

THE IMPACT OF SECTOR-SPECIFIC AND ECONOMY-WIDE POLICY REFORMS ON THE AGRICULTURAL SECTOR IN BRAZIL: 1980–98

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This article analyzes the impact of policy reforms and changing macroeconomic conditions on the Brazilian agricultural sector. It stresses four issues: events outside of agriculture were central to the performance of the sector and to the timing and sequence of policy reform; reform involved far more than trade liberalization; the impact of reform on input markets and productivity was key for understanding the period; and policy reform had a highly differentiated impact on the sector. As a result of the reforms, agriculture became the most dynamic sector of the Brazilian economy in the 1990s. Policies still in need of reform are identified. (JEL O13, Q18)

I. INTRODUCTION

The Brazilian economy began a process of restructuring in the 1990s as a result of dramatic changes in economic policy. The government abandoned policies associated with the import substitution industrialization (ISI) model and began shaping a new path of development. The government liberalized trade, privatized state-owned enterprises, deregulated domestic markets, and helped create a South American Common Market (MERCOSUL). The extent of the reforms was profound. Nominal tariff rates for the 16 principal industrial sectors, for example, fell from an average of 105% in the late 1980s down to 13% in the 1994–97 period (Rossi and Ferreira, 1999). The agricultural sector was no exception. The country carried out a transition from an agricultural policy regime designed for a closed economy with substantial state intervention to

a new regime tailored to an open economy and a curtailed role of the state.

This article analyzes the impact of the policy reforms and the changing macroeconomic conditions on the agricultural sector in Brazil. The Brazilian case is important for several reasons. Brazil is a large country, has a large agricultural sector, and is an important exporter of many agricultural products. In 1999 it accounted for 33% of the population in Latin America, 38% of the region's gross domestic product (GDP), and 28% of its agricultural exports.¹ For such a large country, the success or failure of its reforms has a disproportionate impact on the region's welfare. Brazil is also very heterogeneous, with large regional variations in income, climate, and competitiveness. This provides a rich environment for studying the differentiated impacts of policy reform. Finally, the Brazilian case permits researchers to test whether the policies produced the expected results and, when they did not, to explore the reasons for their failure.

1. The trade data are from www.fao.org. The other data are from World Bank (2001).

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ABBREVIATIONS

CPR: Cédula de Produto Rural
GDP: Gross Domestic Product
IBC: Brazilian Coffee Institute
ISI: Import Substitution Industrialization
MERCOSUL: South American Common Market
NRP: Nominal Rate of Protection
TFP: Total Factor Productivity

The authors emphasize four aspects of the reform period that were unexpected or did not receive sufficient attention from authors writing prior to the reforms. The first issue relates to the importance that events outside of the agricultural sector had not only for the performance of the sector but also for the timing and sequence of policy reform. In the ISI period it was clear that *indirect* policies, such as an overvalued currency and industrial protection, played a critical role in shaping the performance of the agricultural sector, and it was expected that the reform of these policies would have a positive impact on the sector (see Krueger et al., 1988). What was unexpected—and this is especially true for the case of Brazil—was the difficulty and length of time that would be necessary to stabilize the economy. The numerous stabilization plans that the Brazilian government adopted in the 1980s and 1990s joined the more traditional indirect policies as a key force that shaped the performance of the sector in this period. In this context, the policy reforms that affected the agricultural sector were driven not primarily by agricultural policy objectives but by the painful quest for price stability and the decision to abandon ISI policies.

A second issue emphasized here is that policy reform involved far more than trade liberalization. Deregulation and the reform of credit and support price policies were central as well. In fact, the most dramatic transformations in the agricultural sector took place for those products that were most heavily regulated, such as wheat, milk, sugarcane, and coffee.

A third issue to which the prereform analyses did not give sufficient attention was the impact of policy reform on input markets and productivity.² Liberalization altered relative input prices and increased access to high-quality imported inputs. It also exposed domestic producers to greater competition. Both factors contributed to productivity gains and falling costs. The performance of some activities, such as animal production, was greatly aided by these changes.

A fourth and final issue addressed herein is that policy reform had a highly differentiated impact on the sector. Reform was neither uniformly beneficial nor entirely prejudicial.

Thus, the analysis seeks to distinguish between different groups of products, such as importables and exportables, and different geographic regions, farm sizes, and subperiods. Because not all reforms were introduced simultaneously, the 1990s should be treated as a decade of transition in which the old model was replaced but not all of the features of the new model were firmly established.

Section II provides an overview of the policy reforms of this period. Some of the reforms were enacted as a response to the debt crisis, so the authors provide selected information on the 1980s when necessary. Section III identifies the expected effects of the reforms on the sector. Section IV analyzes the impact of the reforms on agricultural prices, output, trade, productivity, and input markets in the 1980–98 period. Section V provides conclusions.

II. OVERVIEW OF POLICY REFORMS RELATED TO AGRICULTURE

A. *The Role of the Macroeconomic Environment*

A first wave of policy reform began in the early 1980s in response to the debt crisis. Fiscal adjustment led to the reform of rural credit policy, reducing the volume of credit and eliminating the subsidies that had exceeded US\$6 billion in 1979 (1996 dollars).³ At the same time, the government depreciated the currency and expanded the support price program. The aim of the currency depreciation was to improve the balance of payments by increasing exports and discouraging imports. The purpose of the support price program expansion was both to save foreign exchange by stimulating the production of import substitutes and to increase food production to restrain inflation. Not all elements of the policy package were internally consistent. For example, credit restrictions created obstacles for agricultural production, and the currency depreciation contributed to inflation. Thus the government used a variety of additional policies in the 1980s to address the balance of payments problem and accelerating inflation. The sugar-alcohol program and wheat policy are two examples that will be discussed.

2. Quiroz and Opazo (2000) have recently addressed this issue.

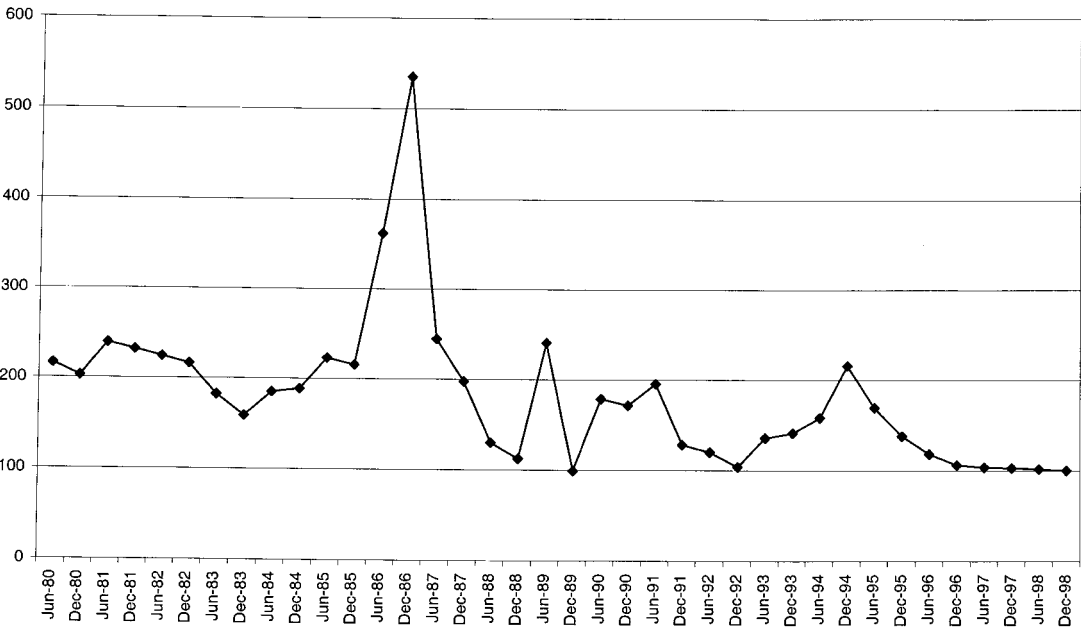
3. See Helfand (2001) for estimates of credit subsidies in the 1970s and 1980s.

