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

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Presentation Outline

- Trade Policy Analysis and Modeling in Developing Countries
- WTSM -- World Trade Simulation Model
- WTSM Applications -- Multilateral, Regional, and Unilateral Policy Studies
- WTSM and Trade Capacity Building
  - A Trade Policy Analysis and Modeling Program
  - Potomac Associates
- VORSIM Model Building Software for Microsoft Excel

(Click on Underlined Links)

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) $$M^{d}_{k(i)} = C^{m}_{k(i)} \left[P^{m}_{k(i)} \right]^{\eta k(i)}$$ **Import demand (country i, good k)**

$$P^{m}_{k(i)} = (1 + \tau_{k(i)})^{fk(i)} \left[P\$_{k} (1 + t_{k(i)}) / e_{(i)} \right]$$ **Import price (country i, good k)**

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

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

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

(4) $$\Sigma_{k} (P\$_{k} X^{s}_{k(i)} - P\$_{k} M^{d}_{k(i)}) + K\$_{(i)} = 0$$

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-Sahara Africa (23)**

WTSM Countries (Details)

OECD
Austr, Can, EU,
Jpn, Nz, Nor,
Switz, US

East Asia
China
Hong Kong
Indonesia
Korea, Rep.
Malaysia
Pap. New Guinea
Philippines
Singapore
Taiwan
Thailand
Viet Nam

Eastern Europe
Albania
Belarus
Czech Republic
Estonia
Hungary
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Moldova
Poland
Russia
Ukraine

Latin America
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Dominican Rep.
Ecuador
El Salvador
Guatemala
Honduras
Jamaica
Mexico

Latin America
Nicaragua
Panama
Paraguay
Peru
Trin. & Tobago
Uruguay
Venezuela

S. Saharan Afr.
Burkina Faso
Cameroon
Cen. African Rep.
Chad
Congo
Côte d'Ivoire
Ethiopia

S. Saharan Afr
Gabon
Ghana
Kenya
Madagascar
Malawi
Mali
Mauritius
Mozambique
Nigeria
Rwanda
South Africa
Sudan
Tanzania
Uganda
Zambia
Zimbabwe

Middle East
Algeria
Egypt
Israel
Morocco
Oman
Saudi Arabia
Tunisia
Turkey

South Asia
Bangladesh
India
Nepal
Pakistan
Sri Lanka

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) $$M^{d}_{k(i)} = C^{m}_{k(i)} \left[P^{m}_{k(i)} \right]^{\eta k(i)}$$ **Import demand (country i, good k)**

$$P^{m}_{k(i)} = (1 + \tau_{k(i)})^{fk(i)} \left[P\$_{k} (1 + t_{k(i)}) / e_{(i)} \right]$$ **Import price (country i, good k)**

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

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

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

(4) $$\Sigma_{k} (P\$_{k} X^{s}_{k(i)} - P\$_{k} M^{d}_{k(i)}) + K\$_{(i)} = 0$$

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)		($Bill.)	(Percent)		($Bill.)
Developing Countries	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
OECD Countries	…	…	…	2	2	61
World	…	…	…	3	3	131

Source: WTSM.

EAC Trade Simulation Model

(1) $M^{d}_{k(i)} = C^{m}_{k(i)} \left[P^{m}_{k} - \Sigma_j (a_{jk} \; P^{m}_{j}) \right]^{\eta k(i)}$ **Import demand (country i, good k)**

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

(2) $X^{s}_{k(i)} = C^{x}_{k(i)} \left[P^{x}_{k(i)} - \Sigma_j (a_{jk} \; P^{m}_{j}) \right]^{\alpha k(i)}$ **Export supply (country i, good k)**

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

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

(4) $\Sigma_k \left(P\$_k \, X^{s}_{k(i)} - P\$_k \, M^{d}_{k(i)} \right) + K\$_{(i)} = 0$

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 ($26,179 GDP)		
	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%	CU-20%	CU-10%	MFN-0%
Percent Change in Real Exchange Rate (U.S.$/Local Currency)												
All Products	0.9	-1.9	-9.6	-12.0	-14.6	-21.3	2.6	0.2	-5.6	...	...	...
Change in Real Exports												
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
Trade Creation = Change in Real Imports												
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
Trade Diversion												
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
Forgone 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) $$M^d_k = C^m_k \left[P^m_k - \Sigma_j \left(a_{jk} \; P^m_j \right) \right]^{\eta k}$$

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

Export Supply

(2) $$X^s_k = C^x_k \left[P^x_k - \Sigma_j \left(a_{jk} \; P^m_j \right) \right]^{\alpha k}$$

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

International Payments Equilibrium

(3) $$\Sigma_k \left(P\$_k \, X^s_k - P\$_k \, M^d_k \right) + K\$ = 0$$

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	Export Price	Imports	Exports	Imports	Exports	Employ-ment	Producer Surplus	Consumer Surplus	Economic Welfare	Tariff Revenues
	(Percent)		(Frw Million)		(Percent)		(ManYrs)		(Frw Million)		
					Free Trade Zone Scenarios						
Economywide FTZ											
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
Manufacturing EPZ											
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
Textiles and Apparel EPZ											
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
					Related Scenarios						
Reduced Foreign Aid											
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
Increased Fertilizer Use											
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

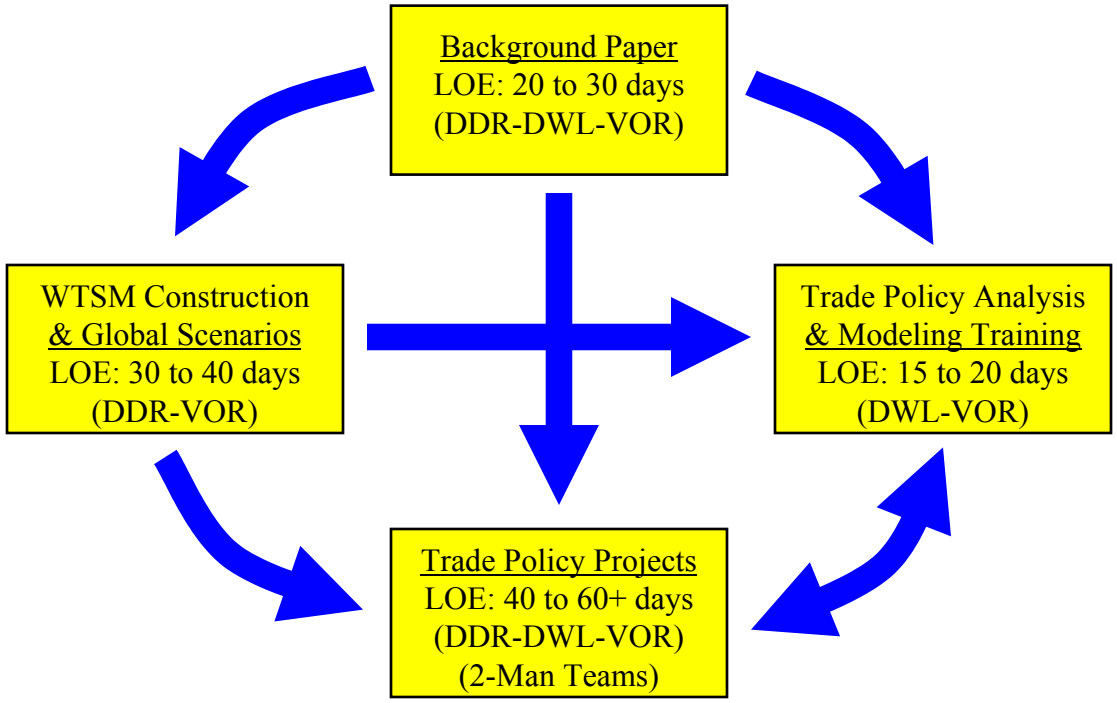
WTSM can be adapted to support trade capacity building activities in developing countries, in at least two modes:

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



(Continue | Program Notes | Return to Outline)

