

**Trade Policy Analysis and Modeling in Developing Countries
Using a Simple Model of World Trade**

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Trade Policy Analysis and Modeling in Developing Countries

- **Developing countries have increasing interest in applied trade policy analysis and modeling.**
- **Policymakers in these countries want to rely on their own technical advisors for estimates of trade and welfare impacts.**
- **Trade policy advisors and analysts in most low- and middle-income countries are ill-trained and ill-equipped to undertake quantitative analyses of trade policy issues.**
- **This presentation outlines a simple world trade model, implemented in Microsoft Excel, that can be applied to numerous multilateral, regional, and unilateral trade policy issues as an integral part of trade capacity building activities in less developed countries.**

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WTSM -- World Trade Simulation Model

Objective

To develop a relatively compact analytical tool for assessing national, regional, and global economic impacts of trade policies and practices undertaken unilaterally or in concert by a wide variety of industrial countries and developing countries.

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WTSM -- A "Price Elasticities" Model of World Trade

- **Assumes homogeneous products and perfect competition.**
- **Covers 40 commodities and 89 countries but "scalable" to any finite number of commodities and countries.**
- **Presently incorporates 1995-96 trade and protection levels but "updatable" to any year for which national or UN/ITC/UNCTAD statistics for trade and protection are available.**
- **Solves for equilibrium exchange rates, prices, and international trade by commodity and country.**
- **Simulates effects of multilateral, regional, or unilateral changes in tariffs and nontariff barriers (NTBs).**
- **Implemented in familiar Microsoft Excel, using relatively easy-to-learn and inexpensive VORSIM software for economic modeling.**

WTSM

(1)
$$M_{k(i)}^d = C_{k(i)}^m [P_{k(i)}^m]^{\eta_{k(i)}}$$
 **Import demand
(country i, good k)**

$$P_{k(i)}^m = (1 + \tau_{k(i)})^{f_{k(i)}} [P\$_k (1 + t_{k(i)}) / e_{(i)}]$$
 **Import price
(country i, good k)**

(2)
$$X_{k(i)}^s = C_{k(i)}^x [P_{k(i)}^x]^{\alpha_{k(i)}}$$
 **Export supply
(country i, good k)**

$$P_{k(i)}^x = P\$_k / e_{(i)}$$
 **Export price
(country i, good k)**

(3)
$$\sum_i M_{k(i)}^d = \sum_i X_{k(i)}^s$$
 **World market
equilibrium (good k)**

(4)
$$\sum_k (P\$_k X_{k(i)}^s - P\$_k M_{k(i)}^d) + K\$_{(i)} = 0$$
 BOP equilibrium (country i)

WTSM Policy Variables and Parameters

Border Measures

$t_{k(i)}$ *Ad valorem* import tariff
(UNCTAD/TRAINS).

$f_{k(i)}$ Frequency of NTBs
applied to imports
(UNCTAD/TRAINS).

Other Parameters

$\eta_{k(i)}$,
 $\alpha_{k(i)}$ Own-price elasticity of
import demand, export
supply.

$\tau_{k(i)}$ NTB restrictiveness
parameter.

WTSM Product Categories

- **Agricultural categories (21)**
 - Primary foods (9)
 - Agricultural raw materials (5)
 - Processed foods (7)
- **Non-agricultural categories (19)**
 - Crude fertilizers and ores (1)
 - Mineral fuels (1)
 - Non-ferrous metals (1)
 - Chemicals (3)
 - Iron and steel (1)
 - Machinery and equipment (3)
 - Other manufactured products (9)

WTSM Product Categories (Details)

Primary Foods

Live animals
 Meat products
 Dairy products
 Cereal grains
 Vegetables
 Fruits & nuts
 Sugar & honey
 Animal feed stuffs
 Oil seeds

Agr. Raw Materials

Tobacco & manufactures
 Hides & skins
 Natural rubber
 Natural fibers

Processed Foods

Fats & oils
 Cereal preparations
 Prepared vegetables
 Prepared fruits
 Coffee, tea, & spices
 Beverages
 Other agr. products

Crude Fertilizer & Ores

Mineral Fuels

Non-Ferrous Metals

Chemicals

Pharmaceuticals
 Toiletry & perfumes
 Manufactured fertilizers

Iron & Steel

Machinery & Equipment

Non-electric machinery
 Electric machinery
 Transport equipment

Other Manuf. Products

Leather & travel goods
 Rubber products
 Wood products
 Paper products
 Textiles & clothing
 Non-metallic min. prods.
 Furniture
 Footwear
 Professional equipment

WTSM Country Coverage

- **OECD (7 + EU aggregate)**
- **Eastern Europe (13)**
- **East Asia (11)**
- **South Asia (5)**
- **Middle East (8)**
- **Latin America (21)**
- **Sub-Saharan Africa (23)**

WTSM Countries (Details)

OECD	Eastern Europe	Latin America	Latin America	S. Saharan Afr	Middle East
Austr, Can, EU,	Albania	Argentina	Nicaragua	Gabon	Algeria
Jpn, Nz, Nor,	Belarus	Bolivia	Panama	Ghana	Egypt
Switz, US	Czech Republic	Brazil	Paraguay	Kenya	Israel
	Estonia	Chile	Peru	Madagascar	Morocco
East Asia	Hungary	Colombia	Trin. & Tobago	Malawi	Oman
China	Kazakhstan	Costa Rica	Uruguay	Mali	Saudi Arabia
Hong Kong	Kyrgyzstan	Cuba	Venezuela	Mauritius	Tunisia
Indonesia	Latvia	Dominican Rep.		Mozambique	Turkey
Korea, Rep.	Lithuania	Ecuador	S. Saharan Afr.	Nigeria	
Malaysia	Moldova	El Salvador	Burkina Faso	Rwanda	South Asia
Pap. New Guinea	Poland	Guatemala	Cameroon	South Africa	Bangladesh
Philippines	Russia	Honduras	Cen. African Rep.	Sudan	India
Singapore	Ukraine	Jamaica	Chad	Tanzania	Nepal
Taiwan		Mexico	Congo	Uganda	Pakistan
Thailand			Côte d'Ivoire	Zambia	Sri Lanka
Viet Nam			Ethiopia	Zimbabwe	

WTSM Applications -- Multilateral, Regional, and Unilateral Policy Studies

- **"Modeling the Effects on Agriculture of Protection in Developing Countries," Study for World Bank, December 1999**
- **"Regional Integration Arrangements in MENA: Analysis of Egypt's Trade and Development Interests," Study for USAID/Egypt, 2000**
- **"A Trade and Food Security Model for Low-Income Countries," Prototype Model for USDA/Economic Research Service, January 2001**
- **"The New EAC Customs Union: Implications for Uganda," Study for Uganda Ministry of Finance and USAID/Uganda, March 2002**
- **"Rwanda as Free Trade Zone: Inquiry into the Economic Impacts," Study for USAID/Rwanda, June 2002**

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World Trade Simulation Model

(1)
$$\mathbf{M}_{k(i)}^d = \mathbf{C}_{k(i)}^m [\mathbf{P}_{k(i)}^m]^{\eta_{k(i)}}$$
 Import demand
(country i, good k)

$$\mathbf{P}_{k(i)}^m = (1 + \tau_{k(i)})^{f_{k(i)}} [\mathbf{P}_k (1 + t_{k(i)}) / e_{(i)}]$$
 Import price
(country i, good k)

(2)
$$\mathbf{X}_{k(i)}^s = \mathbf{C}_{k(i)}^x [\mathbf{P}_{k(i)}^x]^{\alpha_{k(i)}}$$
 Export supply
(country i, good k)

$$\mathbf{P}_{k(i)}^x = \mathbf{P}_k / e_{(i)}$$
 Export price
(country i, good k)

(3)
$$\sum_i \mathbf{M}_{k(i)}^d = \sum_i \mathbf{X}_{k(i)}^s$$
 World market
equilibrium (good k)

(4)
$$\sum_k (\mathbf{P}_k \mathbf{X}_{k(i)}^s - \mathbf{P}_k \mathbf{M}_{k(i)}^d) + \mathbf{K}_{(i)} = 0$$
 BOP equilibrium (country i)

WTSM Policy Variables and Parameters

Border Measures

$t_{k(i)}$ *Ad valorem* import tariff
(UNCTAD/TRAINS).

$f_{k(i)}$ Frequency of NTBs
applied to imports
(UNCTAD/TRAINS).

Other Parameters

$\eta_{k(i)}$,
 $\alpha_{k(i)}$ Own-price elasticity of
import demand, export
supply.

$\tau_{k(i)}$ NTB restrictiveness
parameter.

Impacts of Trade Liberalization on Agriculture and Welfare in Low-Income Countries

Variable	Unilateral Trade Liberalization		Multilateral Trade Liberalization	
	Agriculture	All Goods	Agriculture	All Goods
Percentage Change				
Exchange Rate (\$/L)	-2.2	-8.8	-0.7	-5.5
Ag. Prices: Exportables (L)	2.8	10.2	5.6	11.1
Primary Foods	2.9	10.4	5.3	10.8
Processed Foods	2.7	10.0	5.7	11.4
Ag. Raw Materials	3.0	10.0	5.9	11.3
Ag. Prices: Importables (L)	-11.1	-5.8	-9.2	-5.5
Primary Foods	-10.5	-4.7	-7.9	-3.8
Processed Foods	-13.9	-9.2	-11.6	-8.4
Ag. Raw Materials	-8.9	-3.6	-8.5	-4.8
Ag. Exports (qty)	2.1	9.0	5.4	9.6
Primary Foods	2.1	9.4	5.3	9.5
Processed Foods	1.7	8.2	5.2	9.3
Ag. Raw Materials	2.6	9.8	5.8	10.4
Ag. Imports (qty)	35.3	16.5	26.7	16.5
Primary Foods	34.7	16.2	24.6	15.1
Processed Foods	47.6	25.2	37.7	24.1
Ag. Raw Materials	20.8	5.9	16.4	9.4
Ec. Welfare (\$ Bill.)	2.9	20.4	3.0	25.3

Source: WTSM.