The macroeconomic environment of the late 1980s and early 1990s also played a crucial role in shaping the evolution of the reforms that affected the agricultural sector. The government liberalized trade and deregulated agricultural markets, in addition to making changes in the rural credit and support price policies, as part of an overall strategy to fight the threat of hyperinflation. Macroeconomic events also caused considerable instability for the agricultural sector. The numerous stabilization plans that were adopted in this period were almost always accompanied first by euphoria and then by a deep financial crisis for the sector. The instability was expressed through price cycles in agricultural asset markets—principally land and cattle—as well as in agricultural commodity markets since commodity stocks also served as real assets. Figure 1, which shows the real price of land, captures these cycles in 1986–87 (*Cruzado* plan), 1989 (Summer plan), 1990–91 (Collor plans I and II), and 1993–95 (*Real* plan). According to Goldin and Rezende (1990) and Rezende (1993), the launching of these plans increased uncertainty and reduced the attractiveness of financial assets. This in

turn caused the prices of land, cattle and commodities to rise, which led to increased borrowing and investment in agriculture. As these plans failed, financial assets once again became more attractive. The consequence was an abrupt fall in the prices of agricultural assets and commodities and deep financial problems for the sector.

There are important similarities and differences between the *Real* plan and the previous failed attempts at macroeconomic stabilization. First, as with all of the stabilization plans in this period, the *Real* plan generated an asset price cycle that led to increased indebtedness. When combined with the currency appreciation and high real interest rates that characterized the 1995–98 period, however, the result was one of the most severe financial crises that the sector experienced in the past two decades. Second, following the asset price cycle, land prices stabilized at a level that was about half of what they had been in the early 1980s (Figure 1). This facilitated access to land for competitive producers, lowered the cost of carrying out a state-led redistributive land reform program, and generated a healthy debate in

FIGURE 1
Real Price of Crop Land (12/98 = 100)



Note: Deflated with IGP-DI inflation index.

Source: Getulio Vargas Foundation.

Brazil about the causes of falling land prices.⁴ Finally, as will be shown, the stabilization of the economy produced important gains for the agricultural sector and for consumers.

B. Trade Liberalization

Trade liberalization for agriculture took place in the context of the economy-wide reforms of the late 1980s and early 1990s. The sector benefited from a rapid fall in industrial protection and from the elimination of taxes and quantitative restrictions on agricultural exports. In the case of coffee, for example, the export tax had been as high as 50% a decade earlier. Trade reform for primary exports advanced further in 1996 when the government removed the 13% value-added tax to ease balance of payments pressures without a devaluation.

At the same time the initial reforms for exportables took place, importables lost their tariff and nontariff protection. In cases like wheat, protection had contributed to raising producer prices to as much as double their international counterparts. For most importables, tariffs fell from the 35%–55% range prior to 1988 down to around 10% in 1991 (Helfand, 2000). Fernando Collor abruptly removed nontariff barriers in 1990 when he became president. Shortly thereafter, Brazil signed the Treaty of Asunción, which created MERCOSUL. MERCOSUL eliminated the tariffs on imports from Argentina and Uruguay, two countries with very competitive agricultural sectors.

C. The Reform of Agricultural Credit and Price Support Policies

In contrast to trade liberalization, which happened quickly and broadly, the pace and coverage of reforming credit and price support policies was slow and varied. From this long process, the authors highlight the following themes. First, the reforms eventually led to a substantial reduction in the role of the state. Second, the government redefined its role in the

areas where it continued to operate and sought to rely increasingly on market mechanisms and instruments that were consistent with the new reality of an open economy.

Reduction of the Role of the State. Due to its fiscal cost, the government eliminated the subsidies and substantially reduced the volume of real credit provided to the agricultural sector in the 1980s. Relative to the peak years of 1979 and 1980, annual lending was about 50% lower in 1988 and 1989. The government accelerated the credit contraction in 1990 when the flow of new credit fell by an additional 43%.⁵ This reduction was not solely an expression of a policy decision to reduce government involvement in agricultural finance. It was also the result of an 18-month freeze on financial assets that was one component of a macroeconomic stabilization plan aimed at combating inflation. With the exception of 1994—the first year of the *Real* plan—the level of lending never recovered in the 1990s. The average annual volume of real agricultural credit in 1990–98 remained at about half that of its 1988–89 level.

As the government scaled down credit policy in the 1980s, it simultaneously expanded the price support program. The purpose of the program was not just to stabilize commodity prices. Perhaps more important, the goals of the program were to guarantee an adequate domestic supply of food, save foreign exchange, and contribute to controlling inflation. As an indication of the level of activity of this policy in the second half of the 1980s, in 1987 the government purchased 27% of the rice and 24% of the corn harvest. In addition, it provided storage credit to cover 85% of the cotton, 30% of the rice, and 25% of the soybeans harvested in that year (Goldin and Rezende, 1990). After several years of inactivity, the government once again acquired a large volume of agricultural stocks in the period 1992–95. This time, however, it happened at the same time as the private sector was carrying out imports. These events made it clear that policies had to change.⁶ From this point on, the government began to develop price support

4. Many authors have argued that land prices were lower in the late 1990s because land was no longer being held as a hedge against inflation. Rezende (2003), in contrast, argues that falling land prices were due to an increase in the supply of high-quality land. Several of the most important contributions to this debate and other issues surrounding the *Real* plan are Homem de Melo (1999), Dias and Amaral (1999), and Mendonça de Barros and Miranda (1998).

5. The credit data come from the Central Bank Record database and refer to crops and animals. They are deflated with the IGP-DI inflation index of the Getúlio Vargas Foundation.

6. See Rezende (2003) for a more in-depth analysis of price support policy in the 1990s.

instruments that were consistent with an open economy and that involved a much lower fiscal cost. By 1999, government stocks of rice, beans, corn, wheat, and soybeans had each been reduced to less than 2% of annual consumption (Villa Verde, 2001).

As a result of the changes in credit, price support, and other agricultural policies, the government dramatically reduced the level and share of fiscal expenditures related to agriculture. In the 1980s, for example, 5.65% of all federal expenditures targeted the agricultural sector. In the period 1995–99, this share was only 2.11% (Gasques, 2001).

Redefinition of the Role of the State. At the same time the government reduced the volume of credit, it also significantly altered the sources of finance. In the 1980s there were two main sources: the Treasury and compulsory lending by private banks. Private banks had the option of lending a specified fraction (often around 25%) of their demand deposits to agricultural producers at interest rates set by the government, or depositing those funds in an account that earned zero interest at the Central Bank. In 1985, for example, 64% of agricultural credit came from the Treasury and 32% from required lending. By the late 1990s, this picture was altered dramatically. Compulsory lending became the most important source of agricultural credit after the economy stabilized under the *Real* plan. In the late 1990s, it accounted for around 40% of rural credit. Treasury funds, in contrast, fell to under 2%. In their place, the government used constitutional funds that had been created by the 1988 constitution to support regional development efforts; a workers' support fund, which was financed with a tax on businesses; and other funds, such as for coffee and commodities. These funds were financed by earmarked taxes, and depending on the fund, the money could be loaned at below-market rates of interest. There were two important drawbacks of the new model. First, the public sector continued to provide most rural credit or to heavily regulate it, as in the case of required lending. Second, because most rural finance did not pass through the congressional budget process, there was a substantial lack of transparency. Thus, this is one area where additional reforms were still necessary.

