A Note on the Macroeconomic effects of Aid in Zambia

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Introduction: Aid and Dutch Disease

A major concern in the literature on aid effectiveness is that aid may lead to what economists call Dutch Disease. While the policy debate on Dutch Disease is often confusing and sometimes confused,[1] the basic idea is quite simple. There is an exogenous change which enables the country to import more. The change could be the discovery of a natural resource which can be exported (as when a large natural gas deposit was discovered in The Netherlands, the case from which Dutch Disease took its name). A second possibility is that the country experiences an improvement in the terms of trade (higher relative export prices or lower import prices) so that it can finance a larger volume of imports with the same export volume. A third possibility is an increase in aid.[2]

In all three cases the change is obviously beneficial for the country as a whole: private agents or the government can spend more than would otherwise be the case. Some of that extra spending will be on "tradables", goods or services the price of which is determined in world markets and therefore unaffected by extra spending in a small open economy. However, some of the spending may be on non-tradables (such as most services) and to that extent it will induce "real appreciation": the relative price of non-tradables will have to rise to induce the extra supply needed to meet the increase in demand. This "spending effect" will lead to changes in the structure of production. In particular, production of non-tradables will increase and production of tradables will fall.[3]

The upshot is that exports will fall.[4] Production in export sectors becomes uncompetitive since production factors can earn a higher return by producing non-tradables. This does not mean that the country does not benefit (as the misleading Dutch Disease label suggests).[5] It does, but less than one would think if the induced changes in relative prices were not taken into account.

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[1] Dutch Disease is sometimes explained as the consequence of changes in the nominal exchange rate. This is confused: depending on the exchange rate regime (fixed or floating) the exchange rate may be affected, but this is not the heart of the matter: Dutch Disease would also occur under a fixed exchange rate regime.

[2] For an extensive discussion of Dutch Disease in both static and dynamic models see P. Collier and J.W. Gunning, *Trade Shocks in Developing Countries*, Oxford University Press, 2 vols., 1999, especially ch. 1.

[3] In the case of an export boom the spending effect implies that non-tradables production is expanded at the expense of non-booming tradables. This is reinforced by "resource movement effect": if the booming sector uses production factors which are not fully specialized (e.g. unskilled labour) it will bid up their price and thereby induce them to leave the other export sectors.

[4] In the case of an export price increase, exports will rise in the booming sector and fall in sectors where world prices have remained unchanged.

[5] Only in special cases is Dutch Disease really a disease, e.g. when technical progress in the export sector requires learning by doing and the boom is temporary. A short run boom then has a permanent effect in terms of missed

Initially we focus on the case of aid. Dutch Disease implies that aid has the unintended effect of lowering exports.[6] Since successful development is often associated with export growth policymakers are understandably concerned about this effect. A useful way of thinking about the Dutch Disease effect is as a mechanism which reduces the short run effect of aid.[7] For example, without Dutch Disease an aid package of $ 100 million would lead to an increase of imports of $ 100 million, assuming no change in capital flows or use of reserves.[8] Dutch Disease might reduce exports by, say, $ 30 million so that imports would increase by only $ 70 million. This suggests a natural measure of Dutch Disease: the reduction in exports as a percentage of the amount of aid. In this example we would measure the Dutch Disease effect as 30%.

Aid and Dutch Disease in Zambia

Zambia is very dependent on aid: about 30% of government expenditure is aid-financed. There is therefore reason to be concerned about Dutch Disease effects. Unfortunately we cannot use ZAMMOD, the macro model used by the Government of Zambia, to analyze this issue: ZAMMOD is largely an accounting model. In particular, it does not allow for endogenous changes in relative prices and therefore rules out Dutch Disease. Dutch Disease can therefore be analyzed only by imposing it exogenously on the model. (We will illustrate this in the Appendix.)

Analyzing Dutch Disease requires an applied general equilibrium model. Clausen and Schürenberg (2009) have developed such a model.[9] At our request Hannah Schürenberg has used that model for additional simulations which we here report. The base case is the same as in Clausen and Schürenberg (2009); it reproduces the 2001 SAM.

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learning and therefore lower productivity and growth. Cf. S. van Wijnbergen, 'The Dutch Disease: a Disease After All?', *Economic Journal*, vol. 94, 1984.