Unilateral versus Multilateral Trade Liberalization

	Unilateral Trade Liberalization			Multilateral Trade Liberalization		
	Exports	Imports	Economic Welfare	Exports	Imports	Economic Welfare
	(Percent)	(Percent)	(\$Bill.)	(Percent)	(Percent)	(\$Bill.)
<u>Developing Countries</u>	6	7	68	6	8	70
Low-Income	9	12	20	8	15	25
Middle-Income	6	7	38	6	6	37
Lower-Middle	7	7	18	7	6	17
Upper-Middle	6	6	20	6	6	20
High-Income	3	2	10	4	2	7
<u>OECD Countries</u>	...	...	...	2	2	61
<u>World</u>	...	...	...	3	3	131

Source: WTSM.

EAC Trade Simulation Model

(1) $M_{k(i)}^d = C_{k(i)}^m [P_k^m - \sum_j (a_{jk} P_j^m)]^{\eta_{k(i)}}$ **Import demand**
(country i, good k)

$P_{k(i)}^m = (1 + \tau)^{fk(i)} [P\$_k (1 + t_{k(i)}) / e_{(i)}]$ **Import price**
(country i, good k)

(2) $X_{k(i)}^s = C_{k(i)}^x [P_{k(i)}^x - \sum_j (a_{jk} P_j^m)]^{\alpha_{k(i)}}$ **Export supply**
(country i, good k)

$P_{k(i)}^x = P\$_k / e_{(i)}$ **Export price**
(country i, good k)

(3) $\sum_i M_{k(i)}^d = \sum_i X_{k(i)}^s$ **World market**
equilibrium (good k)

(4) $\sum_k (P\$_k X_{k(i)}^s - P\$_k M_{k(i)}^d) + K\$_{(i)} = 0$ **BOP equilibrium (country i)**

EAC Model Policy Variables and Parameters

Border Measures

$t_{k(i)}$ *Ad valorem* import tariff
(UNCTAD/TRAINS).

$f_{k(i)}$ Frequency of NTBs
applied to imports
(UNCTAD/TRAINS).

Other Parameters

$\eta_{k(i)}$,
 $\alpha_{k(i)}$ Own-price elasticity of
import demand, export
supply.

$\tau_{k(i)}$ NTB restrictiveness
parameter.

a_{jk} Production input
requirements parameter.

Table 8. Trade and Welfare Effects under Alternative EAC Customs Union Arrangements and "Open Regionalism"
(Millions of U.S. Dollars, at 1999 Prices)

	Kenya (\$10,697 GDP)			Tanzania (\$9,035 GDP)			Uganda (\$6,447 GDP)			EAC (\$26,179 GDP)		
	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%
<u>Percent Change in Real Exchange Rate (U.S.\$/Local Currency)</u>												
All Products	0.9	-1.9	-9.6	-12.0	-14.6	-21.3	2.6	0.2	-5.6	...	...	...
<u>Change in Real Exports</u>												
Primary Prods	3.8	27.4	92.9	36.7	44.1	64.7	-6.5	0.3	18.6	34.0	71.8	176.2
Pri Foods	-0.2	4.5	18.6	12.7	14.7	21.7	-0.3	0.6	3.6	12.1	19.7	43.8
Proc Foods	-1.4	12.1	55.0	12.7	15.7	24.1	-5.7	-0.3	13.6	5.7	27.4	92.6
Ag Raw Mats	-0.5	2.6	11.1	8.4	10.4	15.3	-0.6	0.0	1.4	7.3	12.9	27.8
Oth Pri Prods	5.9	8.3	8.2	2.9	3.4	3.7	0.0	0.0	0.1	8.9	11.8	12.0
Manufactures	43.0	38.6	39.9	18.2	17.1	18.3	0.8	0.7	0.4	62.0	56.5	58.6
Chemicals	8.4	9.3	8.1	0.4	0.4	0.4	0.1	0.1	0.1	8.8	9.8	8.6
Iron & Steel	3.2	3.3	2.9	0.2	0.2	0.2	0.0	0.0	0.0	3.4	3.4	3.0
Mach & Eq	10.3	9.1	8.0	2.6	2.7	2.6	0.4	0.4	0.2	13.3	12.3	10.8
Oth Manufs	21.1	16.9	20.9	15.0	13.8	15.2	0.3	0.2	0.1	36.5	31.0	36.3
Sensitive Prods	1.1	2.5	8.5	6.9	7.8	11.9	0.2	0.5	2.2	8.2	10.8	22.6
All Products	46.8	66.0	132.8	54.9	61.2	83.0	-5.8	1.0	19.0	96.0	128.3	234.9
<u>Trade Creation = Change in Real Imports</u>												
Primary Prods	8.3	9.1	12.3	-2.1	2.1	4.5	1.0	2.0	7.6	7.2	13.2	24.5
Pri Foods	3.6	2.0	2.9	-0.6	0.7	1.6	0.0	0.3	1.7	3.0	3.0	6.1
Proc Foods	0.1	7.0	8.4	1.1	5.6	6.8	-2.0	0.6	2.6	-0.9	13.3	17.7
Ag Raw Mats	2.3	1.4	1.1	0.0	-0.7	-0.5	1.1	0.7	1.1	3.5	1.4	1.7
Oth Pri Prods	2.3	-1.3	0.0	-2.6	-3.5	-3.3	1.9	0.3	2.2	1.6	-4.5	-1.0
Manufactures	76.4	81.9	120.5	48.7	54.2	78.5	-30.3	-19.0	11.4	94.9	117.1	210.4
Chemicals	1.0	-15.0	-5.7	-0.1	-5.1	-2.0	-3.3	-6.5	0.9	-2.5	-26.5	-6.7
Iron & Steel	7.1	2.0	4.8	5.3	6.4	7.9	-1.1	-1.6	0.6	11.2	6.8	13.2
Mach & Eq	34.2	23.7	41.3	27.8	16.2	30.0	-17.4	-15.7	-2.5	44.5	24.2	68.7
Oth Manufs	34.2	71.1	80.1	15.8	36.7	42.7	-8.4	4.8	12.4	41.7	112.6	135.2
Sensitive Prods	4.1	8.3	8.2	1.2	6.1	6.8	1.7	2.5	0.9	7.0	16.9	15.8
All Products	84.7	91.0	132.8	46.6	56.4	83.0	-29.2	-17.1	19.0	102.1	130.3	234.9
<u>Trade Diversion</u>												
Primary Prods	83.4	83.9	0.0	24.3	23.9	0.0	7.1	7.0	0.0	114.7	114.9	0.0
Pri Foods	8.5	8.6	0.0	10.7	10.4	0.0	0.9	0.8	0.0	20.1	19.8	0.0
Proc Foods	12.7	12.1	0.0	2.5	2.3	0.0	0.4	0.4	0.0	15.6	14.8	0.0
Ag Raw Mats	8.0	8.1	0.0	6.4	6.4	0.0	5.1	5.2	0.0	19.5	19.8	0.0
Oth Pri Prods	54.3	55.1	0.0	4.6	4.7	0.0	0.6	0.7	0.0	59.5	60.5	0.0
Manufactures	213.9	206.8	0.0	66.4	61.3	0.0	25.1	20.9	0.0	305.4	289.0	0.0
Chemicals	49.6	50.3	0.0	2.9	3.1	0.0	0.7	0.7	0.0	53.2	54.1	0.0
Iron & Steel	17.0	17.3	0.0	1.0	0.8	0.0	0.0	0.0	0.0	18.0	18.1	0.0
Mach & Eq	46.9	46.4	0.0	20.9	20.6	0.0	7.0	6.5	0.0	74.7	73.5	0.0
Oth Manufs	100.5	92.8	0.0	41.6	36.9	0.0	17.4	13.7	0.0	159.4	143.3	0.0

Table 8 (Cont.). Trade and Welfare Effects under Alternative EAC Customs Union Arrangements and "Open Regionalism"
(Millions of U.S. Dollars, at 1999 Prices)

