The Impact of Structural Adjustment on Food Production in Zambia

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Abstract
The paper examines the impact of selected structural adjustment policies on food production in Zambia. Using a four year panel of post-harvest data, a system of six crops, two variable inputs and three fixed inputs is estimated. The resulting supply responses suggest a negatively slopped supply curve for sorghum and millet and this has been attributed to the presence of credit constraints. Simulations are conducted to assess the impact of the removal of subsidies and exchange rate controls. The results indicate that these policies have led to increased food production although the magnitude of the increase is in general not very large. The results also indicate a significant fall in fertiliser use. Information, credit and distance to the market are also very important variables for food production. Deliberate efforts are needed to develop both input and output markets and to provide more formal credit institutions targeted at small scale farmers.

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1 Introduction

For over two decades, the Zambian economy was dominated by government ownership. The government regulated commodity and food prices and food consumption was heavily subsidised. The mainstay of the economy was mining and revenue from the export of copper was used not only in financing domestic expenditure but also to import food in years of shortages. The impact of the oil crises of the 1970s, falling copper prices and the resulting general economic deterioration turned the focus to agriculture as a possible source of growth, export revenue and increased food availability.

To recover from the economic problems that the country was experiencing, the government turned to borrowing both domestically and internationally. With no significant recovery in either copper revenues or agriculture, the balance of payments and fiscal deficits became enormous and ultimately the country started to get conditional loans, which was the beginning of the Structural Adjustment Program (SAP) in Zambia. The general objectives in the agricultural sector were the reduction of government intervention in the market, the promotion of agricultural or non-traditional exports and improvement of food production. In practice, macro level implementation involved the freeing of the exchange rate, trade liberalisation, freeing interest rates, removal of subsidies and all forms of price controls, the abolishing of state agricultural companies and marketing boards.

More than a decade later, the expected benefits of these reforms do not seem to be very visible in the agricultural sector. The objective of this study is to look at the impact of some of the policies that were implemented as part of the SAP in Zambia. Supply responses of food production amongst the small scale farmers are estimated and used to simulate the effects of the removal of subsidies and exchange rate controls. Six food crops (maize, sorghum millet, sweet potatoes and cassava) are included in the system. Of these, maize is the most rain-fed while sorghum, millet and cassava are quite drought resistant and are a potential substitute in making nshima the staple starch for almost the whole country. Sweet potatoes are also a major food crop grown and consumed almost all
over the country. The paper is organised as follows. Section 2 presents the background on the agricultural sector in the backdrop of the macroeconomic environment. This is followed by the discussion of the methodology and empirical model in section 3. The results are outlined and discussed section 4. Section 5 concludes with a summary and policy implications.

2 Agriculture and the Macroeconomic Environment

The changes in both the agricultural sector and the macro-economy as a whole resulting from the implementation of SAP have obviously had a significant effect on agricultural and food production. Take the exchange rate for example. The dependence of Zambian maize production on imported fertilisers and other chemicals means that the liberalisation of the exchange rate will affect the cost of production for maize. Where agricultural produce is exported, this also affects the price farmers receive for their crop. Trade liberalisation will also affect the farmers due to changes in terms of trade between traded and the non-traded goods for both agricultural and manufactured goods.

Liberalisation of the credit market has also had significant effects on the agricultural sector. Before the reforms, the agricultural sector was a major beneficiary of low interest loans. Removing controls on credit and its pricing has meant that farmers have to compete for credit with other potential borrowers in the country. Where farmers have no adequate collateral and are high risk (especially for small scale farmers), access to credit has reduced and this might have contributed to the fall in agricultural output. It is clear that both macro economic and agricultural specific reforms have a potentially significant impact on agricultural output and food production in particular. In this section, we look at the evolution of the general macro economy in post-independence Zambia. We then proceed to look in more detail at the reforms that have been implemented in the Agricultural sector.
2.1 Macroeconomic Reforms

During the early years of independence, Zambia benefited from high copper prices on the world market. Copper constituted over 90% of the foreign exchange earnings, about 70% of the government budget and over 40% of GDP. The revenue from copper was used to finance the provision and expansion of free social services such as education and health. Many consumption commodities especially those in agriculture were subsidized. The rationale was that the urban population was large and it was important to provide enough and affordable food to everyone. The output and prices of copper continued to be good and real GDP grew at an average of 2.3 % per year (World bank 1984). Because of this, exports were generally greater than imports and there were no major problems with the external balance. The shortfall in food supply was met by increased imports. The import substitution strategy was put in place to encourage local manufacturing. However, most of the firms were highly dependent on imported inputs and the import bill continued to be high. Again the export revenues from copper provided the needed foreign exchange. Administrative controls were also put in place as part of broader development policies. Commercial banks were required to give a percentage of their lending to agriculture at preferential interest rates. The public sector played a very big role in economic development with most of the key firms in the hands of parastatals.

By the mid 1970s, copper prices on the world market began to decline. This was believed to be a short run situation and the government made no effort to adjust national consumption. Instead, the financing gap was met by borrowing from both the domestic and international market. This shielded public consumption from the effects of economic decline. The oil shock of 1973/74 and the resulting world recession reduced the demand for copper and led to reductions in export revenue. The reliance of the manufacturing industry on imported raw materials and spare parts also led to reduced capacity utilisation and a fall in real GDP. The result was a shortage of foreign exchange and a negative current account. With no improvement in the copper receipts and no attempt at serious diversification of the economy, the country accumulated large arrears on loan
The government responded by increasing borrowing and putting more trade barriers and other controls in place.

During this period, Zambia operated a fixed exchange rate system. Between 1964 and 1968, the official currency in Zambia was the Zambian pound which was pegged to the British pound and fully convertible. In 1968, the currency was changed to the kwacha and de-linked from the pound and linked to the US dollar and later to the SDR in 1976. Despite the pressure on the exchange rate, the kwacha remained fixed and the exchange rate was maintained through administrative controls such as import licensing and through monetary expansion. Licensing was based on a priority list of goods and services determined by the government’s development objectives. Import quotas and high tariffs were also used.

By the early 1980s however, it was apparent that Zambia was an economy under pressure. Its borrowing options narrowed and in 1983, Zambia received the first conditional loan from the International Monetary Fund (IMF). The World Bank and the IMF increasingly influenced the implementation of economic policy. The government embarked on a program to reduce the current account deficit and its external payment arrears, decontrol domestic prices, and reduce subsidies on basic food and fertilizer and to relax interest rate ceilings.

