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Aid-Financed Public Investments and the Dutch Disease:

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Abstract

In this paper we discuss the impact of scaling-up aid in Tanzania using an economy-wide dynamic CGE model. The major conclusions coming out from this work is that productivity effects matter. If additional aid and consequently increased public spending has a positive impact on productivity this would spur GDP growth and reduce the risk of an appreciating real exchange rate. In a way this resembles previous results in the aid-growth literature that aid has a positive impact on growth in a country with good economic policies assuming that good policies have a positive impact on productivity. Presenting various scenarios on the impact of additional aid a sustained GDP growth rate of around 7 percent would be possible to achieve in a modest scaling-up aid scenario without any significant changes in the real exchange rate.

JEL classification: F35, O11, O55
Keywords: Aid, Dutch Disease, Tanzania

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1. Background

The case for scaling up aid as a necessary condition for rapid economic growth has been increasingly recognized in various global fora in recent years. For example, a core message that came out from the just ended China-African Summit in Beijing was a promise to double aid to Africa. A similar pledge was made at the 2005 summit of G-8 countries in Gleneagles, Scotland with a commitment to doubling aid to Africa from 25 billion dollars to 50 billion dollars by 2010. The UN Millennium Project (2005) has advocated for a large scaling up of Official Development Assistance to meet the Millennium Goals. The World Bank and IMF (2005) have also stressed the need for greater aid inflows ranging from $14 to $18 billion per year from 2006-2008 and a further increase to $24-$28 billion by 2015 from Overseas Development Agency (ODA) to boost infrastructure and human development in Africa (OECD/DAC, 2005). The fulfilment of these pledges implies a transfer of real resources to some developing country recipients.

Standard analyses suggest that foreign aid flows augment domestic resources and present opportunities for recipient countries to generate sustained growth towards poverty reduction and improved standard of living (Adams, 2005). However, there is growing unease with regard to the multiplicity of consequences, both intended and unintended associated with scaling up foreign aid. These consequences, broadly characterized as ‘absorptive capacity constraints’ have been amply discussed in the literature (Burnside and Dollar, 2004, Clemens and Redelet, 2003, Heller, 2005, Allen, 2005. One of the main concerns is the Dutch disease effect which describes the situation where the aid inflows put pressure on demand for domestic goods and services in a way that consequently raises the real exchange rate and makes tradable goods uncompetitive. There is an already extensive body of literature and debate on the interaction between aid flows and Dutch disease effects but the conclusions have not been definitive. Recent evidence (including Bevan and Adam, 2003, Nkusu, 2004, Allen, 2005, Heller, 2005, IMF, 2005, World Bank, 2005, Bourguignon and Sundberg, 2006) has shown that the conventional Dutch disease effects may be overturned if there are productivity spillovers in both tradable and non-tradable sectors. Presumably, the seriousness of the existence of any such Dutch disease and the extent to which productivity spillovers from aid-financed investments can potentially counteract it will depend on the particular circumstances of the country. This paper is intended to contribute to the discussion by providing evidence from Tanzania using the economy-wide dynamic CGE model calibrated to contemporary conditions in the country.

Tanzania has been one of the largest aid recipients in sub-Saharan Africa since the 1960s (Ndulu and Mwase, 2005) and still remains a good 'candidate' for increased aid disbursements in the near future. Tanzania reached the HIPC Completion Point in November 2001 and this has improved her external debt profile significantly with debt service savings averaging US $2,026 million in net present value (NPV) terms. Furthermore, Tanzania has been selected as one of 19 post-HIPC countries to benefit from the recently announced Multilateral Debt Relief Initiative (MDRI) 100 percent, irrevocable stock of debt cancellation of outstanding obligations to the IMF, World Bank and African Development Bank contracted prior to January 1, 2005, amounting to over US$4 billion (World Bank, 2006).

Tanzania is also progressing steadily with strong political stability and economic growth. Since 2000, the country has been generating about 5-7 percent GDP growth on average, with the performance in 2005 hitting 6.8 percent. The need to generate broad based growth that gives impact to poor people and the central importance of addressing supply-side constraints such as inadequate infrastructure- ports, roads, rails systems, and energy supplies etc have been emphasized in its current National Strategy for Growth and Reduction of Poverty Reduction known as the MKUKUTA, which seems to have high level of donor support. Based on the assumption that aid disbursements are likely to increase for Tanzania, what this study seeks to do is to investigate the extent to which Tanzania is likely to 'catch' the Dutch disease and examine the potential role that appropriate aid-financed investments can play in counteracting any such effects in the growth and poverty reduction prospects of the country.

The rest of the paper is structured as follows. The next section 1.2 provides theoretical insights and evidence on the linkage between aid-financed investments and the Dutch disease. This is followed up in Section 1.3 with a discussion on dynamic CGE modelling framework used for the study. The results from implementing the dynamic CGE model are presented in Section 1.4 whiles the final Section 1.5 provides brief conclusions and recommendations from the paper.

2. The Literature

A good way of beginning is to define exactly what constitutes aid and follow it up with an explanation of how aid inflows cause the Dutch disease. According to Bigsten et al (1999), the standard aid concept is normally used to refer to Official Development Assistance (ODA), which mainly consists of financial aid and technical co-operation. Financial aid includes grants and concessional loans having a grant element of at least 25 percent. Technical cooperation includes grants to nationals of aid recipient countries receiving education or training, and payments to consultants, advisors, administrators and similar persons working on assignments of interest to the recipient countries.

Aid inflows into a country can serve several purposes. It can be added to savings with a view to building up the country's foreign exchange reserves or be passed directly on to the private sector through tax cuts or direct transfers. Aid could also be used to augment public expenditure, substitute for domestic debt financing or be used in a combination of all of them (Mckinley, 2005). Except for the savings option which would defer immediate consequences of aid inflows temporarily, the remaining options which can be grouped into two, namely, absorption and spending generate different outcomes (IMF, 2005). Aid absorption defines the extent to which a country's non-aid current account deficit widens in response to an increase in aid inflows. This captures the quantity of net imports financed by the increased aid and represents the additional transfer of real resources enabled by aid. Absorption captures both the direct purchases of imports by government as well as the indirect second round increases in net imports which results from aid-driven increases in government or private expenditures. Aid spending is defined as the widening of the government fiscal deficit (net of aid) that accompanies an increase in aid. Spending captures the extent to which the aid that comes in is used to finance increases in government expenditures or reduction in taxes. It is the combination of absorption and spending chosen by an economy that defines the macroeconomic responses to aid inflows, including the Dutch Disease effect (IMF, 2005).