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

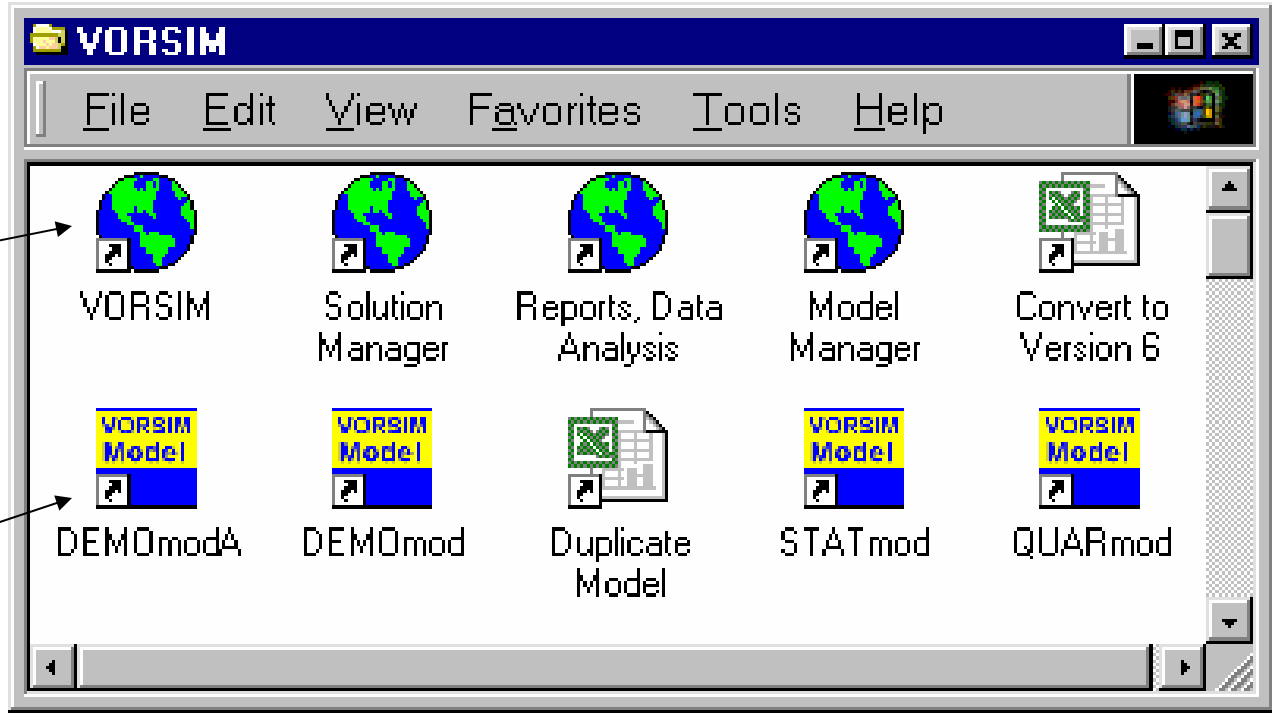
- **Dean A. DeRosa** is principal economist of ADR International, Ltd., an economic research and policy consulting firm located in Falls Church, Virginia (www.adr-intl.com). DeRosa holds a Ph.D. (1975) in economics from the University of Oregon. He has been engaged in trade research and policy analysis 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)

VORSIM™

A Model Building Software Package for Microsoft Excel in Windows

VORSIM Window



Icons for programs

Icons for models

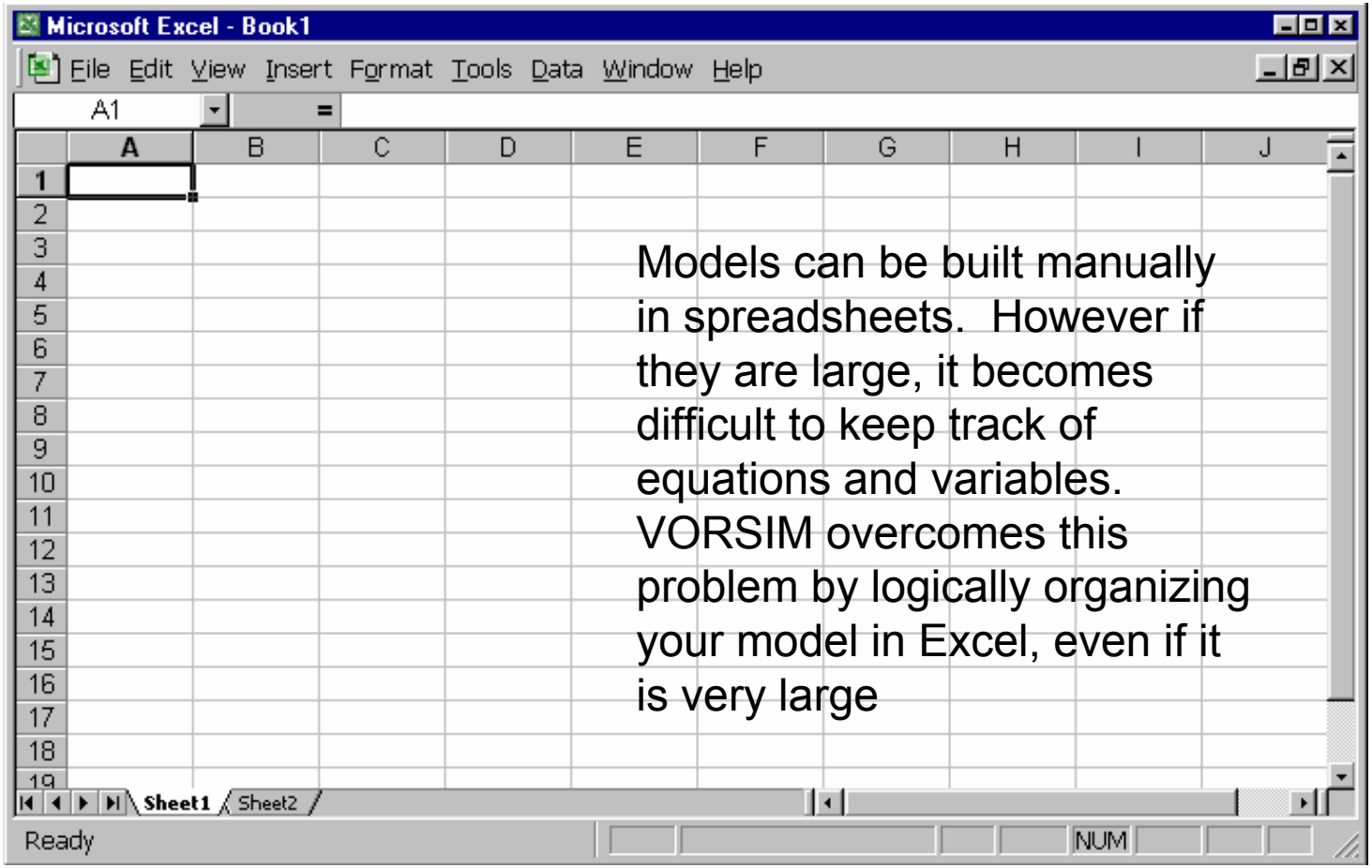
Programs and models are accessed with icons in the VORSIM window.

(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.

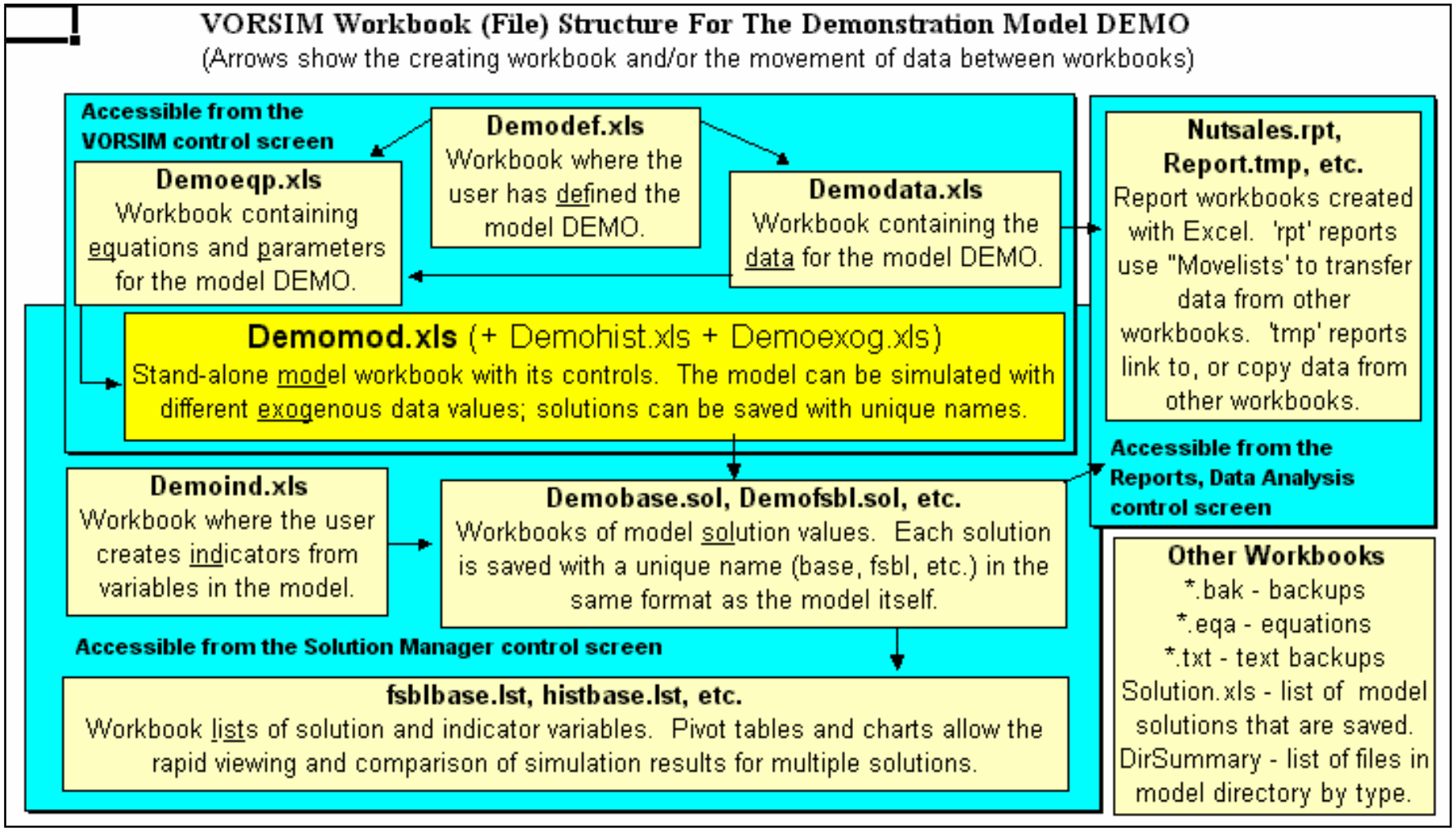


Models can be built manually in spreadsheets. However if they are large, it becomes difficult to keep track of equations and variables. VORSIM overcomes this problem by logically organizing your model in Excel, even if it is very large

