequality rather than reduce it.

Table 2
Descriptive statistics, vanilla farming

	All, 1993-2001	Vanilla
Sample size	9'504	578
Family size	5.12	5.08
HH head gender (proportion of HHs in category)		
Male	0.85	0.87
Female	0.15	0.13
HH head education (proportion of HHs in category)		
None	0.31	0.25
Primary	0.54	0.58
Secondary	0.16	0.16
Cropland surface (ha)	1.51	2.72
Land tenure (proportion of HHs in category)		

Owned	77.68	79.54
Sharecropping	4.42	5.45
Rented	3.82	3.30
% hholds w/outstanding loan	4.18	1.75
Remoteness (proportion of HHs in category)		
Low	0.37	0.26
Medium	0.43	0.57
High	0.20	0.17
Expenditure per capita		
Thousand Malagasy Francs	102.92	126.15
US dollars at PPP	27.78	30.32
Share of livestock sales in cash income	0.22	0.06
Share of crop sales in full income b/	0.14	0.32
First-crop share in total harvest	0.58	0.49

Source: EPM, 1993-2001

Further information on vanilla farmers can be extracted from the household surveys by looking at both "participation" decisions (whether or not to grow vanilla at all, a binary variable) and output decisions (how much of vanilla to grow, a continuous variable). For this we estimate a standard two-stage selection model of the form

$$y_i = X_i\beta + u_{1i},$$
$$I_i^* = Z_i\gamma + u_{2i},$$
$$I_i = \begin{cases} 1 & \text{if } I_i^* > 0 \\ 0 & \text{otherwise,} \end{cases}$$

where y_i is the log of farm i's vanilla output and I_i is equal to one when farm i grows vanilla. X is a vector of household characteristics likely to influence a farmer's portfolio choice whereas Z is a vector of household and community characteristics —including location— likely to influence a farmer's decision or ability to grow vanilla at all. Identification of the selection equation comes from the location and community characteristics.[7] Results are shown in Table 3.

[7] We chose to estimate a selection model because omitted variables such as a farmer's ability or equipment may influence both his decision to grow vanilla and how much to grow, which implies that $\text{cov}(u_1, u_2) \neq 0$.

Table 3
Estimation results, vanilla farming regression

Dependent variable	ln vanilla output (kg)	Vanilla=1 (selection)
HH size	0.18**	0.04
	[2.09]	[0.40]
HH head age	-3.22	-2.66
	[1.54]	[1.22]
HH head age squared	0.46	0.40
	[1.64]	[1.34]
AV HH members age	0.21**	0.05
	[2.40]	[0.62]
HH head schooling	0.03**	0.02*
	[2.31]	[1.74]
HH average schooling	0.03	0.01
	[1.59]	[0.45]
Cropland size	0.11**	0.28***
	[1.99]	[4.65]
Owner	0.05	0.40**
	[0.28]	[2.16]
Sharecropper	-0.63*	0.09
	[1.67]	[0.28]
Tenant a/	0.15	-0.33
	[0.56]	[1.19]
Past price change b/	0.29	-2.65***
	[0.30]	[4.08]
Past price volatility c/	-0.27***	-0.26***
	[3.10]	[5.52]
Vanilla price d/	-0.08***	
	[7.12]	
Input store		-0.57
		[1.58]
Bank		0.74***
		[3.57]
Temp. amplitude		-0.13
		[1.19]
Hurricanes		-0.78***
		[5.99]
Farmers association		0.34*
		[1.72]

Share agri. pop.		0.04***
		[3.57]
Transport cost		0.00***
		[3.21]
National road		0.23
		[1.19]
vanilla region		3.23***
		[6.26]
1997	1.01***	0.66**
	[3.57]	[2.12]
1999	0.61**	0.81***
	[2.13]	[2.63]
2001	0.65**	0.19
	[2.51]	[0.57]
Constant	7.50*	-4.06
	[1.83]	[1.02]
Observations		7'674
ρ	-0.485	
	(0.134)	
σ	0.952	
	(0.067)	
λ	-0.462	
	(0.148)	

Notes
a/ Omitted category: landless farmers tilling community land
b/ Preceding 3-year change in output-weighted Laspeyres price index
c/ Preceding 3-year standard deviation in output-weighted Laspeyres price index
d/ Residual of unit-value regression on individual/local characteristics (see Table 6 below)

As expected, the output equation gives positive and significant estimates for labor and land. However as the equation's "land" variable is the farm's overall land holdings rather than vanilla acreage, the estimated coefficient cannot be used to retrieve the marginal product of land. Education seems to raise the productivity of factors, and the effect is estimated precisely. Aggregate price volatility has a negative effect, possibly because with nonexistent capital markets price shocks impair a farmers' ability to save and invest.[8]

[8] The EPM reports very little access to credit. However, as noted elsewhere in this paper, this should be taken cautiously as farmers may fail to report pre-financing of the harvest as credit. This said, pre-financing of a harvest alleviates short-run liquidity problems but is not a substitute for investment credit to buy tools or seeds.

As for the selection equation (a probit on vanilla = 1), remarkably the location variable (vanilla region dummy variable for Antsiranana and Toliari) does not kill the explanatory power of household or community characteristics. Schooling again has a positive and significant effect. Farm size, whose influence on output was measured imprecisely in the output equation, is now highly significant in determining a farmer's choice to grow vanilla. One possible interpretation is that vanilla production is a sort of luxury for farms with enough land to grow other (food) crops. Ownership of land seems also to matter, possibly because the relatively long maturing of vanilla plants (three years) requires some security of title.[9] The negative coefficient on past price changes suggests a substitution effect between crops (the variable is an output-weighted average of past changes in all producer prices), although it may simply be that vanilla farmers also produce other crops whose prices happened to go down in the sample period. Price volatility in previous years is again a negative and significant correlate, probably for the reasons noted above.

Turning to market-related characteristics, the presence of a nearby bank which proxies access to credit while being arguably exogenous to an individual farmers's decision to grow vanilla has a positive and significant effect, suggesting that access to credit may have something to do with the decision to grow vanilla. However not much should be made of this given that vanilla farming does not require purchased inputs. The positive coefficient on the "farmers association" variable suggests that vanilla farmers are more organized than others, something that can be of importance in the bargaining with traders, although the effect is picked up with little precision.

[9] Few farmers in Madagascar actually have secure land titles.

2.2 Madagascar's vanilla policy, 1960-2003

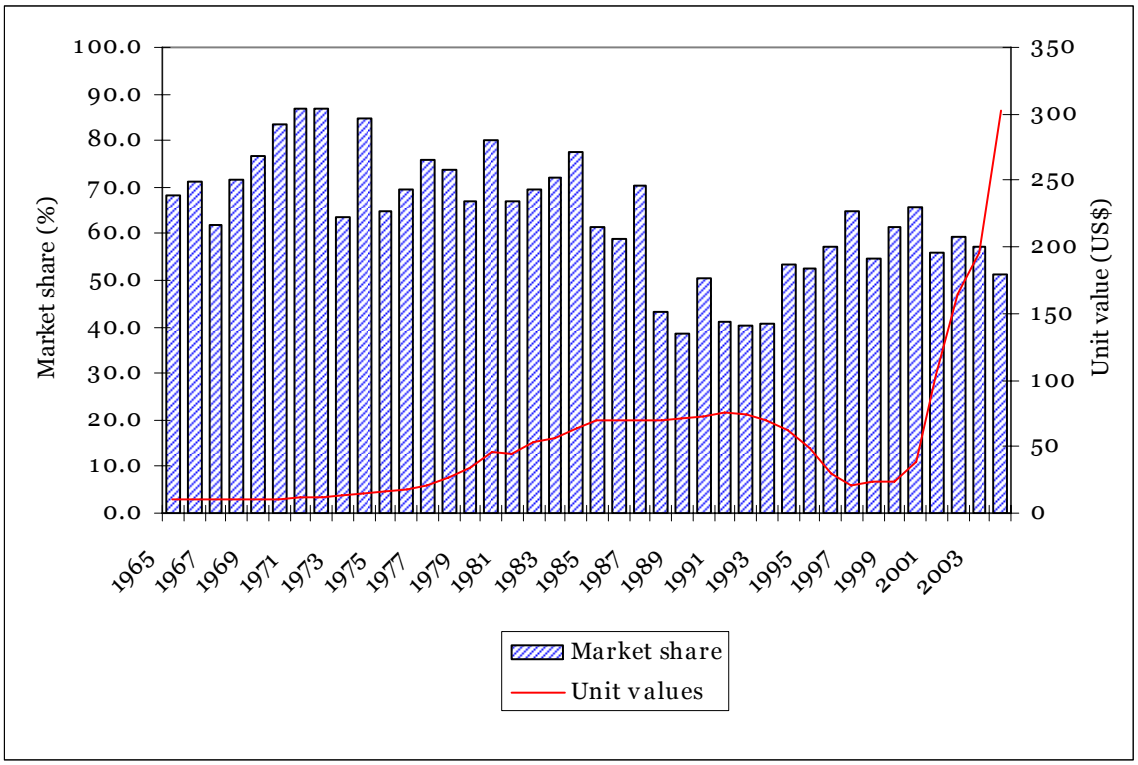
Madagascar's vanilla policy has gone through three successive phases since independence, the first two following a pattern common to much of SSA. Throughout the colonial period (not covered here), the vanilla market had been marred by price instability, low farmgate prices, and collusion among traders. Interestingly, the price volatility, trader concentration, and hands-off government policy which were the hallmarks of the colonial period —and prompted government intervention after independence— also characterize the current, post-reform regime. One essential difference, though, is that the contestability of the worldwide vanilla market has increased, making a swing of the pendulum back to interventionism unlikely.