The Dutch Disease is an economic phenomenon that tries to explain the seeming relationship between an economic boom (normally a discovery of natural resource or any development that results in a large inflow of foreign currency) and a consequent real exchange rate appreciation, mediated by an increase in demand for and price of non-tradables and hence to a decline in the rate of economic growth. The term was coined to describe the adverse impact on the economy of the Netherlands in the 1960s following the discovery of natural gas in the North Sea. It so happened that the large foreign exchange earnings from the export of gas led to changes in prices and in the exchange rate which resulted in a decline in their manufacturing sector. The Dutch disease model is predicated upon the small country assumption where tradable goods prices are fixed on the international markets with an added view that productivity growth is particularly high when resources are devoted to tradables probably because of learning-by doing or other dynamic externalities. Again, the Dutch disease phenomenon assumes the aid recipient countries have no supply capacity constraints and are fully utilizing all available productive resources, with production factors freely mobile between sectors.

The phenomenon also presumes all foreign currency inflows (aid) are not entirely used to purchase imports instead of domestic goods and there is also a perfectly elastic demand for tradable goods. Clearly, the Dutch disease effects may be muted or lessened with a variation or relaxation of any of these underlying assumptions. For example, the impact of Dutch disease could be non-existent if the aid inflows are used to induce a rapid supply-side response in the economy that more than offsets the demand response (Li and Rowe, 2006). Government could directly use its new stock of foreign currency to purchase imports instead of domestic goods and as such minimize the potential for inflation or better still, enhance this option by importing capital goods, which would raise domestic productivity (McKinley, 2005).

The empirical evidence to support the interaction between aid flows and Dutch disease effects as well the benefits of aid-financed investment has not been definitive. With regards to the extent to which aid inflows lead to an appreciation of the exchange rate, the evidence is mixed. There are studies like IMF (2005) that have reported of the absence of Dutch disease effects for five countries (Ghana, Ethiopia, Mozambique, Tanzania and Uganda) that experienced aid surges. Years in which aid inflows surged were associated with depreciations (not appreciations) of the real effective exchange rate. A similar result in Li and Rowe (2006) confirms a strong negative and significant relationship between aid inflows into Tanzania and real effective exchange rate (REER). An earlier study by Nyoni (1998) during 1967-93 also found the same results where aid inflows were associated with real exchange rate depreciation, all of which contrast the predictions of the Dutch disease model.

There are also a number of country case studies (eg Malawi and Sri Lanka) where aid inflows have been associated with real exchange rate appreciations. The study by Rajan and Subramanian (2005) provide evidence of a systematic adverse effect of foreign aid on competitiveness of exports for 33 sampled countries over the 1980s and 15 countries for the 1990s. A 1 percentage point increase in the ratio of aid to GDP is roughly associated with a 4 percentage point overvaluation of the exchange rate. Regression estimates from a sample of 73 aid-receiving countries for the period 1981-2000 in a study by Arellano et al (2005), indicate a strong negative relationship between the level of manufactured good exports and the scale of aid, which is consistent with the theoretical Dutch disease model. The study by Prahti, Sahay and Tressel (2003) showed that a doubling of aid might lead to an appreciation of the real exchange rate of 4 percent in the short term and up to 30 percent over a decade. Other economists like Adam (2005), Gupta, Powell and Young (2005) find no strong relationship between the amount of aid a country receives and its real exchange rate.

The strand of literature that investigates the impact of aid-financed investments on an economy largely supports the view that the conventional Dutch disease effects may be overturned if there are productivity spillovers in both tradable and non-tradable sectors. Chatterjee, Sakoulis and Turnovsky (2003) analyse the impact of aid tied to public investment in infrastructure on private capital formation and growth and show the effect of this type of transfers on growth depends on the initials stock of public capital. Agenor, Bayraktar and El Aynaoui (2005) capture the link between foreign aid, the level and composition of public investment, growth and poverty reduction for Ethiopia and provide results that are consistent with Nkusu (2004) which emphasise that in assessing the scope for Dutch disease effects associated with foreign aid, the possibility of a rapid supply response should not be discarded on a dogmatic basis. Under a flexible exchange rate regime, substitution effects between aid and debt-creating capital flows may have a large impact on the behaviour of the nominal exchange rate and thus on the magnitude of the real appreciation associated with increases in foreign assistance. Clemens and Redelet (2004) found that particular types of aid, termed 'short-impact aid' (which includes budget support, investments in infrastructure and aid to productive sectors), have a much stronger impact on growth than aid taken as a whole.

Levy (2006) looks at the impact of using Chad's annual revenue (similar to a scaling up of aid scenario) for public investment, particularly in the development of road and irrigation structure and conclude that each of these investment policies improve productivity and capital stock and present particular advantages in terms of growth and household welfare. The paper by Bourguinon and Sundberg (2006) based on a MAMS model calibrated to the Ethiopian data conclude among other things that the impact of large aid inflows on the Dutch disease can be serious but strategic investments to boost productivity and address trade constraints are important in addressing the adverse effects. Adam and Bevan (2004) analysed possible short and medium term responses to alternative aid-financed public expenditure programs in low-income countries. The simulations conducted showed that public infrastructure augments the productivity of private factors and that there are potentially large medium-term gains from aid funded increases in public investment, despite the presence of some short-run Dutch disease effects. A similar result was obtained in the work by the World Bank (2004) on Ethiopia which particularly focused aid-financed investments in human capital, specifically through public expenditure on health and education. This paper is fundamentally similar in spirit and conception to these SAM-based simulation models described above but applied to reflect the structural features of the current Tanzanian economy.

3. The Model

The dynamic Tanzania model described briefly in Appendix 1 below represents an extension of the standard static CGE model developed at the International Food Policy Research Institute as described in Lofgren *et al.* (2002).[1] The model is a recursive dynamic model, which implies that the behaviour of its agents is based on current and past conditions as opposed to future conditions. The underlying database is a Social Accounting Matrix (SAM) which identifies 43 productive sectors or activities that combine primary factors with intermediate commodities to produce output.