In addition to creating new public sector sources of credit, the government and the private sector sought to develop new sources

of private finance.⁷ The authors offer three examples. First, the government adopted measures intended to increase the flow of foreign capital into the agricultural sector. In 1995 the government eliminated the financial operations tax—a tax used to control short-run flows of foreign capital—only for funds that were destined for agriculture. A second government innovation was the creation of the rural product note (*Cédula de Produto Rural*, or CPR). CPRs permitted agricultural producers to acquire liquidity at the time of planting through advance sales of their products. CPRs reduced this risk of these operations because they were legal documents that if not honored by either party could be enforced through the courts and because they were guaranteed with insurance that was provided by a bank. Finally, most authors agree that there were many private-sector innovations for providing agricultural producers with credit from processors, input suppliers, and traders. However, because these mechanisms did not require reporting to the Central Bank, they are much more difficult to quantify. In general, they were limited to the most modern segments of the agricultural sector and to the producers of highly traded goods.⁸

Among the many changes in the price support policy, there were two key innovations that are worthy of mention. Both new instruments sought to guarantee a predetermined minimum price at a lower cost than the traditional policy and without leading to the formation of public stocks of agricultural goods. Both instruments also made use of auctions to lower costs and increase transparency. First, the government created an options contract that gave farmers the option to sell a given quantity of a product to the government at a predetermined price and date. The cost of the contract was determined in an auction. The owner of the contract could choose to exercise

7. See Faveret (2002) and Gasques and Conceição (2001) on credit in the 1990s.

8. Although the relative importance of the private sector increased as a source of lending, the performance of commercial agriculture still depended on its relationship with the official credit system because of a substantial amount of debt held by farmers. Because default prevented access to new credit, in 1995 the government initiated a process of debt renegotiation. Due to the power of the lobbies that represented large producers, the renegotiation resulted in large implicit subsidies for the debtors. Thus the government signaled that it was still willing to bail out and subsidize large indebted farmers. This signal ran counter to the spirit of the reforms.

it when market prices fell below the price specified in the contract. When this happened, the government could choose to purchase the good or pay the difference between the market price and the price specified in the contract. The other important innovation was the creation of a marketing premium. When market prices fell below support prices, rather than purchase the product directly or finance storage, the government agreed to make a payment to commodity purchasers in exchange for a commitment to purchase the targeted crop from farmers at the support price. The purpose of the auction was to determine the minimum payment necessary to induce the private sector to purchase the good. In addition to reducing costs, both the options contract and the marketing premium sought to increase private storage and, consequently, the incentives for investment in storage facilities.

D. *The Agrarian Reform Program*

The government rapidly expanded the agrarian reform program in the second half of the 1990s and targeted an increasing share of rural credit to small farmers. Under the program, the government redistributed more land since 1994 than in the period 1964–94. The decline in land prices to their lowest level in several decades (see Figure 1) reduced the cost of the program. Because the land reform program occurred so late in the period, it is too soon to evaluate its success. As a result, it will not be a major focus of this article.

E. *The Deregulation of the Domestic Markets of Sugarcane, Coffee, and Wheat*

In addition to price support policy in the 1970s and 1980s, which was aimed primarily at corn, rice, beans, soybeans, cotton, and cassava, the government used elaborate systems of regulation for sugarcane and its derivatives (sugar and alcohol), wheat, coffee, and milk. In the 1990s, it deregulated the markets for these goods.

In the case of sugarcane in the 1980s, the government set producer prices and provided a subsidy to producers in the northeast. It used production quotas to regulate supply and was the official buyer and distributor of the final products. The government also fixed the price of alcohol, which was produced from sugarcane and was used as a fuel for automobiles. The government liberalized sugar exports in the

mid-1990s and finally deregulated the sugarcane and alcohol markets in the late 1990s.⁹

Coffee was subject to an export tax in the 1970s and 1980s that was partially used to fund the Brazilian Coffee Institute (IBC). The IBC administered a support price policy for coffee, managed the coffee stocks, and controlled exports to comply with the International Coffee Agreement. Falling coffee prices in the second half of the 1980s led to the gradual withdrawal of the export tax. The Collor administration abolished the IBC in 1990 as part of its reforms aimed at liberalizing trade and deregulating markets.

The government had strictly regulated the market for wheat since 1967, with self-sufficiency and domestic price control as primary objectives. The government set prices at all levels of the market; provided subsidies to producers, millers, and consumers; and held a monopoly on imports. The fiscal burden of the program increased as of 1983, when the government expanded the program in an attempt to save foreign exchange. Rising inflation and the cost of the program forced the government to abandon the policy several years later. The phasing out of subsidies began in 1987, even before the market was deregulated in 1990.

III. THE EXPECTED IMPACT OF POLICY REFORM

The traditional view that agriculture was uniformly taxed as a result of ISI led some observers to expect that the sector as a whole should benefit from the move to a less interventionist and more outward-oriented model (World Bank, 1986, chap. 4). A more nuanced analysis of the impact of ISI on the agricultural sector emerged in the 1980s and was crystallized in the 18-country World Bank study headed by Krueger, Schiff, and Valdés. The results of this project highlighted the importance of policies outside of the agricultural sector, such as overvalued currencies and industrial protection, and demonstrated that these *indirect* policies implicitly taxed much of agriculture more than sector specific policies may have benefited it. Within the agricultural sector, *direct* policies tended to tax exportables, protect importables, and partially compensate for indirect discrimination through input

9. See Lopes and Lopes (1998) for detailed studies of sugarcane, coffee, and wheat in the 1990s.

subsidies. The Brazilian experience was broadly consistent with the international pattern, with the notable exception that its subsidized credit program was far larger than any of the other countries in the sample (Brandão and Carvalho, 1991).

In this context the authors ask: what would be the expected effect on the agricultural sector of the policy reforms that were discussed in the previous section? This article addresses the effects of currency appreciation in this section and the January 1999 depreciation in the conclusions.

The expected impact of trade policy reform would be highly differentiated. All of agriculture would benefit from a reduction in industrial protection, which would raise the relative price of agricultural goods. Exportables would also benefit from reduced export taxation and an elimination of restrictions on trade. Importables, in contrast, would be harmed by the reduction in tariff and nontariff barriers and would be forced to compete more directly with imported goods. If these markets also had been heavily regulated, deregulation would increase competition and lead to falling product prices. Thus, in terms of output prices, one would expect the impact to be positive for exportables, negative for importables, and mixed for nontradables.

The evolution of the real exchange rate would also be an important determinant of relative prices. The real exchange rate appreciated in the late 1980s, and then appreciated again with the adoption of the *Real* in mid-1994. The situation finally became unsustainable in January 1999 when the currency was allowed to float and depreciated by 50%. The failure to depreciate the real exchange rate in the 1990s should not be interpreted as an incomplete reform of the previous model. It resulted from the particular macroeconomic circumstances of the period.¹⁰ Thus, even though most of the antiagriculture bias in policy was removed, the bias against tradables remained. The negative impact on importables

should have been even more severe and the benefits to exportables more modest.