	Kenya (\$10,697 GDP)			Tanzania (\$9,035 GDP)			Uganda (\$6,447 GDP)			EAC (\$26,179 GDP)		
	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%
Sensitive Prods	2.5	2.6	0.0	1.9	1.5	0.0	0.1	0.1	0.0	4.5	4.2	0.0
All Products	297.3	290.7	0.0	90.6	85.2	0.0	32.1	27.9	0.0	420.1	403.9	0.0
Net Trade Creation												
Primary Prods	-75.1	-74.9	12.3	-26.4	-21.8	4.5	-6.0	-5.1	7.6	-107.5	-101.7	24.5
Pri Foods	-4.9	-6.7	2.9	-11.3	-9.8	1.6	-0.9	-0.4	1.7	-17.1	-16.9	6.1
Proc Foods	-12.6	-5.1	8.4	-1.5	3.3	6.8	-2.4	0.3	2.6	-16.5	-1.5	17.7
Ag Raw Mats	-5.6	-6.7	1.1	-6.3	-7.1	-0.5	-4.0	-4.5	1.1	-15.9	-18.3	1.7
Oth Pri Prods	-52.0	-56.4	0.0	-7.3	-8.2	-3.3	1.3	-0.4	2.2	-58.0	-65.0	-1.0
Manufactures	-137.5	-124.9	120.5	-17.6	-7.1	78.5	-55.3	-39.9	11.4	-210.5	-171.9	210.4
Chemicals	-48.6	-65.2	-5.7	-3.0	-8.2	-2.0	-4.0	-7.2	0.9	-55.6	-80.6	-6.7
Iron & Steel	-10.0	-15.3	4.8	4.2	5.6	7.9	-1.2	-1.6	0.6	-6.9	-11.3	13.2
Mach & Eq	-12.7	-22.7	41.3	6.9	-4.4	30.0	-24.4	-22.2	-2.5	-30.2	-49.2	68.7
Oth Manufs	-66.2	-21.6	80.1	-25.8	-0.2	42.7	-25.8	-8.9	12.4	-117.8	-30.7	135.2
Sensitive Prods	1.6	5.7	8.2	-0.7	4.6	6.8	1.6	2.5	0.9	2.5	12.7	15.8
All Products	-212.6	-199.7	132.8	-44.0	-28.9	83.0	-61.4	-45.0	19.0	-318.0	-273.6	234.9
Change in Producer Surplus												
Primary Prods	30.7	63.3	143.2	63.8	75.7	107.3	-8.6	0.4	24.9	85.9	139.4	275.4
Pri Foods	1.3	7.1	25.3	17.8	19.6	28.1	-0.3	0.6	3.3	18.8	27.2	56.8
Proc Foods	3.3	18.7	77.1	18.6	22.9	36.3	-7.3	-0.3	18.6	14.6	41.3	132.1
Ag Raw Mats	-0.1	6.2	23.5	18.9	23.5	34.6	-1.1	-0.1	2.8	17.7	29.6	60.8
Oth Pri Prods	26.2	31.4	17.3	8.5	9.7	8.3	0.1	0.2	0.1	34.8	41.3	25.8
Manufactures	97.7	70.5	38.4	26.4	20.8	16.5	1.9	1.5	0.5	126.1	92.7	55.4
Chemicals	17.3	17.1	8.4	0.6	0.6	0.4	0.2	0.2	0.1	18.0	17.9	8.8
Iron & Steel	5.5	5.6	2.7	0.2	0.2	0.2	0.0	0.0	0.0	5.7	5.8	2.9
Mach & Eq	22.0	17.1	8.3	4.1	4.1	2.9	0.9	0.8	0.3	27.0	22.0	11.5
Oth Manufs	52.9	30.6	19.0	21.5	15.9	13.1	0.9	0.5	0.1	75.3	47.0	32.2
Sensitive Prods	2.1	2.1	4.9	3.3	3.9	6.6	0.1	0.3	1.5	5.5	6.3	13.0
All Products	128.4	133.8	181.6	90.2	96.5	123.9	-6.7	1.9	25.3	212.0	232.1	330.8
Change in Consumer Surplus												
Primary Prods	13.6	12.3	18.2	-3.8	3.0	7.3	2.6	3.0	12.6	12.4	18.3	38.2
Pri Foods	5.5	3.1	4.5	-0.1	2.2	3.8	-0.1	0.5	2.4	5.3	5.8	10.7
Proc Foods	-0.3	10.1	12.1	2.1	9.9	11.8	-3.1	0.9	3.8	-1.3	20.9	27.6
Ag Raw Mats	3.4	2.0	1.6	0.1	-1.1	-0.9	1.7	1.0	1.7	5.1	2.0	2.4
Oth Pri Prods	5.0	-2.9	0.0	-5.9	-8.0	-7.4	4.1	0.5	4.8	3.2	-10.4	-2.5
Manufactures	60.8	62.0	90.7	44.7	45.4	65.8	-21.2	-14.3	8.1	84.3	93.1	164.6
Chemicals	0.7	-11.4	-4.6	0.2	-4.3	-1.7	-2.4	-4.7	0.6	-1.5	-20.5	-5.7
Iron & Steel	5.3	1.3	3.3	5.1	5.2	6.3	-0.5	-1.1	0.4	9.9	5.4	10.1
Mach & Eq	24.7	16.6	29.6	23.6	13.2	24.8	-12.6	-11.1	-1.7	35.6	18.6	52.7
Oth Manufs	30.1	55.5	62.4	15.9	31.4	36.3	-5.8	2.6	8.8	40.3	89.5	107.5

Table 8 (Cont.). Trade and Welfare Effects under Alternative EAC Customs Union Arrangements and "Open Regionalism"
(Millions of U.S. Dollars, at 1999 Prices)

	Kenya (\$10,697 GDP)			Tanzania (\$9,035 GDP)			Uganda (\$6,447 GDP)			EAC (\$26,179 GDP)		
	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%
Sensitive Prods	1.3	2.5	2.5	0.1	1.7	1.9	0.6	0.9	0.3	2.0	5.1	4.7
All Products	74.4	74.3	108.9	40.9	48.4	73.1	-18.6	-11.3	20.8	96.7	111.4	202.7
Foroone Tariff Revenue												
Primary Prods	-10.2	-8.7	0.0	-9.0	-6.3	0.0	-14.1	-12.9	0.0	-33.3	-27.8	0.0
Pri Foods	-1.3	-1.0	0.0	-2.3	-1.3	0.0	-1.5	-1.2	0.0	-5.1	-3.5	0.0
Proc Foods	-2.5	-1.2	0.0	-3.4	-1.7	0.0	-1.8	-0.9	0.0	-7.7	-3.8	0.0
Ag Raw Mats	-0.8	-0.8	0.0	-0.7	-0.7	0.0	-0.5	-0.5	0.0	-2.0	-2.0	0.0
Oth Pri Prods	-5.5	-5.6	0.0	-2.7	-2.7	0.0	-10.2	-10.3	0.0	-18.5	-18.6	0.0
Manufactures	-35.0	-21.1	0.0	-21.3	-12.6	0.0	-20.7	-12.4	0.0	-77.0	-46.1	0.0
Chemicals	-5.9	-5.1	0.0	-3.0	-2.6	0.0	-3.5	-2.8	0.0	-12.4	-10.5	0.0
Iron & Steel	-1.8	-1.7	0.0	-0.9	-0.6	0.0	-2.1	-1.9	0.0	-4.8	-4.3	0.0
Mach & Eq	-7.2	-4.9	0.0	-5.0	-3.6	0.0	-2.9	-1.9	0.0	-15.1	-10.4	0.0
Oth Manufs	-20.1	-9.3	0.0	-12.3	-5.7	0.0	-12.2	-5.8	0.0	-44.6	-20.9	0.0
Sensitive Prods	-0.5	-0.3	0.0	-0.8	-0.4	0.0	-0.7	-0.3	0.0	-2.0	-1.0	0.0
All Products	-45.2	-29.8	0.0	-30.3	-18.9	0.0	-34.8	-25.2	0.0	-110.3	-73.9	0.0
Change in Economic Welfare												
Primary Prods	34.1	66.9	161.5	51.1	72.4	114.6	-20.1	-9.5	37.5	65.0	129.9	313.6
Pri Foods	5.5	9.2	29.8	15.4	20.5	31.9	-1.9	-0.1	5.7	19.0	29.6	67.4
Proc Foods	0.4	27.5	89.2	17.4	31.2	48.1	-12.2	-0.3	22.4	5.6	58.4	159.7
Ag Raw Mats	2.5	7.4	25.1	18.3	21.8	33.7	0.0	0.4	4.5	20.8	29.6	63.2
Oth Pri Prods	25.6	22.9	17.4	-0.1	-1.0	0.9	-6.0	-9.5	4.9	19.6	12.3	23.2
Manufactures	123.5	111.3	129.1	49.8	53.6	82.3	-39.9	-25.2	8.6	133.4	139.7	219.9
Chemicals	12.1	0.6	3.8	-2.3	-6.3	-1.3	-5.7	-7.3	0.6	4.2	-13.1	3.1
Iron & Steel	9.0	5.2	6.1	4.3	4.7	6.5	-2.6	-3.0	0.4	10.8	6.9	12.9
Mach & Eq	39.5	28.7	37.9	22.6	13.7	27.7	-14.6	-12.2	-1.4	47.6	30.2	64.2
Oth Manufs	62.9	76.8	81.3	25.1	41.5	49.3	-17.1	-2.7	9.0	70.9	115.6	139.6
Sensitive Prods	2.9	4.3	7.4	2.6	5.2	8.5	0.1	0.9	1.8	5.6	10.4	17.7
All Products	157.6	178.3	290.5	100.8	126.0	196.9	-60.0	-34.7	46.1	198.4	269.6	533.5
(% GDP)	1.5	1.7	2.7	1.1	1.4	2.2	-0.9	-0.5	0.7	0.8	1.0	2.0
Change in Actual Tariff Revenues												
All Products	-74.0	-139.3	-356.5	-270.6	-314.6	-436.3	8.6	-13.6	-74.6	-336.0	-467.5	-867.3
(% GDP)	-0.7	-1.3	-3.3	-3.0	-3.5	-4.8	0.1	-0.2	-1.2	-1.3	-1.8	-3.3

Rwanda Trade Simulation Model

Import Demand

$$(1) \quad M^d_k = C^m_k [P^m_k - \sum_j (a_{jk} P^m_j)]^{\eta_k}$$

$$P^m_k = P\$_k (1 + t_k) / e$$

Export Supply

$$(2) \quad X^s_k = C^x_k [P^x_k - \sum_j (a_{jk} P^m_j)]^{\alpha_k}$$

$$P^x_k = P\$_k / e$$

International Payments Equilibrium

$$(3) \quad \sum_k (P\$_k X^s_k - P\$_k M^d_k) + K\$ = 0$$

Rwanda Model Policy Variables and Parameters

Border Measures

$t_{k(i)}$ *Ad valorem* import tariff.

Other Parameters

$\eta_{k(i)}$,
 $\alpha_{k(i)}$ Own-price elasticity of import demand, export supply.

a_{jk} Production input requirements parameter.

Table 7. Summary of Simulation Results
(Changes in Variables)

Scenario, Sector	Import Price (Percent)	Export Price	Imports (Frw Million)	Exports	Imports (Percent)	Exports	Employment (ManYrs)	Producer Surplus	Consumer Surplus	Economic Welfare (Frw Million)	Tariff Revenues
<u>Free Trade Zone Scenarios</u>											
<u>Economywide FTZ</u>											
Agriculture	-1.7	8.5	541	3,463	2.9	24.1	4,132	2,492	22	2,512	-1,923
Minerals	2.5	8.5	-833	158	-4.1	4.2	113	247	-13	234	-1,207
Manufacturing	-2.4	8.5	4,010	192	4.9	18.7	-43	148	138	286	-9,397
All Products	-1.6	8.5	3,813	3,813	3.1	19.9	4,203	2,887	145	3,032	-12,527
<u>Manufacturing EPZ</u>											
Agriculture	0.0	0.0	5	-3	0.0	0.0	-13	-4	0	-4	1
Minerals	0.0	0.0	11	-1	0.1	0.0	-1	-1	0	-1	1
Manufacturing	0.0	0.0	77	96	0.1	9.4	13	48	0	48	9
All Products	0.0	0.0	92	92	0.1	0.5	-2	43	0	43	10
<u>Textiles and Apparel EPZ</u>											
Agriculture	0.0	0.0	5	-3	0.0	0.0	-13	-4	0	-4	1
Minerals	0.0	0.0	11	-1	0.1	0.0	-1	-1	0	-1	1
Manufacturing	0.0	0.0	76	95	0.1	9.3	13	47	0	47	9
All Products	0.0	0.0	91	91	0.1	0.5	-2	42	0	42	10
<u>Related Scenarios</u>											
<u>Reduced Foreign Aid</u>											
Agriculture	13.6	13.7	-1,764	1,438	-9.6	10.0	5,207	1,802	-136	1,667	-209
Minerals	13.8	13.7	-3,760	250	-18.5	6.6	324	401	-273	128	-215
Manufacturing	13.8	13.7	-18,426	141	-22.1	13.6	1,022	150	-1,403	-1,253	-2,042
All Products	13.7	13.7	-23,950	1,829	-19.6	9.5	6,552	2,353	-1,811	542	-2,467
<u>Increased Fertilizer Use</u>											
Agriculture	-0.7	-0.7	102	1,951	0.6	13.6	17,351	919	0	919	12
Minerals	-0.7	-0.7	227	-13	1.1	-0.3	-19	-20	1	-19	13
Manufacturing	-0.8	-0.7	1,601	-7	1.9	-0.7	-154	-7	6	-1	128
All Products	-0.7	-0.7	1,931	1,931	1.6	10.1	17,178	892	7	899	153

Source: Simulations of the Rwanda trade simulation model.