[6] See Howard White, 'The Macroeconomic Effects of Development Aid: a Critical Survey, *Journal of Development Studies*, 1992 and Chris Adam and David Bevan, 'Aid and The Supply Side: Public Investment, Export Performance and Dutch Disease in Low-Income Countries, *World Bank Economic Review*, 2006. A recent and influential contribution is R.G. Rajan and A. Subramanian, 'Aid, Dutch Disease and Manufacturing Growth', *Journal of Development Economics*, 2009.

[7] One can think of the short run effect as the additional imports financed through aid. To the extent that aid increases investment or raises productivity there also is a long run effect.

[8] This does not mean that the aid is directly spent on imports, although it might be. When spent on non-tradables it will increase the spending of other agents in the economy. If balance of payments equilibrium is to be preserved these agents must spend more on imports.

[9] Victor Clausen and Hannah Schürenberg, 'Aid, Spending Strategies and Sector Reallocation: a CGE Analysis for Zambia', preliminary version, University of Duisburg-Essen, 2009.

We first use the CGE model to analyze the effects of a 20% increase in aid. This amounts to an increase of about 1.3% of GDP. The results are summarized in Table 1. In the first column we maintain the assumptions of Clausen and Schürenberg (2009). In particular we assume that the four factors of production distinguished in the model: land, unskilled labor, skilled labor and capital, are fully mobile. This implies that factor prices are equalized across sectors. For example, any incipient differential in unskilled wages would immediately induce a flow of labor from low wage to high wage sectors and this would eliminate the differential.

In the base case the increase in aid has no effect on GDP. Welfare (calculated as Hicks compensated demand) rises only marginally, by 0.4%. Exports decline substantially and as a result imports rise by much less than aid. This is reflected in our Dutch Disease measure: 75% of the aid is offset by the induced fall in exports. Since exports are dominated by copper, the decline in exports is accompanied by a sharp contraction in the copper sector: value added in mining falls by 4.2%. The results on changes in factor prices show that aid leads to substantial changes in income distribution: both unskilled and skilled labor gain, at the expense of land.

The results appear to support the concern of some donors and international agencies that aid may have a very strong Dutch Disease effect. However, there is some reason to suspect that the specification of the model exaggerates this. In the Zambian case the extent to which exports can decline depends crucially on the mobility of the factors used in the mining sectors: capital and the two types of labor.

In the third column we assume that capital is mobile but that the two types of labor cannot leave the mining sector. (Technically: mining labor is assumed to be sector-specific.) As expected exports and mining GDP fall less under this assumption, but the difference is very small. The Dutch Disease measure remains quite high: 72%.

Table 1: Factor Mobility in Mining and the Effects of Aid
Aid Used as in 2006

	factor mobility in mining:			
	capital and labor mobile	only labor mobile	only capital mobile	enclave
Δ aid/GDP	0.013	0.013	0.013	0.013
Δ exports/GDP	-0.009	-0.004	-0.009	-0.004
Δ imports/GDP	0.003	0.009	0.003	0.009
Dutch Disease measure (%)	0.750	0.311	0.721	0.291
GDP	1.000	1.000	1.000	1.000
mining GDP	0.958	0.998	0.960	1.000
factor prices in mining:				
unskilled wage	1.018	1.041	0.922	0.970
skilled wage	1.020	1.044	0.961	1.046
profit rate	1.001	0.968	1.002	0.970
factor prices outside mining:				
unskilled wage	1.018	1.041	1.020	1.042
skilled wage	1.020	1.044	1.022	1.046
profit rate	1.001	1.038	1.002	1.039
land rental rate	0.948	0.573	0.917	0.553
welfare	1.004	1.009	1.005	1.010

The results are quite different (column 2) if we make the opposite assumption: that capital in the mining sector is specialized (sector-specific) but that both skilled and unskilled labor can move between mining and the rest of the economy. In this case mining output is hardly affected. exports fall much less. the welfare effect of aid more than doubles and the Dutch Disease effect falls dramatically. to a rather modest 31%. Wages rise. profits fall in the mining sector and rise elsewhere and the land rental rate falls dramatically. This suggests that the distributional effects of aid favor urban over rural groups and. to a limited extent. labor over capital.