In response, the institutionally set interest rates were increased. Between January 1983 and January 1987 when the reforms were briefly abandoned, the lending rate increased by 154 percentage points while the treasury bill rate increased by about 195 percent from 9.5% to 28%. In 1983, a basket of the currencies of Zambia’s five major trading partners was introduced. The kwacha was now adjusted within a narrow range and set to depreciate at 1% per month and this percentage was increased to 2.5% by 1984. This was meant to let the kwacha settle to a realistic market value. The foreign exchange auction

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1 The World Bank and the majority of the donor community also perceived this as a short run problem and therefore made no attempt to push the country to change its development strategy (West (1989) and Bonnick (1997))
was introduced in October 1985 with the official exchange rate at 2.2 kwacha per dollar and by the beginning of 1987; the exchange rate had increased to 15 kwacha per dollar.

Despite these reforms, the economy continued to decline although the decline slowed down. In response, the government put in place much sterner measures. In 1985, the foreign exchange weekly auction was started to put the exchange rate on a path to being market determined. The trade and payments systems were also to be liberalised. Treasury bill auctions were introduced to help free the interest rates and mop out excess liquidity in the economy. Prices were deregulated and subsidies removed for all crops and commodities except maize and fertilizer.

In 1986, a price decontrol for breakfast maize meal was announced. The ensuing devaluation and price decontrols led to marked increases in inflation. Between 1983 and 1987, the CPI inflation more than doubled from 19.6 to 43. During the same period, there was significant growth in monetary aggregates, which also contributed to increases in inflation. In 1987, as the economy wide reforms progressed, maize subsidies were also removed. Coupled with the effects of the auction of the kwacha which increased consumer prices, riots erupted in the country especially on the Copperbelt. As a result, the auction was suspended in early 1987 and the kwacha was revalued. Price controls were also re-introduced. By May, the government succumbed to the domestic pressure and broke ties with the IMF and World Bank.

The government embarked on a new development program—the New Economic Recovery Programme (NERP). One of the major issues was to influence consumption patterns to change in favour of local products. There was emphasis on internally generated resources to finance growth and development rather than relying on aid. Imports were controlled

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2 Maize is the staple food in Zambia and had thus far been heavily subsidised by the government. When price controls were removed on other food crops such as cassava and sorghum, maize subsidies were maintained with the view to remove these subsidies gradually.

3 The Copperbelt is one of the largest and most urbanised provinces in Zambia. It holds almost all of Zambia’s copper mines.
and key products were rationed. Consumption of locally produced goods and services was encouraged.

When the reform program was abandoned, the foreign exchange auction was replaced by a foreign exchange allocation system under a Foreign Exchange Management Committee (FEMAC) and the exchange rate was re-valued from K21/$ to K8/$. In February 1987, the interest rates were also revised downwards. Aid stopped flowing from the IMF and the World Bank and the plan was to rationalise the use of foreign exchange so that it could compensate for this loss of funds through net export earnings. Repayment of the existing debt was limited to 10% of net export earnings.

Many members of the donor community withdrew and the country experienced an acute shortage of foreign exchange. This led to a chronic shortage of imported inputs and consumer goods. However, there was improved economic growth. Net exports were positive mainly due to a significant fall in imports. The resulting pressure and the escalating external debt forced the government to return to IMF/WB sponsored programs in 1989. The program was now re-implemented with increased intensity. The kwacha was devalued, minimum reserve requirements increased and maize meal prices increased. The new program was formalized through a Policy framework paper (PFP). The Immediate policy goal was to reduce inflation and create a stable macroeconomic climate for growth and diversification. There was renewed emphasis on the role of agriculture and small scale industries. These were the two sectors believed to be labour intensive and would therefore generate needed employment. These would also provide a lot of forward and backward linkages for the more established manufacturing industry.

A new program under the title New Economic Program was put in place in 1989. The features of this program were basically the same as those under NERP except that they were implemented with more intensity. The key monetary action was to mop up liquidity in the economy. The minimum reserve requirements of commercial banks were increased and government bonds were introduced.
Nominal interest rates were increased. Between the reintroduction of the reforms in 1989 and September 1992 when the interest rates were liberalised, the lending rate increased from 18.4% to 58.5% while the treasury bill rate increased from 18.5% to 47%. The exchange rate was devalued and later the fixed exchange rate was abandoned for a crawling peg. In 1990, a two-tier exchange rate system was introduced with the official tier determined by BOZ under FEMAC and the second tier operated with a market determined rate and was used for imports under the Open General License system (OGL). Exporters of non-traditional exports were allowed to retain 50% of their export earnings in foreign exchange. Under the new intensified reform program, the inflation rate began to fall. The introduction of multiparty politics in Zambia in 1991 disturbed the program as the then ruling government began to back track on its commitments as a campaign strategy in the run up to the presidential elections.

In October 1991, a new government was ushered into power. The program implemented by the new government differed from the previous one only by the pace and rigor with which it was implemented. From 1992, Zambia entered a Rights Accumulation Program (RAP) which was meant to facilitate the clearing of arrears on debt to the IMF. After proper completion, Zambia would be entitled to a concessional loan facility with only 0.5% annual interest. The new program required tight monetary and fiscal policies. The new government had a strong domestic mandate and was able to implement the reforms without much resistance or social unrest.

The Zambia Revenue Authority (ZRA) was formed to implement tax reforms and improve revenue collection. The government tried to implement the cash budget strategy started in 1993. This strategy required that revenue had to be raised before it could be spent. Cutting the domestic budget entailed the withdrawal of government from economic business the majority of which was agricultural. Many parastatals were either privatised or liquidated. The introduction of the auctioning of government debt in March 1993 allowed Treasury bill rates to be market determined and marked the end of preferential lending to the agricultural sector. By 2001, the cash budget policy was abandoned due to constrained government funding.
In December 1995, the RAP was successfully completed and the IMF approved loans totalling $1313 million and admitted Zambia onto the Enhanced Structural Adjustment Facility (ESAF). The major part of the loan ($1047 million) was provided under a three-year ESAF arrangement and the remainder under a one year Structural Adjustment Facility (SAF) arrangement in support of the government’s economic and financial reform program. The aim of the new program was to strengthen macroeconomic stabilization efforts while consolidating and advancing the structural reforms began under RAP (IMF 1995). Macro economic policy in the last ten years has not seen much change from these goals. The Poverty Reduction Strategy Paper (PRSP) brought renewed emphasis on poverty reduction and subsequently more emphasis on agriculture.