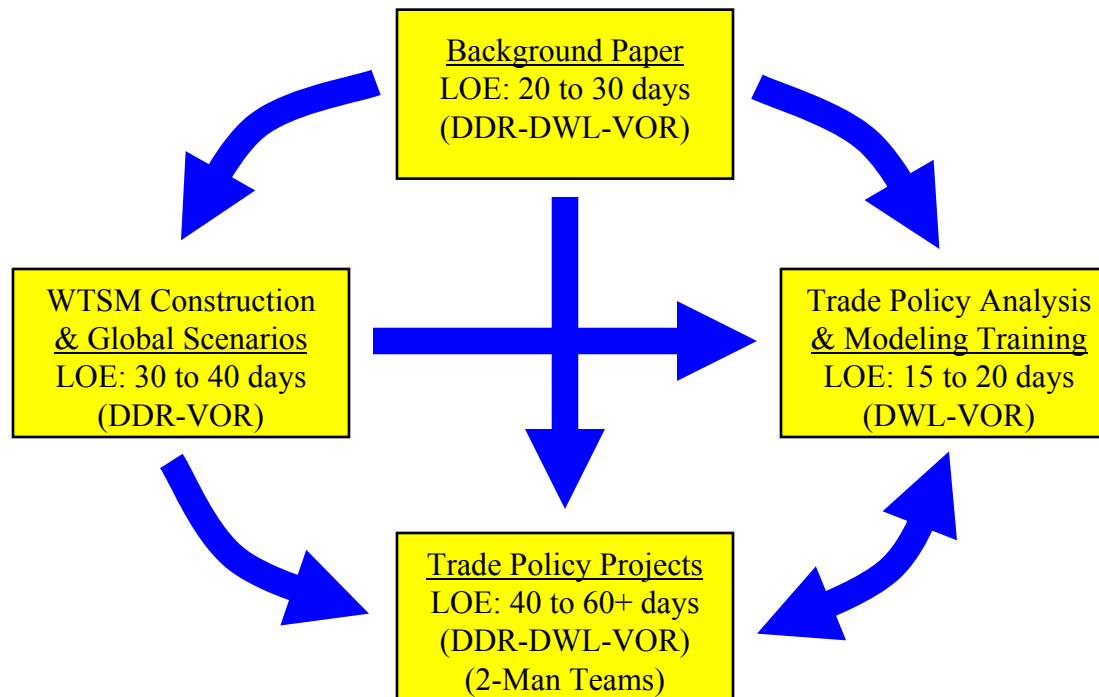
WTSM and Trade Capacity Building

WTSM can be adapted to support trade capacity building activities in developing countries, in at least two modes:

- 1. As a resource for training programs in international trade and trade policy analysis.**
- 2. As a tool for undertaking collaborative research and analysis of trade policy issues, including**
 - Doha WTO Round;**
 - Regional and other preferential trading arrangements; and**
 - Unilateral or sectoral trade issues, including agricultural trade and food security issues.**

([Continue](#) | [Return to Outline](#))

A Trade Policy Analysis and Modeling Program



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Program Notes

- **DDR-DWL-VOR denotes collaborating consultants, Dean DeRosa, Dale W. Larson, and Vernon O. Roningen. Level of effort (LOE) figures are estimates or proposed levels. Two-man teams for trade policy projects to be determined by personnel experience, interest, and availability.**
- **Estimated \$2,000 would be required to purchase UN/ITC and UNCTAD/TRAINS data to construct WTSM using most recent international trade and protection data. Global scenarios might include simulated impacts of selected regional integration arrangements in addition to simulated impacts of the Doha Round.**
- **LOE figures for training sessions and trade policy projects are per session or project. Training sessions include preparation days for standard 1-week training sessions to be held in-country by DWL-VOR team. Training sessions and trade policy projects might be integrated in trade capacity-building programs for targeted government ministries or economic research institutes.**

POTOMAC ASSOCIATES

- **Dean A. DeRosa** is principal economist of ADR International, Ltd., an economic research and policy consulting firm located in Falls Church, Virginia (www.adr-intl.com). DeRosa holds a Ph.D. (1975) in economics from the University of Oregon. He has been engaged in trade research and policy analysis for over 25 years, with the U.S. Treasury Department, Asian Development Bank, and other international organizations.
- **Dale W. Larson** is economic consultant and president of Larson Global Consulting, located in Bethesda, Maryland (dwl@larsonglobal.com). Larson holds a Ph.D. (1976) in economics from the University of Wisconsin. He has been engaged in trade policy analysis and teaching graduate economics for over 25 years. Prior to 2002, Larson was Deputy Manager of Mitsubishi Research Institute, Washington, D.C., and international trade economist with U.S. Treasury Department, USITC, and U.S. Foreign Service Institute.
- **Vernon O. Roningen** is economic consultant and developer of VORSIM, computer software for economic modeling in Microsoft Excel, headquartered in Arlington, Virginia (www.vorsim.com). Roningen holds a Ph.D. (1972) from Columbia University, and has a distinguished record in economic research, trade policy analysis, and world trade modeling, spanning 30 years, with UNCTAD, USITC, and Economic Research Service of the U.S. Department of Agriculture.

[\(Continue | Return to Outline\)](#)