Since the capital stock used in copper mining is highly specialized (with the exception of vehicles) we consider the case shown in column 2 more realistic. One could argue that it still exaggerates factor mobility since it allows full mobility for the workers in the mining sector. The opposite extreme is to assume that the two types of labor used in mining are also sector-specific. This is the "enclave" case shown in the last column: since under these assumptions the mining sector uses *only* sector-specific sectors its output cannot change. It turns out that this makes little difference: the results in columns 2 and 4 are quite similar. This shows that the key issue is whether the capital stock in mining can be thought of as mobile. Once we drop this unrealistic assumption and assume that capital in mining is fixed (either with or without labor mobility: columns 2 and 4 respectively) then the results are very different from the base case and the results reported in Clausen and Schürenberg (2009).

Clausen and Schürenberg (2009) stress that the effect of aid depends critically on how the government spends it. At one extreme government spending changes in proportion: 58% of the aid is used to increase public consumption. 24% public investment and the rest is used for transfers. These are the assumptions used for Table 1. Alternatively. one can assume that the additional aid is entirely used to increase public investment. This is the assumption underlying Table 2.[10] The focus on public investment implies that a much larger share of the additional spending is on tradables. This suggests a weaker Dutch Disease effect. (It also implies that the welfare measure. based on *current* consumption. very much understates the effect of aid.)

[10] These assumptions define the NAIV and PUBINV scenarios in Clausen and Schürenberg (2009). Cf. their Table 2, p. 16.

Table 2: Factor Mobility in Mining and the Effects of Aid
Aid Used for Public Investment

	factor mobility in mining:			
	capital and labor mobile	only capital mobile	only labor mobile	enclave
Δ aid/GDP	0.013	0.013	0.013	0.013
Δ exports/GDP	-0.007	-0.003	-0.006	-0.002
Δ imports/GDP	0.006	0.010	0.006	0.010
Dutch Disease measure (%)	0.530	0.212	0.512	0.199
GDP	1.000	1.000	1.000	1.000
mining GDP	0.969	0.999	0.971	1.000
factor prices in mining:				
unskilled wage	1.011	1.029	0.944	0.978
skilled wage	1.009	1.031	0.973	0.978
profit rate	1.003	0.977	1.004	0.978
factor prices outside mining:				
unskilled wage	1.011	1.029	1.013	1.031
skilled wage	1.009	1.031	1.011	1.033
profit rate	1.003	1.032	1.004	1.033
land rental rate	0.905	0.569	0.881	0.551
welfare	1.001	1.002	1.001	1.002

This is confirmed by a comparison of Tables 1 and 2. In Table 2 the Dutch Disease measure in the base case is 53%. still quite large but substantially lower than in Table 1. In the more realistic case (where capital in the copper sector is not mobile) this falls to about 20% (compared to about 30% in Table 1).

Distributional Effects

Aid has strong distribution effects. This is illustrated in Table 3 which corresponds to the simulations reported in Table 1. We here use the distributional detail generated by the CGE

model (as opposed to the distributional module of the ZAMMOD model). The model distinguished five income classes: small and medium farmers. large-scale farmers. self-employed. formal sector employees and employers. The most striking result is that the first group (which contains the vast majority of the poor) benefits substantially from aid when labor in the copper sector is mobile. but not otherwise. In the cases we consider more realistic (columns 2 and 4) the groups which benefit disproportionally from aid are the workers in the formal sector and large-scale farmers. followed by the employers. The key mechanism here is that the increase in aid reduces the relative return to land substantially; this effect is much more pronounced for small farmers.

Table 3: Aid and Income Distribution

Percentage Increase in Welfare Relative to Base

Aid Used as in 2006

	factor mobility in mining:			
	capital and labor mobile	only capital mobile	only labor mobile	enclave
small and medium farmers	0.87	0.05	0.74	0.00
large-scale farmers	1.06	1.39	1.08	1.41
self employed	-0.15	0.78	-0.08	0.83
formal sector employees	0.76	1.66	0.83	1.71
employers	-0.27	1.31	-0.16	1.39

Conclusion

In the debate on the effectiveness of aid Dutch Disease has become a prime culprit. In this Note we have calculated that in Zambia the effect is modest: about 20-30% of the amount of aid is "lost" through the induced fall in exports so that the aid-financed increase amounts to 70-80% of the amount of aid. This is a sizable effect but much less than what has been suggested in policy discussions in Zambia. Of course, that does not dispel all concerns about aid effectiveness: aid can be ineffective for quite different reasons.[11]

[11] See for example Dambisa Moyo, *Dead Aid*, London: Allen Lane, 2009.