The model distinguishes between various institutions within the Tanzanian economy, including enterprises, the government, and 12 types of households. The household categories are initially separated into rural and urban. The remaining dis-aggregation is based on the income level of the household and on the education of the head of the household. In terms of adult equivalent income levels, the poorest households are those below the food poverty line, followed by households who fall between the food and basic needs poverty lines. The remaining households that do not

[1] See Löfgren and Robinson (2005) for a description of the model

fall into either of these categories (approximately 60 percent of the population) are divided according to the highest educational attainment of the head of the household (see Thurlow and Wobst, 2003 for details).

As the analysis is focusing on the macroeconomic impact of scaling-up aid the number of production sectors have been aggregated into three sectors: agriculture, manufacturing and services. On the production side the public sector is included in the service sector. On the demand side the model distinguishes between different government expenditure categories such as agricultural, education, health, transport, industry and other government expenditures. The model distinguishes between current and capital expenditures. An increase in current expenditures implies more employment in the public sector. On the other hand changes in public investment are linked to changes in Total Factor Productivity (TFP) through changes in the government capital stock. The elasticity of TFP with respect to the government capital stock differs between different functional spending categories. Investing more in education might generate a different growth scenario compared to investments in the health sector.

On the demand side additional public spending does have a similar impact across the different functional spending categories as the SAM does not include a sectoral disaggregation of the public sector. Therefore, composition of the inputs used is assumed to be the same across spending categories. While this might to be considered to be a heroic assumption one could argue that demand for investment goods are rather similar: constructing a health clinic would use similar inputs as the construction of a secondary school.[2] The underlying assumption taken in this paper is that the supply side effects are more likely to be different across the various spending categories.

The approach taken when exploring various scenarios on scaling-up aid is the assumption that this will translate into additional public spending with a higher share targeted to public investments. Increased investments will then have a positive impact on productivity and hence GDP growth. Thus, aid and enhanced public spending has, as described, not only demand effects but also supply-side effects.

However, the empirical evidence on the linkage between aid-supported public spending and productivity is rather scarce. Lofgren and Robinson (2005) review the literature on public spending and its impact on changes in TFP. Fan and Rao (2004) is one of relatively few studies in the area. Six functional public spending categories were analysed in their study. Health spending had the highest impact followed by agriculture and transportation. IFPRI (2005) analysed the marginal return of additional public investment in Tanzania. They found a positive impact of higher public investments in education and infrastructure. Also positive but slightly higher return was found on public investments targeted to agricultural research. Thus, changing composition of public investment expenditures will generate different impact on future growth performance in the economy.

2 A revised SAM with disaggregated government sectors would be able to include demand side effects.

4. Implementing the Model & Data

In this chapter we present five different sets of scenarios analysing the impact of scaling-up aid in Tanzania. The first scenario is a baseline scenario. The second and the third scenarios scale up both foreign aid and public spending across the board. The last two sets of scenarios include the second and the third scenarios but under various assumptions on how productivity is affected by increased public spending. The focus in this study is on aggregate changes in TFP under the assumption that composition of government spending does not change.

4.1 Baseline and scaling-up scenarios

Table 4.1 shows the baseline scenario and two additional scenarios where aid and public spending have been scaled-up. The baseline scenario assumes that aid and public spending as a share of GDP is increasing over the whole period 2001-2015. Government spending reaches 14.8 percent of GDP towards the end of the period while foreign (grant) aid reaches 9.9 percent of GDP in 2015. Thus, the baseline scenario can be seen as a situation with modest expansion in government spending and inflows of aid.[3] The annual average GDP growth rate is growing by 5.8 percent and TFP is assumed to contribute by 1.2 percent. Real household consumption is increasing by 3.5 percent and urban households benefit more than rural households. Government real current expenditure is assumed to grow by 6 percent. Private investment is growing at around 11 percent and public investment is growing by 8 percent per year. Despite an expansion in

[3] Net aid-inflows have in recent years been estimated to 10-11 percent of GDP (see IMF, 2005)

government spending the budget deficit is almost in balance as domestic revenue and additional aid is increasing over time. Export volume is assumed to grow by 8.2 percent while imports are growing by 5.1 percent. The real exchange rate during the baseline scenario is depreciating by 2.1 per year. Thus in this scenario with modest public spending expansion and inflows of aid there are no fears of Dutch Disease.

Table 4.1: Base projection and simulation results (% average annual changes 2001-2015)

	Baseline scenario	Modest scaling-up scenario[1]	High scaling-up scenario[2]
Real GDP growth	5.8	7.3	8.3
Factor use	4.6	4.3	5.0
TFP	1.2	3.0	3.3
Total real household consumption	3.5	5.2	7.0
Real consumption, rural households	3.0	4.8	6.4
Real consumption, urban households	4.5	6.3	8.3
Real private investment	11.0	11.5	13.5
Real public investment	8.0	15.0	18.0
Real government consumption	6.0	8.0	8.0
Total real exports	8.2	9.0	7.8
Total real imports	5.1	7.6	10.6
Real exchange rate	2.1	0.9	-1.9
Investment (% of nominal GDP)	14.3	18.6	23.8
Private savings (% of nominal GDP)	-1.4	-1.3	-0.9
Government savings (% of nominal GDP)	-0.1	-0.7	0.3
Foreign savings (% of nominal GDP)	15.8	20.7	24.4
Foreign grants (% of nominal GDP)	9.9	18.1	25.1
Government spending (% of nominal GDP)[3]	14.8	22.9	25.4

3/ Absolute number, period average

In the scaling-up scenarios aid is increasing which in makes it possible to increase public spending. Most of the additional spending is assumed to be directed towards investment which is assumed to have a positive impact on TFP.[4] In the first

[4] As discussed above we do not attempt at this stage to separate different various spending programmes.

scenario it is assumed that government spending is reaching 22.9 percent of GDP towards the end of the period. The second scenario scales-up aid and public spending further, and towards the end of the period government spending is reaching 25.4 percent of GDP. The major difference between the two scenarios is that additional aid and enhanced public spending generate additional productivity effects which have a positive impact on GDP growth. However, higher spending despite positive productivity effects leads to an appreciating (real) exchange rate.