There are strong grounds to believe that policy reform would lead to improved resource allocation and increased productivity and efficiency. Within the sector, one would expect a change in the product mix as area shares come to more accurately reflect each crop's comparative advantage. Thus importables would experience a decrease in their share of area. This would likely lead to a rise in average productivity, as the least competitive producers were driven out of their respective sectors. Exposure to import competition would pressure the remaining producers to increase efficiency and lower costs, which could lead to positive dynamic effects on investment, growth, and productivity. Because most exportables were already highly competitive in international terms, the short-run effects on productivity would not be as strong.

The elimination of industrial protection should also lead to forces that contribute to increased productivity. Because the industries that produced inputs for agriculture had been protected, a fall in the prices of inputs (such as tractors, irrigation equipment, and fertilizer) should accompany the policy reform. This would contribute to lower unit costs and increased productivity. As Quiroz and Opazo (2000) argue, however, these changes are unlikely to be neutral across farm sizes. A fall in the price of capital and intermediate inputs relative to the price of agricultural labor would create incentives for the adoption of labor-saving techniques. This process is likely to favor large farms and could lead to increased out-migration.

The impact of policy reform on the size distribution of farms is more complex, however, and it is not obvious that small farms should have been harmed the most. Some factors should have hurt the large more than the small, whereas others should have mitigated the impact on the small. The withdrawal of the credit, sugarcane, and wheat subsidies, for example, should have harmed large farms more, as there is ample evidence that they benefited from these policies disproportionately. Similarly, many small farms are not fully integrated into the market or are net buyers of the goods that they produce, with the implication that falling product prices might not harm them and could even provide a benefit. A final factor not discussed so far was the

10. Real exchange rate appreciation was not uncommon in Latin America in the early 1990s. Quiroz and Opazo (2000) suggest that optimistic expectations related to the policy reforms in the region could partially explain the large capital inflows of the 1990s and the resulting currency appreciations. Although this seems plausible for many of the countries in the region, the 1994 real exchange rate appreciation in Brazil was much more an outcome of the adoption of a new currency and the stabilization of the economy in that year.

extension of social security benefits to rural areas in the 1990s. This should have had a positive impact on the welfare of the rural poor, and it is likely to have stemmed out-migration. Due to these offsetting forces, the authors believe that the impact of policy reform on the number and size distribution of farms is a question that can only be answered empirically.

The reform of rural credit policy should have led to multiple results. First, with heavily subsidized credit in the 1970s and early 1980s, a considerable portion of the highly fungible funds were diverted to nonagricultural uses or employed in low-priority investments. An improvement in resource allocation should have occurred as a result of the subsidy reduction. Second, the experience of credit amnesties in the late 1980s and debt refinancing in the 1990s contributed to producers—especially large ones—forming the expectation that a significant portion of the costs of default would ultimately be absorbed by the government. Thus the move toward a more private system of credit that increased the costs of default should have resulted in efficiency gains. In contrast to these observations, the reduction in the volume of credit available to the sector in the 1990s and the difficulty of small farms in accessing private credit are likely to have created obstacles to investment and growth.

The reform of support price policy should also have had important consequences. First, because this policy served to expand production on marginal lands, phasing it out should have led to improved resource allocation within the sector. Second, because the government was not a very discriminating purchaser of agricultural goods nor a very able manager of commodity stocks, an increased role of the private sector in marketing and storage should have led to improvements in product quality and in the country's warehousing sector. Finally, the reduction in the government's role in marketing and storage has stimulated the development of private futures and insurance markets that could help facilitate storage and manage risk. However, these markets are still incipient, and small producers are likely to face substantial obstacles of access.

IV. AGRICULTURAL PERFORMANCE

A. *Agricultural and Food Prices*

In this section the authors analyze the evolution of agricultural prices at the farm

gate. The analysis permits quantifying the impact on prices of policy changes. The authors emphasize four key points: (1) all real agricultural prices fell dramatically throughout the period, (2) the real exchange rate was the principal force causing prices to fall, (3) unfavorable international price movements more than offset the positive impact of policy reform on the relative prices of most exportables, and (4) the products that had been heavily regulated were affected most by policy reform.

The authors use a methodology based on the law of one price to quantify the impact of policy changes on domestic agricultural prices.¹¹ To do this, the authors decompose the percentage change in a good's real domestic price into three components: the percentage change in the real international price, the percentage change in the real exchange rate, and a residual that captures the percentage change in policy and other factors. The authors begin by writing the domestic price of a tradable good as

$$(1) \quad P_{it} = P_{it}^* E_t (1 + \theta_{it}) (1 + T_{it}),$$

where P_{it} and P_{it}^* are, respectively, the nominal domestic price, and the nominal international price measured in foreign currency, of good i in time t . E_t is the nominal exchange rate in period t . θ_{it} is a markup factor that includes the transaction costs and a competitive profit margin that are necessary to make the domestic price comparable with the international price. T_{it} is the residual proportional difference between the two prices after the markup has been considered, and can be thought of as the tariff equivalent, or nominal rate of protection (NRP). NRPs capture the effects of trade taxes, nontariff barriers, alternative market structures, and other policies that drive a wedge between domestic and border prices. Non-competitive or state-regulated markets, for example, can have larger markups than a competitive market.

If one divides both sides of (1) by a domestic inflation index (INF_t^d), multiply and divide the right-hand side by an international inflation

11. As far as these authors know, Quiroz and Valdés (1993) are the first ones to develop the approach used here as a simple tool for analyzing changes in policy. Jaramillo (2001) also uses this approach.

TABLE 1
Decomposition of Changes in Domestic Agricultural Prices for Selected Periods

Product	Period	Real Domestic	Real International	Real Exchange	Policy + Residual ^a
		Price (1)	Price (2)	Rate (3)	(4)
		Percentage Change			
Importables					
Beans, corn, cotton, and rice	(1982–86)–(87–89)	–32	–4	–21	–8
	(1987–89)–(90–94)	–22	–3	–24	4
	(1990–94)–(95–98)	–17	4	–29	8
Wheat	(1982–86)–(87–89)	–46	1	–21	–26
	(1987–89)–(90–94)	–45	–16	–24	–9
	(1990–94)–(95–98)	–14	11	–29	7
Exportables					
Cocoa, oranges, and soybeans	(1982–86)–(87–89)	–21	–7	–21	6
	(1987–89)–(90–94)	–42	–28	–24	3
	(1990–94)–(95–98)	–16	8	–29	7
Coffee ^b	(1982–85)–(87–89)	–29	–20	–21	8
	(1987–89)–(90–94)	–34	–32	–24	14
	(1990–94)–(95–98)	41	49	–29	35
Food prices					
Food component of CPI	(1982–86)–(87–89)	–14			
	(1987–89)–(90–94)	–13			
	(1990–94)–(95–98)	–9			

^aThe residual is presented net of the interaction between the real international price and the real exchange rate in order to isolate the impact of policy.

^bThe 1986 coffee prices were excluded because this was an atypical year. Prices were more than double those of 1985 and 1987.

Source: See text for details and note 13 for data sources.

index (INF_t^*), and then take logs and first differences, one obtains

$$(2) \quad \Delta \ln p_{it} = \Delta \ln p_{it}^* + \Delta \ln RER_t \\ + \Delta \ln(1 + \theta_{it}) + \Delta \ln(1 + T_{it}),$$

where $p_{it} = (P_{it}/INF_t^d)$ is the real domestic price, $p_{it}^* = (P_{it}^*/INF_t^*)$ is the real international price, and $RER_t = [E_t(INF_t^*)/INF_t^d]$ is the real exchange rate. Equation (2) provides a simple method for observing the extent to which real international prices and the real exchange rate do not explain the movement in real domestic prices. Because p_{it} , p_{it}^* , and RER_t are easily observable, the authors treat the other factors as a residual in the empirical work that follows. Large changes in the residual can usually be related to large changes in policy or to a good that is not fully tradable.¹²

12. It is important to point out that equation (2) is an accounting identity. The international price need not be exogenous, and the authors identify cases when this is unlikely to be true.