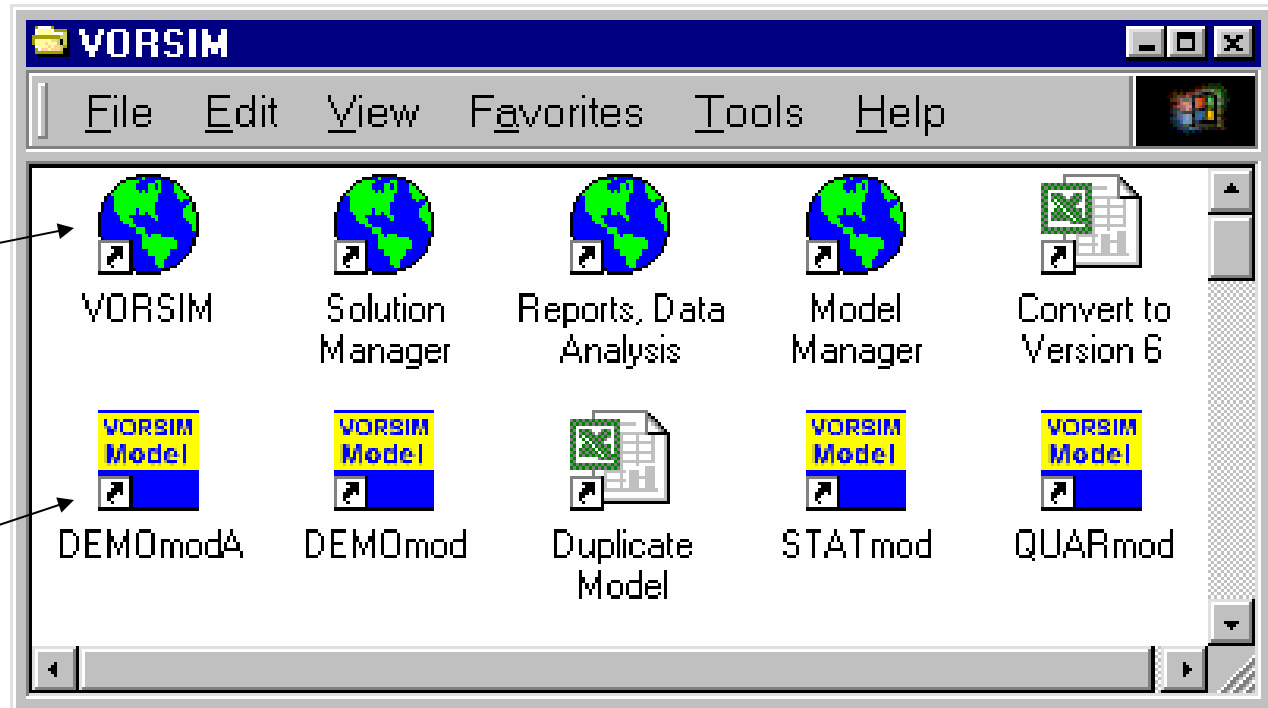
VORSIMTM

A Model Building Software
Package for Microsoft
Excel in Windows

VORSIM Window

Icons for
programs

Icons for
models



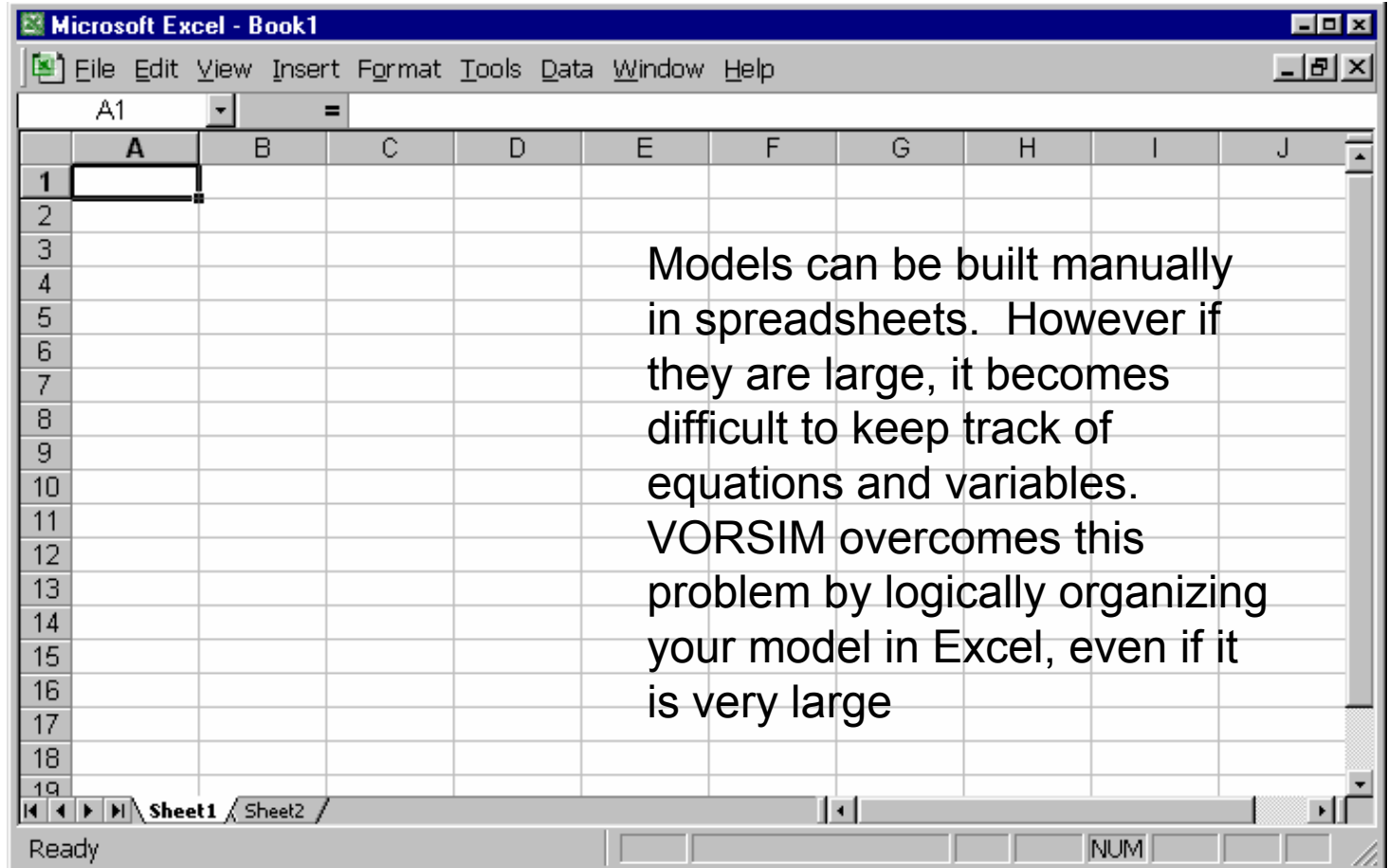
Programs and models are accessed with icons in the VORSIM window.

([Continue](#) | [Return to Outline](#))

Models Built in Excel

VORSIM models and component file(s) are Excel workbooks

When you build models in Excel, VORSIM uses the spreadsheet structure to advantage. Workbook sheets become the major unit of model construction. Cells within sheets are grouped into Categories.



Sheets, Categories, and Variables are given codes which make up names of variables in a VORSIM model.

File Structure

A summary of workbooks (files) associated with a VORSIM model

VORSIM Workbook (File) Structure For The Demonstration Model DEMO

(Arrows show the creating workbook and/or the movement of data between workbooks)

Accessible from the VORSIM control screen

Demoeqp.xls

Workbook containing equations and parameters for the model DEMO.

Demodef.xls

Workbook where the user has defined the model DEMO.

Demodata.xls

Workbook containing the data for the model DEMO.

Demomod.xls (+ Demohist.xls + Demoexog.xls)

Stand-alone model workbook with its controls. The model can be simulated with different exogenous data values; solutions can be saved with unique names.

Demoind.xls

Workbook where the user creates indicators from variables in the model.

Demobase.sol, Demofsbl.sol, etc.

Workbooks of model solution values. Each solution is saved with a unique name (base, fsbl, etc.) in the same format as the model itself.

Accessible from the Solution Manager control screen

fsblbase.lst, histbase.lst, etc.

Workbook lists of solution and indicator variables. Pivot tables and charts allow the rapid viewing and comparison of simulation results for multiple solutions.

Nutsales.rpt, Report.tmp, etc.

Report workbooks created with Excel. 'rpt' reports use 'Movelists' to transfer data from other workbooks. 'tmp' reports link to, or copy data from other workbooks.

Accessible from the Reports, Data Analysis control screen

Other Workbooks

- *.bak - backups
- *.eqa - equations
- *.txt - text backups

Solution.xls - list of model solutions that are saved.
DirSummary - list of files in model directory by type.

Nomenclature

The nomenclature associated with the workbook structure and variable type is used to construct variable names. These names are used to a) document the cell location of variables in the model and data workbooks and b) indicate variable cell positions in model equations.

Variable Code Nomenclature and Model Structure

Sheet	The MAJOR division of information in a VORSIM model. Data and equation workbooks are organized by sheets. Denoted by 1-3 digit upper case letters, e.g. US, CAN, W. Sheet codes are sheet names in data, equation, solution workbooks.
Category	Subdivisions of model information within a Sheet. The Category code allows the same subdivision to be used in multiple sheets. The Category code is denoted by 1-3 digit upper case letters, e.g. WH, RIC, X.
Variable	Variables are used in model equations and as labels in the data workbook. Variable codes label variables and can be from 1-5 lowercase letters. 2 digit codes are category specific (a variable with a 2 digit code is created for each category); 1 and 3-5 digit codes are sheet specific. Examples: qs would be category specific while x, quant, new would be sheet specific codes. A qs variables would have the Sheet code in front followed by the Category code (e.g. USqsWH) while x would only have the sheet code in front (e.g. USx). The full variable name is a concatenation of Sheet, Variable, and Category codes, e.g. USqsWH, USx, Wnew, CANquant. Potential variable names in the US and CAN sheets for data and equations might be (not all potential variables need be used):

US sheet	USqsWH USqsRIC USqsX USx USquant USnew	CAN sheet	CANqsWH CANqsRIC CANqsX CANx CANquant CANnew
----------	-------------------------------------------------------	-----------	-------------------------------------------------------------

Equation Matrices

Equation-parameter matrix

Model equation

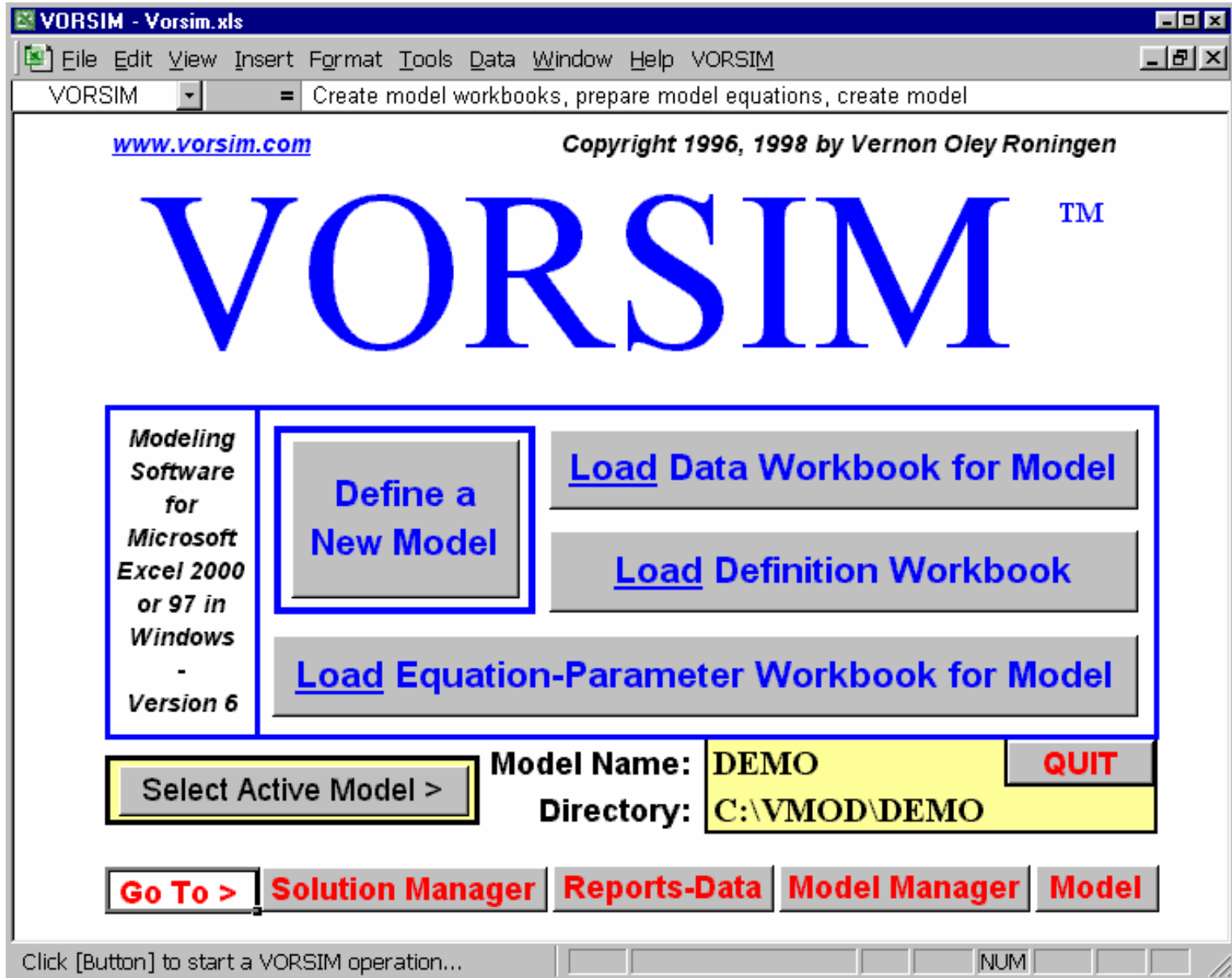
B38 = 2.266483*(1+\$B\$3)*\$B\$6^.89*\$B\$7^.02*\$B\$8^.01*\$B\$15^1.02					
---current price elasticities---					
quantity sold	shift	bolts	nuts	washers	new constr.
qs	*(1+!fs!)	*!pwBL^#	*!pwNUT^#	*!pwW^#	*!new^#
BL	-	-0.89	0.02	0.01	1.02
NUT	-	0.04	-0.78	0.07	0.89
W	-	0.05	0.17	-0.83	0.98
EqsBL		2.266483*(1+EfsBL)*EpwBL^.89*EpwNUT^.02*EpwW^.01*Enew^1.02			
EqsNUT		2.81267*(1+EfsNUT)*EpwBL^.04*EpwNUT^.78*EpwW^.07*Enew^.89			
EqsW		0.8653203*(1+EfsW)*EpwBL^.05*EpwNUT^.17*EpwW^.83*Enew^.98			

Documentation, information, formulas, etc. that are not part of each equation matrix can be put in cells surrounding the matrices. Contiguous documentation is stored along with the matrix in the equation bank.