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



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

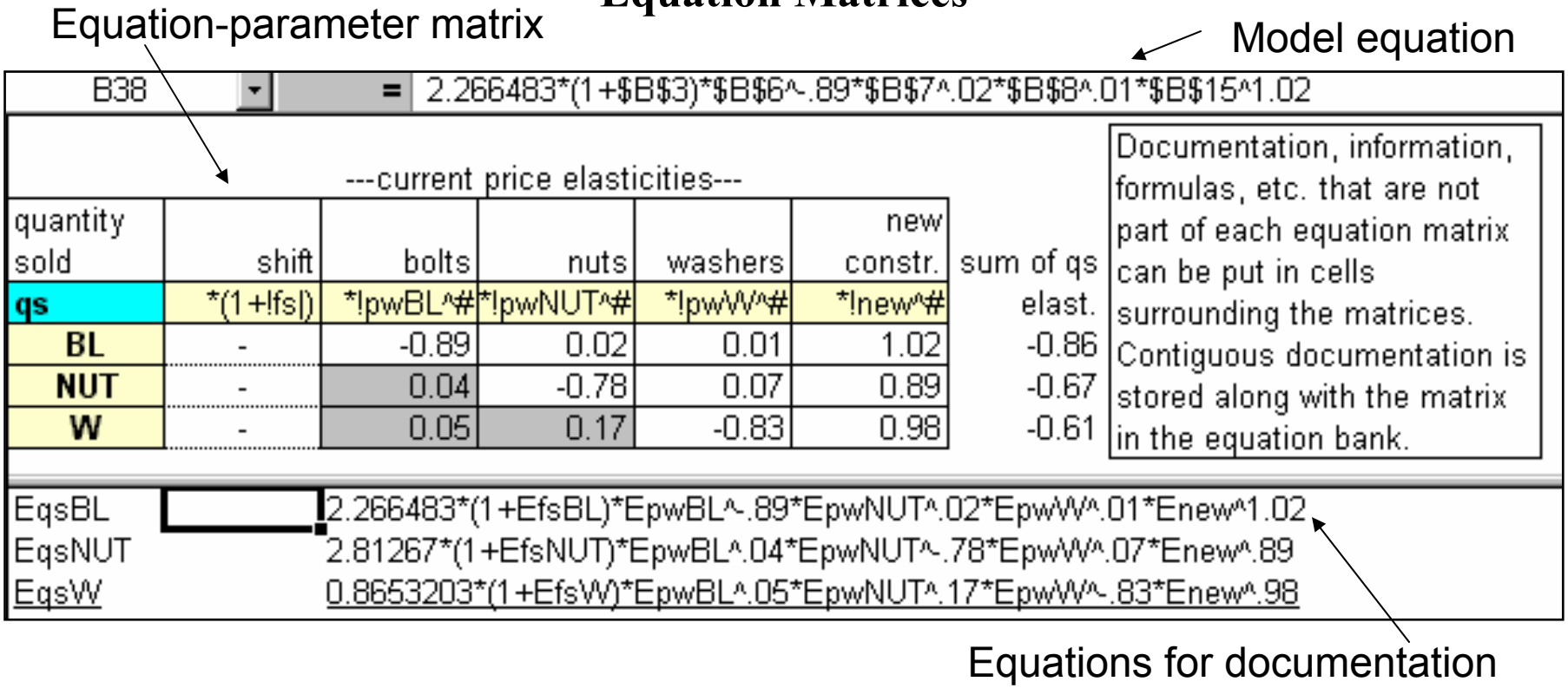
Sheet — The MAJOR division of information in a VORSIM model.
Data and equation workbooks are organized by sheets.
Denoted by 1-3 digit upper case letters, e.g. US, CAN, W.
Sheet codes are sheet names in data, equation, solution workbooks.

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 varible names in the US and CAN sheets for data and equations might be (not all potential variables need be used):

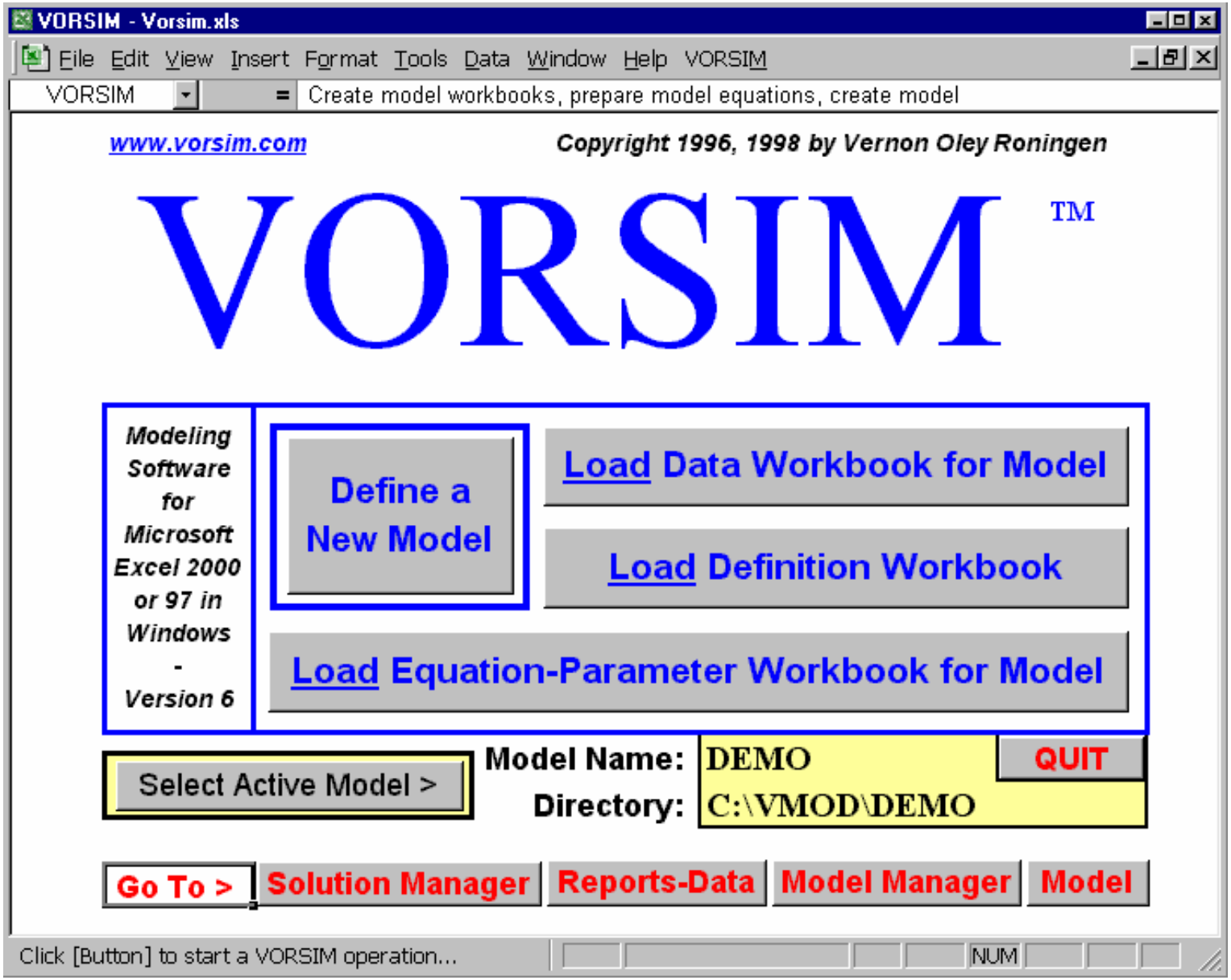
US sheet	CAN sheet
USqsWH	CANqsWH
USqsRIC	CANqsRIC
USqsX	CANqsX
USx	CANx
USquant	CANquant
USnew	CANnew

Equation Matrices



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.

