

**The Impact of Sector-Specific and Economy-Wide Policy Reforms on Agriculture:
The Case of Brazil, 1980-98**

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The Brazilian economy began a process of restructuring in the 1990s as a result of dramatic changes in economic policy. The policies associated with the import substitution industrialization (ISI) model were abandoned and the country initiated a process of shaping a new path of development. Trade was liberalized, state owned enterprises privatized, domestic markets deregulated, and a South American Common Market (MERCOSUL) formed. 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.¹ The agricultural sector was no exception. A transition took place 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.²

In this paper we analyze the impact of the policy reforms, and of the changing macroeconomic conditions, on the agricultural sector in Brazil. We emphasize four aspects of the reform period that were either unexpected or not given sufficient attention by authors writing prior to the reforms. The first issue relates to the importance that events outside of the agricultural sector have 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.³ 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.

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¹ The data is reported in Rossi Jr. and Ferreira (1999).

² See Graham et al. (1987) for an analysis of agricultural policies and performance through the mid-1980s.

³ See the works by Krueger, Schiff, and Valdés.

The numerous stabilization plans that were 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 reform of agricultural policies was almost entirely subordinated to the reform of ISI policies and the painful quest for price stability.

A second issue that we emphasize is that policy reform involved far more than trade liberalization. Deregulation and the reform of credit and support price policy have been 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. The products that lost import protection or gained a reduction in export taxation as a result of trade liberalization also were affected, but to a lesser degree. For this group, the evolution of credit and support price policy was extremely important.

A third issue that was not given sufficient attention by the pre-reform analyses that focussed on agricultural prices is the impact of policy reform on input markets and productivity.⁴ We identify changes in input markets as one of the key components of the adjustment process. Liberalization altered relative input prices and increased access to high quality imported inputs. It also exposed domestic production to greater competition. Both of these factors contributed to productivity gains and falling costs. Increases in productivity and efficiency are among the most important measures of the success of the reforms.

A fourth and final issue that we address is that policy reform had a highly differentiated impact on the sector. Reform was neither uniformly beneficial, nor entirely prejudicial. Thus, our analysis seeks to distinguish between different groups of products, such as importables and exportables, geographic regions, farm sizes, and sub-periods. Since 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.

The paper is organized as follows. In Section 2, we provide an overview of the policy reforms in this period. Since some of the reforms began in the 1980s as a response to the debt

⁴ Quiroz and Opazo (2000) have recently addressed this issue.

crisis, we provide selected information on the 1980s when necessary. In Section 3, we provide a conceptual framework for identifying the expected effects of the reforms on the sector. Section 4 analyzes the impact of the reforms on agricultural prices, output, trade, productivity, and input markets in the 1980-98 period. Section 5 provides a summary and the main conclusions.

2. Overview of Policy Reforms Related to Agriculture

2.1 The Role of the Macroeconomic Environment

A first wave of policy reform began in the early 1980s in response to the debt crisis. Macroeconomic adjustment policies led to the reform of rural credit policy, reducing the volume of credit and eliminating the subsidies that had exceeded 6 billion 1996 dollars in 1979.⁵ At the same time, the government depreciated the currency and expanded the support price program. This change in the policy mix was a result of the pressures to control the fiscal deficit and to generate foreign exchange. The expansion of support price policy was accompanied by a state monopoly on trade for many goods. 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 below.

Like the debt induced adjustment policies of the 1980s, the macroeconomic environment of the late 1980s and early 1990s played a crucial role in shaping the evolution of the reforms that affected the agricultural sector. Trade liberalization and deregulation of agricultural markets, in addition to changes in rural credit and support price policies, were measures that were adopted as part of an overall strategy to fight the threat of hyperinflation. These policy changes had more to do with the fight against inflation than with a belief that the new model would provide superior growth or development.

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

⁵ See Helfand (2001) for estimates of credit subsidies in the 1970s and 1980s.

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 (1993),⁶ the reduced attractiveness of financial assets that accompanied the launching of these plans caused the prices of land and agricultural commodities to rise. This, in turn, led to increased borrowing and investment in agriculture. As these plans failed, however, 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.

It is interesting to observe that the *Real Plan* generated a similar cycle even though it was pre-announced. As soon as the plan started to be implemented, in early 1994 when the *unidade real de valor* (URV) index was created, land and other asset prices started to rise. The peak was reached in December of 1994, shortly after the final stage of the plan was launched and the new currency (the *Real*) was created. Although the *Real Plan* succeeded, in contrast to previous attempts at stabilization, extremely high interest rates in the post stabilization period once again increased the attractiveness of financial assets. The result was an abrupt fall in land prices accompanied by a fall in the prices of cattle and agricultural commodities. Since agricultural investment and borrowing had grown substantially in the agricultural year 1994/95, the consequence was one of the most severe financial crises that the sector has gone through in the past two decades.

It is in this light that one should consider the multiple impacts of the *Real Plan* on the agricultural sector.⁷ On the one hand, the Plan created substantial obstacles for the sector due to the currency appreciation in the second semester of 1994 and the asset price cycle that led to

⁶ Also see Rezende (1993), and Dias and Amaral (1999b).

⁷ The debate about the impact of the Real Plan on the agricultural sector has been very controversial. See Homem de Melo (1999a and 1999b), Dias and Amaral (1999a), Ferreira Filho (1999), Lopes and Lopes (1998), Mendonça de Barros and Miranda (1998), and Coelho (1997).

increased indebtedness. On the other hand, as we will show, the stabilization of the economy produced important gains for the agricultural sector and for consumers.

2.2 Trade Liberalization

Trade liberalization for the agricultural sector 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, serving to drive a large wedge between the producer and international prices. Trade reform for primary exports advanced further in 1996 when the 13% value added tax was removed in order to ease balance of payments pressures without devaluing the currency.