### 2.2 Agricultural Reforms in Zambia

One of the main arguments in favour of market liberalisation in the agricultural sector is based on the benefits of market prices. It has been argued that controlled prices are in favour of the consumer and are a tax to the producer. The removal of these subsidies and controls would lead to higher output prices, which would in turn act as an incentive for increased production (GRZ, 1995). To this effect, liberalisation attempts were made in the early 1980s and fully embarked upon in 1991.

In the early 1980's, subsidies on crops such as sorghum, millet and cassava were removed. Because of the importance of maize in the consumption basket of most Zambians, the maize subsidies were to be removed gradually over the years. In 1984, maize subsidies were just 5.5% of the domestic expenditure but by the late 1980, it had become as high as 16% (World Bank 1994). The pressure to remove the subsidies was very high and in 1986, maize subsidies were removed. This together with increases in the exchange rate resulting from the exchange rate auctioning sparked major food riots. The government then abandoned the reforms and the subsidies were re-introduced in 1987. By

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4 Zambia had a three year ESAF programme starting in 1999 and was completed in 2001. The ESAF programme was renamed the Poverty Reduction Growth Facility in November 1999. These are more based on own country-owned poverty reduction strategies drawn by each country with IMF assistance, and the participation of local civil society and development partners.
1989 when the reform program was restarted, maize subsidies accounted for as much as 40% of the domestic deficit. With the election of a new government in 1991, agricultural reforms were fully implemented beyond just removal of subsidies.

In addition to subsidies on grains, agricultural inputs were also subsidised. Fertiliser and seed were subsidised and inputs were delivered to the farmers via several National Marketing Board (NAMBOARD) depots located in all the districts. These were also the depots where farmers delivered their crop output for the government to sell. The government operated a policy of 'pan-territorial' and 'pan-seasonal' pricing which entailed same prices throughout the country and through the year. The margins set by the government between the buying and selling prices were small and often the gains were felt in deficit rather than surplus areas.

A number of issues arise from this. Firstly, farmers had no need or indeed incentive to look for a market for their produce. Transport and accessibility issues did not arise. The government both delivered inputs and collected output. In addition, the government set the prices for both inputs and output. Secondly, this provided an incentive to move away from the production of other food crops such as sorghum, millet and cassava. These crops are drought resistant and are more of the traditional crops in certain parts of Zambia than is maize. All four crops can be used to make nshima which is the traditional staple food in the country. In effect, the existing marketing policy tended to encourage inefficiency and lack of entrepreneurship on the part of the farmers.

Agricultural finance was provided in two main ways. The first was through loans provided by the government owned Agricultural Finance Company (AFC). This company provided both cash and input credit. Secondly, commercial banks were required by law to give a percentage of their lending to the agricultural sector. The lending provided to the farmers was also subsidised. However, repayment of these loans was very poor and monitoring was inadequate. This tended to increase the government deficit which often
had to bear the losses of the parastatals. In the face of these policies, the government experienced serious financing constraints and continuously incurred debt.

With the implementation of the SAPs, marketing boards and other parastatals such as the AFC were abolished and all subsidies removed on inputs. By 1992, the dismantling of the marketing boards was under way. Prices were liberalised, subsidies removed and all active government participation in agribusiness withdrawn. On the wider macro level, interest rates were liberalised, administrative controls on banks removed and the exchange rate floated.

Liberalisation of financial markets and the removal of controls on credit and its pricing has meant that farmers have to compete for credit with other potential borrowers in the country. Where farmers have no adequate collateral and are high risk (especially for small scale farmers), access to credit has reduced significantly. This is the situation of the majority of the medium and small scale farmers. In cases where farmers have obtained credit and had a bad harvest; they have lost almost everything they have in loan repayments. The result is that many small and medium scale farmers have no access to credit. A number of non-government organisations have made efforts to lend inputs but the coverage of these programmes is limited. Existing out-growers schemes mainly focus on cash crops and are limited to less than a third of the whole country. A number of initiatives have been attempted by the government but have not worked (Mwanaumo, 1999). Most of these attempts have not particularly targeted medium or small scale farmers and in effect have had the same failures as the private sector credit. This failure has the potential to reduce food production because a lot of these farmers depend on credit for input supply.

The abolition of NAMBOARD affected the transportation of both inputs to the production centres and output to the consumption centres. Most of the small scale farmers

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5 There was an attempt at a credit import facility in 1996, market credit revolving fund and the agricultural credit management programme, all of which have not yielded any substantial results.
growing grains are in remote areas of the country that are not easily accessible and far from the urban areas which are the main consumption centres. The state of the roads in most of these areas is bad and hence their access to the market is even more constrained. Without proper or organised marketing arrangements in rural areas as was the case before the reforms, output is likely to reduce not only because of limited access to output markets but input markets as well. Mwanaumo and Preckel (1997) simulate possible effects of liberalisation on maize marketing and find that there are likely to be some positive welfare gains despite the increases in transport costs. The reality however is that access to markets by small scale farmers has reduced significantly. This has been compounded by inconsistent and contradictory local government policies. For example, many local governments have imposed a tax on the movement of maize from surplus to deficit areas where prices are higher. This has also compounded food insecurity. The taxes imposed are often prohibitive and farmers would rather keep their maize. In many cases, private grain traders either have to pay a bribe to the local council or buy the maize from the farmers at a very low price in order to maintain their margins.

The dependence of Zambian maize production on imported fertilizers and other chemicals means that the liberalisation of the exchange rate had an affect on the cost of production for maize. Where agricultural produce is exported, the exchange rate also affects the price farmers receive for their crop. Combined with other trade liberalisation measures, changes in terms of trade between the tradable and non-tradable goods will also affect the farm gate prices that farmers receive. The removal of exchange rate controls however can be a mixed blessing for food producers. While liberalising the exchange rate implies the removal of the implicit taxation of agriculture due to an overvalued exchange rate, higher exchange rates imply higher production costs due to imported inputs. For example, Jansen (1990) estimates that domestic maize prices were about 77% of border prices at the official exchange rate. On the one hand, if maize production is responsive to output prices as suggested by some studies, removing these controls imply significant gains in maize production. On the other hand, the same process may significantly increase the cost of inputs such as fertiliser to a point of wiping off the gains made due to price increases.
Reforms also pose the possibility of shifting farm activity into cash crops. This shift would mainly be amongst commercial farmers leaving food production to small-scale farmers whose access to the export markets and possibly required technology is limited. For most of the period after the reforms, Zambia along with other southern African countries has experienced severe droughts. As a result of this, there has been a shift towards, more traditional and drought resistant crops such as cassava, millet and sorghum. The removal of pan-territorial pricing may also have contributed to this shift by removing the surplus gains provided by these implicit subsidies. These crops are also less demanding in chemical fertilisers and the increased fertiliser prices arising from the liberalisation of the exchange rate may have had an effect. The role for the government under the reformed agricultural sector is mainly to formulate policy and provide an enabling environment for the private sector. The enabling environment entails provision of support services such as roads, and information. Although there have been attempts at improving feeder roads, most of the remote areas are no better then they were before the reforms and the major beneficiaries of the reforms are those farmers located along the line of rail. The limitations of the market have also led the government to get involved in the provision of inputs such as fertiliser again. In some places, the government has re-implemented subsidies although these are under a gradual reduction program. The government also sets floor prices especially for maize due to underhand methods used by grain traders to buy maize at very low prices from the small scale farmers. In many cases however, there is no enforcement of these floor prices and farmers still have to sell their crops at very low prices.