Phase 1 (1960-75). Right after independence, the Government of President Tsiranana intervened, setting up institutions with a twin objective: (i) correcting market failures and externalities in a bid to develop world demand for vanilla, and (ii) bring more stability and equity in the distribution of the gains from vanilla trade. [10] A Vanilla Stabilization Fund (VSF—CAVAGI under its French acronym) was created together with a licensing committee overseeing export trade. At all stages of the production process described above, prices were set by the authorities according to a cost-plus formula, the *différentiel*. Under this institutional set-up, the VSF was committed to buy all production at a pre-specified price and to stock it. Curers, packers and exporters had to obtain a license to operate and the date when the season for selling green vanilla was allowed to start, was set by decree.

As described by Blarel and Dolinsky (1995), the government's primary objective was to establish conditions for an orderly market that would continue to rely on the private sector, notably by setting up the regulatory foundations for an interprofessional vanilla organization (GNIV). Nonetheless, from the start, the registration of packers-exporters was also intended to limit competition and entry, an objective that was surely favored by established incumbents.

[10] At the production stage, measures included the registration of vanilla growers, regulation of the marketing season for green vanilla to prevent harvesting before maturity, and the branding process described above. At the curing stage, registration required compliance with minimum quality standards —essentially not to purchase immature vanilla beans. Packers-exporters also had obligations (purchase all vanilla beans on the market and store them with exports controlled by a quality department) which were overseen by a licensing committee. In the early years, the licensing committee which also oversaw the activities of the GNIV and the VSF was collegial, being composed of representatives from the private sector and the government.

Figure 4
Madagascar's unit values and market share, 1965-2003



Source: Blarel and Dolinsky (2000), COMTRADE (mirror statistics), authors' calculations.

During this phase, a cartel was also formed in 1962 with the Comoros and the Réunion, the "Vanilla Alliance". Its objective was to take advantage of the region's huge market power over the world's second most expensive spice, but also to correct externalities and bring the collective action necessary to develop the market by generic market promotion in the major consuming countries, and to insure quality. In the mid-seventies, the cartel's worldwide market share was above 80%.

As shown in figure 4, government intervention initially brought about positive results, with the world market expanding rapidly and Madagascar exports up by a factor of five in the fifteen years following independence. It is also the phase when Madagascar established its lead in the market for vanilla (see figure 5). Blarel and Dolinsky (p. 295) conclude that this first phase was successful both on equity grounds, as the FOB price was about equally divided between growers, packers, and the GOM/VSF, and on efficiency grounds as the farmers' supply response was strong and quality maintained.

Phase 2 (1975-95). Starting in the mid-1970s, the Socialist revolution of President Didier Ratsiraka took the country into a State-led import-substitution development strategy that rapidly threw the vanilla sector, like the rest of the economy, into disarray. Although the institutional setup remained largely unchanged, policy became increasingly prone to rent-seeking, inefficiency, and corruption.

Growers were required to hold three-year licenses and processor-stockers annual ones, both granted by the Ministry of Trade which also hand-picked small numbers of them (38 in 1989, 13 in 1990) for participation in the export trade. The Ministry also fixed the export quota allotted to each authorized processor-stocker. Again under the direction of the GOM, the VSF (CAVAGI) purchased the largest part of the crop to market it directly, fixing the price for all export transactions, its own and those of the authorized exporters.

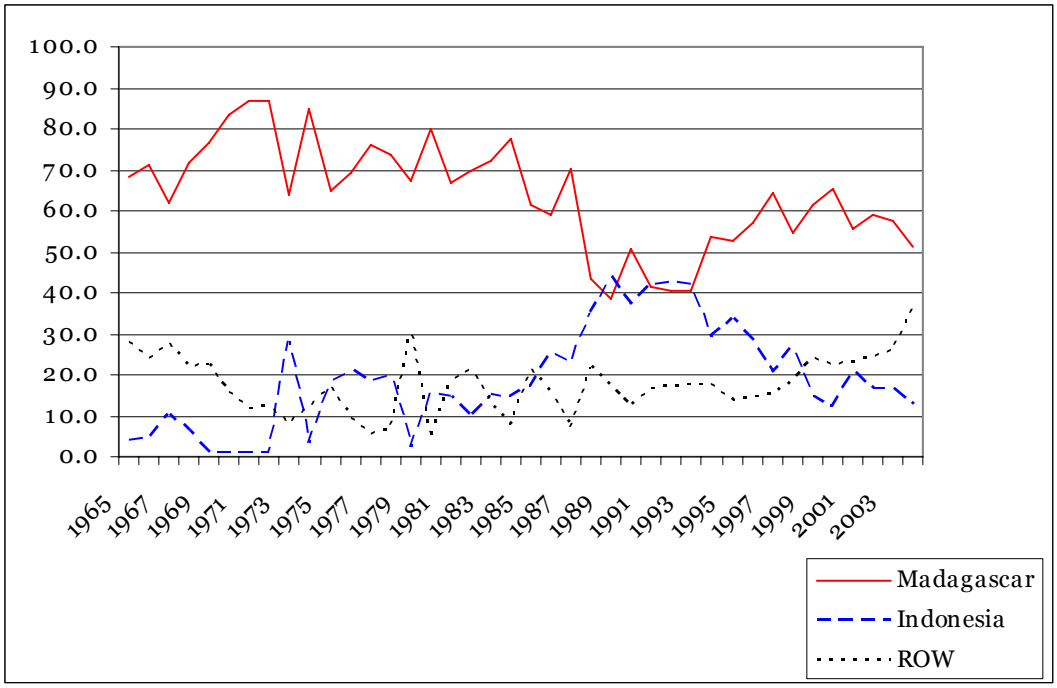
Export quotas were allocated to politically favored traders as were licenses for curing and packing, resulting in a concentration of market power in the hands of a few. The tri-partite decision process involving growers, packers-stockers and the GOM which had been put in place after independence collapsed as virtually all decisions were taken by the Ministry of Trade.

The replacement of the cooperative management system put in place under the previous government by centralized and politically-motivated decisions led to increasingly distorted outcomes. Internally, export taxation became confiscatory, peaking at 82% of the pre-tax export price in the early 1990s with the fraction of the export price received by farmers squeezed to less than 8% (see table 5 and Blarel and Dolinsky, p. 292). In spite of two exchange-rate corrections, in 1987 and in 1994, extortionary taxation was compounded, like in many other SSA countries, by currency overvaluation. Low producer prices discouraged plantation and made it all but impossible for farmers to renew plant material and maintain quality. It also contributed, albeit on a limited scale because vanilla farmers were in small numbers, to the countryside's descent into poverty documented by Paternostro et al. (1999).