4.2 Public spending and productivity changes

In the final two sets of scenarios assumptions are imposed on the productivity impact of increased aid and enhanced public spending. Table 4.2 illustrates the impact of different productivity assumptions of increased public spending and foreign aid on various macroeconomic variables. The scenario is exactly as the modest scaling-up scenario described above but with different assumptions on how productivity is changing.

As shown in Table 4.2 the productivity aspects are indeed important. For example, assuming low productivity effects of public spending (resulting in lower TFP growth) reduces the average annual GDP growth to 4.3 percent. This should be compared with a scenario with higher productivity effects (moving to the right in the Table) where growth in GDP is about 7.3 percent. Looking at the impact on the real exchange rate we also notice the productivity effects also determines whether the real exchange rate depreciates or appreciates. A lower, but still positive, TFP growth leads to lower GDP growth and a faster appreciation compared to the scenario with higher TFP growth.

Table 4.2: Scaling-up aid and productivity impact – modest scenario

	Modest scaling-up scenario – productivity impact									
Real GDP growth	4.3	5.0	5.5	5.9	6.3	6.5	6.8	7.0	7.2	7.3
Factor use	3.1	3.4	3.6	3.8	4.0	4.1	4.1	4.2	4.3	4.3
TFP	1.2	1.6	1.9	2.1	2.3	2.5	2.7	2.8	2.9	3.0
Total real household consumption	2.1	2.8	3.3	3.7	4.1	4.4	4.7	4.9	5.1	5.2
Real consumption, rural households	1.7	2.3	2.8	3.3	3.6	3.9	4.2	4.4	4.6	4.8
Real consumption, urban households	3.0	3.7	4.3	4.7	5.1	5.4	5.7	5.9	6.1	6.3
Real private investment	6.9	8.3	9.2	9.9	10.3	10.7	11.0	11.2	11.4	11.5
Real public investment	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Real government consumption	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Total real exports	4.5	5.5	6.3	6.9	7.4	7.8	8.2	8.5	8.8	9.0
Total real imports	5.1	5.6	6.1	6.4	6.7	6.9	7.1	7.3	7.4	7.6
Real exchange rate	-0.9	-0.4	-0.1	0.2	0.4	0.6	0.7	0.8	0.9	0.9
Investment (% of nominal GDP)	20.3	20.4	20.2	20.0	19.8	19.6	19.3	19.1	18.9	18.6
Private savings (% of nominal GDP)	-1.5	-1.5	-1.5	-1.4	-1.4	-1.4	-1.4	-1.3	-1.3	-1.3
Government savings (% of nominal GDP)	-4.3	-3.3	-2.6	-2.1	-1.8	-1.5	-1.2	-1.0	-0.9	-0.7
Foreign savings (% of nominal GDP)	26.1	25.2	24.3	23.6	23.0	22.4	21.9	21.5	21.1	20.7
Foreign grants (% of nominal GDP)	22.0	21.3	20.7	20.2	19.7	19.3	19.0	18.7	18.4	18.1
Government spending (% of nominal GDP)[3]	31.9	29.5	27.9	26.6	25.6	24.9	24.2	23.7	23.3	22.9

Table 4.3 shows similar scenarios, as reported in Table 4.2, but now with additional aid and public spending (High scaling-up scenario in Table 4.1). A similar pattern emerges: productivity effects determine the impact of increased public sending and additional aid-flows. However, comparing Table 4.3 with Table 4.2 we note that a situation with higher public spending and more aid can, if productivity effects are modest, result in lower GDP growth rates compared to a scenario with less aid and public spending and larger productivity effects. This resembles earlier familiar results that aid has a positive impact

on growth in a country with good economic policies (assuming that good policies have a positive impact on productivity).[5]

In the case when policies deteriorates and increased public spending leads to modest changes in TFP growth, government spending crowds-out private investments which in turn reduces GDP growth in the future. This also has a negative impact on government revenue which could lead to a situation with fiscal un-sustainability. Higher expenditure in the short-term cannot, despite additional inflows of aid, be financed by future revenues.

Table 4.3: Scaling-up aid and productivity impact – modest scenario

	Higher scaling-up scenario – productivity differences									
Real GDP growth	4.1	5.1	5.8	6.4	6.9	7.3	7.6	7.9	8.1	8.3
Factor use	2.8	3.4	3.8	4.1	4.3	4.5	4.7	4.8	4.9	5.0
TFP	1.3	1.7	2.1	2.3	2.5	2.7	2.9	3.1	3.2	3.3
Total real household consumption	2.9	3.8	4.6	5.1	5.6	6.0	6.3	6.6	6.8	7.0
Real consumption, rural households	2.4	3.3	4.0	4.6	5.0	5.4	5.7	6.0	6.2	6.4
Real consumption, urban households	3.9	5.0	5.8	6.4	6.8	7.2	7.6	7.8	8.1	8.3
Real private investment	2.7	6.7	8.9	10.2	11.2	11.9	12.5	12.9	13.3	13.5
Real public investment	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Real government consumption	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Total real exports	1.1	2.7	3.9	4.8	5.5	6.1	6.7	7.1	7.5	7.8
Total real imports	7.4	8.2	8.7	9.2	9.5	9.8	10.0	10.2	10.4	10.6
Real exchange rate	-5.3	-4.4	-3.8	-3.3	-2.9	-2.6	-2.4	-2.2	-2.0	-1.9
Investment (% of nominal GDP)	20.2	21.7	22.7	23.2	23.5	23.7	23.8	23.8	23.8	23.8
Private savings (% of nominal GDP)	-1.2	-1.2	-1.1	-1.0	-1.0	-1.0	-0.9	-0.9	-0.9	-0.9
Government savings (% of nominal GDP)	-4.8	-3.4	-2.4	-1.7	-1.1	-0.7	-0.4	-0.1	0.1	0.3
Foreign savings (% of nominal GDP)	26.3	26.2	26.1	25.9	25.6	25.4	25.1	24.9	24.6	24.4
Foreign grants (% of nominal GDP)	26.7	26.6	26.5	26.3	26.1	25.9	25.7	25.5	25.3	25.1
Government spending (% of nominal GDP)[3]	39.2	35.2	32.5	30.6	29.2	28.1	27.2	26.5	25.9	25.4