An agricultural market information service was started in 1993 with the creation of an information department under the ministry of Agriculture, Food and Fisheries, MAFF (now the ministry of agriculture and cooperatives). This department was to disseminate market information on prices and quantities of various agricultural products. However, the dissemination and use of information has been limited (Mwanaumo and Preckel, 1997). The extension officers are the point of contact with the farmers and in many cases they do not have enough resources to do their job. Information from the local farmers to
the department does not flow very well either. There have been incidences where the
government provided subsidised fertilizer through the extension officers who end up
selling the fertiliser at higher prices to the farmers. The farmers buy this fertilizer because
they have no knowledge that this fertiliser is subsidised. There have been other
information constraints at the farm level mainly due to lack of dissemination and
monitoring. Although radio programs are run by the ministry of Agriculture and Co-
operatives, most small scale farmers have no access to radios and their best source of
information remain the extension officers.

2.3 Food Production Trends in Zambia

Despite the reforms, food security has not improved in the country. In 1994, 33 percent
of the population was said to be vulnerable to food insecurity (Shawa and Shuba, 1994).
By 1997, this figure had risen to 82 percent in some areas of the country (CSO, 1998).
With the drought in the 2000/2001 farming season, more than 25 percent of the
population were faced with complete starvation. Without the copper revenues for
importing food, the country was at the mercy of foreign donors hence the controversies
that arose over genetically engineered maize.
Figure 1: Agricultural production Indices

Figure 1 shows three indices of agricultural production in Zambia between 1985 and 2000. There has not been much change in food production since the reforms. In fact we see been a general decline especially in per capita food production which is much lower in 2000 than it was before the reforms. A number of factors discussed above could account for this. Increases in production costs especially arising from the removal of subsidies and increases in the exchange rates could contribute to this fall. It could also be due to the fall in credit access as most small and medium scale farmers rely on credit for the supply of inputs. The country also experienced severe droughts for most of the last decade. This has contributed to the fall in maize output which is chiefly rain-fed.

Despite the lack of improvement in food production, the export of non-traditional exports such as the export of flowers is increasing. Such exports are mainly from commercial farms. The dependence of maize production on fertilizer and other imported inputs could have proved its undoing leading to many commercial farmers shifting into the production of cash crops. The continual increase in the exchange rate since the reforms may have
had a negative effect on maize production (which is mainly consumed locally) while increasing the export receipts from the sale of flowers, hide, fruit and other agricultural exports. Net exports of cereals have declined but still remain at high levels.

Economic reforms have now been in place for over a decade. The exchange rate has been floating since 1992 and food subsidies were abolished by 1995. The interest in the paper is to look at the effect of changes resulting from the implementation of policies under SAP on food production. We estimate price elasticities and use these to simulate effects of policy on the production of several food crops in Zambia.

A number of studies have shown the responsiveness of both small scale and large-scale farmers to prices in developing countries. A few studies that were accessible on Zambia show that supply response to output prices is not very strong. Mwansa (1992) in a study of maize and cash crops found that crop supply responds to prices. The same conclusion was reached at by Hamusankwa (1997) in a study on the responsiveness of maize and sorghum. An earlier study by Mwanza (1989) shows that although farmers are responsive to own prices, they are more responsive to non-price factors such as the performance of the non-agricultural sector and prices of other crops. A study by Krapft and Mwape (1990) found that maize supply was more responsive to fertilizer prices than to own prices.

Despite these studies, a substantial knowledge gap remains in the area of factors that affect food production in Zambia. Firstly, all the accessible studies have focused on maize. Although maize is still the most important staple for the country, it has become quite important to explore the possibility of diversification into more drought resistant and less input demanding crops. Secondly, except for the study by Hamusankwa (1997), all these studies have covered periods before structural adjustment was fully undertaken. The study also differs in that we take account of the simultaneous decision making process of the farmer where a household grows more than one of the grains in question. We include a number of non-price factors as well. Studies in other African countries have shown that most reform programs in the agricultural sector have not yielded the expected
results because of constraints in some non-price factors whose constraining influence may not be relaxed through improved price incentives. (Oyejide (1990), Cheru 2002).

3 Methodology

It has been argued that macroeconomic performance under a program should be compared to the ‘counterfactual’, defined as the macroeconomic performance that would have taken place in the absence of the program (see Guiti n 1981). Although it is the most appealing yardstick by which to assess program performance, the counterfactual cannot be measured or observed and therefore must be estimated or approximated. Three approaches have been used widely in assessing the effect of IMF funded adjustment programs to approximate the counterfactual. These include the ‘before and after approach’ which compares the performance of the economy to that before and after the program, the ‘with and without’ approach which compares economic performance of an adjusting economy against a non-adjusting one and the ‘actual vs. target’ approach where performance targets are set for the economy and the impact of the program is judged based on how well it performs against the preset targets.

The problem with the ‘before and after approach’ is that all outcomes are assumed to be due to the program. There is no way of controlling for exogenous variables. The ‘with and without’ approach is a variant of the ‘before and after’ approach. The performance of adjusting countries is compared to that of similar but non-adjusting countries before and after adjustment. The difference in performances is then attributed to the program policies. The performance of the non-performing country is used as the counterfactual.

Although the ‘with and without’ approach allows the identification of exogenous shocks and resulting possible effects, it requires stringent assumptions to implement realistically. Most important of these assumptions is that, the country chosen as the control must closely describe the counterfactual for the country that is being analysed. Furthermore,
the countries that adjust self select so that the performance of such a country post-adjustment is a combination of the impact of the program and the country's own characteristics. Isolating the effects of adjustment policies by using a non-adjusting country as a control, therefore, becomes very difficult. Where both countries are adjusting, this comparison would still be problematic because programs tend to be country specific. Moreover, even where programs are very similar, their implementation is likely to differ. In some cases, countries may not implement programs incompletely making the analysis even more difficult. Goldstein and Montiel (1986) discuss ways of modifying this approach to obtain more robust results. Noorbaksh and Paloni (1998), Dicks-Mireaux, et.al. (2000) and Hutchinson (2003) amongst others implement these modifications.