Externally, attempts to over-exploit monopoly rents led to the allocation of unused export quotas across exports from the Indian Ocean cartel. Even putting dynamic considerations aside, simulations suggest that CAVAGI's price was about twice the static welfare-maximizing level, and a third above the revenue-maximizing level (de Melo et al., 2001), implying welfare losses adding up to

about 1% of GDP. Illegal trade flourished, while the cartel's high prices encouraged the entry of Indonesia into the market (see figure 5). [11]

Figure 5
Market shares on the world vanilla market, 1965-2003



Source:
Blarel and Dolinsky (2000), COMTRADE (mirror statistics), authors' calculations.
Notes:
ROW stands for world exports minus Madagascar and Indonesia.

Worst of all, declining revenues meant that the cost of keeping exploding inventories (as the cartel's high prices discouraged demand) escalated beyond what could be financed out of CAVAGI's revenue. In the end, three quarters of the stock of inventories, which by 1990 exceeded four years' worth of export under good times, were ultimately burnt, an extraordinary waste given the high unit value of vanilla and the extreme poverty of the farmers whose output was thus destroyed.[12]

[11] Indonesia's entry into the vanilla sector was essentially driven by market incentives rather than a grand plan of the Government of Indonesia, which had no particular policy in that sector. Indonesia's vanilla production was kickstarted by the vanilla shortage of the 1970s (de Melo et al., 2000). A key difference between the two major players, is that Indonesia did not tax vanilla exports.

[12] Examples of the corruption surrounding the operation of CAVAGI are described in Ecott (chapter 13, especially pp 220-223). This type of confiscatory policy extended beyond vanilla to other sectors (e.g. rice, clove etc.) and contributed to a trend of worsening rural poverty.

Phase 3 (since 1995). This third phase, which extends to this day, finally saw donor policy advice (see e.g. World Bank 1991) taken on board. In 1995 the GOM eliminated CAVAGI and the licensing system. Licenses were still required of processors, but the system is a lot less constraining than it used to be. The impact effect of CAVAGI's elimination was a sharp reduction of the world price which settled roughly at the Indonesian unit cost (still three times the Malagasy unit cost). Thus, with CAVAGI gone the Indonesians' rents were gone, too, although Malagasy producers still enjoyed a substantial rent due to their lower unit costs. Fixed prices for producers were progressively lifted between 1995 and 97.

CAVAGI was eliminated and export taxes progressively phased out, following a pattern common to large chunks of SSA where clumsy attempts to exploit monopoly power over commodity markets led to similarly unsuccessful policies.

The State's role is now essentially confined to sanitary/quality inspections and to setting the date and place of vanilla marketing every year.[13] Although this power alone has been shown elsewhere to be a possible vehicle for extortion,[14] the motivation here seems to be merely to discourage the marketing of non-mature vanilla (WTO 2002).[15] Efforts aimed at quality improvements are financed by the EU's Stabex fund in cooperation with the GES (Groupement des entrepreneurs de la SAVA) under a five-million euros project extending from 1997 to 2006.

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[13] *Arrêté interministériel* n° 11672/2004 of June 21, 2004 (Agriculture and Trade ministries of Malagasy Republic) prohibits the sales and exports of more than 100g of vanilla less than six months after harvest. Annual ministerial decisions fix legal harvesting dates and stocking periods. In addition, the Sava region recently issued an Arrêté establishing minimum quality standards for vanilla, partly in response to the entry of fringe, low-quality producers during the high-price 2004 campaign. We are grateful to Sofia Bettencourt for pointing this out to us.

[14] For instance, Chad's cotton monopoly uses its power to set date and place for the marketing of cotton separately for each village to extort bribes from village associations. In the case of Madagascar, following the disintegration of the Soviet bloc, the weakening of President Ratsiraka in his second term (1996-2001) prevented him from laying his hands on vanilla which had accounted for up to 10% of national income during his first tenure as President (see Ecott (2004, chp. 13)).

[15] Government regulation of market opening dates is (at least in principle) necessary because of Government regulation is called on to control this potential market failure. Whether Malagasy authorities succeed in their regulatory function is an open question, as Madagascar's vanilla market is less than fully transparent. According to a 2003 article published by Radio-France International on the web, about a third of Madagascar's vanilla might be sold on the parallel market, some of which as part of money-laundering schemes (Péguy 2003). Traders associations also complain that the prohibition of early collection makes harvests easy targets for organized crime. Large-scale thefts and armed ambushes of traders were reported in the local press during the high-price period of 2001-3. The situation was apparently serious enough to affect the harvest's pre-financing by foreign buyers.

Inspecting developments in the vanilla market since the reforms in 1995, three trends are apparent. First, recent years have been marked by a contraction of world exports matched by a spectacular rise in prices. Second, the decline in Madagascar's market share has reversed itself during the 1990s. Third, new entrants are progressively overtaking Indonesia as the main competition facing Madagascar. This development mirrors the early days of phase 2 when high prices triggered Indonesia's entry. As shown in figure 4, the evolution of prices is particularly striking as they slowly eroded during 1993-98 but literally exploded from a low of US$21.26 in 1997 to a high of US$251.17 in 2004 (some vanilla was reportedly sold at 600$ per kilo in 2004), a more than ten-fold increase, only to collapse again in 2005 much like they had before. During the same period, trade volumes contracted by about two thirds, from three thousand tons to little over one thousand tons, as several hurricanes in Madagascar and a large-scale fire destroyed a substantial chunk of the worldwide vanilla production capacity. While exogenous factors leading to supply shortages certainly contributed to this development, it is unlikely that demand was sufficiently inelastic to explain such a reaction, suggesting some market manipulation with supply withholding to fuel prices.

The erosion of Madagascar's market share, which started in the 1970s as a result of the cartel's high-price policy, strikingly reversed itself in the latter part of the 1990s. Some erosion is again apparent in later years but arguably due to adverse weather conditions rather than a policy shift. In a sharp reversal of fortunes, the Asian crisis and 1997 Indonesian fire precipitated a decline in Indonesia's market share that started in the early to mid-1990s. Once again, following high prices, partly due to climatic conditions in Madagascar (cyclonic conditions in 2000 followed by heavy rains in 2002) competition from new entrants, which together account today for more than a third of world exports, is rising.[16] Undeniably, the free market has certainly not stabilized the price, and it is said that the price hike of 2004 which saw vanilla sold at 600$ per kilo, the food industry has substituted up to 30% of its purchases of natural vanilla with artificial vanillin (Ecott 2004, p. 18).

With the knowledge that cyclonic conditions and the Indonesian fire in 1997 have contributed to the volatility of the vanilla market during the last decade, the challenge is to try and detect whether the policy reforms carried out since 1995

[16] Entrants include Costa Rica, India (whose output, at 120-130 tons, is equivalent to the Comoros'), Mexico, and Papua-New Guinea (around 300 tons). Uganda is also reported to be raising output and quality (see e.g. www.cgiar.org/foodnet).

have had a discernible effect on the price signals received by farmers, on their supply response, and ultimately on their well-being. We now confront this task in the two related ways mentioned in the introduction, looking for evidence from the household surveys in the first part of Section 3, and turning to simulations in the second part.

3. Assessing the effect of reforms

3.1 Prima-facie evidence from household surveys

We return here to the EPM to assess the evolution of various indicators of rural poverty and income inequality before and after the reforms. Because the small sample of vanilla farmers limits the extent of statistical analysis, annex A1 reports several descriptive statistics on the larger sample of close to 10,000 agricultural households giving background on the characteristics and evolution of poverty and inequality in rural areas. The annex also shows various decompositions attempting to measure the impact of price changes since 1993 for this larger sample. Essentially they show that farmers at the top of the distribution responded better to price shocks. The decompositions also show that exporters faced better price incentives than other farmers over the period and that Madagascar imported strong price volatility during 1999-01.