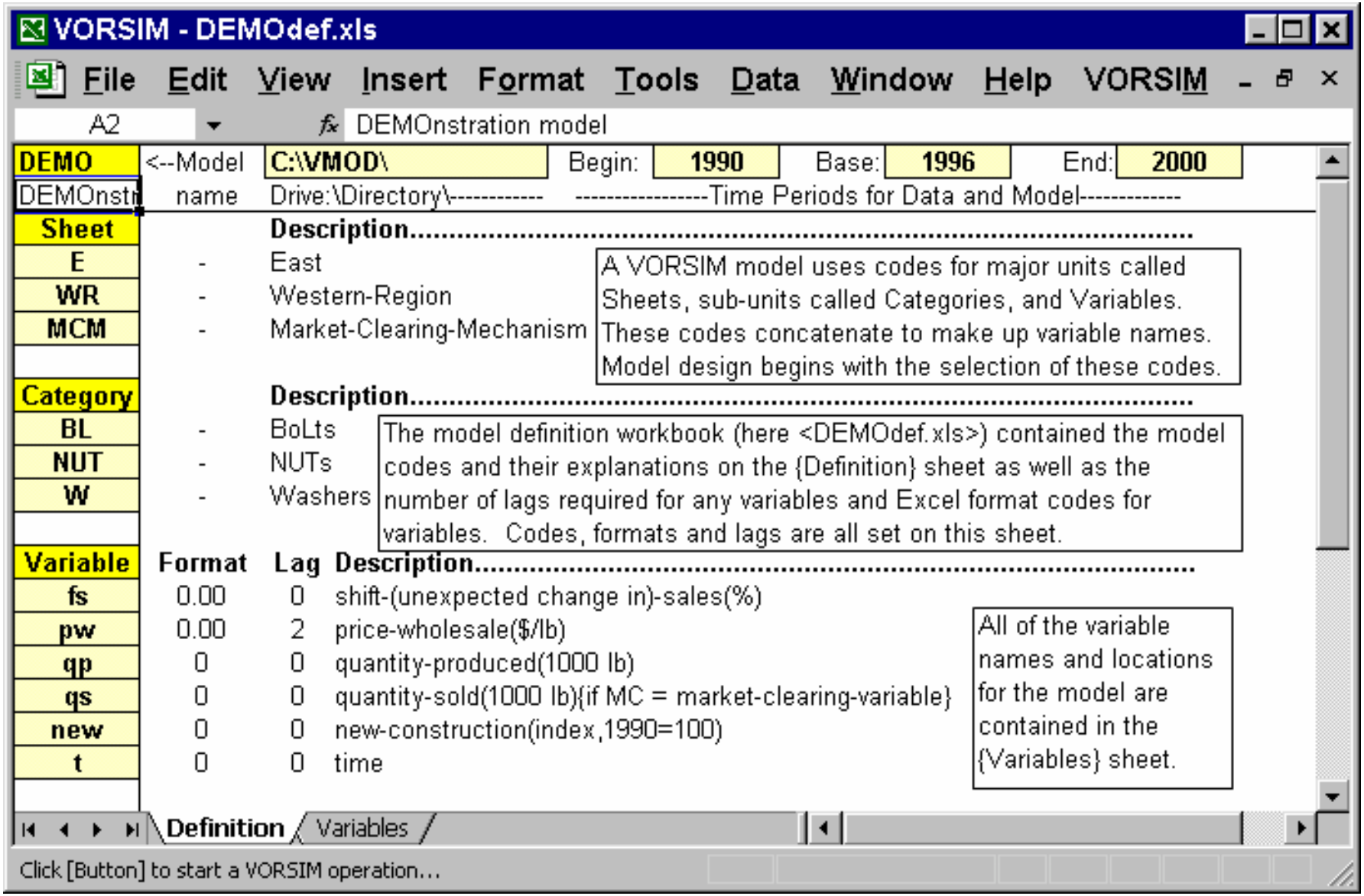
VORSIM Screen



The main VORSIM model building control screen

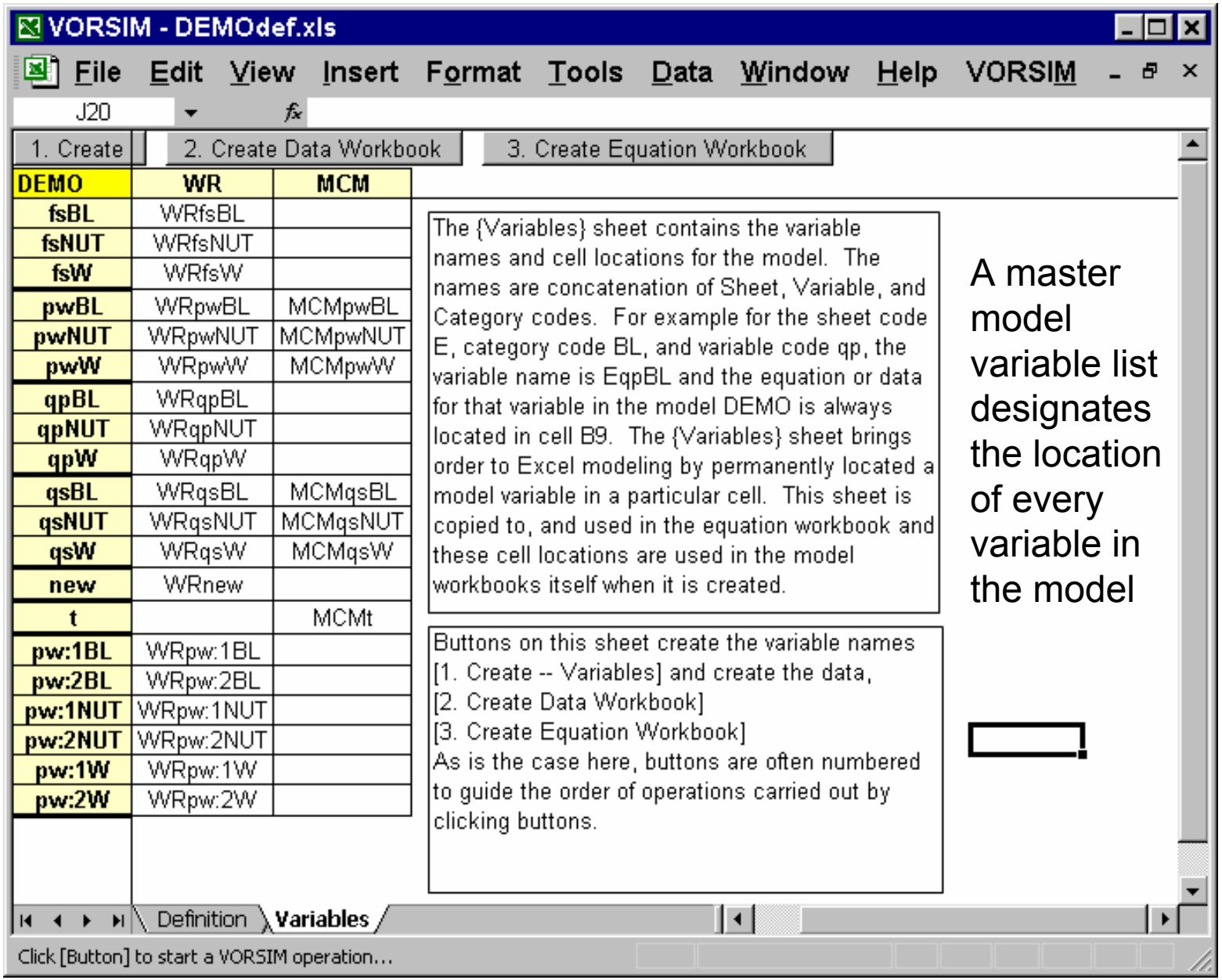
Home

Model Definition



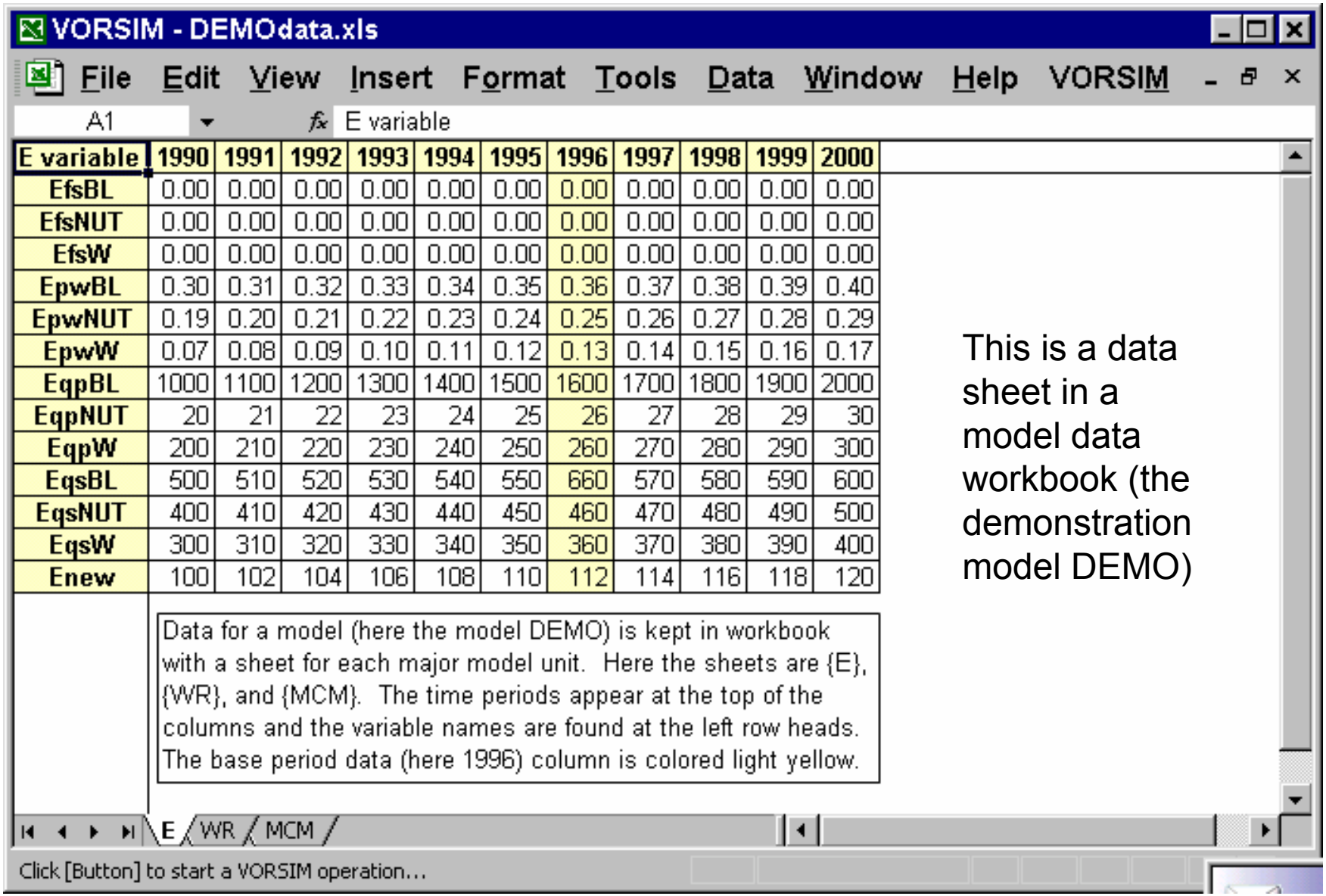
The model definition sheet in a model definition workbook