The third method used is the ‘actual vs. target’ approach. In this approach performance targets are set for the economy and the impact of the program is judged based on how well it performs against the preset targets. The main shortcoming of this approach is that program targets are often not available to the public. Program targets may also be overambitious and failure to achieve these targets may not signal failure of the program. Likewise, the achievement of under-ambitious targets does not necessarily signal the program’s success. Furthermore, the observed results may be affected by exogenous shocks whose effects may not easily be isolated from those of the program.

It is important to point out that all these methods are plagued with difficulties and none is superior to the other methods. Results obtained using any of these methods therefore, must be interpreted within the caveat of their limitations (Killick, 1995, Gibbon 1996). The analysis in the study is done in the spirit of the ‘actual vs. target’ approach. Targets are defined loosely as the achievement of the general objective of the reforms in the agricultural sector which is to improve agricultural output and food production. Supply responses are estimated and these are used to evaluate whether food production has improved since the reforms or not. The counterfactual therefore is seen in broad terms, as improved food production.
3.1 The Empirical Model

We start by assuming that the farmers are optimising economic agents whose motive is profit maximisation. Let \( \pi \) be a vector of output prices, \( w \) a vector of input prices, \( x \) a vector of variable input and \( z \) a vector of fixed inputs. Let \( q \) be planned output so that we can write the farmer's problem as below (for strict profit maximisation).

\[
\max_{(x,q,z)\geq 0} \quad pq - wx \\
\text{s.t} \\
f(xz) \geq q
\]

\( f(x, z) \) is the production function. The function is assumed to be continuous, strictly increasing and quasi-concave. Since the function is assumed to be strictly increasing, we can replace the inequality in the constraint with an equal sign and rewrite equation 1.

\[
\max_{(x,q,z)\geq 0} \quad pf(xz) - wx
\]

The solution to this maximisation problem is a set of input demand and output supply functions that can be written as

\[
x = x(p, w, z) \\
q = q(p, w, z)
\]

Substituting these functions into the profit function gives us the optimal profit function. Let \( \pi \) the profit function. Then

\[
\pi = pq(p, w, z) - wx(p, w, z)
\]

This profit function must be non-decreasing in output prices and non-increasing in input prices. It must be of homogenous degree one, convex in prices and continuous. Once we have our profit function, we can differentiate with respect to prices and by Hotelling's lemma obtain the supply and input demand functions. Hence

\[
\frac{\partial \pi}{\partial p}(p, w, z) = q
\]

The obtained supply function must be homogenous and the substitution matrix symmetric and positive semi-definite.
The specific form of the function used in the study is the translog. This form is a second order function in prices and fixed in factors and a good approximation to any arbitrary functional form. Because of its flexibility, the estimated parameters can be tested to see if the relevant restrictions imposed by theory are satisfied.

If we take a second order Taylor approximation of the equation and differentiate with respect to prices, we obtain

$$\frac{\partial \pi}{\partial p_i} S_i = a_i + \sum_j b_{ij} \ln p_j + \sum_{ik} b_{ik} \ln w_{ik} + \sum_{im} b_{im} \ln z_{im} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldot
\[ \eta_i = (\frac{\hat{b}_i}{s_i}) + s_i \] ..............................7
\[ \eta_{ij} = (\frac{\hat{b}_ij}{s_i}) + s_i - 1 \] ..............................8

Where the subscript \( ij \) represents cross elasticities and \( ii \) represent own elasticities

### 3.2 Data

We use data from several national Post-harvest Surveys (1996/97-1999/00) conducted by the Central Statistics Office. The surveys are conducted every year after the harvest season.\(^6\) Over 7000 households are interviewed each year. The sampled households over the study period have remained unchanged.

The data shows that the Southern province moved from being the country's largest producer of maize to being second to the eastern province (CSO, 2000). The shift in the rain belt has led to most maize farmers shifting from the Southern to the Central province, increasing central province's share in total national output. The Post harvest survey of 2000 shows that Southern and eastern provinces account for 62% of total maize production (29.6 for the former and 32.4 for the later) while Northern province alone accounts for 21% of sorghum production and 57% of millet production.

### 4 Estimation

The results of the study are outlined and discussed in this section. The system estimated includes six crops; maize, sorghum millet, groundnuts, sweet potatoes and cassava with fertiliser and labour as the variable inputs. The wage rate is calculated as the average rate paid per acre of land for weeding, planting and land preparation. Precipitation (measured as average annual rainfall), distance to the main market and an information index are the

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\(^6\) The data for analysis is aggregated over farmers in the same Census Supervisory area (CSA). These are sub-areas of a district consisting of several households living close to each other.
The equations are estimated using Zellner's Seemingly Unrelated Regression (SUR) with symmetry constraints imposed. The wage rate is used for normalisation and its equation is dropped in the estimation due to linear dependency. The parameters are recovered using the restrictions shown in equation 6. The results are shown in table 1 below. The standard errors are shown in brackets. We show the $\chi^2$ values for the test that $\rho=\theta$ at the bottom of the table.

\[
D = H\Theta + u
\]

where $D$ is an unobserved latent variable determining the farmers' choice whether to grow any of these crops and/or use fertiliser. $H$ is a set of characteristics of the households hypothesised to affect their choice of crop to grow and $u$ is the error term. $D$ equals one when the CSA in question grows the crop and zero otherwise. The resulting $\Theta$ vector is used to compute the inverse mills ratio which is then used in the regressions. A likelihood ratio test is performed to check if bias is significant. We found that for all crops, the bias was not significant and therefore did not make any correction.

The equations are estimated using Zellner's Seemingly Unrelated Regression (SUR) with symmetry constraints imposed. The wage rate is used for normalisation and its equation is dropped in the estimation due to linear dependency. The parameters are recovered using the restrictions shown in equation 6. The results are shown in table 1 below. The standard errors are shown in brackets. We show the $\chi^2$ values for the test that $\rho=\theta$ at the bottom of the table.