3.1.1. Prices, output and intermediation margins

Before talking about "the" producer price, it is worth noting that the prices reported by farmers in the EPM show substantial variation across households (standard error over twice the mean). Such variation can come from (i) measurement errors, (ii) individual characteristics such as quality differences in the vanilla produced or the bargaining ability of farmers, or (iii) local rather than individual characteristics such as transport costs or the bargaining power of the intermediary. In order to explore these conjectures we ran OLS regressions of individually-reported unit values on farmer characteristics and dummy variables for small geographical entities ("fivondroanana").[17]

[17] OLS results are likely to have a selection bias since the price received by farmers may be affected by omitted variables (such as the quality of their land) that also affect their decision to be in vanilla production. In order to control for this we also ran a selection model in which the selection equation was identified by the geographical variables but the results were not different (which is of course not surprising since none of the individual characteristics were significant in

The results, reported in Table 4, suggest little systematic variation across individual households but substantial variation across space, even though vanilla farmers are relatively concentrated. The story is probably that the bad shape of roads has the effect of segmenting the area into smaller sub-areas even though it is small to start with. However the data does not allow us to tell whether the price variation generated by the segmentation is in terms of transport costs or market power of local intermediaries. Thus, the best that can be said of the regression results is that they suggest that there is substantial noise in the producer-price variable. This should of course be kept in mind for the rest of the analysis.

Table 4
Estimation results, vanilla price regressions

	1993	1997	1999	2001
Ln HH size	0.118	0.226	0.188	0.215
	(0.42)	(1.45)	(1.53)	(1.42)
HH head age	1.094	-1.635	-2.135	-1.639
	(0.25)	(0.43)	(0.60)	(0.43)
HH head age 2	-0.037	0.214	0.276	0.218
	(0.07)	(0.42)	(0.56)	(0.43)
HH head schooling	0.044	0.010	0.004	0.009
	(0.99)	(0.27)	(0.13)	(0.24)
Members age	-0.075	-0.313	0.087	-0.331
	(0.33)	(2.14)*	(0.64)	(2.30)*
Cropland size	-0.018	0.073	-0.309	0.079
	(0.32)	(0.70)	(1.57)	(0.76)
Inputs	0.101	0.926	-0.388	0.922
	(0.40)	(1.29)	(1.36)	(1.27)
fivondroanana303	-1.115	-0.504	-1.285	-1.235
	(8.72)**	(1.28)	(5.22)**	(5.51)**
fivondroanana304	-1.074		-0.988	-0.649
	(13.82)**		(5.83)**	(1.26)
fivondroanana710	0.219	0.086		-0.654
	(1.35)	(0.16)		(3.15)**
fivondroanana711		0.319	0.390	-0.420
		(0.65)	(1.70)	(1.90)
fivondroanana712	-0.625	0.214	-0.388	-0.527

the OLS regression, so using a Heckman procedure on very small samples was unlikely to give better results). Remoteness and transport-cost variables were not included because they are collinear with fivondroanana dummies.

	(4.24)**	(0.43)	(2.36)*	(1.98)
fivondroanana716	-0.202	0.868	-0.336	
	(1.53)	(1.77)	(1.35)	
Constant	4.986	12.192	16.551	12.906
	(0.61)	(1.73)	(2.38)*	(1.75)
Observations	91	222	174	222
R-squared	0.32	0.12	0.34	0.11

Dependent variable: EPM-reported vanilla producer prices (unit values), uncorrected for CPI
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Number of strata: 12, Number of PSUs: 398
For each year, fivondroanana effects are relative to the omitted one, which is the one with the smallest number of vanilla farmers.

With this caveat in mind, can we find in the data any prima-facie evidence of the reform's effects on producer prices and intermediation margins? The elimination of Madagascar's marketing board implies the replacement of a state-owned monopoly by a market structure for intermediaries that can be expected to be fairly concentrated at the outset but to become more competitive over time as entry is attracted by high intermediation margins. Thus, except under very peculiar settings, one should expect intermediation margins to narrow down over time, especially given that, as explained in the previous section, CAVAGI's margins were vastly in excess of even a rational monopoly's optimal level. Table 5 shows the evolution of prices and intermediation margins over 1991-2001.

Table 5
Farmgate, FOB and CIF vanilla prices, 1991-2001

Year	FAO farmgate price, FMG	FAO FOB price, FMG	% of FOB market price received by producers	COMTRADE CIF unit value, MFG	% of CIF market price received by producers	EPM average producer price
1991	2'000	132'743	1.51	135'620	1.47	
1992	5'000	136'363	3.67	131'161	3.81	
1993	5'000	136'182	3.67	130'555	3.83	4'062
1994	8'450	213'532	3.96	186'325	4.54	
1995	10'000	237'090	4.22	210'557	4.75	
1996	5'150	75'216	6.85	124'044	4.15	
1997	10'500	74'789	14.04	101'230	10.37	17'788
1998	10'500	99'031	10.60	126'767	8.28	
1999	25'000	106'650	23.44	142'435	17.55	21'950
2000	66'250	219'897	30.13	254'324	26.05	
2001	69'828	598'189	11.67	608'232	11.48	133'559

Source: FAO, COMTRADE, EPM.

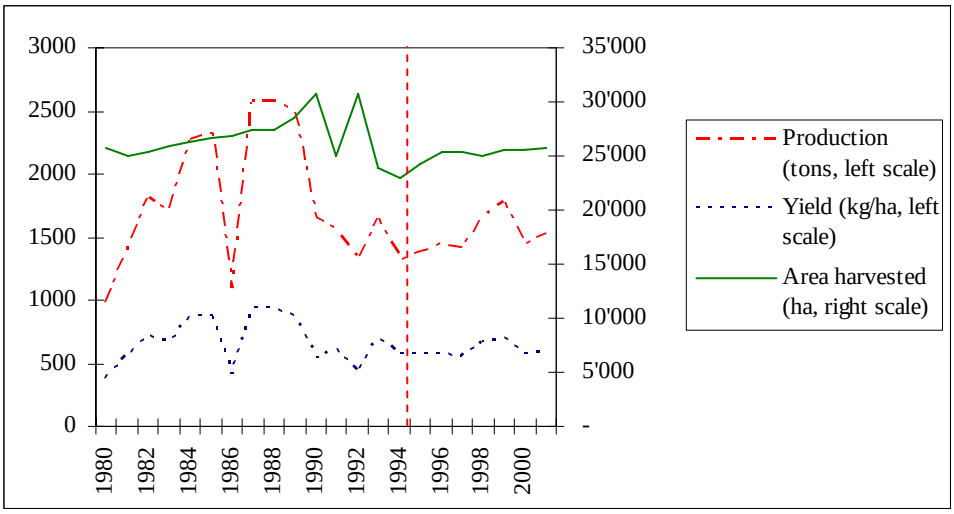
Two trends stand out in Table 5. First, prices went up sharply between 1999 and 2001, from FMG 200'000 to 600'000 per kilogram. According to various press and professional sources, prices continued to climb until 2004, reaching close to US$150/kg, only to collapse abruptly in the fall of 2004, settling at US$60/kg (FMG 600'000 at the 2004 exchange rate). Prices were also oriented downward in 2005. The high prices of 2001-3, partly due to the fact that hurricane Hudah in September 1999 wiped out about a third of the region's output and 15% of its stocks,[18] are widely reported to have encouraged the entry of informal traders in the market, with consequent loss of control by established traders and government authorities.

Second, as expected, the elimination of CAVAGI in 1995 immediately translated into a sharp increase in the fraction of vanilla FOB prices retained by producers, from a low of less than 2% in 1991 to a high of 30% in 2000.[19] However, interestingly, this squeeze in intermediation margins abruptly reversed itself in 2001, a year in which none of the sharp increase in export prices was retained by producers whose farmgate prices stayed flat.[20]

Figure 6 shows hectares planted, yields and output of vanilla over a twenty-year period straddling CAVAGI's elimination. As is obvious from the figure, there is little prima-facie evidence of a strong supply response to the reduction in intermediation margins over 1995-2001, although of course this statement can only be taken cautiously in the absence of a counterfactual (see next section) and an increase in planted areas in the Sava region did take place in 2004 according to local sources.[21]

Figure 6 Vanilla: areas planted, yield and output, 1980-2001

[18] See www.vanilla.com. Hurricane damage on production capacity persists for about three years, the plant's maturing period. The wet season in 2002 also accounted for a poor harvest whose effects on supply were felt two later in 2004.
[19] The 2% figure is probably an underestimate. Blarel and Dolinsky (1995, p. 292) quote a figure of 8% but suggest that this number is itself an upper bound, so the truth is likely to be somewhere between 2% and 8%.
[20] Note however that FAO farmgate prices are in all likelihood prices quoted by established traders. It is possible though unverified that parallel exports were purchased from farmers at higher prices.
[21] The absence of a positive supply response in 2001 may also have had to do with the political crisis.