[5] See Burnside and Dollar (2004)

What comes out as a crucial factor in determining whether “fiscal pace” can be created in the Tanzanian economy is if increased public spending has a positive impact on productivity. Two recent studies found that recent growth performance in Tanzania has been driven by improvements in TFP (Utz, 2005 and Treichel, 2005). While in the early 1990s, the contribution of TFP was negative its contribution since then has gradually increased, possibly reflecting the positive effects of economic reforms. The improvement in TFP in Tanzania augurs well for the possibility of strong growth in the future and an important question is what is a reasonable to expect? Treichel (2005) projected growth over the next 10 years assuming a TFP growth rate of 2.5 percent a year, contributing 2.7 percent to the overall projected growth rate of 5.2 during 2004-2013.

In the case of TFP contributing 2.5-3.0 percent, additional aid would be beneficial to the Tanzanian economy. Assuming that TFP would contribute to 2.7% to the overall growth rate implies according to the above scenarios (table 4.2 and Table 4.3) that the annual GDP growth rate would be around 6.8 in the modest scaling-up scenario and slightly higher, 7.3 percent in the higher scenario. A difference though is that in the latter case we would have an appreciation of the exchange rate which would slow down export growth in the economy.

6. Conclusions

Recent evidence has shown that the conventional Dutch disease effects may be overturned if there are productivity spillovers in both tradable and non-tradable sectors.

Presumably, the seriousness of the existence of any such Dutch disease and the extent to which productivity spillovers from aid-financed investments can potentially counteract it will depend on the particular circumstances of the country. In this paper we discuss the impact of scaling-up aid in Tanzania using an economy-wide dynamic CGE model calibrated to contemporary conditions in the country.

The major conclusions coming out from this work is that productivity effects matter. If additional aid and consequently increased public spending has a positive impact on productivity this would spur GDP growth and reduce the risk of an appreciating real exchange rate. In a way this resembles previous results in the aid-growth literature that aid has a positive impact on growth in a country with good economic policies assuming that good policies have a positive impact on productivity.

The improvement in TFP in Tanzania augurs well for the possibility of strong growth in the future and an important question is what is a reasonable to expect? In the case of TFP contributing 2.5-3.0 percent, additional aid would be beneficial to the Tanzanian economy. A sustained GDP growth rate of around 7 percent would be possible to achieve in a modest scaling-up aid scenario without any significant changes in the real exchange rate.

Appendix 1

The Equations of the Model[6]

(A) Price Block

- **Import Price:**

$$PM_c = pwm_c.(1+tm_c).EXR + \sum_{c \in CT} PQ_c.icm_{cc} \qquad (1)$$

where PM_c is the import price in local currency units including transaction costs, pwm_c is the c.i.f import price in foreign currency units, tm_c is the import tariff rate, EXR is the exchange rate, PQ_c is the composite commodity price (including sales tax and transaction costs) and icm_{cc} is the quantity of commodity c as trade input per imported unit of c.

- **Export Price**

$$PE_c = pwe_c.(1-te_c).EXR - \sum PQ_c ice_{cc} \qquad (2)$$

where $c \in CE(\subset C)$ is a set of exported commodities (with domestic production), PE_c is the export price (LCU), pwe_c is the f.o.b. export price (FCU), te_c is the export tax rate and ice_{cc} is the quantity of commodity c as trade input per exported unit of c.

- **Demand Price of Domestic Non-traded Goods**

$$PDD_c = PDS_c + \sum PQ_c.icd_{cc} \qquad (3)$$

where $c \in CD(\subset C)$ is a set of commodities with domestic sales of domestic output, PDD_c is the demand price for commodity produced ansd sold domestically, PDS_c is the supply price for commodity produced and sold domestically and icd_{cc} is the quantity of commodity c as trade input per unit of c produced and sold domestically.

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[6] The entire model is adapted from Lofgren et al., (2002).

- **Absorption**

$$PQ_c.(1-tq_c)QQ_c = PDD_c.QD_c + PM_cQM_C \qquad (4)$$

where QQ_c is the quantity of goods supplied to domestic market (composite supply), QD_c is quantity sold domestically of domestic output, QM_c is the quantity of imports of commodity and tq_c is the rate of sales tax (as share of composite price inclusive of sales tax).

- **Marketed Output value**

$$PX_c.QX_c = PDS_c.QD_c + PE_c.QE_c \qquad (5)$$

where PX_c is the aggregate producer price for the commodity, QX_c is the aggregate marketed quantity of domestic output of commodity, QE_c is the quantity of exports and $c \in CX\,(\subset C)$ is a set of commodities with domestic output.

- **Activity Price**

$$PA_a = \sum_{c \in C} PXAC_{ac}.\theta_{ac} \qquad (6)$$

where $a \in A$ is a set of activities, PA_a is the activity price (gross revenue per activity unit), $PXAC_{ac}$ is the producer price of commodity c for activity a, and θ_{ac} is the yield of output c per unit of activity a.

- **Aggregate Intermediate Input Price**

$$PINTA_a = \sum PQ_c.ica_{ca} \qquad (7)$$

where $PINTA_a$ is aggregate intermediate input price for activity a, and ica_{ca} is the quantity of c per unit of aggregate intermediate input a.

- **Activity Revenue and Costs**

$$PA_a.(1-ta_a).QA_a = PVA_a.QVA_a + PINTA_a.QINTA_a \qquad (8)$$

where ta_a is the tax rate for activity, QA_a is the quantity (level) of activity, QVA_a is the quantity of (aggregate) value-added, $QINTA_a$ is the quantity of aggregate intermediate input and PVA_a is the price of (aggregate) value-added.

- **Consumer Price Index**

$$\overline{CPI} = \sum PQ_c .cwts_c \,, \qquad (9)$$

where $\overline{CPI}$ is the consumer price index (exogenous variable), which in this model functions as the numeraire. The model is homogenous of degree zero in prices-a doubling of the value of the numeraire would double all prices but leave all quantities unchanged.