At the same time as the initial reforms for exportables took place, importables lost their tariff and non-tariff protection. In cases like wheat, protection had contributed to raising producer prices to as much as double their international counterparts.⁸ For most importables, tariffs fell from the 35%-55% range prior to 1988 down to around 10% in 1991. Non-tariff barriers were removed abruptly in 1990 when Fernando Collor became President. Shortly thereafter, Brazil signed the Treaty of Asunción which created the South American Common Market (MERCOSUL). MERCOSUL eliminated the tariffs on imports from Argentina and Uruguay, two countries with very competitive agricultural sectors.

2.3 Rural Credit Policy

There was a substantial reduction in the volume of credit provided to the agricultural sector in the 1980s. Relative to the peak in 1979 and 1980, rural credit had fallen by about 50% in 1988 and 1989. The contraction was accelerated in 1990 when the flow of new credit fell by an additional 43%. The credit squeeze in 1990 was caused by a stabilization plan announced in March, 1990. One of the components of the Collor Plan was an 18 month freeze on all financial

⁸ See Helfand (2000) for nominal protection rates in the 1970s and 1980s.

assets. The sharp reduction in the supply of rural credit right at the beginning of the new decade, therefore, was not an expression of a conscious policy decision to reduce government involvement in agricultural finance. It was a side effect of the macroeconomic policies that were aimed at combating inflation. With the exception of 1994, when borrowing expanded as a result of favorable policies and optimism surrounding the initial phase of the *Real* Plan, agricultural credit in 1990-98 remained at about half of its 1988-89 level. An important consequence of the contraction of credit was to create incentives to develop alternative mechanisms for financing the production and marketing of agricultural products.⁹

As private international capital flows to developing countries grew in the early 1990s, the Brazilian government adopted several measures intended to increase the flow of foreign capital into the agricultural sector. In 1995, for example, the government eliminated the Financial Operations Tax (IOF) only for funds that were destined for agriculture. The IOF was a tax used to control short run capital flows. This exemption was later extended to industrial, commercial, and trading companies for financing their operations with the agricultural sector. In addition to the IOF exemption, farmers benefited from being able to import fertilizers and other inputs with low-interest international financing. Some analysts estimate that external sources of finance for the sector amounted to more than US\$ 4 billion in 1998. Several firms even created their own banks in order to borrow abroad and finance their operations with the sector.¹⁰

Another important change occurred in the 1995/96 agricultural year when fixed nominal interest rates began to be charged again. With several brief exceptions, this had not happened since the early 1980s. Interest rates were fixed below market rates, but in contrast to the subsidized program of the 1970s and early 1980s, real interest rates were positive. From this point on, the Treasury stopped providing funds to finance the agricultural sector directly. Instead, it provided resources to cover the difference between the cost of funds and the interest rates charged to the borrowers. As a result, Treasury funds which had accounted for 65% of

⁹ See Gasques and Villa Verde (1995) and Araujo and Almeida (1996) on credit in the 1990s.

¹⁰ See "As Agroindustrias Assumem o Papel dos Bancos." *Gazeta Mercantil*, March 11, 1999.

total funds in 1985-86, and 27% between 1987 and 1994, fell to only 2% in 1996-98. In the place of Treasury funds, the requirement that banks lend a share of their deposits to the agricultural sector once again became a major source of funds for rural credit, rising to above 40% of total rural credit in 1997 and 1998. Required lending had traditionally been an important source of finance for the sector, accounting for about a third of the total between 1985 and 1988, but its relevance was undermined in the period of high inflation. The “Worker’s Support Fund” (FAT) also became important as of 1996, accounting for about 20% of rural credit. FAT funds were only permitted to be used in a new government program aimed at supporting small family farmers (PRONAF), and they were used primarily for investment.

Our analysis of credit policy reveals that the total volume of credit provided to the agricultural sector fell dramatically in the 1990s, and with the exception of small farmers the relative importance of the private sector increased. The performance of commercial agriculture in the medium run, however, will still depend on its relationship with the official credit system because of a substantial amount of debt that farmers accumulated since the late 1980s. Total debt with the Bank of Brazil equaled R\$24 billion as of May, 1999, with an additional R\$8 billion owed to private banks. There was a very high degree of debt concentration with the Bank of Brazil, with 2.1% of the debtors (those owing R\$ 200,000 or more) holding 57.2% of the total debt. Delinquency also varied tremendously across groups.¹¹ Since default prevents access to new credit within the official and private credit markets, as of 1995 the government began trying to devise a solution to the debt problem. The solution had to involve a commitment by farmers to repay the debt, as well as an improvement in the terms of the debt so that farmers would be capable of paying it back. The government’s objective was to improve the financial situation of farmers so that investment in the agricultural sector could resume, and to improve the value of banks’ assets. Several rounds of debt renegotiation have taken place successfully since 1995.

¹¹ See Santiago and Silva (1999).

2.4 The Agrarian Reform Program

In addition to targeting rural credit to small farms, the government rapidly expanded the agrarian reform program in the second half of the 1990s. More land was redistributed since 1994 than in the 1964-94 period. Between 1995 and 1999, over 370 thousand families benefited from the program. The feasibility of the program was aided by land prices that fell to their lowest level in several decades (see Figure 1). Since the land reform program occurred so late in our period, it is too soon to evaluate its success. As a result, it will not be a major focus of this paper. We note in passing that land and credit alone are unlikely to be sufficient to ensure the success of the beneficiaries. As we discuss below, the experience of the existing small farms that operated in the policy environment of the 1990s--even when complemented by additional sources of income--does not provide much grounds for optimism. Therefore, it remains to be seen whether or not a more comprehensive package of support can be designed that could (cost effectively) facilitate the long run success of the beneficiaries. This is clearly an important area for future research.