Source: FAOstat.

Overall, the data in Figure 6 suggest is that the improvement in Madagascar's market share observable in Figure 5 is likely to reflect more the slackening of the competitive pressure from Indonesia than a positive domestic supply response to the improved price signals received by Malagasy vanilla farmers. This interpretation should be taken cautiously. First, FAO data on planted area and yields is very imperfectly measured. Second, the regression results reported in Table 3 give a somewhat different picture. The coefficients on year effects (all relative to 1993) are suggestive of entry and output increases in 1997 and 1999, but not in 2001, the year immediately after the hurricane.[22]

3.1.2 Regional Income inequality and poverty

At less than 100,000 (1% of the total), the number of vanilla farmers is too small for vanilla policy to affect nationwide measures of inequality and poverty. However, as vanilla farming is concentrated in just two provinces (Antsiranana and, to a lesser extent, Toamasina) it makes sense to explore the evolution of inequality and poverty indices for those regions in order to track any possible aggregate effect of the 1995 change in Madagascar's vanilla policy. Table 6 shows changes in selected income and price variables for the two vanilla-producing region, by income-distribution decile.

[22] The "hurricane" variable is the statistical frequency of hurricanes in the region.

Table 6
Income, wage and price changes, vanilla region, 1999-2001

Decile a/	Per-capita income b/	Income from vanilla sales c/	Wage change 1999-2001 d/	Producer price change 1999-2001 e/
1	220'391	28'628	4.04	0.51
2	337'558	32'135	0.35	-0.12
3	427'348	45'412	3.99	4.83
4	521'138	38'283	2.02	-0.44
5	627'169	148'841	3.42	0.13
6	735'808	101'400	2.46	0.87
7	866'146	102'574	1.74	0.14
8	1'066'679	114'097	1.96	0.63
9	1'361'700	152'066	2.25	0.16
10	2'462'838	257'644	0.69	0.91

Notes
a/ Ranked from poorest to richest.
b/ Decile's average per-capita income in real (CPI-deflated) FMG, 1999.
c/ Decile's average income from vanilla sales, real FMG, 1999.
d/ 1999-2001 wage change was calculated for pseudo-panels defined by the narrowest geographical areas for which we had observations in both years.
e/ Calculated as the decile's average of the individual weighted-producer price change, itself calculated as $\Delta p_{ij} = \sum_j w_{ij}^P \Delta p_j^P$ where i indexes households in the decile, j indexes crops, and w_{ij}^P is the weight of crop j in household i's income.

It can be seen that income from vanilla sales represents about 10% of per-capita income except in deciles 4 (7%) and 5 (23%). Real wage changes over 1999-2001 (the only period where vanilla producer prices went significantly up) show little reaction, with rates between 2% (toward the top of the distribution) and 4% (towart the bottom, a very slightly progressive evolution). The evolution of producer prices other than vanilla, shown in column e, is essentially noise. Together, these numbers suggest little spillover of the rise in vanilla producer prices on other prices in the region.

Table 7 shows estimates of Gini indices, poverty headcount, and poverty gap for the vanilla region (ignore for now the simulated numbers given for 2001). Starting with the poverty headcount, calculated here as the number of individuals with full incomes (i.e. overall consumption including self-produced) lower than what is necessary to purchase a 2'100 calories-a-day diet at current prices (see Paternostro et al., 1999, for a discussion). Between 1993 and 1999, the period

straddling the reforms, the headcount went down by about 74'485 individuals, or a full 17.4% of the regional population. The Gini index also showed a favorable trend, shrinking from 0.427 to 0.39 (only to go up again between 1999 and 2001). Both numbers indicate large and favorable shifts in the regional distribution of income which stand in contrast with the seemingly endless descent into poverty that characterized Madagascar over the previous quarter-century.

Table 7
Poverty headcount, Poverty gap and Gini indices, vanilla region

	Headcount		Headcount ratio		Poverty gap		Gini coef.	
	Actual	Counter.	Actual	Counter.	Actual	Counter.	Actual	Counter.
93	333'879	n.a.	0.749	n.a.	0.380	n.a.	0.427	n.a.
97	271'424	n.a.	0.596	n.a.	0.227	n.a.	0.366	n.a.
99	259'394	n.a.	0.575	n.a.	0.213	n.a.	0.39	n.a.
01	261'618	282'510	0.674	0.728	0.276	0.320	0.418	0.418

Source: authors' calculations from EPM.
Headcount: number of individuals; headcount number: proportion of individuals (using EPM's survey design).
Counter. : Counterfactual values obtained from baseline scenario ($\sigma = 4$, $\varepsilon_s = 0.5$, $\varepsilon_v = 1.0$). See text and annex A.2 for description of the simulation model.

The fact that this reversal takes place precisely during the reform period is remarkable. Before crying victory, however, one needs to take a hard look at how much of it can reasonably be attributed to the vanilla reforms. One can only be suspicious that at least some of it has little to do with the reforms for two reasons. First, the trend is the same nationwide. Second, vanilla output and producer prices evolved, in fact, *unfavorably* during the period 1995-98. For all its limitations, only a simulation-based counterfactual analysis recreating the old policy environment under current market conditions can give a beginning of an answer to the real question: how much did the reforms achieve by themselves?

3.2 A simple counterfactual

Our description of Madagascar's vanilla sector suggests that domestic competition in processing and intermediation was limited both by technical factors and by the GOM's policies. Internationally, competition was also limited with only two major producing countries, at least until recently, each producing a differentiated good. We exploit this characteristic of the vanilla market described

earlier to complement the household-based descriptive analysis of the previous section with a counterfactual exercise based on a model of imperfect competition domestically and internationally. The simulation exercise is particularly useful here as the noise due to vanilla price volatility drowns the faint signal from policy reform. With limited data, counterfactual analysis can help separate the two and by providing orders of magnitude.

Suppose then that the vanilla market can be approximated by modeling three types of players: a supply side with atomistic producers (farmers); a demand side black-boxed with a constant price-elasticity of demand for aggregate (Madagascar and Indonesia) natural vanilla; and a layer of imperfectly competitive curers-stockers-traders engaged in Cournot competition in the middle. In this set-up, reminiscent of the vanilla market in Madagascar, the taxation of exports followed during phase 2 leads to an outcome akin to double marginalization (see annex A2 for a detailed précis of the model and calibration to Madagascar and Indonesian data). Starting from observed mark-ups, we let the model determine the number of traders consistent with imposed behavior under the current policy regime of no taxation and domestic market intervention restricting entry. These model-generated numbers are close to the anecdotal evidence (about five traders).

Then, in a counterfactual experiment we reduce the number of traders to a single one (i.e. we resuscitate the marketing board) and re-impose taxation at the pre-reform maximum rate of 82% during phase two. Resuscitating the marketing board in this framework generates implied FOB and producer prices consistent with this policy-imposed limited competition. We then use the counterfactual producer prices to recalculate farmer incomes using Madagascar's 2001 household survey. Finally, we recompute poverty and inequality indices (poverty headcount, poverty gap and Gini coefficient) and compare the actual outcome with the counterfactual outcome. The difference in poverty headcounts is then an estimate of the number of individuals lifted out of poverty by the vanilla sector reform.