---

$^7$ $\rho$ shows the correlation between the selection equation and the equation of interest. When $\rho$ differs significantly from zero, the bias is large and the selection model should be used.
Table 1: Estimated Supply and Demand System

<table>
<thead>
<tr>
<th></th>
<th>Output Supply</th>
<th>Input demand</th>
<th>Fixed inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>Maize</td>
<td>Millet</td>
</tr>
<tr>
<td>Maize</td>
<td>3.98</td>
<td>0.461</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(2.86)</td>
<td>(0.024)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Millet</td>
<td>-0.048</td>
<td>0.03</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.097)</td>
<td>(0.006)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Sorghum</td>
<td>3.5</td>
<td>0.025</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>-0.3</td>
<td>0.06</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.56)</td>
<td>(0.02)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Potatoes</td>
<td>-0.207</td>
<td>0.006</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.008)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Cassava</td>
<td>-2.028</td>
<td>0.23</td>
<td>-0.073</td>
</tr>
<tr>
<td></td>
<td>(0.35)</td>
<td>(0.024)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>-0.372</td>
<td>0.102</td>
<td>0.185</td>
</tr>
<tr>
<td></td>
<td>(1.672)</td>
<td>(0.074)</td>
<td>(0.071)</td>
</tr>
<tr>
<td>labour</td>
<td>-0.37</td>
<td>0.12</td>
<td>-0.054</td>
</tr>
<tr>
<td></td>
<td>()</td>
<td>(0.577)</td>
<td>(0.328)</td>
</tr>
</tbody>
</table>

\( \rho = 0 \)

\( 0.22(0.64) \quad 0.0(0.998) \quad 0.11(0.74) \quad 0.01(0.93) \quad 0.0(0.98) \quad 0.06(0.81) \quad 0.24(0.627) \)
The own and cross price elasticities are calculated from the estimated parameters at mean values and these are shown in table 2.

### Table 2: Own and Cross Price Elasticities

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>0.37** 0.02** 0.07 0.1 0.01*** 0.23 -0.22* -0.27**</td>
</tr>
<tr>
<td>Millet</td>
<td>0.8 0.07 -0.36*** 0.46*** 0.02 0.15 -0.08 -0.007</td>
</tr>
<tr>
<td>Sorghum</td>
<td>0.24** -0.32*** 0.09 0.01 -0.13** 0.16 0.15 0.1</td>
</tr>
<tr>
<td>Groundnut</td>
<td>0.95 0.005 -0.4** 0.09*** 0.1 0.52* -0.28 -0.7**</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0.06*** -0.07** 0.01 0.08 -0.84 0.09 0.76*** 0.2</td>
</tr>
<tr>
<td>Cassava</td>
<td>0.79 0.04 0.04 0.18* 0.04 -0.69 -0.26*** 0.15</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>-0.8* 0.03 0.03 -0.10 0.34*** -0.27*** -0.21 1.28***</td>
</tr>
<tr>
<td>labour</td>
<td>-0.58** 0.04 0.003 0.05** 0.19 0.31 0.61*** -0.01</td>
</tr>
</tbody>
</table>

Five of the six own-price supply elasticities are significant. Of these, two are positive (maize and groundnuts) and the other three negative (millet, sorghum and cassava). The negative elasticities for millet, sorghum and cassava can be explained by the relationship between output prices and seed prices plus the increase in organisations promoting these crops as drought resistant alternatives.\(^8\)

Out of the 10 significant cross price elasticities, 6 are positive reflecting complementary relationships. The magnitudes for most of these are similar to those found in studies on other African countries.\(^9\) The lack of competition in the crops reflects the way in which these crops are used. In most districts, Sorghum, millet and cassava are grown both for beer brewing and home consumption. For both uses, maize is combined with one or more of the other three crops. However, maize is more commercialised than the other three crops. In areas where sorghum and millet are consumed as the staple food, maize is not traditionally grown and its importance in these areas began with the introduction of maize subsidies in the late 1960's making it mainly a commercial rather than a subsistence

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\(^8\) See section 4.1 below for a more detailed discussion.
\(^9\) See Govindan and Babu (2001) and Abrar (2002) for example.
It is interesting to note that some of the cross price elasticities with respect to maize are almost as high as own-price elasticities and that for others, the price of maize is more important than the crop’s own price. Again this is indicative of the commercial nature of maize production even amongst small scale farmers. The complementary relationships imply that as maize prices rise, there is a tendency for new inputs to be drawn into the general production process. Subject to the net effect, there seems to be a potential for improving food supply through improved maize prices.

The own-price input demand elasticities are -0.21 for fertiliser and -0.01 for labour and are both not significant. The cross input demand elasticities show that the two inputs are gross substitutes. It often happens that when farmers cannot afford to buy fertiliser, they attempt to increase output by increasing acreage hence increasing their demand for labour. The supply elasticities with respect to input prices are generally negative while the input elasticities with respect to output prices are generally positive. The fertiliser elasticity with respect to the price of maize is surprisingly negative. Being a commercial crop, it was expected that an increase in the price of maize would increase fertiliser use. It is worth noting however that this elasticity is significant only at the 10 % level.

4.1 Perverse Supply Response
Although perverse supply response is rarely observed in empirical studies, under certain circumstances, it not only obtains but is in line with rational economic behaviour. Since the seminal study by Shultz (1964) in which he presented his view of a rational but poor peasant, it has been understood that peasants are price conscious and price responsive within the technological constraints they were facing. This was shown by shifts in production between various crops as their relative prices changed. With this is implied a positive supply response even amongst peasant farmers. However, several empirical studies (For example see Fulginiti and Perrin (1990) for linseed, Abrar (2002) for barley

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10 Apart from maize which is generally consumed everywhere in the country, millet, sorghum and cassava are considered to be traditional foods in some parts of the country. In these areas, these crops are used alongside maize to make nshima, the main staple in the country. For example, in 1999/2000 season, Eastern(32%), Southern(29%) and Central(14%) provinces accounted for 75% of all maize production, Northern (20.6), Southern(19) and Western(14)provinces accounted for 63.6% of all sorghum produced while Northern(57%) Western(18%) and Central (9%) accounted for 84% of all millet produced while Luapula, Northern and Western provinces accounted for over 75 % of all the cassava grown.
and Danielson (2002) for cashew, coffee and cotton) have found perverse supply response even amongst commercial farmers (Ozanne, 1999). Askari and Cummings (1976, Rao (1989) and Ozanne (1999) provide a detailed survey of empirical literature.¹¹

The idea of an upward slopping supply curve is based amongst other things on the idea that commodities can distinctly be divided into inputs and outputs. In a peasant agricultural household, this distinction is not clear. Production and consumption decisions are intricately tied. When growing crops, seed is often a produced input retained from surplus output. In the case of Zambian peasants, it is not only a produced input but a residual input. If a family produces enough to eat, then they will save some for planting. If not, they will consume everything and buy from surplus neighbours during the planting season. The sign of the supply response therefore depends on the relative magnitude of the substitution and income effects. There are two possible reasons why we observe a negative supply response for sorghum and millet for here. The first is that because the cost of seed and price of output are tied, increases in the output price will inevitably increase the cost of producing the crop. Depending on the seed input demand elasticity, price increases may reduce the output of the crop. Secondly, a negative response may be observed if supply is increasing against falling prices. We explore each of these possibilities in turn.