2.5 Support Price Policy

The support price program was expanded in the early 1980s and reached very high levels of activity in the second half of the 1980s. Perhaps more important than commodity price stabilization, the goals of the program were to guarantee an adequate domestic supply of food, to save foreign exchange, and to contribute to controlling inflation. The program used both government purchases (AGF) and marketing loans (EGF) to guarantee the minimum price. Purchases of corn, rice, cotton, and beans exceeded 20% of production in some years, as did the marketing loans for rice, cotton, and soybeans. Both facets of the program were virtually discontinued in the years 1990-91. The lack of purchases in these two years reflected the fact that market prices were well above the support prices. This was partly due to crop failures and partly to the price cycles associated with the stabilization plans of 1990 and 1991. The lack of marketing loans reflected the crisis in the official credit system.

Support price policy was reactivated in the period 1992-95, yet it turned out to be very problematic.¹² In the first place, the new program was more of a complement to credit policy than a return to the old minimum price policy. Under the old system, any farmer who wanted to sell to the government at the minimum price could do so. Beginning in 1992, however, use of the minimum prices was restricted to the farmers who had access to loans provided by the official credit system. Thus, the new policy lost the universal character that the old policy possessed. A second problem related to the accumulation of stocks. The government ended up acquiring large agricultural stocks at the same time as the private sector carried out imports. By 1995 it had accumulated about 20 million tons of grain, or one fourth of the country's grain production in that year. These events made it clear that policies had to change. From this point on, the government began to develop instruments for providing price support that were consistent with an open economy and that involved a much lower fiscal cost than the traditional program. The new instruments were intended to stimulate private rather than public storage.

The first important change was the elimination of marketing loans that carried the option to sell to the government. In their place, the government created an options contract that gave farmers the option to sell to the government a given quantity of the product at a predetermined price and date. The contract price was determined in a public auction. The purpose of the options contract was to reduce the risk of private storage. The government also hoped that it would stimulate banks to finance the storage and marketing of agricultural products. Another important policy change was the creation of a Marketing Bonus (PEP). When market prices fell below support prices, the government would use public auctions to sell PEPs to commodity purchasers on the condition that they would buy the targeted crop from farmers at the minimum price. The bonus was usually set at a level that approximately covered the difference between the minimum and market prices, plus a profit margin. This instrument resembles deficiency payments in the United States. The differences are that the bonus is given to the buyer rather than the farmer, and that the entire production of a crop is not covered.

¹² See Rezende (2000) for a more in depth analysis of support price policy in the 1990s.

A final aspect of the policy transition was the abandonment of minimum prices as an important parameter for support price policy. For example, when the government sells options contracts, it fixes the price at which individuals can exercise options in the future. This price can be fixed without reference to the minimum price. Since the government may form stocks based on the options contracts, the support prices lost their function as a reference for when government purchases would begin. Reflecting their abandonment, minimum prices fell by 27% in real terms between 1995 and 2000. Agricultural interest groups have been relatively silent about this issue. This would seem strange if it were not for the fact that the debt re-negotiation of 1995 established that support prices would be used to index the debt. Thus, even though their adjustment may be unnecessary from the point of view of support price policy, it is essential in order to prevent the concession of a hidden subsidy to farmers.

2.6 The Deregulation of the Domestic Markets of Sugarcane, Coffee, Wheat, and Milk

In addition to the support price policy, which was aimed primarily at corn, rice, beans, soybeans, cotton and cassava, the government utilized elaborate systems of regulation for sugarcane and its derivatives (sugar and alcohol), wheat, coffee, and milk. In the 1980s these policies were administered outside the sphere of the Ministry of Agriculture. In the 1990s the markets for these goods were deregulated.

In the case of sugarcane, producer prices were set by the government, with producers in the Northeast receiving a subsidy. Production quotas were used to regulate supply, and the government was the official buyer and distributor of the final products. The government also fixed the price of alcohol, which is produced from sugarcane in Brazil, and is used as a fuel for automobiles. Policy was aimed at stabilizing domestic prices and ensuring an adequate supply of sugarcane to produce alcohol. Sugar exports were liberalized in the mid-1990s, and the sugarcane and alcohol markets were finally deregulated in the late 1990s.¹³

¹³ See Lopes and Lopes (1998) for detailed studies of sugarcane, coffee, wheat, and other sub-sectors in the 1990s.

In the case of coffee, there was an export tax that was partially used to fund the Brazilian Coffee Institute (IBC). The IBC administered a minimum price policy for coffee and managed the coffee stocks. Coffee exports were controlled in order to comply with the International Coffee Agreement in the 1970s and 1980s. 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.

Wheat had its market strictly regulated 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, and wheat production quickly returned to the levels of the early 1980s.¹⁴ The phasing out of subsidies began in 1987, even before the market was deregulated in 1990.

For milk, there was a large bureaucracy in the Ministry of Finance that fixed prices at the level of consumers and producers. The system undermined the incentives to improve quality and productivity at the farm level, as well as to modernize the processing sectors.

3. Conceptual Framework: 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, Chpt. 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

¹⁴ See Helfand and Rezende (2000).

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 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.¹⁵

In this context, we ask, what would be the expected effect on the agricultural sector of policy reform? We consider the broad set of reforms that were discussed in the previous section. We address the effects of currency appreciation in this section, and the January, 1999 depreciation in the conclusions.

The expected impact of policy reform would be highly differentiated. The short run effects on prices would be as follows. 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 non-tariff 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 would probably lead to falling product prices. It is likely that some non-tradable goods would become importables and would be forced to compete with imports. Others could become exportables and would benefit from reduced export taxation. Thus, in terms of output prices, we would expect the impact to be positive for exportables, negative for importables, and mixed for non-tradables.