The gist of the model, which is laid out formally in Annex A2, boils down to a simple formula relating the share of the world price retained by Madagascar's producers as a function of demand and supply elasticities and, more importantly, the number of local traders. Namely, letting P_M be the selling price of Madagascar's vanilla (whose formula is derived in the appendix), p_M^P its farmgate producer price, σ the elasticity of substitution between Madagascar's and

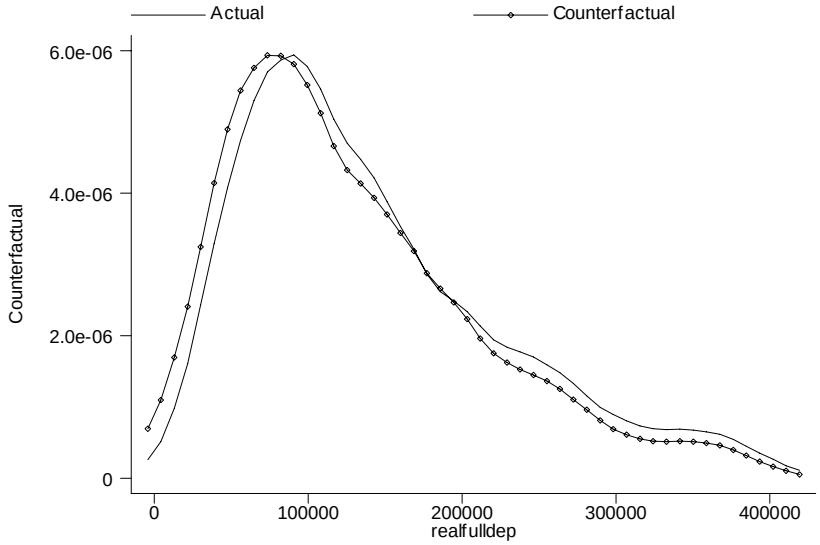
Indonesia's vanilla, s_M a market-share parameter, and ε_M^s the elasticity of supply of Madagascar's vanilla,

$$\theta_M = \frac{p_M^P}{P_M} = \frac{1-\left\{(1/\sigma)+\left[1-(1/\sigma)\right]s_M\right\}}{1+\left[1/\left(n_M\,\varepsilon_M^s\right)\right]}.$$

It is easily checked that θ_M is increasing in the elasticity of supply and in the number of traders, as raising either of those parameters reduces their monopsonistic power.

The counterfactual experiment described above yields simulated values for θ_M, p_M^p and X_M which we then combine with household-survey data to generate a simulated income distribution. Finally, we recalculate the poverty headcount and the poverty gap, with results shown in the last columns of Table 7 (poverty gap and headcount and Gini coefficient) and in Figure 7 (actual and counterfactual kernel density estimates of the distribution of income in the vanilla region).

Figure 7
Kernel density estimates of income distribution, vanilla region



Source: EPM, authors calculations.

Detailed results are shown in Annex Table A2. Note that the benchmark number of Malagasy traders consistent with observed markups under the Cournot assumption (n_M^0) ranges between four and five, an estimate that is just consistent with evidence given in Blarel and Dolinsky (1995, p. 274) that five packers

dominate the vanilla intermediation business. Taken at face value, this suggests that there was little entry since the mid-1990s or that, if there was, new entrants followed the incumbents' pricing policy.[23]

Under the counterfactual, producer prices are reduced very sharply compared to their current values. In percent of the current FOB price, the simulated producer price lies between 2% and 11%, as against 22% currently. The after-tax FOB price, by contrast, shoots up by a factor ranging between 2.3 and 4.4. This price increase is obtained by a sharp contraction of volumes exported, which go down by a factor between 3 and 6. In accordance with intuition, Indonesian prices and volumes both go up (although by much less) as Indonesia free-rides on Madagascar's output restrictions. These simulations, suggesting drastic effects on prices and quantities, no doubt provide upper bounds on the effect of change in the policy environment induced by the 1995 reforms.

Once re-introduced in the household survey, however, the new producer prices turn out to have a meek effect on the distribution of income, as shown by the last columns of Table 7 and Figure 7. The reason is essentially that most of the effective consumption of Malagasy rural households is self-produced. Cash income represents a small part of their effective income, and vanilla is only part of it. Thus, even drastic price changes do not change the picture much in terms of poverty. Using a central scenario with a unit elasticity of supply, a unit elasticity of vanilla demand and an elasticity of substitution between Malagasy and Indonesian varieties equal to two, the change in the poverty headcount ratio suggests that only about 20'000 individuals were lifted out of poverty as a result of the 1995 reforms.

4. Concluding Remarks

The reforms initiated in 1995 at the behest of international donors (elimination of the marketing board and phasing out of export taxes) put to an end two decades of a policy of over-exploitation of market power on the outside front and extortion of farmer incomes on the domestic one that was clearly unsustainable.

[23] Our counterfactual experiment reduces the number of traders to one, based on the assumption that they colluded during the socialist era. With export quotas, they obviously had little incentive to compete on prices. Indeed, Blarel and Dolinky (1995) describe a process through which the political allocation of export licences increasingly concentrated power in the hands of a single exporter allowed to ship fixed quantities of vanilla alongside the State marketing board.

Our attempt to evaluate the effects of those reforms contains both good and bad news. On the positive front, Madagascar has been able to regain some of the competitive ground it lost during the disastrous Ratsiraka era. However some of this competitive recovery simply reflects the (exogenous) difficulties that affected Indonesia, then its main competitor, in the second half of the 1990s. More ominously, following the recent price hike, new entrants are appearing on the horizon, together with bio-engineered substitutes. It remains that little of this 'improvement' in the policy environment can be traced back to higher farmer incomes in the household surveys. Nor have presumably better incentives for farmers translated into a noticeable producer response, at least according to FAO data which suggest that yields and planted areas have remained about flat.

Because large price fluctuations in a market that has always been very volatile render any interpretation of prima-facie evidence difficult, we turned to a counterfactual experiment to assess the effect of policy reform "ceteris paribus". The results, again, contain good and bad news. Producer prices seem to have benefited from a substantial narrowing of intermediation margins after the reforms and phase-out of export taxes which stood in the early 1990s at absurdly high levels. However, once introduced into household survey data, this improvement does not translate into large effects on measures of poverty and inequality simply because cash income from export crops is too small relative to self-consumption.

In a nutshell, thus, our main result is that the vanilla sector reforms may have had a large and positive effect on producer prices (travelers in the vanilla producing region report a change in consumption to beer and to the purchase of durables like radios and bricks for construction), but the reductions in intermediation margins (i) were dwarfed by the volatility of world prices and (ii) could not have a very large impact on farmers' consumption simply because the latter is essentially self-produced.

For market reforms to take hold and make a difference, two conditions must be met. First, for impact effects to be substantial the economy needs to "re-marketize", a process that can only take time after decades of retrenchment under strongly anti-market policies. This is an important point. In Madagascar, decades of bad policies and predatory taxation have raised transaction costs to such prohibitive levels that the market economy has largely shrunk to urban areas, leaving rural households isolated and forced to rely on themselves. Once this has happened, reforms affecting the price signals faced by rural farmers can

only have small effects. Only over time, as rural economies "re-marketize", can reforms be expected to have quantitatively large effects. This of course does not mean that they do not work: rather, that they have increasing returns.

Second, the farmers' supply response must become more dynamic than what we either observed in the data or assumed in the simulations. This requires credibility and stability in the policy environment. After several changes of government but only modest improvements in the readability of government policy, much progress is still needed on that front.

This case study suggests two further conclusions, the first relating to the difficult separation between malfunctioning markets due to excessive government intervention and that due to market failures. Thus, for all the evidence of government failure during the 1975-95 period, the reforms have created a regulatory vacuum in which unchecked concentration of intermediaries can lead to renewed exploitation of producers, although probably not to an extent comparable to what CAVAGI was doing. There is, indeed, plenty of anecdotal evidence that a large part of the price hike in 2004 was caused by strategic stockpiling between two large intermediaries in the sector.

Second, strategic behavior in highly concentrated markets with informational failures can lead to largely undesired outcomes, at least from a national standpoint. Thus, when by 1995 the conditions that made reforms politically feasible were eventually met, rent extraction was largely exhausted and the world market had become increasingly contestable, as shown by the rising output of new producers. To use Margaret McMillan's expression (McMillan 2003), by then the golden goose had already been killed.

References

Baffes, J., 2005, "The Cotton Problem", *The World Bank Research Observer,*

Barrett, Christopher and P. Dorosh (1996), "Farmers' Welfare and Changing Food Prices: Non-Parametric Evidence from Rice in Madagascar"; *American Journal of Agricultural Economics* **78**, 656-669.

Blarel, Benoît, and Diane Dolinsky (1995), "Market Imperfections and Government Failures: the Vanilla Sector in Madagascar"; in Steven Jaffe and John Morton, eds., 255-318.

Cleveland, William S. (1979), "Robust Locally Weighted Regression and Smoothing Scatterplots", *Journal of the American Statistical Association* **74**, 829-836.

Deaton, Angus (1997), *The Econometric Analysis of Household Surveys,* Cambridge University Press.