Model Variable List



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

Data Workbook

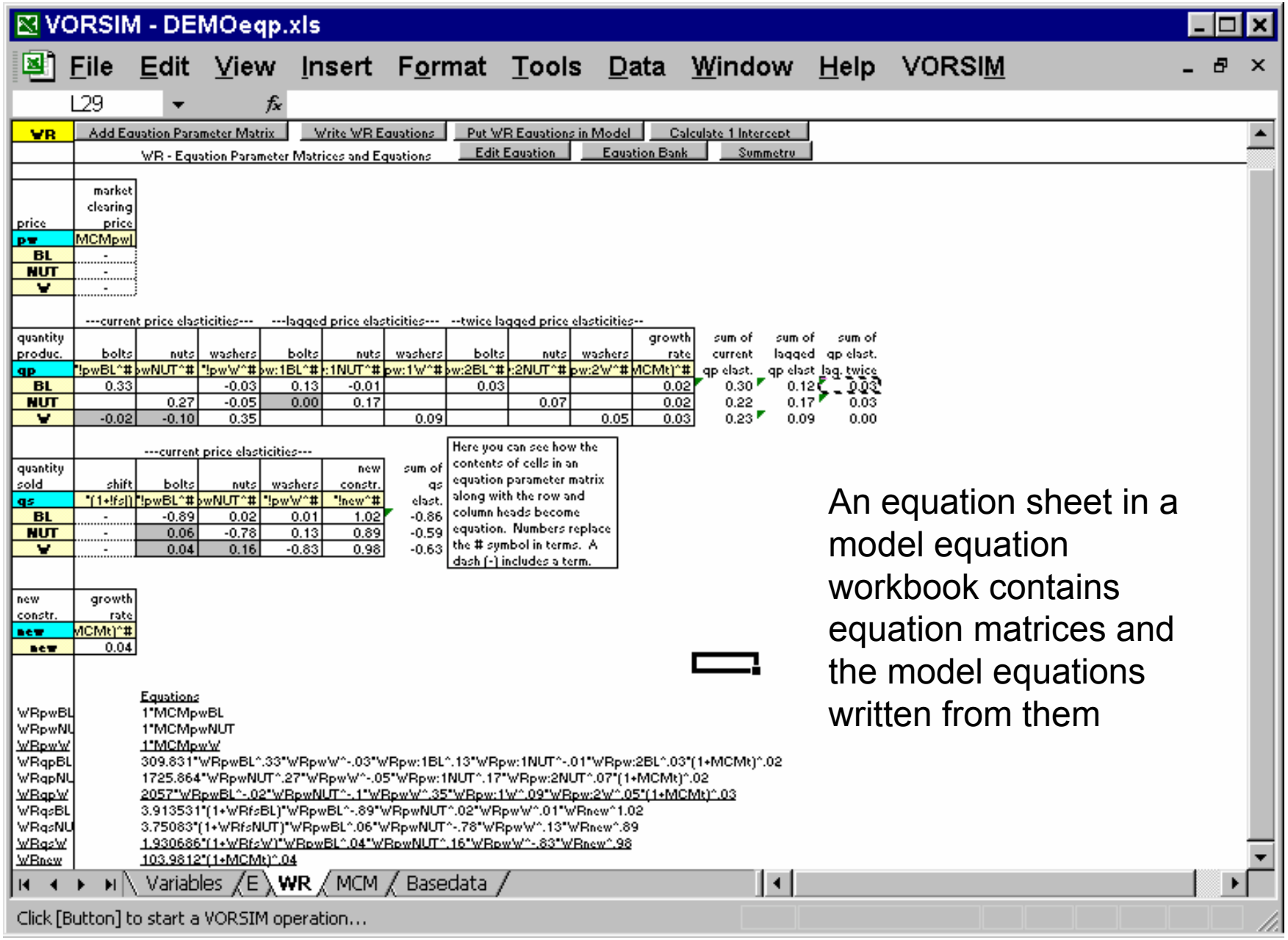


E variable	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
EfsBL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EfsNUT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EfsW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EpwBL	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39	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.

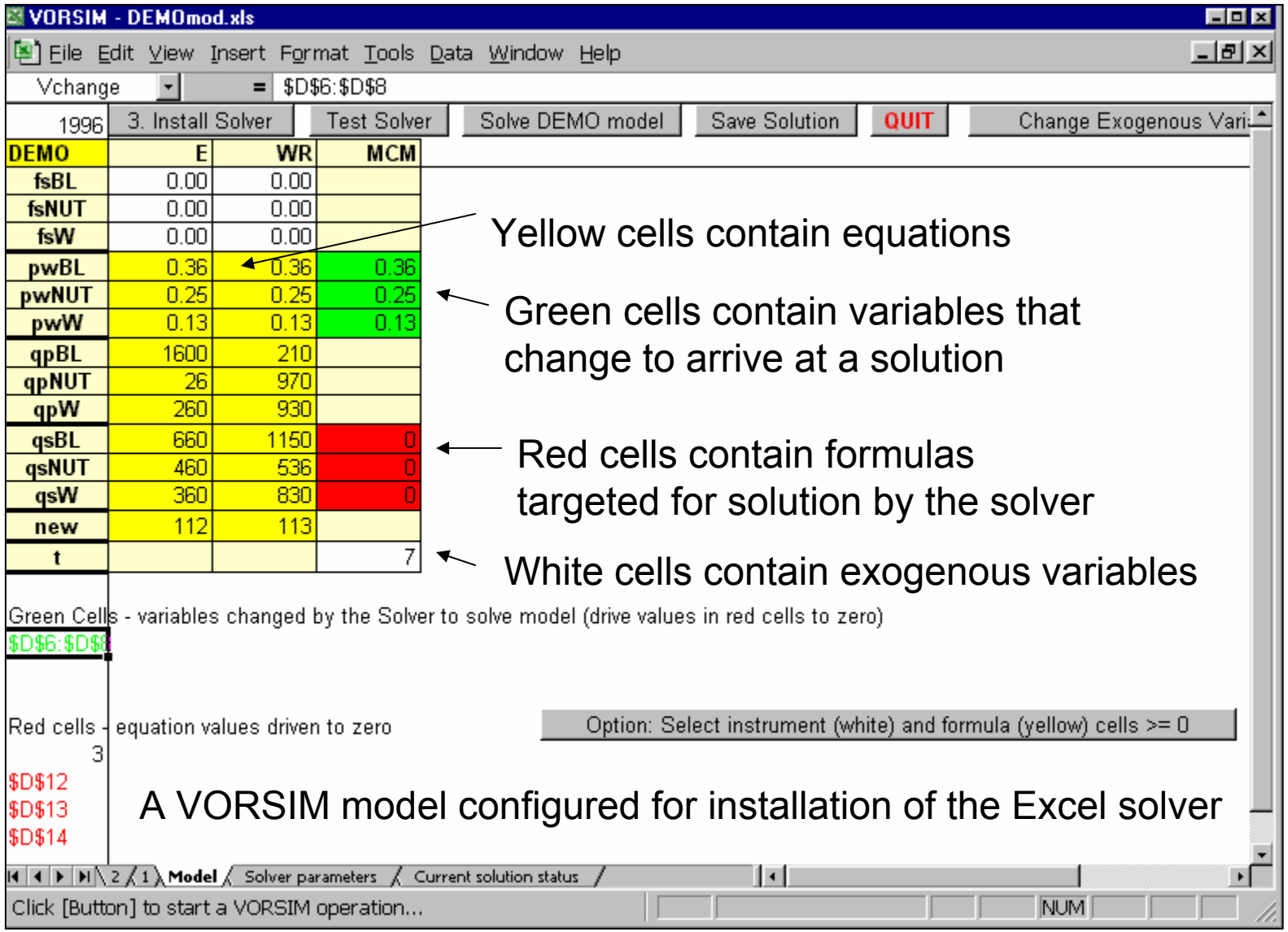
This is a data sheet in a model data workbook (the demonstration model DEMO)