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 of 1999 when the currency was allowed to float and depreciated by 50%. The failure to

¹⁵ In the Brazilian context, Homem de Melo (1981) was one of the first to criticize the notion of uniform discrimination. Dias and Lopes (1983) also clearly demonstrated the differentiated impact of policies across products. The background study to Brandão and Carvalho (1991) is one of the most comprehensive analyses of the pre-debt crisis period. Also see Goldin and Rezende (1993) and Helfand (2000) for analyses of policy in the 1980s.

depreciate the real exchange rate in the 1990s at the same time as the other ISI policies were being eliminated should not be interpreted as an incomplete reform of the previous model. It resulted from the particular macroeconomic circumstances of the period, including extremely high inflation and numerous attempts at stabilization.¹⁶ Thus, even though most of the anti-agriculture 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 agricultural sector, we would expect a change in the product mix as area shares come to more accurately reflect each crop's comparative advantage. Thus, exportables would experience an increase in their share of area and importables a decline. The fall in area for importables would likely lead to a rise in average productivity as the least competitive producers would be driven out of their respective sectors. Exposure to import competition would pressure the remaining producers to search for ways to increase efficiency and lower costs, which could lead to positive dynamic effects on investment, growth, and productivity. Since most exportables were already highly competitive in international terms, the short run effects on productivity would not be as strong.

There are several other channels through which productivity and growth would be expected to rise in the medium run. The first is through increased investment in the sector. If expected profitability were to rise as a result of the policy reforms, there would be incentives for investment to grow. And if capital markets were liberalized, the investment could be financed with access to low international interest rates. In a more open trade regime, this would permit incorporating imported technology. All of these factors would contribute to lower costs and increase productivity and growth.

¹⁶ 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. While 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. The appreciation was then sustained through capital inflows, but was also a function of high domestic real interest rates and substantial privatization.

The elimination of industrial protection should also lead to forces that contribute to increased productivity. Since the industries that produced inputs for agriculture in Brazil had been protected, a substantial fall in the prices of goods such as tractors, irrigation equipment, and fertilizer, should accompany the policy reform. This would contribute to a more intensive use of these inputs, lower unit costs, and increased productivity. Real exchange rate appreciation would enhance this effect. 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, while 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, which we have not discussed thus far, was the 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 by providing a complement to farm income. Due to these offsetting forces, we believe that the impact of policy reform on the number and distribution of farms is a question that can only be answered empirically.

The reform of rural credit policy should have led to multiple results. An improvement in resource allocation should have occurred for several reasons. First, with heavily subsidized credit in the 1970s and early 1980s, a considerable portion of the highly fungible funds were diverted to non-agricultural uses. Even within the sector, the high degree of subsidy implies that credit was not always directed to the activities with the highest private (or social) returns.

Second, the move toward a more private system of credit that increased the costs of default should also have resulted in efficiency gains. The experience of credit amnesties in the late 1980s and debt refinancing in the 1990s contributed to producers forming the expectation that a significant portion of the costs of default would ultimately be absorbed by the government.¹⁷ An important consequence is likely to have been excessive risk-taking. In contrast to the observations above, the reduction in credit availability 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, since this policy served to expand production on marginal lands, its phasing out should have led to improved resource allocation within the sector. Second, since 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 to facilitate storage and manage risk. However, these markets are still incipient, and small producers are likely to face substantial obstacles of access.

4. Agricultural Performance

4.1 Agricultural and Food Prices

In this section we analyze the evolution of agricultural prices in the 1980s and 1990s. The analysis permits us to infer the degree to which domestic prices diverged from international prices in the late 1980s and to quantify the impact of policy changes in the 1990s. We emphasize four key points: a) all agricultural prices fell dramatically throughout the period, b) the real exchange rate was the principal force causing real agricultural prices to fall, c) unfavorable international price movements more than offset the positive impact of policy reform

¹⁷ See Rezende (1999) for an analysis of the Special Credit Program for Agrarian Reform (PROCERA) that stresses the negative consequences of excessive subsidy and relatively costless default.

on the relative prices of most exportables, and d) the products that had been heavily regulated were affected most by policy reform.

We use a methodology based on the law of one price to quantify the impact of policy changes on domestic agricultural prices.¹⁸ In order to do this, we 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. We begin by writing the domestic price of a tradable good as:

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

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 transactions 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). The NRP need not coincide with the explicit import tariff or export tax on good i for a number of reasons. In addition to trade taxes, NRPs capture the effects of non-tariff barriers and other domestic policies that drive a wedge between domestic and border prices. NRPs also capture the effects of different market structures. Non-competitive or state regulated markets for example, can have larger markups than a competitive market.

If we divide both sides of (1) by a domestic inflation index, multiply and divide by an international inflation index, and then take logs and first differences, we obtain:

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

where p_{it} is the real domestic price, p_{it}^* is the real international price, RER_t is the real exchange rate. Equation (2) decomposes movements in the real domestic price into movements in the real

¹⁸ While the econometric literature on the law of one price is enormous, as far as we know Quiroz and Valdés (1993) are the first ones to develop the approach used here as a simple tool for analyzing changes in policy. Helfand (August, 2001) extends the approach to analyze the impact of policies on the variability of domestic prices.

international price, the real exchange rate, and other factors. It is a simple method for observing the extent to which p_{it}^* and the RER_t do not explain the movement in domestic prices. Since p_{it} , p_{it}^* , and RER_t are easily observable, we 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. Changes in θ_{it} , in contrast, are unlikely to be large because θ_{it} reflects a hypothetical competitive rather than an actual profit margin, and because changes in transactions costs are unlikely to represent a large share of a change in a good's price.

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.¹⁹ The entries in the Table are the percentage changes in each variable between selected periods that correspond roughly to policies. Within each category, a simple average was calculated for those products that exhibited similar behavior in terms of the impact of policy reform. The third column of Table 1 highlights the fact that the real domestic price of most agricultural products fell dramatically throughout the period. The product prices in Table 1 were all 50% to 60% lower in 1995-98 than in the period 1982-86, with the exception of coffee (-34%), cocoa (-70%), and wheat (-75%). The appreciation of the real exchange rate (column 5) was the principal factor leading to falling prices. It accumulated a 57% drop during the same period.²⁰

The final column of Table 1 shows that the effect of policy on the real domestic price of most importables was quite limited. On average, the effect on beans, corn, cotton, and rice only led to an 8% fall in their domestic prices in the late 1980s beyond what can 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 other MERCOSUL countries), it would be incorrect to conclude that these products

¹⁹ The domestic prices come from the Getulio Vargas Foundation (FGV). The international prices were taken from the 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 FGV, 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 of food are from the national CPI of IBGE.