Appendix: Linking the CGE and ZAMMOD models

Macroeconomic models such as ZAMMOD are very useful for policy analysis in that they provide a comprehensive and consistent overview of important economic variables. Unfortunately they are much less suitable for analyzing policy scenarios likely to result in relative price changes. Such price changes and their further impact are best studied in Computable General Equilibrium (CGE) models. In this Appendix we illustrate how output of the CGE model underlying the Tables in this Note can be used as 'input' to the ZAMMOD model. This allows presenting the CGE results as ZAMMOD Tables.

One major difference between ZAMMOD and the Zambia CGE is that ZAMMOD gives the time path of important macroeconomic variables, whereas the Zambia CGE is static: one uses it by comparing simulation outcomes to (a stylized) representation of the Zambian economy in the year 2001. Since ZAMMOD too is essentially a static model, linking it to the CGE outcomes gives different sets of outcomes for the year 2001. These are reported in the Table below (which shows only a subset of all the ZAMMOD variables; notably changes over time and price deflators have been omitted). The columns from left to right represent the original ZAMMOD outcomes, the base 2001 solution of the CGE model, and the four scenarios discussed in this note. Not all ZAMMOD variables have counterparts in the CGE model and *vice versa* not all CGE outcomes have a direct ZAMMOD counterpart. In the latter case ZAMMOD variables have been imputed from the CGE outcomes;[12] in the former case ZAMMOD variables have been copied unchanged across the scenarios. Differences of more than 5% with respect to the CGE baseline solution have been highlighted.

[12] The exact rules applied are available on request from the authors.

ZAMMOD, Macroabc-Zambia and CGE model	Unit	2001 ZAMMOD	2001 CGE, base	2001 capital and labor mobile	2001 only capital mobile	2001 only labor mobile	2001 enclave
Central Government							
Source: CGE outcomes and MoF							
Revenues							
Total tax revenues	K' billions	3 270	3 022	3 033	3 059	3 035	3 060
Personal income tax	K' billions	366	322	322	322	322	322
Corporate income tax	K' billions	953	838	838	838	838	838
Excise taxes	K' billions	821	754	759	770	760	770
VAT /sales tax	K' billions	544	432	435	443	435	443
Trade taxes	K' billions	278	322	324	327	324	328
Extraction royalty	K' billions	285	330	332	336	333	336
Clearance of ZESCO tax arrear	K' billions	23	23	23	24	23	24
Total nontax revenues	K' billions	60	60	60	61	60	61
Grants (tied)	K' billions	754	754	905	905	905	905
of which: Debt reduction (including MDRI)	K' billions	0	0	0	0	0	0
Total revenues	K' billions	3 330	3 082	3 093	3 121	3 095	3 122
Total Revenues and grants	K' billions	4 084	3 836	3 998	4 026	4 000	4 027
Expenditures							
Current expenditure (calculated)	K' billions	2 578	2 386	2 516	2 507	2 515	2 507
Wages and salaries	K' billions	907	905	959	954	959	954
Goods and Services	K' billions	801	799	847	843	847	843
Interest payments	K' billions	331	124	124	124	124	124
Domestic	K' billions	207	0	0	0	0	0
External	K' billions	124	124	124	124	124	124
Other current expenditures	K' billions	539	559	586	586	586	586
of which: transfers and subsidies	K' billions	353	559	586	586	586	586
Capital expenditures	K' billions	1 557	695	715	715	715	715
Domestic arrears payments (= net lending)	K' billions	77	0	0	0	0	0
Total expenditures and net lending (calculated)	K' billions	4 212	3 081	3 231	3 222	3 230	3 222
Savings	K' billions	752	696	577	614	579	615
Primary balance after grants	K' billions	97	772	785	822	787	823
Overall balance excluding other	K' billions	-128	754	767	804	769	805
Change in balances and other	K' billions	-106	-106	-106	-106	-106	-106
Overall balance (cash)	K' billions	-234	648	661	698	663	699
Statistical discrepancy	K' billions	822	1 704	1 717	1 754	1 719	1 755
Financing	K' billions	-1 056	-1 056	-1 056	-1 056	-1 056	-1 056
Domestic	K' billions	589	589	589	589	589	589
Nonbank	K' billions	106	106	106	106	106	106
Bank financing	K' billions	483	483	483	483	483	483
of which: BOZ on lending of IMF MDRI	K' billions	0	0	0	0	0	0
External	K' billions	467	467	467	467	467	467