Equation Workbook



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

A VORSIM Model

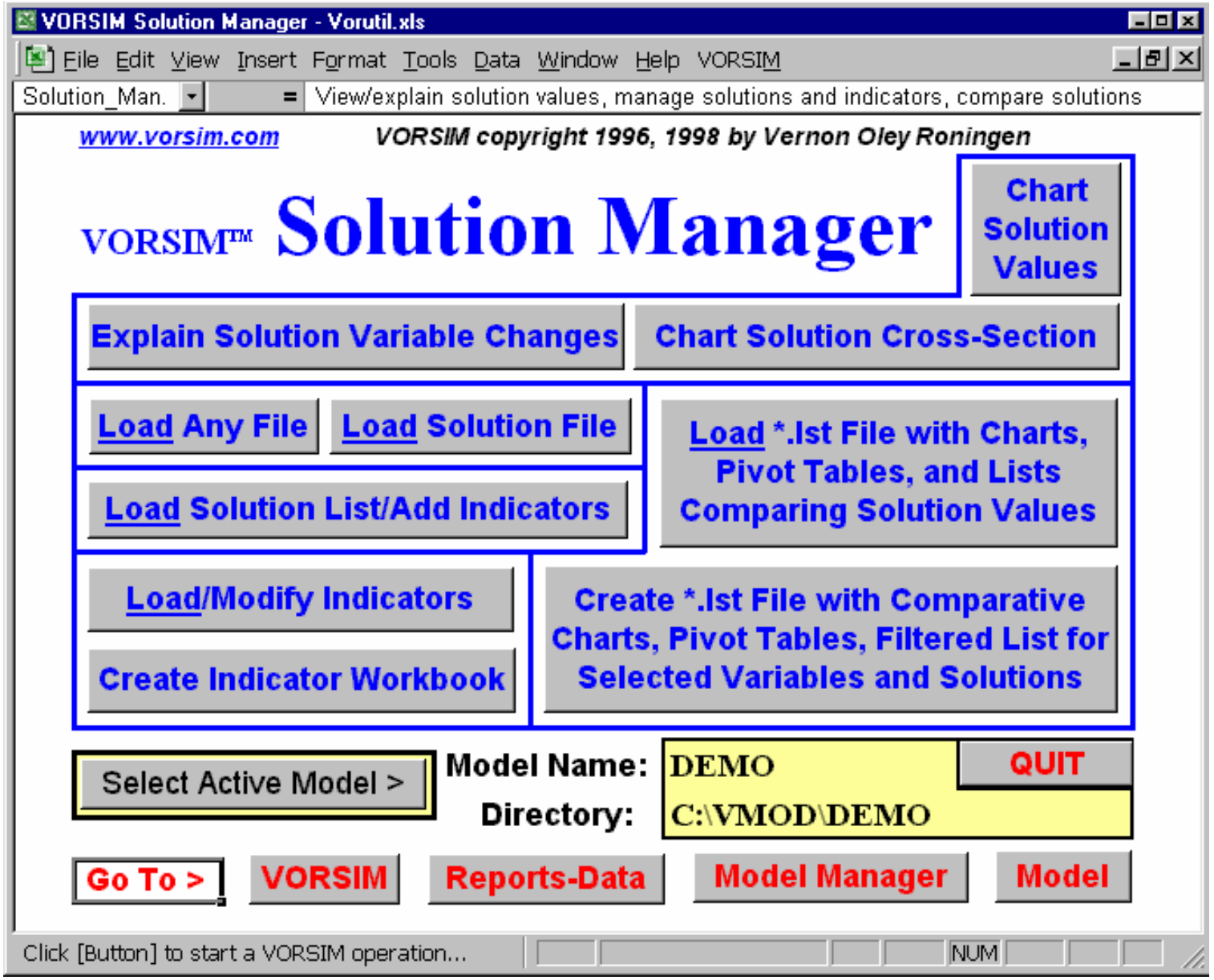


Home

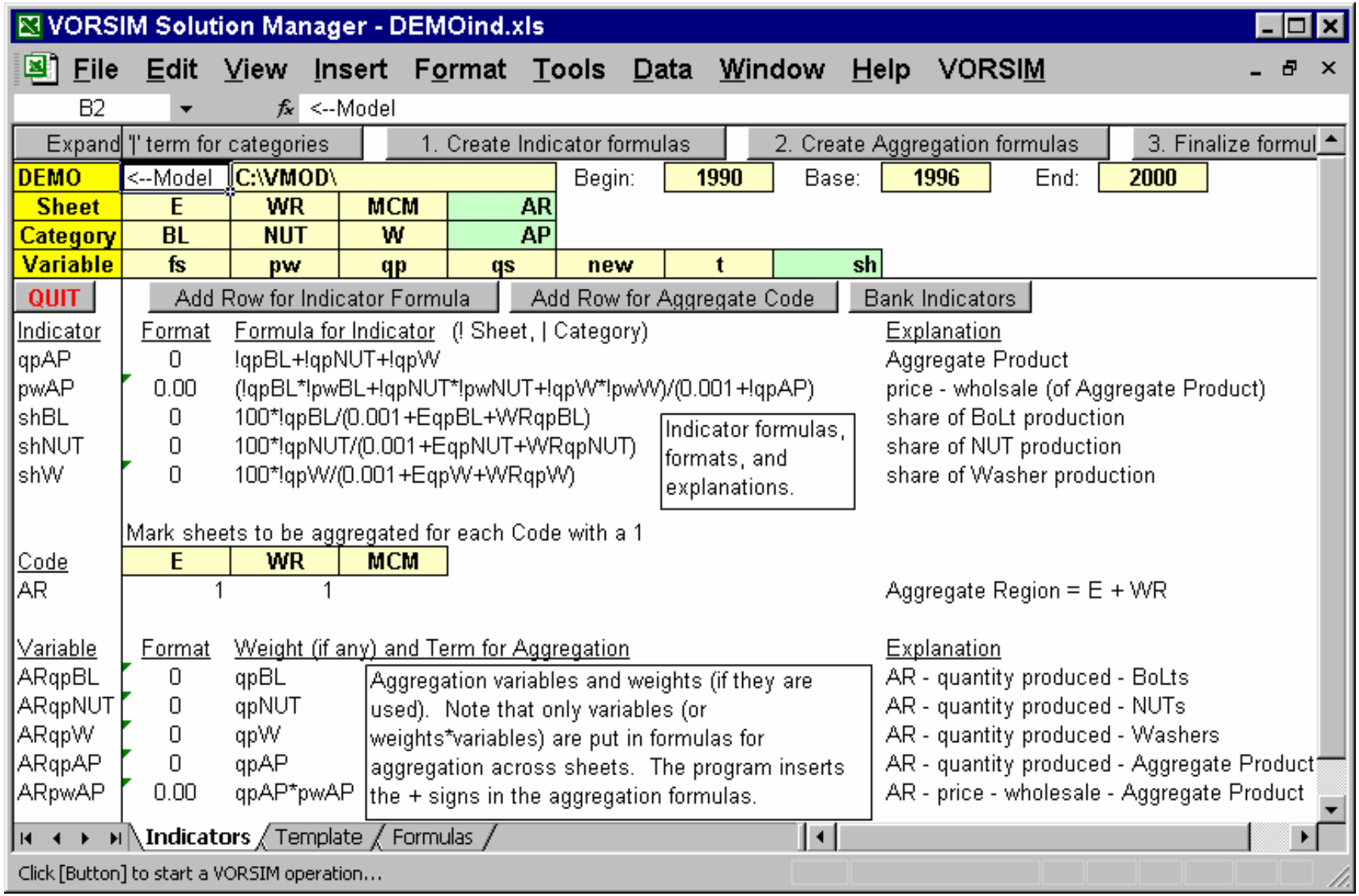
Solution Manager

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

Red buttons move you between control screens

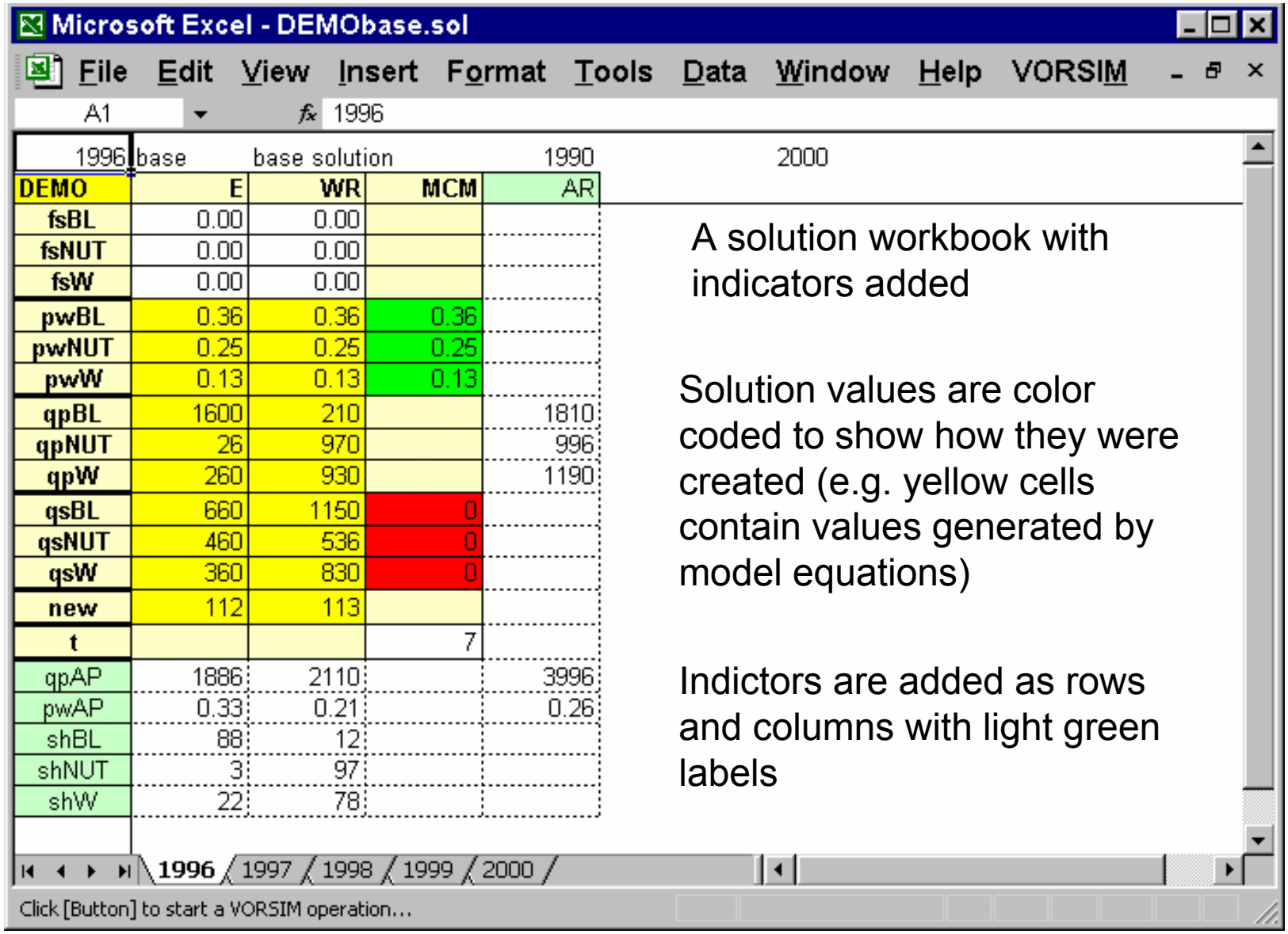