²⁰ Prior to this period of appreciation, there was a 30% real devaluation in 1983 that was sustained for several years.

experienced 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 impact on these goods came from the elimination of non-tariff barriers which exposed them to increased competition with imports, and through the changes in credit and support price policy. Real prices were falling, but this was attributable to the real exchange rate appreciation.

The effect of policy reform on wheat, which involved far more than trade liberalization, was dramatic. 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 can 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 the impact of trade liberalization and deregulation (-9%). The consequences of such a substantial fall in domestic prices on production and trade will be shown in the following section.

Consistent with our expectations, the effect of policy reform on exportables was positive. The 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. 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. A comparison of the evolution of domestic prices of this group of exportables relative to the importables (beans, corn, cotton, and rice) reveals that although policy reform had a positive impact on exportables, the offsetting influence of international prices implies that domestic relative prices did not change in their favor in the 1990s.

As we described in Section 2, coffee was one of the most heavily regulated products in the sector. As in the case of wheat, policy reform had a pronounced effect on prices. The end of the International Coffee Agreement and the abolition of the Brazilian Coffee Institute (IBC) contributed to depressing international coffee prices by 20% in the late 1980s and another 32% in the early 1990s (Table 1). The removal of the coffee export tax helped to partially offset the

downward effect on domestic prices, but since Brazil is a large country in the international coffee market, the tax removal might also have contributed to the decline in international prices. Domestic coffee prices rebounded by 41% in the second half of the 1990s, and it was the only crop in our sample whose real price was actually higher in 1995-98 than in 1990-94.²¹

Sugarcane is not listed in Table 1, but several observations are warranted. Since sugarcane is used to produce both a crucial import substitute (alcohol as a substitute for gasoline) and an important export (sugar), a decomposition of its price would be considerably more complicated. Due to sugarcane's strategic importance in providing fuel for Brazilian automobiles, deregulation of the sector proceeded more slowly. After a 50% fall in the real domestic price of sugarcane that occurred between 1984 and 1989, prices were once again stabilized with extremely little variation in the 1990s. Although it took place more gradually, deregulation did eventually occur in the late 1990s for sugarcane, sugar, and alcohol.

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 CPI--household goods (-50%) and clothing (-60%)--but considerably more than the non-tradable components--housing, healthcare, and personal expenditures--which all rose by about 60%. The conclusion that we draw is that consumers derived significant benefits from falling food prices in this period, and that falling agricultural prices contributed to make this possible.

4.2 Output and Trade of Agricultural Products

Aggregate Agricultural Output

In contrast to the 1950-80 period, real indices of output show that 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%, while real agricultural output

²¹ The size of the residual in the 1995-98 period is beyond what we would have expected and requires additional research. See Lopes and Lopes (1998) for an analysis of the coffee sector in the 1990s.

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. This reversal is testimony to the powerful impact of the policies that were adopted to deal with the debt crisis, and of the policy reforms of the late 1980s.²²

As can be seen in Figure 2, the non-animal sub-sector of agriculture exhibited impressive growth of 32% between 1980 and 1987, but growth slowed at the end of the 1980s as the currency began to appreciate. The effect of trade liberalization and deregulation for importable crops, and low international prices for exportable crops, led to a contraction of crop output in the 1990-93 period. Thus, for a variety of reasons, the initial years of operating in an open economy were quite painful. Crop output began to recover in 1994 and has performed well since then.

Although the crop sub-sector performed slightly better in the 1980s, one of the most striking features of this period is the dynamism of the animal sub-sector 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 to lower the costs of corn and soybeans—the main ingredients for feed—as well as of imported genetic material used for breeding. Although poultry production grew the fastest, tripling between 1980 and 1996, cattle and hog slaughter also grew rapidly, rising by roughly 100% 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.²³

Importables: Trade and Output

Consistent with our predictions in Section 3, the reduction of tariffs and the elimination of non-tariff barriers led to a substantial decline in the harvested area of the domestically

²² The data is from IBGE. On the positive performance of agriculture in Brazil during the 1980s, see Goldin and Rezende (1993) and Schuh and Brandão (1991). de Janvry and Sadoulet (1993) show that adjustment policies favored agriculture throughout Latin America during this period.

²³ On modernization of the cattle sector, see *Agroanalysis*, June, 2000.

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, from an average of approximately two billion to six billion 1998 U.S. dollars per year. Among the importables, there is a clear relationship between rising imports and falling domestic production. Table 3, for example, shows that harvested area for wheat, cotton, corn, rice, and beans fell by 20% between 1985-89 and 1995-98. In what follows, we 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). Since wheat is 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. When non-tariff barriers were eliminated in 1988, imports definitively surpassed exports and eventually grew to an average of 700 million per year in the late 1990s (Table 2). Simultaneously, cotton production declined by 50% (Table 3). Area and production doubled in the Center-West, however, as new varieties have contributed to the ability of this region to successfully compete with imports in terms of quality and price (Table 3).

Corn, beans, and rice experienced less dramatic changes in trade, but a significant restructuring of production did take place. Although corn imports grew moderately, 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 in the case of cotton, the Center-West was the most dynamic region (Table 3), as the growth of corn production was pulled along by the expansion of soybeans and animal based agroindustries. Many corn producers linked to the feed and animal industries throughout the Center-South have modernized and are capable of competing with imports.

Imports of edible beans grew somewhat faster than corn imports, but only reached a modest 6% of domestic production in 1995-98. Area harvested for beans fell by about 20% in

the 1990s, but output grew due to rising yields. Bean producers are 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.

The growth of 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. Most of the increase in imports came from the other MERCOSUL countries. Relative to the other regions in Brazil, two states in the South (RS and SC) produce a higher quality rice, use a different technology (irrigation), and obtain yields that are triple the national average. These states suffered considerable pressure from imports, but have managed to hold their ground in the 1990s. Area and output fell substantially in the rest of the country (Table 3).