Ecott, Tim, (2004), *Vanilla: Travels in Search of the Ice Cream Orchid,* Grove Press, New York

Goodall, Colin (1990), "A Survey of Smoothing Techniques"; in J. Fox and J. S. Long, eds., Modern methods of data analysis, Sage, pp. 126-176.

Harrison, Ann, and A. Revenga (1995), "Factor Markets and Trade Policy Reform", mimeo, The World Bank.

Hoekman, Bernard, C. Michalopoulos, M. Schiff and D. Tarr (2001), "Trade Policy Reform and Poverty Alleviation"; in World Bank (2002), *Poverty Reduction Source Book.*

Isham, John, Michael Woolcock, Lant Pritchett, Gwen Busby, (2005), "The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth", *World Bank Economic Review* **19**.

Jaffee, Steven, and John Morton, eds. (1995), *Marketing Africa's High-Value Foods*; Kendall.

Krueger, Anne; Maurice Schiff, and Alberto Valdes (1988), "Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economiwyde Policies"; *World Bank Economic Review* **2**, 255.271.

McMillan, Margaret (2001), "Why Kill the Golden Goose? A Political Economy Model of Export Taxation", *Review of Economics and Statistics*, **83**, 170-84.

—, Karen Horn, and Dani Rodrik (2003), "When Economic Reform Goes Wrong: Cashews in Mozambique"; *Brookings Trade Forum*,

Melo, Jaime de, Marcelo Olarreaga and Wendy Takacs (2001), "Pricing Policy Under Double Market Power: Madagascar and the International Vanilla Market", *Review of Development Economics* **4**, 1-20.

Nicita, Alessandro (2004), "Who Benefited From Trade Liberalization in Mexico? Measuring the Effects on Household Welfare"; Chapter 3 *of Essays on Trade Liberalization and Poverty*, unpublished dissertation, University of Geneva.

Oxfam-IDS (1999), *Liberalization and Poverty*; Final report to DFID.

Papageorgiou, Demetrios, A. Choksi, and M. Michaely (1990), *Liberalizing Foreign Trade in Developing Countries: The Lessons of Experience*; The World Bank.

Paternostro, Stefano; J. Razafindronona, and D. Stifel (2001), "Changes in Poverty in Madagascar: 1993-1999"; mimeo, The World Bank.

Péguy, Olivier (203), "Flambée des prix sur la vanille" ; Radio-France International, September 22, 2003 (http://www.rfi.fr/actufr/articles/045/article_25068.asp).

Robillard, Anne-Sophie (1998), "L'Offre de riz des ménages agricoles malgaches" ; INRA, Document de Travail DT/98/09.

Sahn, David, and A. Sarris (1991), "Structural Adjustment and the Welfare of Rural Smallholders: A Comparative Analysis from Sub-Saharan Africa*"; World Bank Economic Review* **5**, 259-289.

Schiff, Maurice, and Alberto Valdes (1992), *The Political Economy of Agricultural Pricing Policy in Developing Countries; A Synthesis of the Economics*, vol. 4,; Johns Hopkins.

Winters, L. Alan (2000), "Trade Policies for Poverty Alleviation"; in A. Matoo and P. English, eds., *Trade and the WTO: A Handbook*; The World Bank, pp. 28-38.

—, N. McCulloch, and A. McKay (2003), "Trade Liberalisation and Poverty: The Evidence so far"; mimeo.

World Bank (2001), Madagascar Diagnostic Trade Integration Study, unpublished.

Annex
The simulation model

A.1 The model

This annex describes the partial equilibrium simulation model used for the counterfactual analysis of Section 4.2. Consider first a non-parameterized (general) formulation. Let X_M and X_I be the quantities of vanilla marketed by Madagascar and Indonesia respectively. Let P_M be the world-market price of Malagasy vanilla and p_M its farmgate price. The inverse demand function for Malagasy vanilla is

$$P_i = P_i\left(X_M, X_I\right) \qquad i = M, I \tag{0.1}$$

and the inverse supply is

$$p_i = p_i\left(X_i\right). \tag{0.2}$$

Let x_k be the quantity of vanilla purchased and marketed by one of n_i symmetric Malagasy (Indonesian) traders, so

$$X_i = \sum_{k=1}^{n_i} x_k .$$

Let $x_{-k} = \sum_{j \neq k} x_j$. The profit-maximization problem of Madagascar's trader k is

$$\max_{x_k} \pi\left(x_{kM}\right) = \left[P_M\left(x_k + x_{-k}, X_I\right) - p_M\left(x_k + x_{-k}\right)\right] x_k \tag{0.3}$$

and similarly for the representative trader in Indonesia. Let $e_{ki}^D \equiv \left|\partial \ln x_k / \partial \ln P_i\right|$ and e_{ki}^S be respectively the price elasticities of demand and input supply facing trader k in country i. Maximization of (0.3) gives a familiar expression equating marginal revenue with marginal input cost, namely

$$\frac{P_i}{1+t_i}\left(1-\frac{1}{e_{ki}^D}\right) = p_i^P\left(1+\frac{1}{e_{ki}^S}\right) + c_i \tag{0.4}$$

where c_i is an intermediation cost and t_i is the ad-valorem export-tax rate, if any. Under symmetry of traders, $x_{ki} = X_i/n_i$, so letting ε_M^D and ε_I^D stand for the price elasticity of *market* demand in Madagascar and Indonesia respectively, $e_{ki}^D = n_i \varepsilon_i^D$. Substituting in (0.4) gives

$$\frac{P_i}{1+t_i}\left(1-\frac{1}{n_i \varepsilon_i^D}\right) = p_i^P\left(1+\frac{1}{n_i \varepsilon_i^S}\right) + c_i, \quad i = M, I. \tag{0.5}$$

It is easy to verify by implicit differentiation that the purchase price p_i^P is an increasing function of the number of traders, n_i, and of the elasticity of supply. In the former case the monopsony power of traders is reduced by large numbers whereas in the latter it is reduced by a flat supply curve. Note that the presence of an export tax acts as if there was "double marginalization". To see this, suppose that there were two layers of intermediaries, no intermediation cost and no tax. Using upper-case letters for the second layer of intermediaries, (0.5) would then become

$$P_i\left(1-\frac{1}{n_i\varepsilon_i^D}\right)=p_i^P\left(1+\frac{1}{n_i\varepsilon_i^S}\right)\left(1+\frac{1}{N_iE_i^S}\right). \qquad (0.6)$$

Let $\tau=1/N_iE_i^S$. Then the presence of the second layer of intermediaries acts like an ad-valorem export tax at rate τ.

In order to derive an expression for ε_i^D, we now parameterize the model. On the supply side, the farmers' vanilla supply is

$$X_i^S=A_i^S\left(p_i^p\right)^{\varepsilon_i^S} \qquad (0.7)$$

where p_i^p is the price paid to farmers, ε_i^S is the price elasticity of the farmers' supply, and A_i^S is a calibration parameter. This function subsumes the behaviour of farmers, implicitly assuming some hoarding behaviour whose intertemporal aspects we leave aside.

On the demand side, overall utility is quasi-linear in vanilla (X_v) and an aggregate of all other goods (X_o):

$$U=X_0+\frac{1}{\tilde{A}_v}X_v^{\frac{\varepsilon_v-1}{\varepsilon_v}} \qquad (0.8)$$

implying a constant marginal utility of income and a worldwide demand for vanilla of the form

$$X_v=A_vP_v^{-\varepsilon_v}, \qquad (0.9)$$

ε_v being its constant price elasticity and $A_v=\tilde{A}_v\varepsilon_v/\left(\varepsilon_v-1\right)^{-\varepsilon_v}$. The vanilla aggregate X_v has the familiar CES form:

$$X_v = A\left(\sum_i \beta_i X_i^{\rho}\right)^{\frac{1}{\rho}} = A\left(\sum_i \beta_i X_i^{1-1/\sigma}\right)^{\frac{1}{1-1/\sigma}} \qquad (0.10)$$

$i = M, I$, and $\rho = 1-(1/\sigma)$, σ being the elasticity of substitution between Malagasy and Indonesian vanilla on the world market, and A a calibration parameter. Worldwide expenditure on vanilla is

$$E = \sum_i P_i X_i . \qquad (0.11)$$

Under the assumption of two-stage budgeting, (0.10) can be maximized under constraint (0.11) independently of upper-level choices (between X_o and X_v), giving a demand for variety i ($i = M, I$) equal to

$$X_i = X_v A^{\sigma-1} \beta_i^{\sigma} \left(\frac{P_i}{P_v}\right)^{-\sigma} \qquad (0.12)$$

where

$$P_v = \frac{1}{A}\left(\sum_i \beta_i^{\sigma} P_i^{1-\sigma}\right)^{\frac{1}{1-\sigma}} . \qquad (0.13)$$

Under the assumption that traders play Cournot (by which is meant that they take as constant the quantities marketed by both their national and foreign competitors), it is easily verified that

$$\frac{1}{\varepsilon_i^D} = \left.\frac{\partial \ln P_i}{\partial \ln X_i}\right|_{X_{-i} \text{ constant}} = \frac{1}{\sigma} + \left(1 - \frac{1}{\sigma}\right) s_i \qquad (0.14)$$

where s_i is variety i's share of the worldwide vanilla market. This expression can then be substituted into (0.5) to close the model.