Indicators



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

Simulation Solution

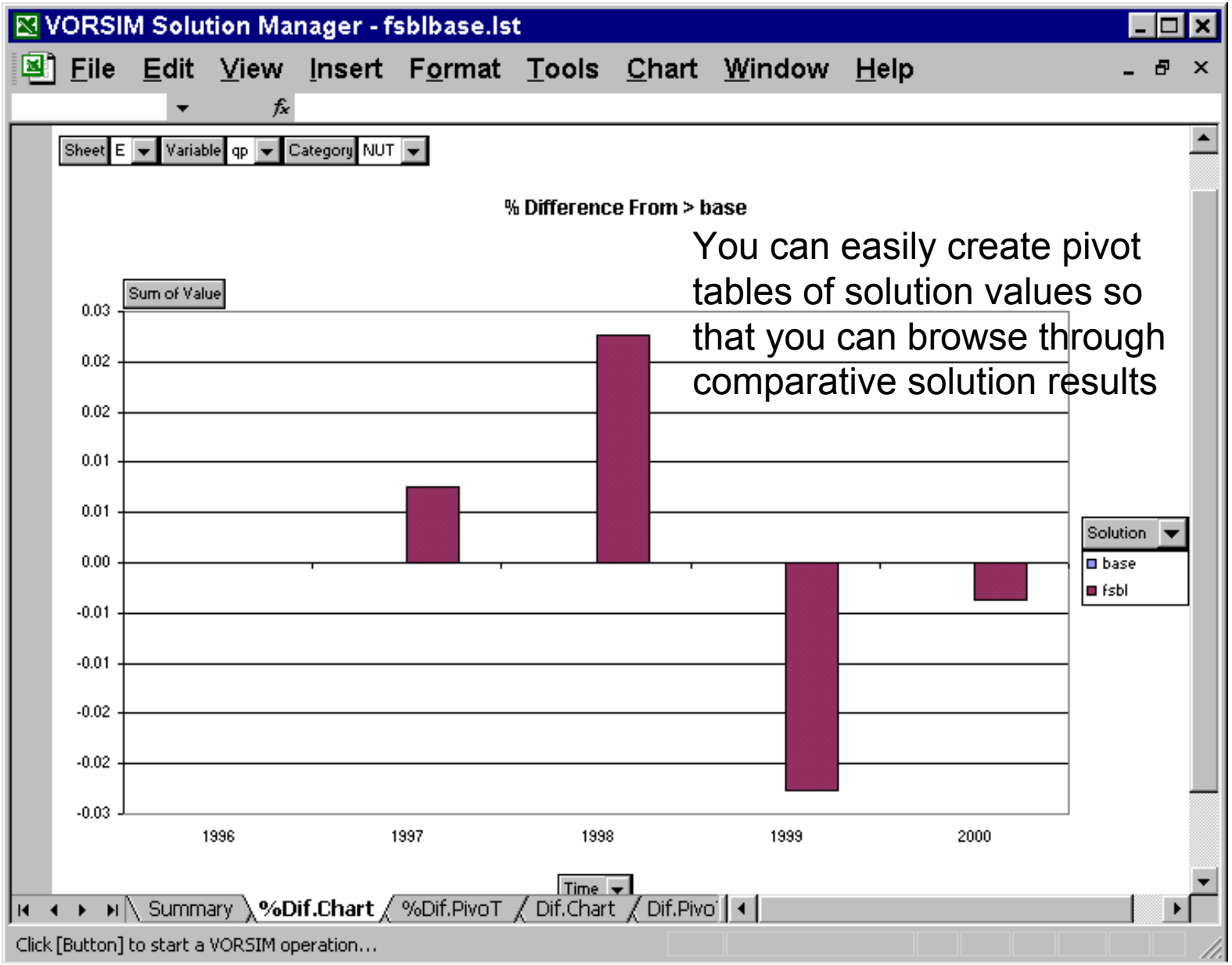


A solution workbook with indicators added

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

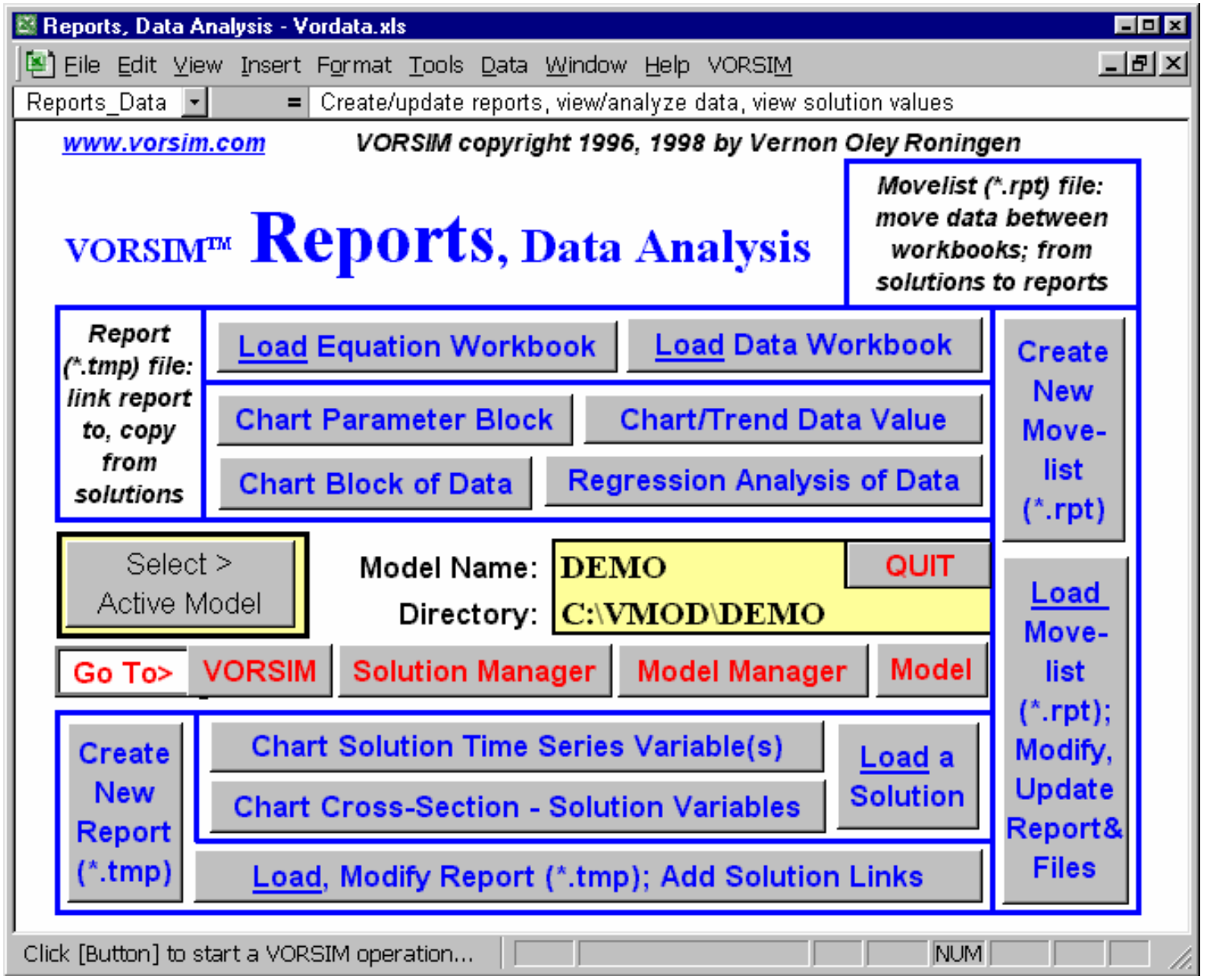
Indictors are added as rows and columns with light green labels