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. In spite of the currency appreciation, Table 2 shows that the total value of agricultural exports rose by about four 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, while 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 our sample of importables fell by six million hectares. The harvested area for the exportables, in contrast, rose by 1.6 million hectares. This suggests that there was a significant improvement in the utilization of resources within the sector. 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 which should 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, even though area harvested remained unaltered, output and yields fell by more than 30% as a

result of the “witches broom” fungus which spread throughout the cocoa growing region of Bahia. The area harvested in coffee, in contrast, fell by 30% between 1985-89 and 1995-98, as the sector experienced a significant reorganization.

Soybean output grew by more than any of the other crops in the 1990s, with virtually all of the expansion coming from the Center-West (Table 3). The value of exports was relatively constant between 1980 and 1994, yet favorable external prices in 1996-97, in addition to the elimination of the ICMS sales 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 are grown principally in the state of São Paulo, where 75% of the oranges and 50% of the sugarcane in Brazil are produced. After sugar exports were freed from quantitative restrictions in the mid-1990s, exports responded rapidly and increased to nearly two billion dollars per year (Table 2). Both crops continue to face significant restrictions from importing countries. Concentrated orange juice exports face an additional set of obstacles, as described in Brandão (1999), including changing consumer preferences away from concentrated juice and companies transferring production from Brazil to southern Florida.

Table 2 also provides data on meat exports. While beef exports were stagnant in the past twenty years, chicken and pork exports grew rapidly in the 1990s. Poultry and hog production traditionally have been concentrated in the South of Brazil, but the expansion of soybeans and corn in the Center-West has been 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.

4.3 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 we focus on Barros (1999).²⁴ The author uses a non-parametric Tornquist index as well as a growth accounting approach. The author measures the value of agricultural production with and without animals, and he devises three different indexes to proxy for capital services. Notwithstanding substantial problems of measurement error, the results point to some plausible conclusions.

First, with six different specifications, TFP measured with the growth accounting approach increased between 16% and 36% in the period 1975-95. The second column of Table 4 shows the results for the case when tractors are measured in units and animals are excluded. Although TFP rose by 20% between 1975 and 1995 under this scenario, all of the net growth came since 1986, and most of it was in the 1990s. The correspondence with the period of policy reform is significant. Second, the growth in land and labor do not explain the growth in TFP, as both inputs changed little in relative terms over the entire period. Column 3 of the Table, for example, shows that total employment in 1992-95 was very similar to what was observed in 1981-83. Third, in contrast to land and labor, the number of tractors and fertilizer use both roughly doubled between the mid-1970s and mid-1980s, and then grew by about 20% and 40%, respectively, in the next ten years. As columns 4 and 5 show, however, fertilizer use continued to grow in the late 1990s, while the stock of tractors began to decline. We will return to this point later. Fourth, as a result of the differential evolution of inputs, land and labor productivity grew by about 30% between 1985-86 and 1994-95, TFP by 15%, capital productivity by 7%, and fertilizer productivity by -7%. This is an important result because it demonstrates that land productivity overstates the true gains in productivity in Brazilian agriculture.²⁵

²⁴ Also see Bonelli and Fonseca (1998), and Gasques and Conceição (1997).

²⁵ Barros shows that when capital is measured with the number of tractors or with the horsepower of the stock of tractors, capital productivity falls over the 1975-95 period, but when it is measured by the services provided by the

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 the least productive land was withdrawn from production, and as crops were shifted 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 tend to be much larger and where expansion has occurred often by incorporating the latest technologies.²⁶ Productivity gains were especially important for certain activities, such as milk, poultry, and hog production, where rapid modernization has taken place. Clearly, these are areas in need of further research.

Land Productivity

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

value of the stock of tractors, the estimated productivity rises. This does not, however, significantly alter the other results. Similar measurement problems apply to land (quality) and labor (human capital and effort).

²⁶ Gasques and Conceição (2000) confirm that TFP grew extremely rapidly in the Center-West.

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. It is likely that the producers who remained have also been striving to lower their unit costs in order to compete with growing imports. These factors appear to have been quite strong for rice in the Center-West and beans throughout the country, yet they are not evident for wheat for which yields were stagnant. Corn and cotton in the Center-West were the two main exceptions to the pattern of contraction, as they both increased area and yields in the 1990s. Increased productivity in this region is probably associated with technological improvements and scale effects. Rice in the South is also a partial exception, as output expanded in the 1990s due to a combination of modest increases in area and yields.

Our expectation for exportables was that productivity gains would be less associated with policy reform, at least in the short run, 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 is the one major exception, with most of the growth coming from the Center-West. Rapid expansion of area in this region (38% between 1985-89 and 1995-98) has been accompanied by rapid growth in yields (22%). Without a doubt, the expansion of cotton, corn, and soybeans in the Center-West, along with the associated animal based agroindustries, have combined to make this the most dynamic agricultural region in 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 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 one million, or 16%, and that the number of people employed in the agricultural sector dropped by more than five 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 (PNAD), Helfand and Brunstein (forthcoming) estimate 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. In these two regions it is clear that many people have chosen to exit from the sector and that labor saving technologies have increasingly been adopted.

To date, research has been unable to unambiguously answer the question about the impact of policy reform on the size distribution of farms. We can, however, provide evidence on the evolution of yields by farm size which is suggestive of problems of competitiveness for small farms. Two caveats are warranted. First, since yields are only a partial measure of productivity, the evidence is not conclusive. Second, farm income only represents a portion of total income, and is thus not the only determinant of the well-being of small farmers. Nevertheless, according to data presented in Graziano da Silva and Del Grossi (forthcoming), there were more than twice as many rural households that were specialized in agricultural activities in 1997 than were diversified. And, even for the pluriactive households, farm related income continued to represent between 50 and 55% of family income, regardless of whether the household was classified as an employer, self-employed, or employee. Thus, although diversification of income sources was increasingly common, the ability to compete in agricultural product markets remains central to the well-being and survival of small farmers.