Equations for documentation

Models equations are written in cell notation for efficiency. There are also written in the equation workbook using variable names and Excel math notation as documentation. All of the information (equation terms, parameters, and types) in a set of equations if maintained in an EQUATION-PARAMETER MATRIX. If any part of the matrix is changed (i.e. a term, a parameter), the equation for the model and for documentation can be re-written automatically at the click of a button. Furthermore, the equation-parameter matrices can be banked and restored to workbook sheets with control buttons on a menu of equation bank programs.

VORSIM Screen



The main VORSIM model building control screen

[Home](#)

The screenshot shows the 'VORSIM - DEMOdef.xls' spreadsheet. The 'Model' section includes parameters for the model name, drive, directory, begin year (1990), base year (1996), and end year (2000). The 'Sheet' section lists categories: E (East), WR (Western-Region), and MCM (Market-Clearing-Mechanism). The 'Category' section lists: BL (BoLts), NUT (NUTs), and W (Washers). The 'Variable' section lists: fs (shift-(unexpected change in)-sales(%)), pw (price-wholesale(\$/lb)), qp (quantity-produced(1000 lb)), qs (quantity-sold(1000 lb){if MC = market-clearing-variable}), new (new-construction(index,1990=100)), and t (time). Three text boxes provide explanatory text about VORSIM codes, model definition workbooks, and variable names.

Model	name	Drive:\Directory\-----	Begin:	Base:	End:
DEMO	C:\VMOD\		1990	1996	2000

Sheet	Description.....
E	East
WR	Western-Region
MCM	Market-Clearing-Mechanism

Category	Description.....
BL	BoLts
NUT	NUTs
W	Washers

Variable	Format	Lag	Description.....
fs	0.00	0	shift-(unexpected change in)-sales(%)
pw	0.00	2	price-wholesale(\$/lb)
qp	0	0	quantity-produced(1000 lb)
qs	0	0	quantity-sold(1000 lb){if MC = market-clearing-variable}
new	0	0	new-construction(index,1990=100)
t	0	0	time

Click [Button] to start a VORSIM operation...

The model definition sheet in a model definition workbook

Model Variable List

VORSIM - DEMOdef.xls

File Edit View Insert Format Tools Data Window Help VORSIM

J20

1. Create 2. Create Data Workbook 3. Create Equation Workbook

DEMO	WR	MCM
fsBL	WRfsBL	
fsNUT	WRfsNUT	
fsW	WRfsW	
pwBL	WRpwBL	MCMpwBL
pwNUT	WRpwNUT	MCMpwNUT
pwW	WRpwW	MCMpwW
qpBL	WRqpBL	
qpNUT	WRqpNUT	
qpW	WRqpW	
qsBL	WRqsBL	MCMqsBL
qsNUT	WRqsNUT	MCMqsNUT
qsW	WRqsW	MCMqsW
new	WRnew	
t		MCMt
pw:1BL	WRpw:1BL	
pw:2BL	WRpw:2BL	
pw:1NUT	WRpw:1NUT	
pw:2NUT	WRpw:2NUT	
pw:1W	WRpw:1W	
pw:2W	WRpw:2W	

The {Variables} sheet contains the variable names and cell locations for the model. The names are concatenation of Sheet, Variable, and Category codes. For example for the sheet code E, category code BL, and variable code qp, the variable name is EqpBL and the equation or data for that variable in the model DEMO is always located in cell B9. The {Variables} sheet brings order to Excel modeling by permanently located a model variable in a particular cell. This sheet is copied to, and used in the equation workbook and these cell locations are used in the model workbooks itself when it is created.

Buttons on this sheet create the variable names [1. Create -- Variables] and create the data, [2. Create Data Workbook] [3. Create Equation Workbook] As is the case here, buttons are often numbered to guide the order of operations carried out by clicking buttons.

A master model variable list designates the location of every variable in the model

Click [Button] to start a VORSIM operation...

Data Workbook

VORSIM - DEMOdata.xls

File Edit View Insert Format Tools Data Window Help VORSIM

A1 E variable

E variable	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EfsBL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EfsNUT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EfsW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EpwBL	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.40
EpwNUT	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29
EpwW	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17
EqpBL	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
EqpNUT	20	21	22	23	24	25	26	27	28	29	30
EqpW	200	210	220	230	240	250	260	270	280	290	300
EqsBL	500	510	520	530	540	550	660	570	580	590	600
EqsNUT	400	410	420	430	440	450	460	470	480	490	500
EqsW	300	310	320	330	340	350	360	370	380	390	400
Enew	100	102	104	106	108	110	112	114	116	118	120

Data for a model (here the model DEMO) is kept in workbook with a sheet for each major model unit. Here the sheets are {E}, {WR}, and {MCM}. The time periods appear at the top of the columns and the variable names are found at the left row heads. The base period data (here 1996) column is colored light yellow.

E / WR / MCM

Click [Button] to start a VORSIM operation...

This is a data sheet in a model data workbook (the demonstration model DEMO)

Equation Workbook

VORSIM - DEMOeqp.xls

File Edit View Insert Format Tools Data Window Help VORSIM

L29 fx

WR Add Equation Parameter Matrix Write WR Equations Put WR Equations in Model Calculate 1 Intercept

WR - Equation Parameter Matrices and Equations Edit Equation Equation Bank Summetry

price	market clearing price																				
pw	MCMpw																				
BL	-																				
NUT	-																				
w	-																				

---current price elasticities--- ---lagged price elasticities--- ---twice lagged price elasticities---

quantity produc.	bolts	nuts	washers	bolts	nuts	washers	bolts	nuts	washers	growth rate	sum of current qp elast.	sum of lagged qp elast.	sum of qp elast. lag. twice
qp	*pwBL*#	*pwNUT*#	*pwW*#	*pw:1BL*#	*1NUT*#	*pw:1W*#	*pw:2BL*#	*2NUT*#	*pw:2W*#	MCMt*#			
BL	0.33	-0.03	-0.01	0.13	-0.01		0.03			0.02	0.30	0.12	0.03
NUT		0.27	-0.05	0.00	0.17			0.07		0.02	0.22	0.17	0.03
w	-0.02	-0.10	0.35			0.09			0.05	0.03	0.23	0.09	0.00

quantity sold	shift	bolts	nuts	washers	new constr.	sum of qp elast.
qs	*(1+fs)	*pwBL*#	*pwNUT*#	*pwW*#	*new*#	
BL	-	-0.89	0.02	0.01	1.02	-0.86
NUT	-	0.06	-0.78	0.13	0.89	-0.59
w	-	0.04	0.16	-0.83	0.98	-0.63

Here you can see how the contents of cells in an equation parameter matrix along with the row and column heads become equation. Numbers replace the # symbol in terms. A dash [-] includes a term.

new constr.	growth rate
new	MCMt*#
new	0.04

Equations

WRpwBL 1*MCMpwBL
 WRpwNUT 1*MCMpwNUT
 WRpwW 1*MCMpwW
 WRqpBL 309.831*WRpwBL^0.33*WRpwW^-0.03*WRpw:1BL^0.13*WRpw:1NUT^-0.01*WRpw:2BL^0.03*(1+MCMt)^0.02
 WRqpNUT 1725.864*WRpwNUT^0.27*WRpwW^-0.05*WRpw:1NUT^0.17*WRpw:2NUT^0.07*(1+MCMt)^0.02
 WRqpW 2057*WRpwBL^-0.02*WRpwNUT^-0.1*WRpwW^0.35*WRpw:1W^0.09*WRpw:2W^0.05*(1+MCMt)^0.03
 WRqsBL 3.91353*(1+WRfsBL)*WRpwBL^-0.89*WRpwNUT^0.02*WRpwW^0.01*WRnew^1.02
 WRqsNUT 3.75083*(1+WRfsNUT)*WRpwBL^0.06*WRpwNUT^-0.78*WRpwW^0.13*WRnew^0.89
 WRqsW 1.930586*(1+WRfsW)*WRpwBL^0.04*WRpwNUT^0.16*WRpwW^-0.83*WRnew^0.98
 WRnew 103.9812*(1+MCMt)^0.04

Variables | E | **WR** | MCM | Basedata

Click [Button] to start a VORSIM operation...