National Accounts:							
Government							
revenues total		3 901	3 632	3 793	3 812	3 794	3 813
balance of non-tax revenues <E> to <G>	bln K	814	814	965	966	965	966
indirect taxes	bln K	1 460	1 305	1 313	1 326	1 314	1 327
corporate taxes on profits	bln K	1 261	1 191	1 193	1 197	1 194	1 198
direct taxes on households	bln K	366	322	322	322	322	322
expenditures total		2 316	1 933	1 995	1 976	1 994	1 976
net mat. consumption	bln K	489	369	399	378	387	378
public investment	bln K	597	695	715	715	715	715
wage bill government	bln K	846	689	698	701	709	701
interest payments	bln K	331	124	124	124	124	124
transfers to households	bln K	54	56	59	59	59	59
depreciation government	bln K	0	0	0	0	0	0
stat. Discr. Gov't total	bln K						
financial deficit (+=surplus)exl. Depreciation	bln K	1 585	1 699	1 798	1 835	1 800	1 837
National Accounts Private Sector							
GDP by type of expenditure at current prices							
Total consumption	bln K	10 838	12 214	12 197	12 204	12 197	12 205
Government consumption	bln K	1 335	1 058	1 097	1 079	1 096	1 078
Private consumption	bln K	9 504	11 156	11 099	11 125	11 101	11 127
Total investment	bln K	3 158	2 627	2 647	2 647	2 647	2 647
Gross fixed capital formation	bln K	2 980	2 426	2 444	2 444	2 444	2 444
Public investments	bln K	597	695	715	715	715	715
Private Investment	bln K	2 383	1 730	1 729	1 729	1 729	1 729
Changes in stocks	bln K	178	202	203	203	203	203
Gross domestic expenditure	bln K	13 996	14 841	14 843	14 851	14 844	14 852
Exports of goods and services	bln K	3 712	3 712	3 712	3 712	3 712	3 712
Imports of goods and services	bln K	5 849	5 849	5 849	5 849	5 849	5 849
Total GDP	bln K	11 860	12 705	12 707	12 715	12 708	12 715
GDP Income Side							
wage bill Gov	bln K	846	689	698	701	709	701
Statistical Discrepancy	bln K	117	689	698	701	709	701
wage bill gov from the Earnings survey	bln K	729	0	0	0	0	0
Wage Bill Private Sector	bln K	1 504	-689	-698	-701	-709	-701
wage bill Total from the Earnings survey	bln K	2 350	0	0	0	0	0
Gross Profits	bln K	8 050	11 400	11 394	11 388	11 394	11 388
Indirect Taxes	bln K	1 460	1 305	1 313	1 326	1 314	1 327
GDP	bln K	11 860	12 705	12 707	12 715	12 708	12 715
Towards Disposable Income							
Net Factor Income From Abroad	bln K	-504	-504	-504	-504	-504	-504
Gross national Product	bln K	11 356	12 200	12 203	12 211	12 203	12 211
Net Tranfers From Abroad	bln K	40	40	40	40	40	40
Gross National Income=	bln K	11 396	12 240	12 243	12 250	12 243	12 251
National Disposable Income							
break Down of Disposable income into Gov and Private							
Value Added Private sector	bln K	11 014	12 016	12 009	12 014	11 998	12 015
wage bill government	bln K	846	689	698	701	709	701
Net Factor Income From Abroad	bln K	-504	-504	-504	-504	-504	-504
Net Tranfers From Abroad	bln K	40	40	40	40	40	40
interest payments	bln K	331	124	124	124	124	124

transfers to households	bln K	54	56	59	59	59	59
Nontax revenues excluding grants	bln K	60	60	60	61	60	61
indirect taxes	bln K	1 460	1 305	1 313	1 326	1 314	1 327
corporate taxes on profits	bln K	1 261	1 191	1 193	1 197	1 194	1 198
direct taxes on households	bln K	366	322	322	322	322	322
Disposable Income Private Sector	bln K	8 633	9 542	9 537	9 526	9 536	9 525
Value Added gov't	bln K	846	689	698	701	709	701
Disposable income of gov't	bln K	2 762	2 698	2 706	2 725	2 707	2 725