Table 5 shows the percentage change in yields by farms size between 1985 and 1996.²⁷ 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

²⁷ The data come from the agricultural censuses. Yields calculated from the censuses are unlikely to be influenced substantially by the change in the reference period of the 1995/96 census. An important bias would only occur if the farms that were not surveyed were systematically different than the farms that were included. It is highly unlikely that a selection bias of this type could be large enough to change the results that we discuss in Table 5. The use of the censuses for comparing the levels of variables in 1985 and 1995/96 is much more problematic.

grew by more than 70% for farms over 100 hectares, yet by less than 30% for farms under 20 hectares. To varying degrees, most of the crops shown in Table 5 reveal relative gains for large producers. Irrigated rice production in the South (RS and SC) provides a counterexample, while soybeans and cocoa exhibit relatively equal gains and losses across farm sizes.²⁸

The conclusion that we draw is that small farms do not appear to be increasing productivity at the same rate as large farms. In the context of falling output prices, productivity gains are likely to be an important means for maintaining profitability. Productivity gains, however, often require adopting technologies for which a minimum scale of operation is necessary. When this is the case, it presents obstacles to the viability of previously existing small farms as well as to the new small farms created under the land reform program.

Input Prices and Quantities

In Section 3 we argued that policy reform would be 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 use tradable inputs intensively and that economize on non-tradable inputs such as land and labor. Thus far we have discussed the contraction in the amount of land used by agriculture. We now present 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. The reason why average input prices fell less quickly in the second half of the 1990s relates almost exclusively to wages. While the real prices of pesticides, fertilizers, services, fuels, and seeds all fell between 14% and 27% between 1990-94 and 1995-98, agricultural wages rose by 49%. Column 6 of Table 4 shows that the increase in wages occurred almost entirely between 1994 and 1995. It is likely that agricultural wages rose due to the planting and harvesting of a record grain crop in the 1994-95 agricultural year as well as in

²⁸ In cases like soybeans and cotton, where the 0-5 hectare group appears to have performed well, this group only accounted for a small percentage of domestic production (less than 1% and 4%, respectively).

response to the increase in economic activity that was associated with the early phase of the *Real Plan*. Agricultural wages were then sustained at a higher level by an increase in the minimum wage from R\$ 70 to R\$ 100 in May of 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 3 of Table 4 captures this, as it shows a contraction in employment of more than one million starting in 1996. There is evidence of the impact on labor use from other sources as well, including the increasing mechanization of sugarcane production in São Paulo, and the transfer of cotton production to the highly mechanized Center-West.

Table 4 also provides information about the impact of policy reform on fertilizer consumption and tractor use. Fertilizer consumption rose from one to four 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. Trade liberalization and the change in 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 demonstrated, however, most of the gains in productivity were concentrated in large farms.

In contrast to fertilizer consumption, Table 4 shows that the estimated stock of wheel tractors, which represents 75% of agricultural machines, peaked in 1994 and has been declining since then. 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 thousand in the 1980s to under 19 thousand for the years 1990-98. Only in 1994, as a result of the *Real Plan*, were sales comparable to the level of the 1980s. Falling sales of domestically produced tractors have only been partially compensated for by imports. The number of imported tractors grew from an average of 19 per year in the 1980s to nearly 1000 in 1995-97 (Barros, 1999). As a

result of these trends, we reach the very troublesome conclusion that the stock of tractors has been aging and shrinking.

5. Conclusions

In this paper we analyzed the impact on the agricultural sector of the wide-sweeping policy reforms that began in Brazil in the 1980s. We 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. We showed that a first wave of reform was debt induced. The debt crisis placed a premium on foreign exchange and a series of policies were adopted in the 1980s to increase the incentives for exports and import substitutes. By the late 1980s, the threat of hyperinflation superceded the problem of debt. A second wave of reform was pursued that involved opening the economy to trade and scaling back or eliminating many of the policies that had contributed to growth in the 1980s. A final phase of reform took place in the second half of the 1990s. The *Real Plan* succeeded in stabilizing the economy and providing a less risky environment for planning production and investment, yet these gains came at the cost of an overvalued exchange rate and high real interest rates.

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 sub-sectors 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. To a lesser degree, changes in credit and support price policy generated similar experiences

throughout the sector. 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. A comprehensive analysis of this issue was hindered by data problems. Nevertheless, the 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 credit to small farms. Additional research is required to investigate the adequacy of the land reform package and to suggest reforms that could contribute to the long run 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 to 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 a series of policies that are 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”²⁹ the agricultural sector and to force productivity gains. The 50% real 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. We expect, however, that by reducing import competition and raising tradable input prices, it will also slow productivity growth and cost reductions within the sector.

The competitiveness of Brazilian agriculture in the 1990s was also harmed by artificially high interest rates, poor infrastructure, and the comparative inadequacies of the country’s tax system. For this reason, we agree with Lopes (2000) who has argued that the Brazilian agricultural sector suffered from a “partial reform.” The floating of the exchange rate and the control of inflation have created the conditions in which real interest rates could fall to the levels

²⁹ The term comes from Schuh (1974) in his writings on U.S. agriculture.

practiced in other developing countries. The necessary investments in infrastructure and the reform of the tax system, in contrast, have been hindered on the one hand by an Administration concerned with fiscal constraint, and on the other by a Congress unable to reach agreement on the design of a new tax code.

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

Product	Period	Real	Real	Real	Policy + Residual ¹		
		Domestic Price	International Price	Exchange Rate			
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 ²	(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					

Notes:

- 1) The 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.
- 2) The 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 footnote 19 for data sources.

Table 2
Average Annual Trade of the Principal Agricultural Products (Thousands of 1998 U.S.\$)

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 ¹	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 Ag. Imports	2,561,215	2,098,302	3,231,770	6,263,002
Exports				
Soybeans ²	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 ³	1,109,854	424,950	710,759	1,821,337
Cocoa ⁴	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 Ag. Exports	12,464,345	11,029,268	10,240,186	14,788,598

Notes:

1) Milk equivalent as defined by the FAO.