An equation sheet in a model equation workbook contains equation matrices and the model equations written from them

A VORSIM Model

Vchange = \$D\$6:\$D\$8

1996	3. Install Solver	Test Solver	Solve DEMO model	Save Solution	QUIT	Change Exogenous Vari...
DEMO	E	WR	MCM			
fsBL	0.00	0.00				
fsNUT	0.00	0.00				
fsW	0.00	0.00				
pwBL	0.36	0.36	0.36			
pwNUT	0.25	0.25	0.25			
pwW	0.13	0.13	0.13			
qpBL	1600	210				
qpNUT	26	970				
qpW	260	930				
qsBL	660	1150	0			
qsNUT	460	536	0			
qsW	360	830	0			
new	112	113				
t			7			

Green Cells - variables changed by the Solver to solve model (drive values in red cells to zero)
 \$D\$6:\$D\$8

Red cells - equation values driven to zero
 3
 \$D\$12
 \$D\$13
 \$D\$14

Option: Select instrument (white) and formula (yellow) cells >= 0

A VORSIM model configured for installation of the Excel solver

Model / Solver parameters / Current solution status /

Click [Button] to start a VORSIM operation... NUM

[Home](#)

Solution Manager

Solutions can be managed and examined with programs accessed from the Solution Manager control screen

Red buttons move you between control screens

VORSIM Solution Manager - Vorutil.xls

File Edit View Insert Format Tools Data Window Help VORSIM

Solution_Man. = View/explain solution values, manage solutions and indicators, compare solutions

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VORSIM™ Solution Manager

Chart Solution Values

Explain Solution Variable Changes **Chart Solution Cross-Section**

Load Any File **Load Solution File**

Load *.lst File with Charts, Pivot Tables, and Lists Comparing Solution Values

Load Solution List/Add Indicators

Load/Modify Indicators **Create *.lst File with Comparative Charts, Pivot Tables, Filtered List for Selected Variables and Solutions**

Create Indicator Workbook

Select Active Model > **Model Name: DEMO** **QUIT**

Directory: C:\VMOD\DEMO

Go To > **VORSIM** **Reports-Data** **Model Manager** **Model**

Click [Button] to start a VORSIM operation... NUM

Indicators

VORSIM Solution Manager - DEMOind.xls

File Edit View Insert Format Tools Data Window Help VORSIM

B2 fx <--Model

Expand | term for categories 1. Create Indicator formulas 2. Create Aggregation formulas 3. Finalize formul

DEMO <--Model C:\VMOD\ Begin: 1990 Base: 1996 End: 2000

Sheet	E	WR	MCM	AR			
Category	BL	NUT	W	AP			
Variable	fs	pw	qp	qs	new	t	sh

QUIT Add Row for Indicator Formula Add Row for Aggregate Code Bank Indicators

Indicator	Format	Formula for Indicator (! Sheet, | Category)	Explanation
qpAP	0	$lqpBL + lqpNUT + lqpW$	Aggregate Product
pwAP	0.00	$(lqpBL * lpwBL + lqpNUT * lpwNUT + lqpW * lpwW) / (0.001 + lqpAP)$	price - wholesale (of Aggregate Product)
shBL	0	$100 * lqpBL / (0.001 + EqpBL + WRqpBL)$	share of BoLt production
shNUT	0	$100 * lqpNUT / (0.001 + EqpNUT + WRqpNUT)$	share of NUT production
shW	0	$100 * lqpW / (0.001 + EqpW + WRqpW)$	share of Washer production

Indicator formulas, formats, and explanations.

Mark sheets to be aggregated for each Code with a 1

Code	E	WR	MCM
AR	1	1	

Aggregate Region = E + WR

Variable	Format	Weight (if any) and Term for Aggregation	Explanation
ARqpBL	0	qpBL	AR - quantity produced - BoLts
ARqpNUT	0	qpNUT	AR - quantity produced - NUTs
ARqpW	0	qpW	AR - quantity produced - Washers
ARqpAP	0	qpAP	AR - quantity produced - Aggregate Product
ARpwAP	0.00	qpAP * pwAP	AR - price - wholesale - Aggregate Product

Aggregation variables and weights (if they are used). Note that only variables (or weights*variables) are put in formulas for aggregation across sheets. The program inserts the + signs in the aggregation formulas.

Indicators Template Formulas

Click [Button] to start a VORSIM operation...

Indicators (post solution calculations) can be added to solutions anytime

Simulation Solution

Microsoft Excel - DEMObase.sol

File Edit View Insert Format Tools Data Window Help VORSIM

A1 1996

1996	base	base solution	1990	2000
DEMO	E	WR	MCM	AR
fsBL	0.00	0.00		
fsNUT	0.00	0.00		
fsW	0.00	0.00		
pwBL	0.36	0.36	0.36	
pwNUT	0.25	0.25	0.25	
pwW	0.13	0.13	0.13	
qpBL	1600	210		1810
qpNUT	26	970		996
qpW	260	930		1190
qsBL	660	1150	0	
qsNUT	460	536	0	
qsW	360	830	0	
new	112	113		
t			7	
qpAP	1886	2110		3996
pwAP	0.33	0.21		0.26
shBL	88	12		
shNUT	3	97		
shW	22	78		

1996 1997 1998 1999 2000

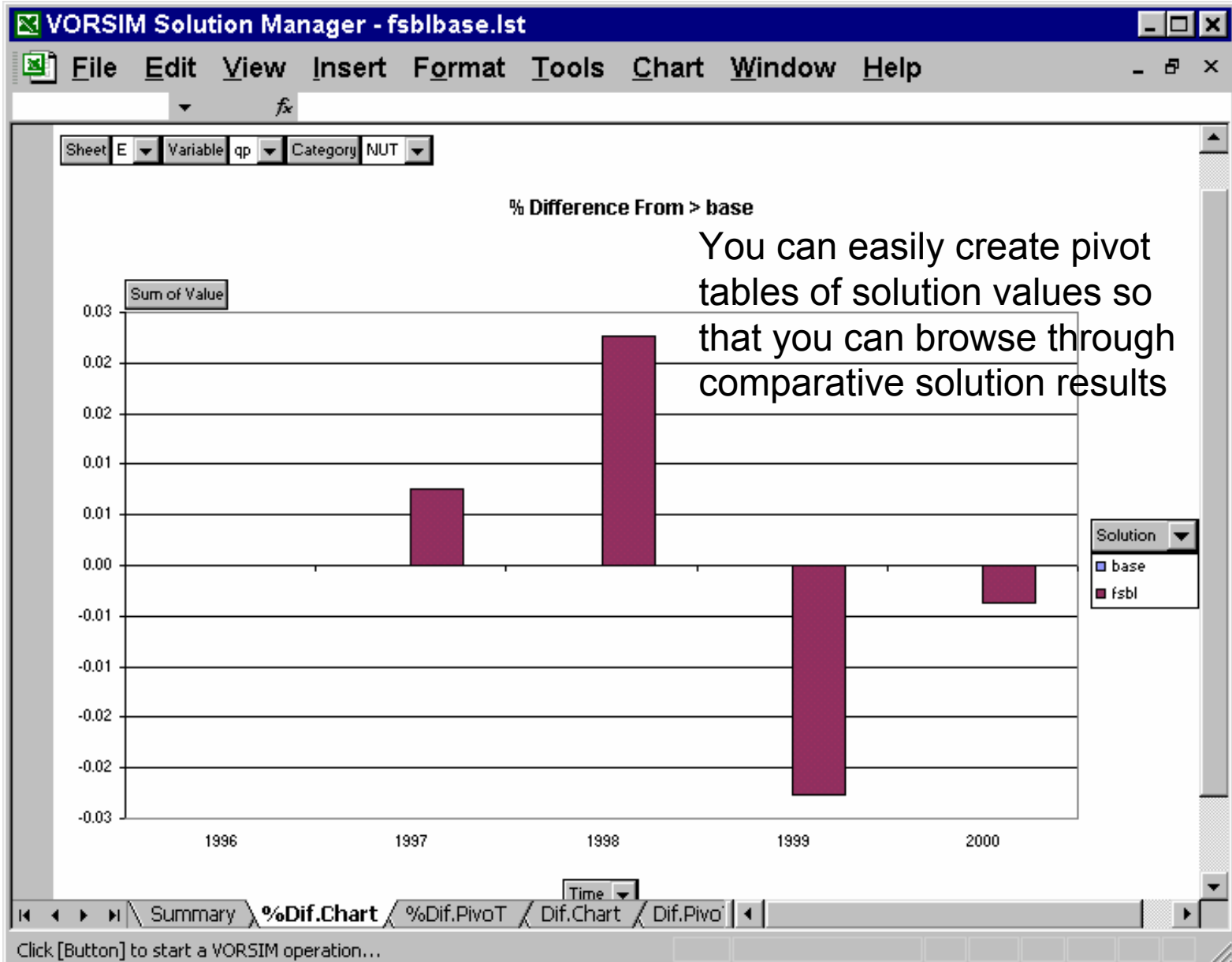
Click [Button] to start a VORSIM operation...

A solution workbook with indicators added

Solution values are color coded to show how they were created (e.g. yellow cells contain values generated by model equations)

Indicators are added as rows and columns with light green labels

Compare Solutions



Generate Reports

You can chart and analyze data and solutions and prepare reports of simulation results from the Reports, Data Analysis control screen

Reports, Data Analysis - Vordata.xls

File Edit View Insert Format Tools Data Window Help VORSIM

Reports_Data = Create/update reports, view/analyze data, view solution values

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VORSIM™ Reports, Data Analysis

Movelist (*.rpt) file:
move data between workbooks; from solutions to reports

Report (*.tmp) file:
link report to, copy from solutions

[Load Equation Workbook](#) [Load Data Workbook](#)

[Chart Parameter Block](#) [Chart/Trend Data Value](#)

[Chart Block of Data](#) [Regression Analysis of Data](#)

Select > Active Model

Model Name: **DEMO** [QUIT](#)

Directory: **C:\VMOD\DEMO**

[Go To>](#) [VORSIM](#) [Solution Manager](#) [Model Manager](#) [Model](#)

[Create New Report \(*.tmp\)](#)

[Chart Solution Time Series Variable\(s\)](#) [Load a Solution](#)

[Chart Cross-Section - Solution Variables](#)