Table 1 decomposes the movements in the real domestic prices of five of the most important agricultural imports and four of the most important agricultural exports.¹³ The entries in the table are the percentage changes in each variable between selected periods that correspond roughly to policies. Within each category, the authors calculate a simple average for those products that exhibited similar behavior in terms of the impact of policy reform. Column (1) of Table 1 highlights the fact that the real domestic price of most agricultural products fell dramatically throughout the period.

13. The domestic prices come from the Getulio Vargas Foundation. The international prices were taken from commodity markets in Chicago (wheat, corn, and soybeans) and New York (cocoa, coffee, and cotton), and from the FAO (beans and rice). The Brazilian inflation index is the IGP-DI from the Vargas Foundation, the foreign inflation index is the U.S. producer price index from the U.S. Bureau of Labor Statistics, and the exchange rate is the commercial sale price of a dollar in terms of domestic currency. Consumer prices are from the national Consumer Price Index of IBGE.

The product prices in Table 1 were all 50% to 60% lower in 1995–98 than in 1982–86, with the exception of coffee (–34%), cocoa (–70%), and wheat (–75%). The appreciation of the real exchange rate (column [3]) was the principal factor leading to falling prices. It accumulated a 57% drop during the same period.¹⁴

The final column of Table 1 shows that the effect of policy on the real domestic price of most importables—as measured by the residual—was quite limited. On average, there was only an 8% fall in the late 1980s in the real domestic prices of beans, corn, cotton, and rice beyond what could be explained by the percentage changes in the real international prices of these goods (–4%) and by the real exchange rate (–21%). The negative effect on prices was then fully reversed in the 1990s, with positive residuals equal to 4% in the early 1990s and 8% in the late 1990s. Given that tariffs on these products fell from the 35% to 55% range prior to 1988 down to 10% in 1991 (and later 0% for imports from MERCOSUL), it is clear that these products did not experience a dramatic reduction in prices as a result of trade liberalization. Rather, by the late 1980s the prices of these goods were already close to their import parity equivalents. The most significant factors affecting this group were the real exchange rate and the elimination of nontariff barriers, which increased the competition with imports.

The effect of policy reform on wheat, which involved far more than trade liberalization, was dramatic. Column (4) of Table 1 shows that the removal of the wheat subsidy in the late 1980s led to a 26% fall in the domestic price beyond what could be explained by the international price (1%) and the real exchange rate (–21%). The combined effect was to generate a 46% drop in the domestic price of wheat. Real wheat prices then fell by another 45% in the early 1990s as a result of low international prices (–16%), the appreciation of the real exchange rate (–24%), and other factors (–9%). The authors show the consequences of such a substantial fall in domestic prices on production and trade in the following section.

Consistent with expectations, the effect of policy reform on exportables was positive. The producer prices of cocoa, oranges, and soybeans all benefited between 10% and 20% from a combination of eliminating export

taxes, quantitative restrictions, and the value-added tax on exports in 1996 (column [4], Table 1). All three products, however, suffered from international prices that were 28% lower on average in 1990–94 than in 1987–89. This negative shock more than offset the gains from reform in the early 1990s.

As described in section II, coffee was one of the most heavily regulated products in the sector. As in the case of wheat, policy reforms and other factors had a pronounced effect on prices. Even though Brazil reduced the quantity of exports in the late 1980s, international coffee prices fell by 20% due to a significant expansion of exports from other countries. This was followed by the end of the International Coffee Agreement in 1989 and the abolition of the IBC in 1990. Without the domestic and international institutions that had contributed to regulating supply, Brazil and other coffee exporters increased their exports by about 10% each in the first half of the 1990s. The result was an additional 32% fall in international prices (Table 1, column [2]). The situation began to improve in 1993 when Brazil and other exporters formed the Association of Coffee Producing Countries and undertook a coordinated effort to implement a voluntary system of export targets. This, in combination with several frosts in Brazil and the creation of the Deliberative Council for Coffee Policy in Brazil in 1996, contributed to bringing coffee prices back—at least temporarily—to roughly the same level as in the 1987–89 period.¹⁵ An important consequence of export targets, however, was that Brazil continued the long-term trend of losing its share of the international coffee market. In the 1960s it had accounted for one-third of world exports. In the 1990s its share fell to 19%.

Table 1 also shows the evolution of real food prices. Food prices fell by 31% between 1982–86 and 1995–98, which is slightly more than half of the average decline in agricultural prices. This was somewhat less than the other tradable components of the Consumer Price Index—household goods (–50%) and clothing (–60%)—but considerably more than the nontradable components—housing, healthcare,

14. Prior to this period of appreciation, there was a 30% real devaluation in 1983.

15. Due in part to the difficulties of cooperation among coffee exporters, the recuperation in prices was short-lived. International prices in 1999–2000 were back to their 1990–94 levels. See the special issues of *Agroanalysis* on coffee published in November 1997 and November 1998.

and personal expenditures—which all rose by about 60%. The conclusion drawn is that consumers derived significant benefits from falling food prices in this period and that falling agricultural prices contributed to make this possible.

B. Output and Trade of Agricultural Products

Aggregate Agricultural Output. In contrast to the 1950–80 period, the agricultural sector outperformed the industrial sector in the 1980s and both the industrial and services sectors in the 1990s. Between 1980 and 1998, real GDP grew by about 40%, and real agricultural output rose by about 70%. This is a remarkable fact in light of the vast international evidence that has documented how the share of agriculture in GDP tends to decline during the process of economic development. The reversal is testimony to the powerful impact of the policies that the government adopted in this period.¹⁶

One of the most striking features of this period was the dynamism of the animal subsector since the mid-1980s. Growth was most rapid for poultry production, which achieved rapid gains in productivity (Helfand and Rezende, 1999). The appreciation of the currency did not create serious obstacles for chicken exports because it simultaneously helped lower the costs of feed (primarily corn and soybeans) and the imported genetic material used for breeding. Although poultry production grew the fastest, rising by 182% between 1980 and 1996, cattle and hog slaughter also grew rapidly, rising by 98% and 70%, respectively. Hog production, with about a decade lag, has followed the same path of modernization as poultry production, and there is evidence that cattle production is now entering a period of rapid intensification as well.¹⁷

Importables: Trade and Output. Consistent with our predictions, policy reform led to a substantial decline in the harvested area of the domestically produced importables and to a dramatic increase in spending on imports. As can be seen in Table 2, the total value of

agricultural imports tripled between 1985–89 and 1995–98, rising from approximately 2 billion to 6 billion 1998 U.S. dollars per year. Table 3 shows that harvested area for the principal importables fell by 20% in this same period. In what follows, the authors briefly highlight some of the most important changes that affected each crop.

The withdrawal of the wheat subsidy and the deregulation of the wheat market led to a decline in production of more than 50% between 1985–89 and 1990–94 (Table 3). By the late 1990s imports had nearly tripled (Table 2). Because wheat was produced almost exclusively in the South of Brazil, the burden of adjustment fell most severely on this region.

The impact of policy reform on cotton production and trade was also dramatic. Imports surpassed exports in the late 1980s and grew to an average of \$700 million per year by the end of the period (Table 2). Simultaneously, cotton production declined by 50% (Table 3). Area and production doubled in the center-west, however, as new varieties contributed to the ability of this region to compete successfully with imports in terms of quality and price.