A.2 Calibration and initial equilibrium

Intermediation cost data was provided to us by industry sources. Elasticities are based on the econometric estimates of de Melo, Olarreaga and Takacs (2001). Their point estimates are (in algebraic form) $\hat{\varepsilon}_M = -2.5$ for the own-price elasticity of demand for Malagasy vanilla, $\hat{\varepsilon}_I = 1.99$ for the own-price elasticity of demand for Indonesian vanilla, and $\hat{\varepsilon}_{MI} = 1.7$ for the cross-price elasticity, which they find, as expected, to be symmetric (in what follows we ignore interaction with the artificial vanilla market). The elasticity of substitution can be retrieved from these estimates using the following decomposition:

$$\sigma = \frac{d\ln\left(X_M / X_I\right)}{d\ln\left(P_M / P_I\right)} = \frac{d\left(\ln X_M - \ln X_I\right)}{d\left(\ln P_M - \ln P_I\right)} = \frac{d\ln X_M}{d\left(\ln P_M - \ln P_I\right)} - \frac{d\ln X_I}{d\left(\ln P_M - \ln P_I\right)}$$
$$= \frac{1}{\frac{d\ln P_M}{d\ln X_M} - \frac{d\ln P_I}{d\ln X_M}} - \frac{1}{\frac{d\ln P_M}{d\ln X_I} - \frac{d\ln P_I}{d\ln X_I}} \qquad (0.15)$$
$$= \frac{1}{\frac{1}{\tilde{\varepsilon}_M^D} - \frac{1}{\tilde{\varepsilon}_{MI}^D}} - \frac{1}{\frac{1}{\tilde{\varepsilon}_{MI}^D} - \frac{1}{\tilde{\varepsilon}_I^D}}$$

where tildes indicate that elasticities are in algebraic rather than absolute-value form. So $\hat{\sigma} = \left|\left(\frac{1}{-2.5} - \frac{1}{1.7}\right) - \left(\frac{1}{1.7} - \frac{1}{-1.99}\right)\right| = 1.933.$ In the simulations that follow, we use $\sigma = 2$. Their estimate of the elasticity of supply is $\varepsilon^S = 0.5$, which we apply to Indonesia as well.

Table A.1
Intermediation cost data, 2001

	"Non Fendues Rouge"		Cuts
	over 12 cm	below 12 cm	
Farmgate price	*60'000*	*n.a.*	*n.a.*
Bulk buying price a/	*200'000*	*150'000*	*50'000*
Transport & collectors	15'000	15'000	15'000
Ristournes	13'000	13'000	13'000
Bulk Delivered:	*228'000*	*178'000*	*78'000*
Dessication (20%)	45'600	35'600	15'600
Labour	30'000	30'000	30'000
Management costs	35'000	35'000	35'000
Packing	10'500	10'500	10'500
Price "packed"	*349'100*	*289'100*	*169'100*
Financial Interests	31'612	26'087	15'037
Insurance	11'157	9'207	5'307
Control Customs	1'000	1'000	1'000
FOB Costs	3'000	3'000	3'000
Margin (10%)	34'900	28'910	16'910
FOB Price	*430'769*	*357'304*	*210'354*

Source: industry data
Notes
a/ Price of prepared vanilla bought by exporters from collectors. Not a farmgate price.

We will from now on assume that $\beta_I = 1 - \beta_M$, an assumption that is inconsequential for the rest. The subscript on β can then be disposed of. Moreover, all prices (those of each variety and the composite's) are normalized to unity. Thus,

$$P_v^0 = 1 \text{ et } P_i^0 = 1 \quad \forall i. \tag{0.16}$$

With parameters calibrated to replicate observed magnitudes as the initial equilibrium, the model's equations are:

1. Composite price (one equation):

$$P_v \equiv (1/A)\left(\sum_i \beta_i^\sigma P_i^{1-\sigma}\right)^{\frac{1}{1-\sigma}}, \tag{0.17}$$

2. Worldwide vanilla demand (one equation):

$$X_v = A_v P_v^{-\varepsilon_v} \tag{0.18}$$

3. Demand for variety *i* (two equations):

$$X_i = X_v A^{\sigma-1} \beta_i^\sigma \left(P_i / P_v\right)^{-\sigma}, \tag{0.19}$$

4. Perceived elasticity of demand (two equations):

$$\left|\varepsilon_i\right| = 1/\left\{(1/\sigma) + \left[1 - (1/\sigma)\right]\left(P_i X_i / P_v X_v\right)\right\}, \tag{0.20}$$

5. Mark-up (two equations):

$$\left[P_i/(1+t_i)\right]\left[1 - 1/\left(n_i \left|\varepsilon_i^D\right|\right)\right] = p_i^p \left[1 + 1/\left(n_i \varepsilon_i^S\right)\right] + c_i, \tag{0.21}$$

6. Producer price (two equations):

$$p_i^p = \left(X_i / A_i^S\right)^{1/\varepsilon_i^S}. \tag{0.22}$$

This gives ten equations in ten unknowns given initial selling prices P_1^0 and P_2^0 (alternatively, one could fix initial producer prices or quantities). The ten endogenous variables determined in the system are P_v, X_v, X_M, X_I, ε_M, ε_I, n_M, n_I, p_M^p et p_I^p.

A.3 Perturbation of the initial equilibrium and results

In the perturbed equilibrium, n_i is fixed at a value that differs from its initial value, whereas P_M et P_I are freed. The number of equations and unknowns is thus unchanged. The values at which n_i are fixed are respectively $\overline{n}_M = 1$ for Madagascar (monopsony/monopoly) and $\overline{n}_I = n_I^*$ for Indonesia (Cournot assumption—no entry). We then recalculate equilibrium values for $P_M, p_M^P, P_I, p_I^P, X_M,$ and X_I (see Table A.2 consistent with the model's behavioural assumption (Cournot) and no entry in Indonesia. We then plug back the new values of p_M^P and X_M in the household survey's farmer-income data and recalculate the income distribution, poverty gap and poverty headcount.

Results are reproduced in Table A.2. The baseline scenario with ε^S = 0.5 and σ = 2 gives n_M = X and n_I = X. These low values, undoubtedly smaller than the actual number of traders, suggest either strong price leadership or collusion. They prove robust to changes in the intermediation cost in a plausible range and also to changes in elasticity parameters.

Table A.2
Baseline scenario and counterfactual

Initial values	Assumed parameter values							
	ε_v	1						2
	ε^S	0.5		1		2		1
	σ	2	4	2	4	2	4	2
	Counterfactual values for endogenous variables							
1.00	p_M^P	0.02	0.02	0.04	0.06	0.09	0.11	0.02
1.00	p_I^P	0.31	0.37	0.38	0.40	0.39	0.40	0.21
0.22	P_M	2.67	2.33	4.13	2.65	4.44	2.77	3.16
0.42	P_I	1.61	1.77	1.79	1.88	1.83	1.92	1.39
1'213	X_M	383	383	216	306	196	281	121
458	X_I	400	438	432	456	434	463	235
	n_M^0	5.12	4.86	4.20	3.94	3.74	3.48	4.20
	$\overline{n}_M$	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	n_I^0	9.58	8.37	6.91	5.74	5.58	4.37	6.91