2) Includes beans, soy cake, and oil.

3) Includes refined and centrifugal (raw).

4) Includes cocoa butter, cake, and paste.

Source: Authors' calculations based on FAO data.

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
Av. Index w/out cocoa						100	106	124		100	101	116

Notes:

1) CW= 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.

2) Prior to 1989 Tocantins (TO) was part of Goias. For consistency, TO has been added to the CW in the 1989-98 period.

3) The average indices are simple averages of the national totals.

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

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

	Total Factor Productivity ¹ (1980=100)	Agricultural Employment ² (millions)	Tractor Stock ¹ (units)	Fertilizer Consumption ³ (millions of MT)	Ag. Wage ⁴ (1987=100)	Fertilizer Price ⁴ (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

Notes:

- 1) TFP is from p. 111, and wheel tractors from p. 66, in Barros (1999). See text for details.
- 2) Agricultural 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 (forthcoming) for details.
- 3) Fertilizer consumption is from the U.N. Food and Agriculture Organization, www.fao.org.
- 4) The 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.

Table 5
Percentage Change in Yields by Farm Size (1985-1996)

Farm Size (ha)	Beans	Corn	Cotton	Rice (south) ^a	Rice (CW) ^a	Wheat	Cocoa	Coffee	Oranges	Sugarcane	Soybeans
0 - 5	15	14	18	72	1	-10	-36	-2	-23	-18	50
5 - 10	11	24	-4	68	1	-9	-35	-4	-24	-18	24
10 - 20	21	29	-6	56	6	-6	-38	5	-23	-9	29
20 - 50	19	38	-6	43	12	-3	-41	13	-22	-7	25
50 - 100	29	55	12	21	17	-4	-44	17	-16	-6	24
100 - 1,000	81	73	44	13	50	13	-45	16	-13	-2	25
1,000 - 10,000	164	95	49	11	56	35	-40	9	10	7	29
10,000 -	107	108	31	-11	45	- ^b	- ^b	- ^b	42	-1	24
Total	34	63	24	19	45	6	-43	12	-12	2	28
Number of farms in 1985 (1000s)	2,946	3,461	438	228	140	143	112	526	889	403	420

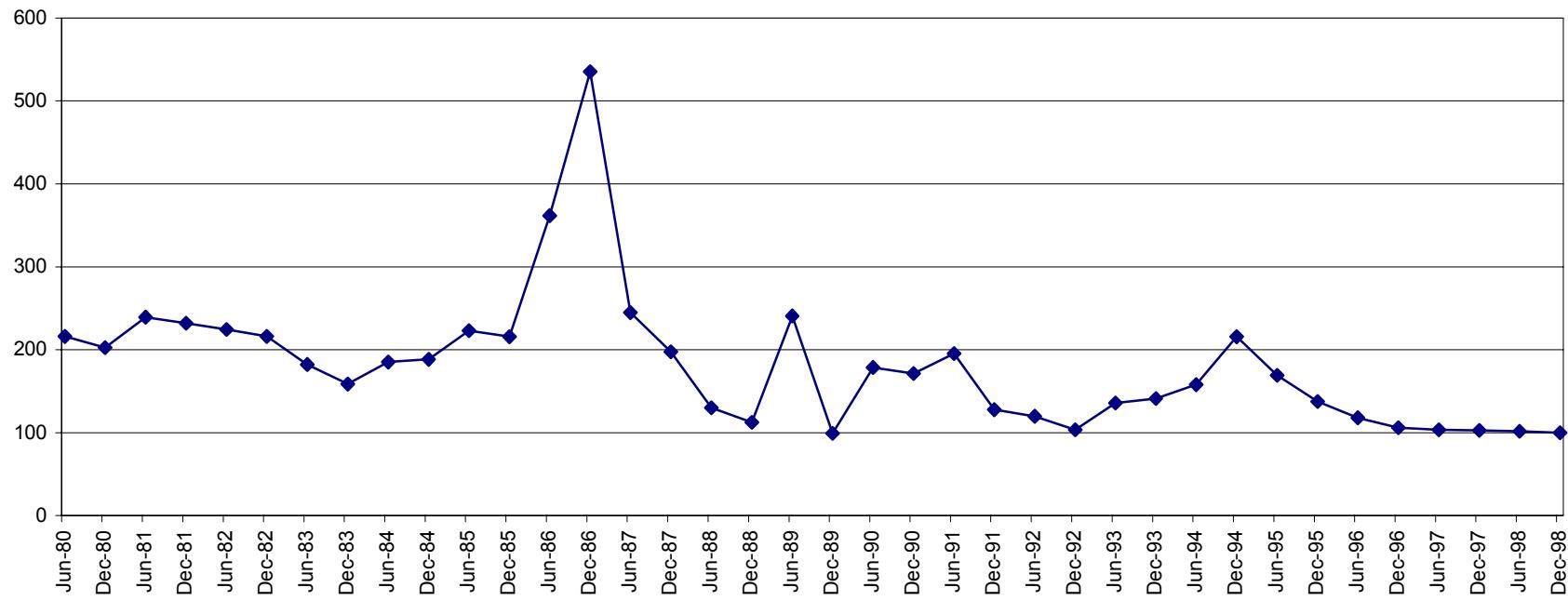
Notes:

a) The data for the South refer to the states of Rio Grande do Sul and Santa Catarina. CW is the Center-West region.

b) There were fewer than 50 farms in each of these cases, and they had an insignificant amount of production.

Source: Authors' calculations based on data from the agricultural censuses, IBGE.

Figure 1
Real Price of Crop Land (deflated with IGP-DI, 12/98=100)



Source: Getulio Vargas Foundation.

Figure 2
Real Indices of Output for Industry, Agricultural Crops, and Animals (1980-98)