- **Producer Price Index for Non-traded Market Output**

$$DPI = \sum_{c \in C} PDS_c .dwts_c \,, \qquad (10)$$

where $dwts_c$ is the weight of commodity c in the producer price index, and DPI is the producer price index for domestically marketed output which also may be fixed.

(B)) Production & Trade Block

The profit maximization problem, which applies for each relevant activity a, is as follows:

Maximize $PA_a .(1 - ta_a).QA_a - \sum_{c \in C} PQ_c .QINT_{ac} - \sum WF_f .WFDIST_{fa} .QF_{fa} \,,$ (11)

Subject to the following equations:

(i) **CES Technology Activity Production Function Specified as:**

$$QA_a = \alpha_a^a .(\delta_a^a .QVA_a^{-\rho_a^a} + (1 - \delta_a^a).QINTA_a^{-\rho_a^a})^{\frac{1}{\rho_a^a}} \qquad (12)$$

(ii) **Value Added and Factor Demands**

$$QVA_a = \alpha_a^{va} .(\sum \delta_{fa}^{va} .QF_{fa}^{\ -\rho_a^{va}})^{\frac{1}{\rho_a^{va}}} \qquad (13)$$

(iii) **Factor Demand**

$$WF_f.\overline{WFDIST_{fa}} = PVA_a(1-tva_a).QVA_a.(\sum \delta_{fa}^{va}.QF_{fa}^{-\rho_a^{va}})^{-1}.\delta_{fa}^{va}.QF_{fa}^{-\rho_a^{va}-1} \qquad (14)$$

This equation simply states that marginal cost of factor f in activity a equals marginal revenue product of factor f in activity a

- **Disaggregated Intermediate Input Demand**

$$QINT_{ca} = ica_{ca}.QINTA_a \qquad (15)$$

where, $QINT_{ca} =$ Quantity of commodity c as intermediate input to activity a, $f \in F(=F') =$ a set of factors, $tva_a =$ rate of value-added tax for activitya, $QF_{fa} =$ quantity demanded of factor f from activity a, $\delta_{fa}^{va} =$ CES value-added function share parameter for factor f in activity a, $\rho_a^{va} =$ CES value-added function exponent, $\alpha_a^{va} =$ efficiency parameter in the CES value-added function, $\alpha_a^a =$ efficiency parameter in the CES activity function, $\delta_a^a =$ CES activity function share parameter, $\rho_a^a =$ CES activity function exponent, $a \in ACES(\subset A) =$ a set of activities with a CES function at the top of the technology nest, $WF_f =$ average price of factor f, $\overline{WFDIST_{fa}} =$ wage distortion factor for factor f in activity a (exogenous variable).

- **Commodity Production and Allocation**

$$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac}.QA_a \qquad (16)$$

where $QXAC_{ac}$ is the marketed output quantity of commodity c from activity a, and QHA_{ach} is also the quantity of household home consumption of commodity c from activity a for household h.

- **Output aggregation Function**

$$QX_c = \alpha_c^{ac}.(\sum_{a \in A} \delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}})^{\frac{1}{\rho_c^{ac}-1}} \qquad (17)$$

where α_c^{ac} is a shift parameter for domestic commodity aggregation function, δ_{ac}^{ac} is the share parameter for domestic commodity aggregation function, and ρ_c^{ac} is the domestic commodity aggregation function exponent.

- **First-Order Condition for Output Aggregation Function**

$$PXAC_{ac} = PX_c.QX_c(\sum \delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}})^{-1}.\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}-1} \quad (18)$$

- **Output Transformation Function**

$$QX_c = \alpha_c^t.(\delta_c^t.QE_c^{\rho_c^t} + (1-\delta_c^t).QD_c^{\rho_c^t})^{\frac{1}{\rho_c^t}} \quad (19)$$

where α_c^t is a CET function shift parameter, δ_c^t is a CET function share parameter and ρ_c^t is a CET function exponent.

- **Export-Domestic Supply Ratio**

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c}.\frac{1-\delta_c^t}{\delta_c^t}\right)^{\frac{1}{\rho_c^t-1}} \quad (20)$$

- **Composite Supply (Armington Function)**

$$QQ_c = \alpha_c^q.\left(\delta_c^q.QM_c^{-\rho_c^q} + (1-\delta_c^q)QD_c^{-\rho_c^q}\right)^{\frac{1}{\rho_c^q}} \quad (21)$$

where α_c^q is an Armington function shift parameter, δ_c^q is an Armington function share parameter and ρ_c^q is an Armington function exponent.

- **Import-Domestic Demand Ratio**

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c}.\frac{\delta_c^q}{1-\delta_c^q}\right)^{\frac{1}{1+\rho_c^q}} \quad (22)$$

- **Composite Supply for non-imported outputs and non-produced imports**

$$QQ_c = QD_c + QM_c \quad (23)$$

- **Demand for Transactions Services**

$$QT_c = \sum_{c' \in C'} (icm_{cc'}.QM_{c'} + ice_{cc'}.QE_{c'} + icd_{cc'}.QD_{c'} \quad (24)$$

where QT_c is the quantity of commodity demanded as transactions services input.

(C) Institution Block

- **Factor Income**

$$YF_f = \sum_{a \in A} WF_f . \overline{WFDIST_{fa}} . QF_{fa} \qquad (25)$$

where YF_f is the income of factor F.

- **Institutional Factor Income**

$$YIF_{if} = shif_{if} . [(1 - tf_f) . YF_f - trnsfr_{rowf} . EXR] \qquad (26)$$

where $i \in INS$ is a set of institutions (domestic and the rest of the world), $i \in INSD(\subset INS)$ is a set of domestic institutions, YIF_{if} is income to domestic institution I from factor f, $shif_{if}$ is share of domestic institution I in income of factor f, tf_f is direct tax rate for factor f, and $trnsfr_{if}$ is transfer from factor f to institution i.