In contrast to wheat and cotton, corn imports as a share of domestic production remained constant at about 3%. Total area harvested in corn was stable in the 1990s, with increased output coming almost exclusively from rising yields. As with cotton, the center-west was the most dynamic region of the country.

Area harvested for beans fell by about 20% in the 1990s, but output grew due to rising yields. Bean producers were highly differentiated, with an increasing share of production coming from irrigated second (23%) and third (7%) harvests. Although farms over 200 hectares only produced 15% of the first harvest in 1995–96, they were responsible for a third of the second harvest and two-thirds of the third harvest.

Relative to corn and beans, rice imports had a more significant impact on the domestic market. As a share of production, imports grew from 6% in the late 1980s to around 15% in the late 1990s. Relative to the other regions in Brazil, two states in the south (Rio Grande do Sul and Santa Catarina) produced a higher-quality rice, used a different technology (irrigation), and obtained yields that were triple the national average. These states suffered considerable pressure from imports but

16. On the positive performance of agriculture in Brazil during the 1980s, see Goldin and Rezende (1990). de Janvry and Sadoulet (1993) show that adjustment policies favored agriculture throughout Latin America during this period.

17. The data come from *Pesquisa Mensal de Abate de Animais* (IBGE). The authors restricted the period to 1980–96 because a change in the methodology of the survey made the data after 1996 less comparable. On modernization of the cattle sector, see *Agroanalysis*, June 2000.

TABLE 2
Average Annual Trade of the Principal Agricultural Products (Thousands of 1998 US\$)

Product	1980–84	1985–89	1990–94	1995–98
Imports				
Wheat	1,219,143	391,275	677,314	1,032,876
Cotton	6,925	108,463	386,457	702,707
Milk ^a	52,512	179,403	191,471	544,248
Rice	89,349	133,992	257,340	367,660
Corn	147,727	107,667	138,465	137,031
Beans	20,300	29,624	52,342	95,409
Subtotal	1,535,956	950,423	1,703,388	2,879,931
Index (1985–89 = 100)	162	100	179	303
Share of total	0.60	0.45	0.53	0.46
Total agriculture imports	2,561,215	2,098,302	3,231,770	6,263,002
Exports				
Soybeans ^b	3,415,908	3,215,734	3,150,235	4,710,945
Orange juice	945,264	1,080,681	1,120,730	1,197,177
Sugar ^c	1,109,854	424,950	710,759	1,821,337
Cocoa ^d	793,497	703,678	305,658	146,680
Coffee	3,187,739	2,765,706	1,661,723	2,593,105
Beef	598,885	593,680	530,222	493,221
Pork	7,152	21,224	63,072	144,250
Chicken	361,403	292,376	492,453	774,025
Subtotal	10,419,701	9,098,031	8,034,852	11,880,741
Index (1985–89 = 100)	115	100	88	131
Share of total	0.84	0.82	0.78	0.80
Total agriculture exports	12,464,345	11,029,268	10,240,186	14,788,598

^aMilk equivalent as defined by the FAO.

^bIncludes beans, soy cake, and oil.

^cIncludes refined and centrifugal (raw).

^dIncludes cocoa butter, powder, cake, paste, and beans.

Source: Authors' calculations based on FAO data (www.fao.org).

managed to hold their ground. Area and output fell substantially in the rest of the country.

Exportables: Trade and Output. Policy reform had a positive impact on exportables, but it was not of the same magnitude as the impact on importables. Table 2 shows that the total value of agricultural exports rose by about \$4 billion (1998 dollars) between 1985–89 and 1995–98, or the same amount as the value of agricultural imports. For imports, however, this represented a 300% increase, whereas for exports it was only 34%. Policy reform also led to substitution of importables in production within the agricultural sector. Table 3 shows that the area harvested for the sample of importables fell by 6 million hectares. The harvested area for the exportables, in contrast, rose by 1.6 million hectares.

A considerable amount of area was freed for more productive activities—such as animal production—or was no longer being used because it was not profitable to do so.

Two of the products that might have benefited the most from the elimination of export taxation—cocoa and coffee—actually performed the worst in the 1990s. In the case of cocoa, output and yields fell by more than 30% as a result of the “witches broom” fungus in Bahia. The area harvested in coffee, in contrast, fell by 30% between 1985–89 and 1995–98. This was a reflection of the difficulties the sector had coping with falling prices between 1987 and 1993 and finding new institutional forms of organization and representation.

Soybean output grew by more than any of the other crops in the 1990s, with most of the expansion coming from the center-west (Table 3).

TABLE 3
Area Harvested, Production, and Yield for the Principal Products in Selected Periods

Products	Area (thousands of hectares)				Production (1985–89 = 100)				Yield (1985–89 = 100)			
	1980–84	1985–89	1990–94	1995–98	1980–84	1985–89	1990–94	1995–98	1980–84	1985–89	1990–94	1995–98
Importables												
Beans	4,996	5,392	4,924	4,362	96	100	115	111	103	100	126	139
Corn	11,663	12,774	12,688	12,510	86	100	114	135	94	100	115	138
Corn (CW)	1,105	1,533	1,589	1,904	57	100	114	161	80	100	111	131
Cotton	1,468	1,771	1,291	828	75	100	76	51	90	100	104	109
Cotton (CW)	85	115	155	223	76	100	127	217	104	100	95	114
Rice	5,766	5,506	4,316	3,567	85	100	90	88	81	100	115	135
Rice (CW)	2,248	1,859	1,057	779	100	100	64	62	83	100	113	149
Rice (RS + SC)	784	923	1,017	1,005	73	100	119	123	86	100	108	113
Wheat	2,298	3,349	1,903	1,430	40	100	48	43	61	100	86	100
Total area	26,191	28,792	25,122	22,697								
Average index	92	100	87	80	76	100	89	86	86	100	109	124
Exportables												
Cocoa	540	663	699	710	86	100	84	70	106	100	80	65
Coffee	2,360	2,801	2,554	1,981	89	100	85	81	104	100	94	113
Oranges	599	757	954	953	78	100	123	141	98	100	97	112
Soybeans	8,607	10,240	10,541	11,683	81	100	112	147	97	100	109	130
Soybeans (CW)	1,531	3,186	3,656	4,407	42	100	121	167	87	100	106	122
Sugarcane	3,130	4,074	4,179	4,790	73	100	105	128	95	100	103	109
Sugarcane (SE)	1,518	2,012	2,198	2,811	73	100	115	146	96	100	105	105
Sugarcane (NE)	1,144	1,373	1,291	1,203	80	100	88	85	96	100	93	97
Total area	15,236	18,535	18,928	20,116								
Average Index	82	100	102	109	81	100	102	113	100	100	96	106
Average index w/out cocoa						100	106	124		100	101	116

^aCW = center-west region; RS = Rio Grande do Sul state, and SC = Santa Catarina state are in the southern region; SE = southeast region; NE = northeast region.

^bPrior to 1989 Tocantins (TO) was part of Goiás. For consistency, TO has been added to the CW in the 1989–98 period.

^cThe average indices are simple averages of the national totals.

Source: Authors' calculations based on data from *Produção Agrícola Municipal* (IBGE).

As will be discussed, falling input prices and rising productivity allowed producers to deal with falling product prices rather easily. The value of exports was relatively constant between 1980 and 1994, yet favorable external prices in 1996–97 in addition to the incentives created by the elimination of the value-added tax on exports contributed to raising the value of exports by about 50% in the 1995–98 period (Table 2).