Over 80% of the seed used by the households in the sample are retained seed-grown either by the household or purchased from surplus households (CSO, 2000). The price of cereals increases over the post harvest season as supply dwindles especially between November and May. By the time planting begins, cereal prices are almost 50% higher than at the beginning of the harvest season.¹² The implication is that households that must buy seed will spend more per kilogram of grain than what they received when they sold

¹¹ Ozanne argues that empirical evidence does not, however, support this view often because empirical evidence tends to confirm the preconceptions of the researchers, and thus empirical results which do not have the “correct” sign tend to be rejected and therefore go unreported in academic publications. In the studies cited here, the negative elasticities are either just highlighted or overlooked with no discussion.
¹² See FEWSnet Monthly reports and WFP(2005)
their crop. The increased cost of production would then lead to a fall in marketed surplus as households increase their subsistence retention. Output may also fall as production shifts to less ‘expensive’ crops.

A negative supply response can also result when output is increasing despite the falling prices. We use real 1994 prices in the study and the data shows that apart from the period between 1997 and 1998, average real prices of the two crops have been downward. On the other hand, both output and acreage have been increasing over the same period (CSO-2000). This could in part be explained by the presence of many organizations that encourage the growth of these crops and the non-monetary incentives attached. Examples of such initiatives include the Sorghum and Millet improvement Programme (SMIP) under the Southern African Development Cooperation (SADC) and the International Crop Research Institute for Semi-Arid Tropics (ICRISAT), the Root and Tuber Improvement Programme (RTIP) and the Potato and Sweet Potato Improvement Programmes (PSIP).

In response, a number of non-governmental organization (NGOs) put in place programs for small scale farmers to increase the production of these crops. From the late 1990’s most of these programs have taken the form of out-growers schemes where the farmers receive seed and other inputs such as lime. They are then required to pay back a certain amount of their output with little or no interest. This has proved to be very popular amongst farmers who have no collateral for formal credit. In some areas, such programmes are available for maize as well but these are very few. However, this tends to push the farmers off their preferred supply curves as subsistence is of primary importance in these households.

The data shows that there is most likely an interplay of the two scenarios set above when other crops are included. Maize and groundnuts are the preferred commercial crops

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13 Households will sell some of their output even when they are not a surplus households to get money for other goods such as education, health, soap and transport.
amongst small scale farmers in Zambia which in many cases are inter-cropped with sorghum and millet. Higher prices for these crops would mean that deficit households will not be able to afford seed and would therefore shift into the production of sorghum and millet as a subsistence strategy despite falling prices\textsuperscript{14}.

\section*{4.2 Impact of Reforms}

Agricultural reforms implemented in Zambia over the past decade have led to significant changes in factors affecting grain production. Most of these have been price policies that have raised both input and output prices. Other significant changes include the liberalisation of the grain market which in turn has implications for the prices that farmers get for their produce. The provision of services by the government to small scale farmers also has a significant effect on agricultural output. In this section, we discuss the possible policy effects of liberalising the exchange rate and removing consumer subsidies using results from the estimated food supply system.

For the purpose of the simulations, a policy change is described as a percentage price resulting from the implemented policy. In the discussion, we focus on the possible effects of the removal of exchange rate controls and price subsidies. Food production in Zambia is dependent on the exchange rate in several ways. One is through the impact of input prices, of which the bulk is fertiliser. The other is through the price of imported food crops which compete with domestically produced crops. An overvalued exchange rate reduces the amount paid to domestic producers in local currency. It also makes exports uncompetitive both on the world and domestic market leading consumers to substitute for imported food crops. To the extent that devaluing or floating the exchange rate will lead to the elimination of this implicit tax on agriculture, output of food crops should therefore increase. The dependence of Zambian food production, especially maize, on imported inputs implies that potentially there is a possibility that the increases in input prices could offset the benefits of improved producer prices. Jansen (1990) estimates that

\textsuperscript{14} See Robins and Ferris (2003) for more discussion of impact of liberalisation and non price factors on African agriculture.
the domestic price of maize was only 76% of the border price at the official exchange rate and 52% at the equilibrium exchange rate. Using these figures, we will assume that the effect of the overvalued exchange rate is 24% a figure quite close to Fulginiti and Perrin (1990)'s estimate of the price wedge due to export taxes in Argentina.

Input subsidies were also widely used in agriculture in Zambia. It has been argued that food subsides in Africa did not benefit the poor farmers but rather provided cheap food for urban residents (Sahn 2004). Input subsidies were often in form of input credit or cheap fertiliser. The removal of such subsidies therefore was commensurate with a credit squeeze and an increase in production costs, the implication being a negative impact on small scale food production. Mwanaumo (1999) suggests that maize subsidies in Zambia had reached 16% of the price of maize by the late 1980s, while Deininger and Olinto (1999) have a higher estimate of 70%. We use the more conservative figure from Mwanaumo (1999) as our price wedge due to maize price subsidies. The removal of price subsidies on sorghum and millet was begun in the early 1980's and so we assume a zero price wedge due to subsidies on these crops. We have not accessed clear estimates of the fertiliser subsidies and we assume the same percentage as that of maize. Cassava, sweet potatoes and groundnuts have not been under any subsidies. They are generally traded locally and use almost no imported inputs. The main price effect would therefore come through cross price effects.