- **Household Consumption Expenditures**

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih}\right) . (1 - MPS_h) . (1 - TINS_h) . YI_h \qquad (28)$$

where $i \in H(\subset INSDNG)$ is a set of households and EH_h equals household consumption expenditures

- **Household Consumption Spending on Marketed Commodities**

$$PQ_c . QHch = PQc . \gamma^m{}_{ch} + \beta^m_{ch} \{ EH_h - \sum_{c \in C} PQ_c \gamma^m_{ch} - \sum_{a \in A} \sum_{c \in C} PXAC_{ac} . \gamma^h_{ach} \qquad (29)$$

where QH_{ch} is the quantity of consumption of marketed commodity c for household h, γ^m_{ch} is subsistence consumption of marketed commodity c for household h, γ^h_{ach} is subsistence consumption of home commodity c from activity a for household h, and β^m_{ch} is the marginal share of consumption spending on marketed commodity c for household h.

- **Household Consumption Spending on Home Commodities**

$$PXAC_{ac}.QHA_{ach} = PXAC_{ac}.\gamma^{h}_{ach} + \beta^{h}_{ach}.\left(EH_{h} - \sum_{c' \in C} PQ_{c'}.\gamma^{m}_{c'h} - \sum_{a \in A}\sum_{c' \in C} PXAC_{ac'}.\gamma^{h}_{ac'h} \right) \quad (30)$$

where β^{h}_{ach} is the marginal share of consumption spending on home commodity c from activity a for household h.

- **Utility Function**

Household consumption is distributed across market and home commodities according to Linear Expenditure System (LES) demand functions. The non-linear expenditure system is derived from a utility function of the form:

$$U = \prod_{i} (Cm_{i} - \gamma\ )^{\beta_{i}} \quad (31)$$

where Cm_{i} is the consumption of good i, γ_{i} is the minimal consumption and β_{i} is the marginal share parameter of the function.

- **Fixed Investment Demand**

$$QINV_{c} = \overline{IADJ}.\overline{qinv_{c}} \quad (32)$$

where $QINV_{c}$ is the quantity of fixed investment demand for commodity, $\overline{IADJ}$ is the investment adjustment factor (exogenous variable) and $\overline{qinv_{c}}$ is the base year quantity of fixed investment demand.

- **Government Consumption Demand**

$$QG_{c} = \overline{GADJ}.\overline{qg_{c}}\ , \quad (33)$$

where QG_c is the government consumption demand for commodity, $\overline{GADJ}$ is government consumption adjustment factor (exogenous variable) and $\overline{qg_c}$ is the base year quantity of government demand.

- **Government Revenue**

$$YG = \sum_{i \in INSDNG} TINS_i .YI_i + \sum_{f \in F} tf_f .YF_f + \sum_{a \in A} tva_a .PVA_a .QVA_a + \sum_{a \in A} ta_a .PA_a .QA_a + \sum_{c \in CM} tm_c .pwm_c .QM_c .EXR + \sum_{c \in CE} te_c .pwe_c .QE_c .EXR + \sum_{c \in C} tq_c .PQ_c .QQ_c + \sum_{f \in F} YIF_{govf} + trnsfr_{govrow} .EXR$$

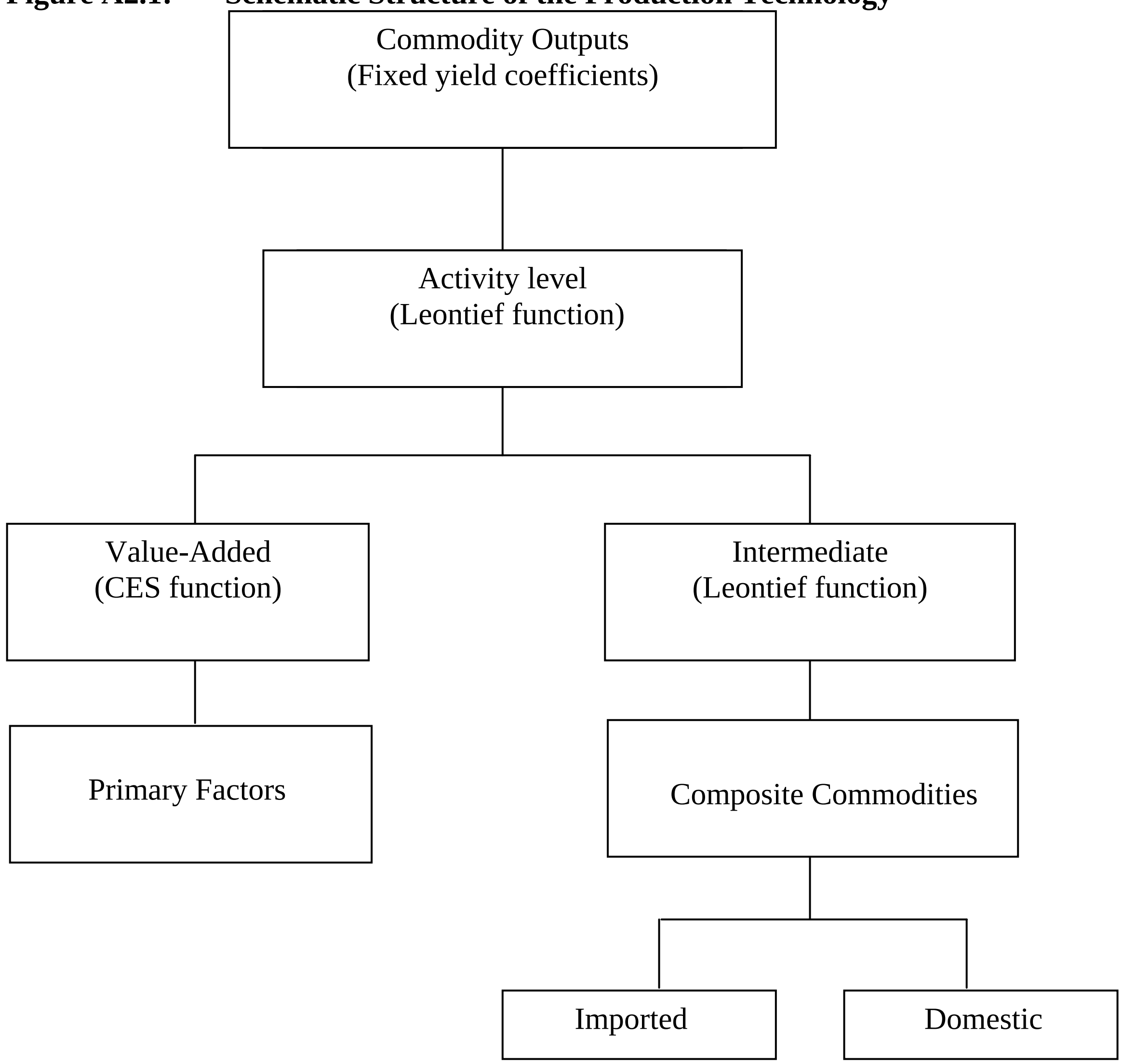
- **Government Expenditure**

$$EG = \sum_{c \in C} PQ_c .QG_c + \sum_{i \in INSDNG} trnsfr_{igov} .\overline{CPI} \qquad (35)$$