Sugarcane and oranges both expanded their area, output, and (to a lesser extent) yields in the 1990s. These crops were grown principally in the state of São Paulo, where 75% of the oranges and 50% of the sugarcane in Brazil were produced. Orange producers benefited from falling input prices and considerable modernization of transport services and of the ports.¹⁸ After the government freed sugar exports from quantitative restrictions in the mid-1990s, exports responded rapidly and increased to nearly \$2 billion per year (Table 2).

Table 2 also provides data on meat exports. Although beef exports were stagnant in the past 20 years, chicken and pork exports grew rapidly in the 1990s. The expansion of soybeans and corn in the center-west was one of the forces leading to dramatic growth in the 1990s in the production of these animals in this region (Helfand and Rezende, 1999). This is another dimension of the challenge to the competitiveness of the south in the 1990s and of the expansion of lucrative activities in the center-west.

C. Productivity Gains and Inputs

Total Factor Productivity. Several recent studies have measured total factor productivity (TFP) at an aggregate level in the Brazilian agricultural sector over the past several decades. The results have been qualitatively similar, and in what follows the authors focus on Barros (1999). Barros tests the sensitivity of his results to alternative methods and specifications and devises three different indexes to proxy for capital services. Notwithstanding the problems of measurement error that are common to all studies of productivity, the results point to some important conclusions. First, with six different specifications, TFP measured with the growth accounting

approach increased between 16% and 36% in the period 1975–95. The first column of Table 4 shows the results for one of the intermediate specifications. Although TFP rose by 20% between 1975 and 1995 under this scenario, most of the growth came in the 1990s. The correspondence with the period of policy reform is significant. Second, land and labor productivity grew by about 30% between 1985–86 and 1994–95, whereas TFP rose by only 15% in this period. This is an important result because it demonstrates that gains in land productivity often overstate the gains in TFP.

Barros concludes that about two-thirds of the growth in output between 1975 and 1995 was attributable to growth in inputs and about one-third to growth in TFP. It is important not to attribute the growth in TFP solely to technological change. As the least productive farmers chose to exit, as farmers withdrew the least productive land from production, and as they shifted crops to more productive regions, average productivity should have risen even without any technological change. In the context of increased competition in the 1990s, it is likely that efficiency gains within the farm were also an important reason for increased productivity. Technological change and scale effects should have contributed as well, especially in the center-west, where farms were much larger and where expansion occurred often by incorporating the latest technologies.¹⁹ Productivity gains were especially important for certain activities, such as milk, poultry, and hog production, where rapid modernization took place.

Land Productivity. The final four columns of Table 3 show changes in yields for the principal importables and exportables in the 1980s and 1990s. Simple averages show that importables performed better than exportables in both the 1980s and 1990s. Between 1980–84 and 1985–89, yields rose by 16% on average for importables, whereas for exportables there was no gain. Between 1985–89 and 1995–98, the average gain in yields for importables was 24%, and for exportables (with cocoa excluded) it was only 16%. This is a striking result that reverses the pattern that had prevailed in the period 1950–80 when exportables almost uniformly outperformed domestic food

18. On the transformation of the citrus sector, see *Agroanalysis*, May 1999 and June 2001.

19. Gasques and Conceição (2001a) confirm that TFP grew faster in the center-west than in any other region.

TABLE 4
Selected Indicators of Productivity, Input Quantities, and Input Prices

	TFP ^a (1) (1980 = 100)	Agricultural Employment ^b (2) (millions)	Tractor Stock ^a (3) (units)	Fertilizer Consumption ^c (4) (millions of MT)	Ag. Wage ^d (5) (1987 = 100)	Fertilizer Price ^d (6) (1987 = 100)
1980	100	—	555,124	4.20	—	—
1981	102	13.20	575,220	2.75	—	—
1982	97	14.04	590,603	2.73	—	—
1983	104	13.01	601,926	2.29	—	—
1984	101	14.85	631,013	3.36	—	—
1985	105	15.10	663,487	3.20	—	—
1986	98	14.22	718,652	3.78	—	—
1987	110	13.98	749,686	3.76	100	100
1988	106	14.10	770,119	3.73	61	92
1989	110	13.90	790,239	3.38	66	86
1990	103	14.04	801,914	3.16	62	76
1991	111	—	805,559	3.39	71	71
1992	109	14.04	800,949	3.54	59	68
1993	110	13.80	800,766	4.45	57	55
1994	117	—	809,941	5.02	55	50
1995	118	13.63	788,574	4.21	85	47
1996	—	12.61	753,037	5.02	93	50
1997	—	12.60	711,661	5.56	92	48
1998	—	12.12	—	5.74	93	46

^aTFP is from p. 111 and wheel tractors from p. 66 in Barros (1999). See text for details.

^bAgricultural employment is from *Pesquisa Nacional de Amostra de Domicílios (PNAD)* (IBGE, various years). PNAD does not cover the northern region of the country. Due to a change in methodology in 1992, for comparability over time we have assumed that 1992 employment equals 1990 employment. See Helfand and Brunstein (2001) for details.

^cFertilizer consumption is from the U.N. Food and Agriculture Organization, www.fao.org.

^dThe agricultural wage and fertilizer price are the labor and fertilizer components of the FGV monthly index of the prices paid by agricultural producers. The index was created in June 1986. We deflated these components with the IGP-DI inflation index, which is the same one used in Table 1 to deflate the output prices.

crops (Graham et al., 1987). For the 1980s it reflects in part the returns on a series of successful investments that the Brazilian government had made in agricultural research. The result for the 1990s is consistent with the current predictions.

With the exception of corn, the other four importables experienced substantial contractions in harvested area. This should have raised average yields as the least productive land and producers exited. Corn and cotton in the center-west were the two main exceptions to the pattern of contraction, because they both increased area and yields in the 1990s. Increased productivity in this region was associated with technological improvements and scale effects.

The expectation for exportables was that productivity gains would be less associated with policy reform because Brazil was already

a highly competitive producer of these goods. As expected, the gains in yields were quite modest for oranges, sugarcane, and coffee, the latter in spite of a significant contraction in area. Soybeans were the one major exception, with most of the growth coming from the center-west. Without a doubt, the expansion of cotton, corn, and soybeans in the center-west, along with the associated animal-based agroindustries, made this the most dynamic agricultural region of the country.

Farm Size, Land Productivity, and Employment.

There has been considerable discussion in Brazil about the impact of policy reform on the number and size distribution of farms in the agricultural sector. Many authors have used the agricultural censuses of 1985 and 1995/96 to argue that the number of farms fell by nearly 1 million, or 16%, and that the

number of people employed in the agricultural sector dropped by more than 5 million, or 23%. The decline was apparently much more severe for small farms, as the censuses indicate a 22% fall for establishments under 10 hectares, yet only a 2% drop for establishments over 1000 hectares. The comparison of the two censuses, however, is compromised by a change in the reference period of the most recent census. Using the National Household Surveys, Helfand and Brunstein (2001) estimated that the decline in the number of establishments and employment was only between one-third and one-half of the fall recorded by the census and that it was concentrated in the south and southeast of Brazil.