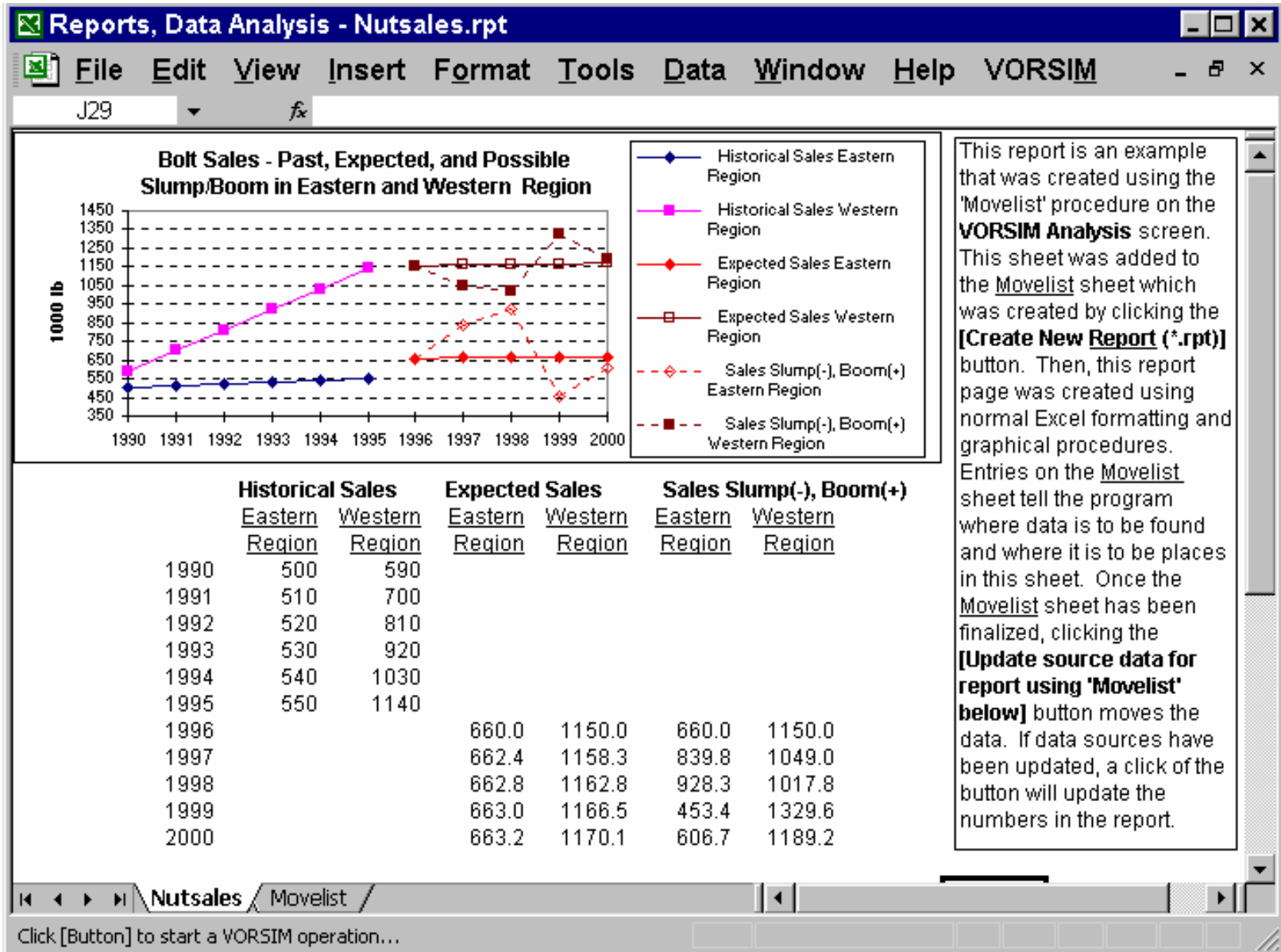
[Load, Modify Report \(*.tmp\); Add Solution Links](#)

[Create New Move-list \(*.rpt\)](#)

[Load Move-list \(*.rpt\); Modify, Update Report & Files](#)

Click [Button] to start a VORSIM operation... NUM

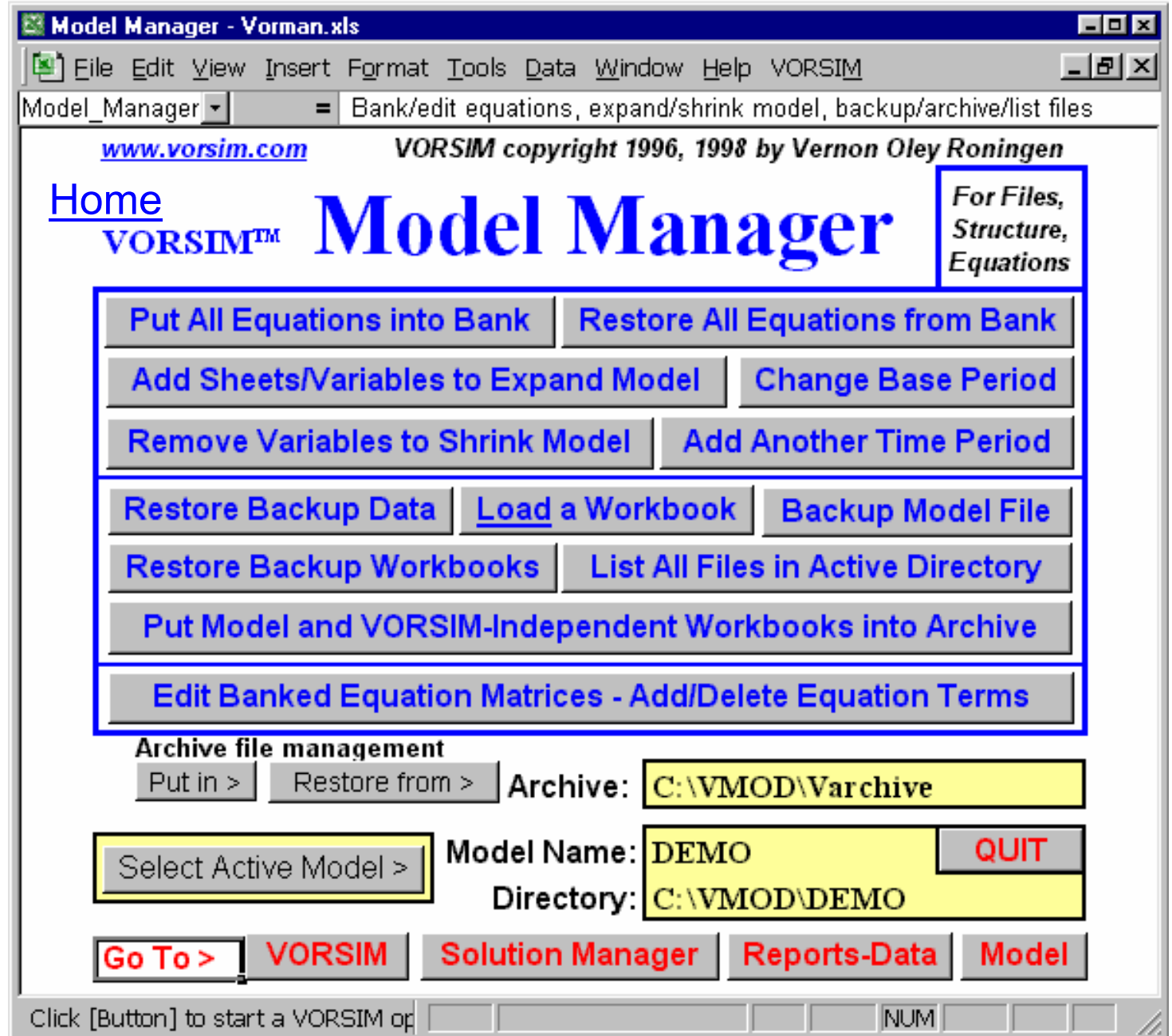
Movelist Report



A sample report created from solution values; the report can be updated as needed

Model Manager

The Model Manager control screen offers many model management options, including the expansion of an existing model by adding Sheets, Categories, and/or Variables



Model Manager - DirSummary.xls

File Edit View Insert Format Tools Data Window Help VORSIM

A1

Model = DEMO Model Directory = C:\VMOD\DEMO

DEMOstration model

Model (*.xls) and Backup (*.bak) Files	Equation Bank (*.eqa) Files	Sheet Backup (*.txt) Files	Solution (*.sol) and Pivot/List (*.lst) Files	Report (*.rpt, *.tmp) Files
DEMOfdata.xls	Enew.eqa	DataE.txt	DEMOfbase.sol	Report.rpt
DEMOfdef.xls	Epw.eqa	DataMCM.txt	DEMOfsbl.sol	Nutsales.rpt
DEMOfeqp.xls	Eqp.eqa	DataWR.txt	DEMOfhist.sol	Nmovelis.rpt
DEMOfhist.xls	Eqs.eqa	Definition.txt	DEMOfsbw.sol	
DEMOfind.xls	MCMqs.eqa	Demoread.txt	DEMOfbadd.sol	Report.tmp
DEMOfmod.xls	WRnew.eqa	MODread.txt		Lreport.tmp
DEMOfmodA.xls	WRpw.eqa	Variables.txt	fsblbase.lst	
DirSummary.xls	WRqp.eqa	AnalForm.txt	histbase.lst	
Equasum.xls	WRqs.eqa		compare.lst	
Indicator.xls			basebsw.lst	
Solution.xls				
DEMOfocsum.xls				
Aggregate.xls				
WBSummary.xls				
DEMOfexog.xls				

DEMOdata.bak
DEMOdef.bak
DEMOeqp.bak
DEMOind.bak
DEMOmod.bak
DirSummary.bak
DEMOmodA.bak
DEMOexog.bak
DEMOfhist.bak

Model File List

A complete list of all files in a model directory can be create any time from the Model Manager control screen

Summary of DEMO Directory

Click [Button] to start a VORSIM operation...

Equation Editor

Model Manager - Vorman.xls

File Edit View Insert Format Tools Data Window Help VORSIM

A3 fx

Get Equation from Bank Put Equation Below in Bank QUIT Clear Marks in Selected Cells

Equation Editor

---current price elasticities---

quantity sold	shift	bolts	nuts	washers	new constr.	sum of qs elast.
qs	$*(1+ifs)$	$*!pwBL^#!$	$*!pwNUT^#!$	$*!pwW^#!$	$*!new^#!$	
BL	-	-0.89	0.02	0.01	1.02	-0.86
NUT	-	0.04	-0.78	0.07	0.89	-0.67
W	-	0.05	0.17	-0.83	0.98	-0.61

Note: In equation terms: ! = Sheet, | = Category, # = parameter from cell.
 The equation is shown below (before substitutions, with the constant calculated at initialization):

$constant*(1+ifs)!pwBL^#!pwNUT^#!pwW^#!new^#$

Click [Button] to start a VORSIM operation...

Banked equation matrices can be edited and modified from the Model Manager control screen while model equations can be edited and modified directly in the equation workbook (from the VORSIM control screen)

www.vorsim.com

For more up to date information about VORSIM, visit our website. The latest version of the User's Guide is posted there and the Q & A section may answer many questions you have.

If you need more information, please E-mail us at info@vorsim.com