Appendix 2

Schematic Representation of Structure of Model

Figure A2.1: Schematic Structure of the Production Technology



Source: **Adapted from Lofgren et al (2002)**

Figure A2.2: Schematic Structure of the Flow of Marketed Commodities

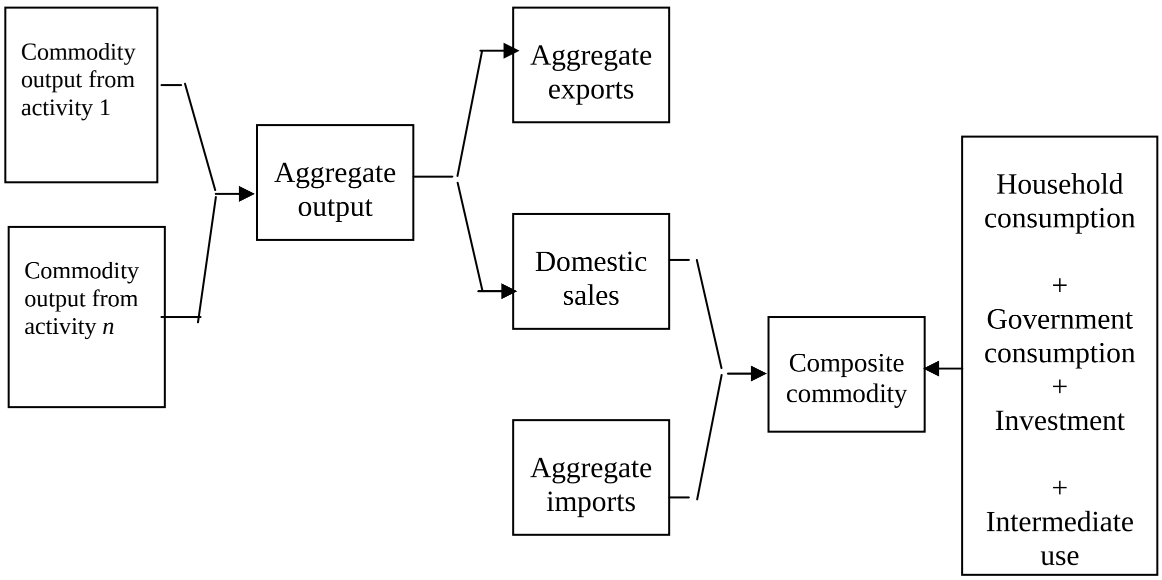
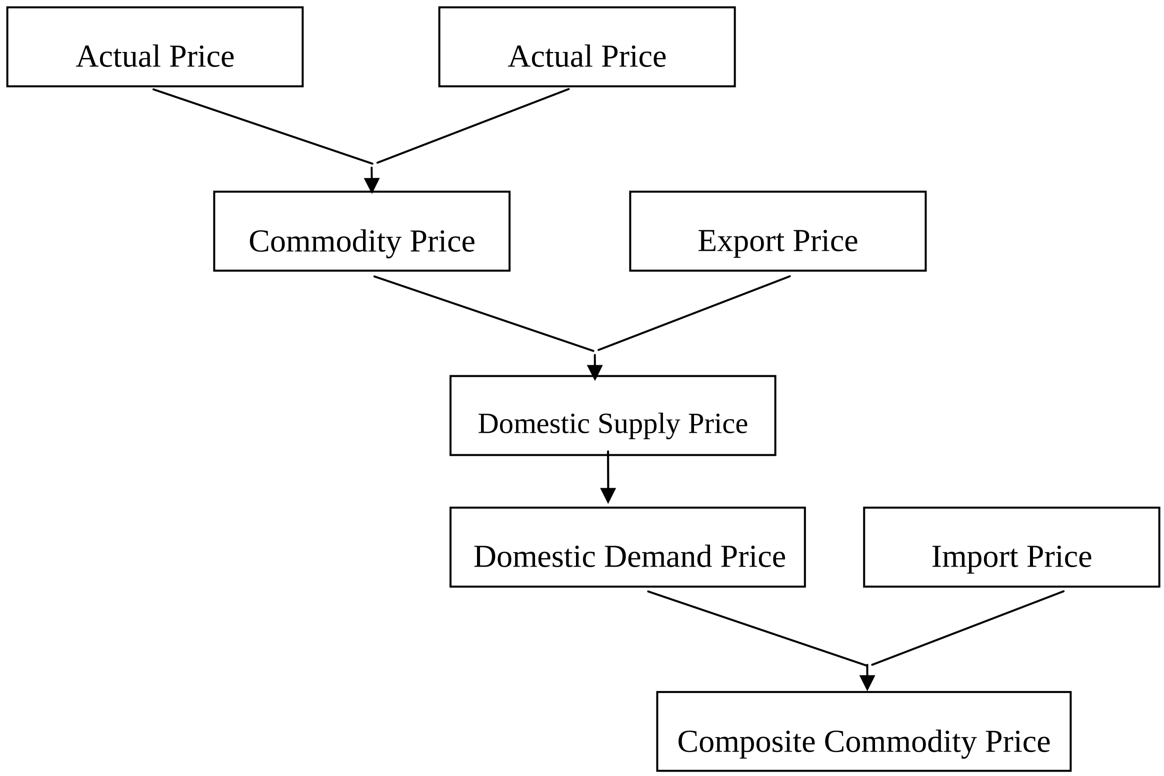


Figure A2.3: Schematic Structure of the Price Variables



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