To date, researchers have been unable to unambiguously answer the question about the impact of policy reform on the size distribution of farms. The authors can, however, provide evidence on the evolution of yields that is suggestive of problems of competitiveness for small farms. Two caveats are warranted. First, because yields are only a partial measure of productivity, the evidence is not conclusive. Second, farm income only represents a portion of total income, and thus is not the only determinant of the well-being of small farmers.²⁰ For beans and corn, which are integral to the production portfolios of millions of small farms, yields grew much more rapidly for large farms. Yields grew between 80% and 165% for bean producers over 100 hectares but by less than 30% for farms under 100 hectares. For corn, yields grew by more than 70% for farms over 100 hectares, yet by less than 30% for farms under 20 hectares. With the exception of rice in the south, most crops reveal relative gains for large producers.²¹

20. Data presented in Graziano da Silva and Del Grossi (2001) show that there were more than twice as many rural households that were specialized in agricultural activities in 1997 than were diversified. Even for the households engaged in multiple activities, farm-related income continued to represent between 50% and 55% of family income. Thus, although diversification of income sources was increasingly common, the ability to compete in agricultural product markets remained central to the well-being and survival of most small farmers.

21. Consult the electronic appendix to this article for data on the percentage change in yields by farms size between 1985 and 1996 for 10 crops. Yields calculated from the agricultural censuses are unlikely to be influenced by the change in the reference period of the 1995/96 census. The use of the censuses for comparing the levels of variables in 1985 and 1995/96 is much more problematic.

The conclusion that the authors draw is that small farms did not appear to be increasing productivity at the same rate that large farms were. In the context of falling output prices, productivity gains were likely to be an important means for maintaining profitability. This relative lack of dynamism presented obstacles to the viability of previously existing small farms as well as to the new small farms created under the land reform program.²²

Input Prices and Quantities. Section III argued that policy reform was expected to lead to a significant realignment of relative input prices within the agricultural sector. This should have led to a greater reliance on techniques that used tradable inputs intensively and that economized on nontradable inputs, such as land and labor. Thus far the authors have discussed the contraction in the amount of land used by agriculture. The authors now presents selected evidence on other inputs.

According to the Getulio Vargas Foundation's input price index for agriculture, real input prices fell by 19% between the periods 1987–89 and 1990–94, and then by another 8% between 1990–94 and 1995–98. Average input prices fell less quickly in the second half of the 1990s because of wages. Although the real prices of pesticides, fertilizers, services, fuels, and seeds fell by an average of 21% between 1990–94 and 1995–98, agricultural wages rose by 49% (see column [5], Table 4). Monthly data show that the increase in wages occurred almost entirely between July 1994 and April 1995. Agricultural wages rose due to the planting and harvesting of a record grain crop in the 1994–95 agricultural year as well as in response to the increase in economic activity that was associated with the early phase of the *Real* plan. Agricultural wages were subsequently sustained at a higher level by an increase in the minimum wage from R\$70 to R\$100 in May 1995. Living standards for those rural workers that succeeded in remaining employed should have risen, but strong pressures to shrink the rural labor force must surely have been felt. Column (2) of Table 4 captures this and shows a contraction in employment of more than 1 million starting in 1996.

22. Neoliberal reforms have created obstacles to the competitiveness of small farmers in many Latin American countries. See, for example, Carter and Barham (1996).

Table 4 also provides information about the impact of policy reform on fertilizer consumption and tractor use. Fertilizer consumption rose from 1 to 4 million tons per year between 1970 and 1980, in large part due to substantial subsidies. After contracting in the early 1980s, consumption stabilized around 3.5 million tons from 1984 to 1992 (column [4]). Trade liberalization and changing relative prices in the 1990s led to more than a 60% increase in fertilizer consumption between 1992 and 1998. This is one of the key factors that contributed to increasing TFP in the 1990s, and it reflects the intensity of efforts to improve competitiveness in the 1990s. As the distribution of yields for corn and beans demonstrate, however, most of the gains in productivity were concentrated in large farms.

In contrast to fertilizer consumption, column (3) of Table 4 shows that the estimated stock of wheel tractors, which represents 75% of agricultural machines, peaked in 1994. Although real tractor prices were falling in the 1990s, tractor sales also depend on the availability of investment credit, which was severely curtailed in the 1990s. As a consequence, sales of domestically produced tractors fell from an annual average of 35,000 in the 1980s to under 19,000 for 1990–98. Imports of tractors have only partially compensated for falling sales of domestically produced tractors. The number of imported tractors rose to nearly 1000 per year in 1995–97 (Barros, 1999). Thus, even though it is likely that credit subsidies induced excessive investment in tractors in the late 1970s and early 1980s, the authors reach the troublesome conclusion that high real interest rates and the lack of investment credit in the 1990s contributed to an absolute decline in the stock of tractors in the second half of the 1990s.

V. CONCLUSIONS

This article analyzed the impact on the agricultural sector of the sweeping policy reforms that began in Brazil in the 1980s. The authors argued that the reform of the policies that influenced the agricultural sector was subordinated to the changing macroeconomic circumstances of the period. Events outside of agriculture were also among the principal forces that conditioned the sector's performance.

The policy reforms of this period brought an end to many of the highly inequitable and

inefficient agricultural policies that had characterized ISI in Brazil. As a result of the reforms, agriculture became the most dynamic sector of the economy in the 1990s. Within agriculture, there were winners and losers. The exportable and animal subsectors benefited disproportionately from the reforms, as did the center-west region of the country. Import-competing products and the south suffered the most. Some of the most profound transitions, however, had little to do with the type of good or the region where it was produced. They came as a result of a redefinition of the role of the state. Thus, in the cases of wheat, coffee, sugarcane, and milk, the transition resulted not only from a change in the level of protection but also from the withdrawal of the state from its traditional role of setting prices, managing production, and regulating or monopolizing the activities of marketing and trade. Taken as a whole, these policy changes led to more competition within the agricultural and processing sectors and to a larger role for the market in coordinating the relationship between them.

Policy reform also had a differentiated impact across farm sizes. The available evidence suggests that there was a significant reduction in the number of farms in the 1990s and that small farms experienced problems of competitiveness. In this context, the government expanded the agrarian reform program and targeted the provision of official credit to small farms. Additional research is required to investigate the adequacy of the land reform package and suggest other reforms that could contribute to the viability of the beneficiaries in the new policy environment.

Among the most important benefits of policy reform was to force improvements in resource allocation, productivity, and product quality and lower the price of food for consumers. There were two ways, however, in which the reform of policies was still incomplete at the end of 1998. The first relates to the exchange rate and the second to other policies that were still in need of reform. The appreciation of the currency in the 1990s undermined the competitiveness of tradable goods, yet simultaneously lowered the price of tradable inputs. The effect was to "stress" the agricultural sector and to force productivity gains.²³ The 50% real

23. The term *stress* comes from Schuh (1974) in his writings on U.S. agriculture.

depreciation that accompanied the floating of the currency in January 1999 was a step in the direction of completing the reforms and will undoubtedly improve the competitiveness of tradable goods. The authors expect, however, that reducing import competition and raising tradable input prices will also slow productivity growth and cost reductions within the sector.

The competitiveness of Brazilian agriculture in the 1990s was also harmed by unusually high interest rates, poor infrastructure, and the comparative inadequacies of the country's tax system. For this reason, the authors agree with Lopes (2000), who has argued that the Brazilian agricultural sector suffered from a partial reform. The control of inflation in 1994 and the floating of the exchange rate in 1999 created the conditions in which real interest rates could fall to the levels practiced in other developing economies. This, however, has yet to happen. The necessary investments in infrastructure and the reform of the tax system, in contrast, were hindered in the period 1994–2002 by an administration concerned with fiscal restraint and by a Congress unable to reach agreement on the design of a new tax code. The Workers' Party government that took office in January 2003 has made tax reform a high priority, and the authors are hopeful that it will achieve more progress on these issues.

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