4.2.1 Estimated Price Effects

To run the simulations, we use a linear model similar to that of Fulginiti and Perrin (1990) shown in equation 10. These results must be seen in the light of the limitations of the methodology.

\[ \delta q = \Phi \delta \ln p \]

Where \( \delta q \) is the vector of quantities, \( \Phi \) is the matrix of elasticities and \( \delta \ln p \) is the vector of price changes as surmised above.
Table 3: Simulated Policy Effects

<table>
<thead>
<tr>
<th></th>
<th>% Rate</th>
<th>% Subsidy</th>
<th>% effect of rate</th>
<th>% effect of Subsidy</th>
<th>% Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>24</td>
<td>16</td>
<td>5.8</td>
<td>2.4</td>
<td>8.2</td>
</tr>
<tr>
<td>Sorghum</td>
<td>24</td>
<td>0</td>
<td>3.8</td>
<td>6.2</td>
<td>10.1</td>
</tr>
<tr>
<td>Millet</td>
<td>24</td>
<td>0</td>
<td>14.2</td>
<td>14.1</td>
<td>28.3</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>0</td>
<td>0</td>
<td>4.2</td>
<td>9.1</td>
<td>13.3</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0</td>
<td>0</td>
<td>18.3</td>
<td>13.1</td>
<td>31.4</td>
</tr>
<tr>
<td>Cassava</td>
<td>0</td>
<td>0</td>
<td>14.9</td>
<td>8.5</td>
<td>23.4</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>24</td>
<td>16</td>
<td>-22.8</td>
<td>-16.2</td>
<td>-39</td>
</tr>
</tbody>
</table>

From the simulations, freeing the exchange rate alone would lead to a meagre 5.8% rise in maize output. This reflects the effect of increases in prices of all the three crops and fertiliser prices. Subsidy removal increases output by 2.4% only giving a net increase of 8.2%. Others have noted this sluggish response in maize production to price reforms. See (CSO (2000) and Mwanaumo (1999)) for example.

The effect on sorghum and millet is higher than that of maize with a net effect of 10% and 28.2% respectively. Output for groundnuts, sweet potatoes and cassava would increase by 13.3%, 31.4% and 23.4% respectively due to the increase in maize and fertiliser prices. These crops are generally grown without the use of chemical fertilisers and an increase in the price of fertiliser prices would tend to shift production towards these crops. Fertiliser demand falls by 39% mainly due to the removal of subsidies and exchange rate controls. A significant fall has been observed in fertiliser use since the reforms (Manaumo (1999) and Deininger and Olinto (1999)), a phenomenon not uncommon in other African countries (Robins and Ferris 2003).

It is also important to note that the linear model used for the simulations tends to over estimate the effect of price changes. However, although we cannot take the quantitative values as they are, we can definitely say that without other constraints in production, price changes resulting from the removal of exchange rate controls and subsidies have led
to increases in food production with the caveat that this positive outlook is mainly due to
the more traditional non-commercial food crops like millet, cassava and sweet potatoes.

4.2.2 Non-Price Factors

The results show a sluggish response in maize output. This crop is still the major food
staple in the country and the most commercialised of the food crops. This means that it is
more dependent on structural variables such as information, distance to the market, and
credit than the other crops. It is also the most rain-fed food crop in the country. These
factors may explain why significant increases in maize output have not been realised. Our
estimations show that maize has a negative response to the distance to the market. This
variable is also significant for most of the other crops. This underscores the need for
improved and efficient markets. Several studies have stressed the need for complimentary
policies and investments (Sahn et.al. 1997, Robins and Ferris and Hammond (1999)

Output for crops like cassava whose markets are mainly local increases the longer the
distance to the market. Markets for most of these crops are basic, on the spot and with
almost non-existent market based risk management. Deliberate efforts to develop better
markets for these crops need to be put in place to persuade farmers to grow these crops
commercially. Providing consumers with information about these crops as alternatives to
maize would also assist in developing a sustainable market for these crops.

The rainfall variable is not significant for maize. This may be explained by the persistent
drought over all the four years included in the sample. Irrigation projects can be
introduced that encourage water capture for use during drought periods. The information
variable is significant in the sorghum, millet, and cassava equations. These crops are
drought resistant and can be used as substitutes for maize. However, they are grown
traditionally for complementary use with maize. Studies have shown that one of the
major constraints in using sorghum and millet as maize substitutes is that they take
considerable effort to de-hull and process into grain meal used to prepare the national
staple nshima. Modern techniques have been developed that make de-hulling easier.
Nevertheless, many small scale farmers continue to use traditional de-hulling methods either due to lack of knowledge or resources. Information provision for both producer and consumers would help commercialise these crops and increase the gains from their production.

5 Conclusion and Policy Implications

In the study, we look at the impact of policy reform measures implemented under the Structural Adjustment Program on food production in Zambia. A system of six crops and two variable inputs is estimated. Elasticities are calculated and used to conduct simulations to look at the impact of the reforms. The results indicate that food production in general is responsive to prices although the magnitudes are not very large. We find a negative supply response for sorghum and millet and we posit two possible reasons. The first is that increased prices increase the cost of production since the seed prices are a function of the output price. Secondly, that credit constraints may lead farmers into growing crops that have non-monetary credit available and allows them to make repayments in a form that is easy for them. This moves the farmers from their preferred supply curve and could result in inefficiency. Coupled with information provision, credit could also enhance the use of high yielding varieties and correct use of inputs such as fertilisers. There is need to improve credit provision for small scale farmers. The obvious problem is how to design credible and farmer friendly forms of repayment.

We also find that almost all the crops in the system are more responsive to the price of maize than to their own prices. The Maize response however is more sluggish and we surmise that this is due to structural factors such as bad roads, undeveloped markets and poor rainfall. Although the maize markets are limited, their existence allows this crops to be grown commercially even by small scale farmers. Development of markets for other crops is needed. Deliberate initiatives such as SMIP could be put in place to promote the consumption of these crops as alternatives to maize and thereby create a market for them. The fixed factors discussed above have remained relatively unchanged since the reforms and in some cases have deteriorated. Given the central role that maize seems to play in increasing the total food production, it is very important that the government should
remove the constraints surrounding the production of maize. Rainfall continues to be a problem for the production of maize and irrigation projects that enhance water capturing should be encouraged. We conclude that although the price incentives provided by reforms have contributed to some increase in food production in the country, greater increases have been hampered by lack of improvement in structural variables.

The results obtained in the study are very important to the development of small scale agriculture in Zambia. However, these results must be presented with a few caveats. Firstly, reforms in the agricultural sector are still going on and there has been a lot of going forth and back in policy. Although fertiliser subsidies were officially removed by 1994, there have been intermittent reintroductions and withdrawals over the last ten years. It is also important to mention that the method used for the simulations is linear and may lead to over estimations. The results must therefore be interpreted with the caution that it is the whole picture that is more important rather than the actual magnitudes estimated. A lot more work needs to be done to identify factors that can improve not only food production but small scale agriculture as a whole. Research into credit design, development of input markets and the role of institutions in enhancing small scale agriculture are just a few of these areas.
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