Compare Solutions

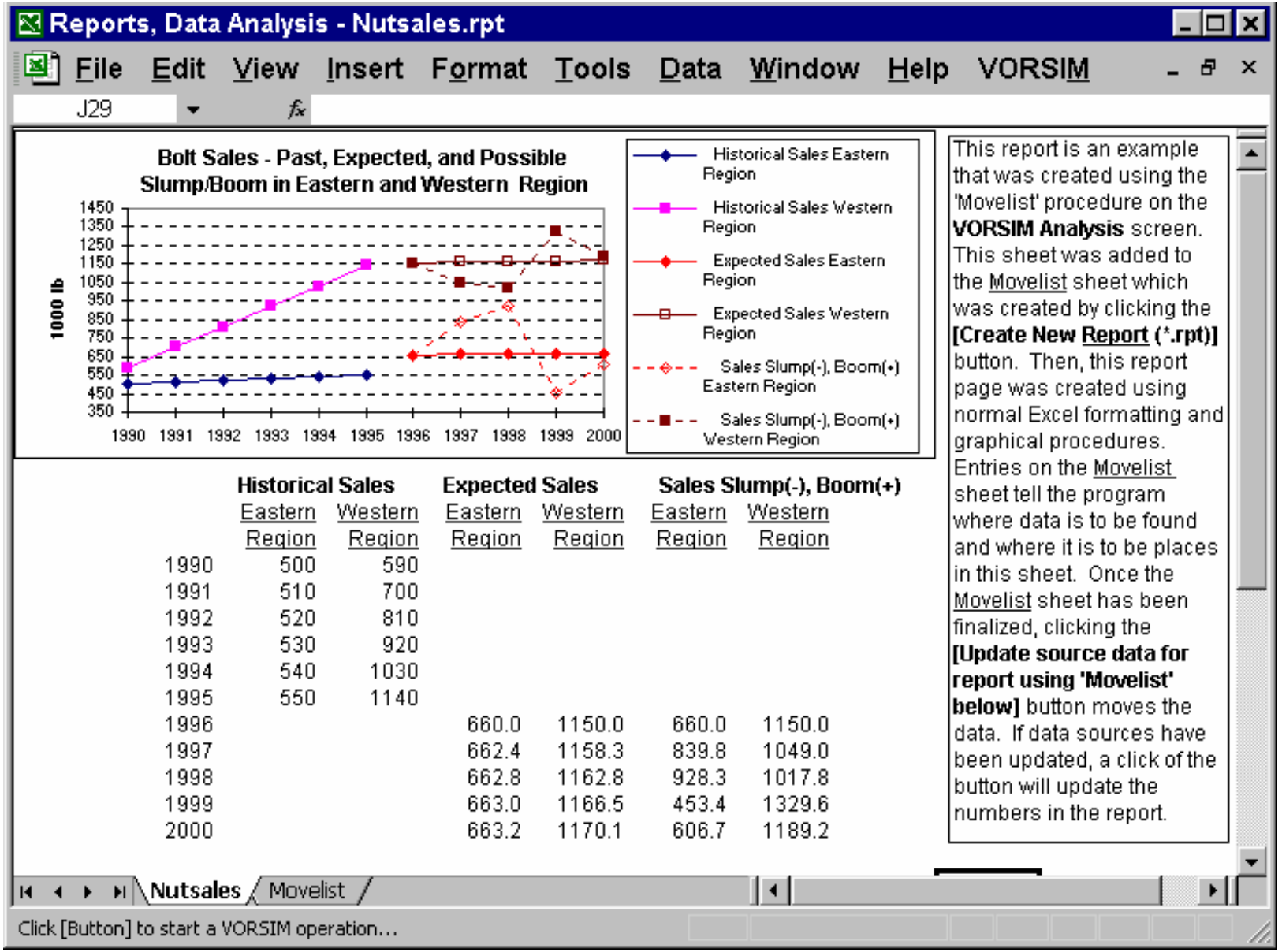


Generate Reports

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



Movelist Report

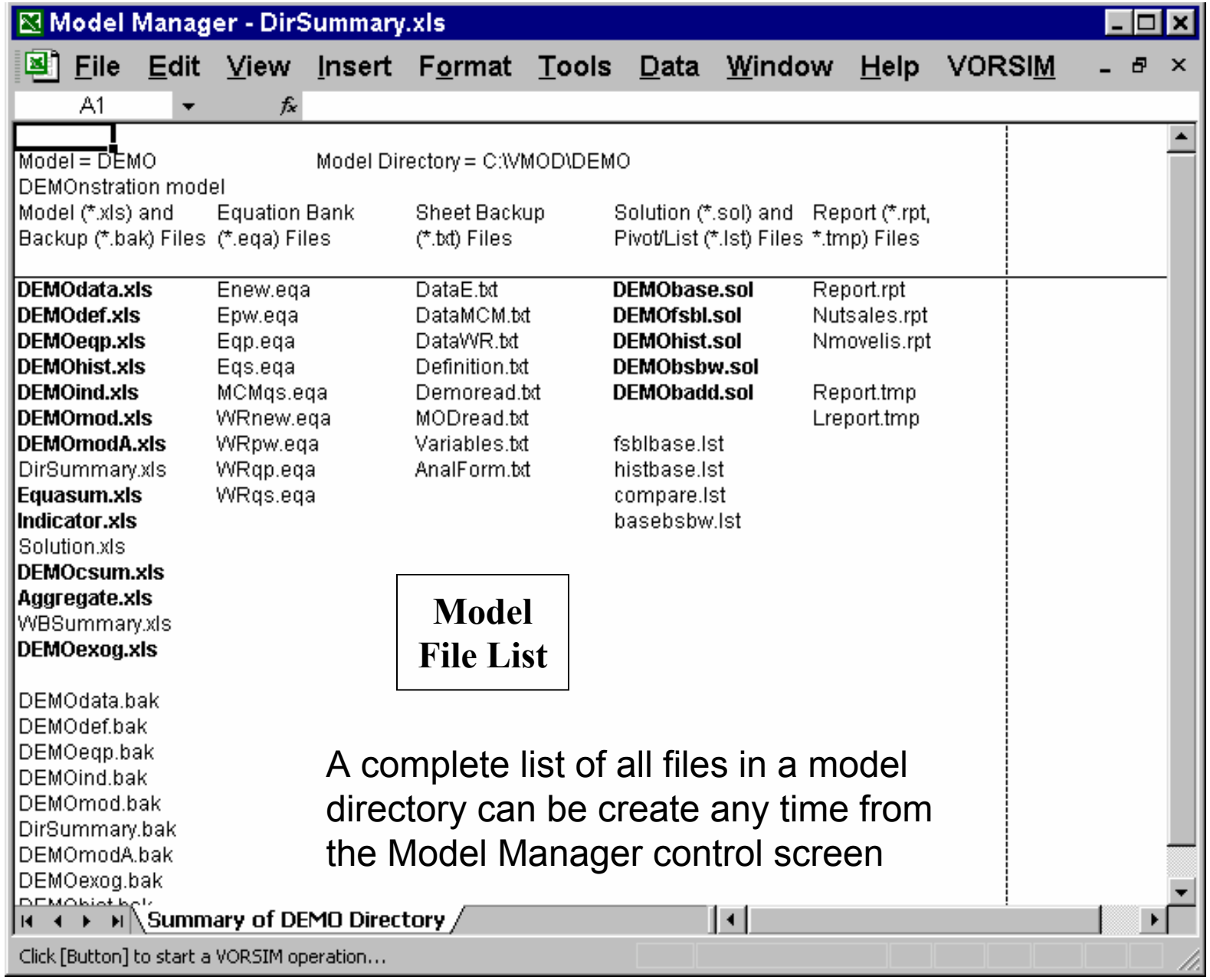


	Historical Sales		Expected Sales		Sales Slump(-), Boom(+)	
	Eastern Region	Western Region	Eastern Region	Western Region	Eastern Region	Western Region
1990	500	590				
1991	510	700				
1992	520	810				
1993	530	920				
1994	540	1030				
1995	550	1140				
1996			660.0	1150.0	660.0	1150.0
1997			662.4	1158.3	839.8	1049.0
1998			662.8	1162.8	928.3	1017.8
1999			663.0	1166.5	453.4	1329.6
2000			663.2	1170.1	606.7	1189.2

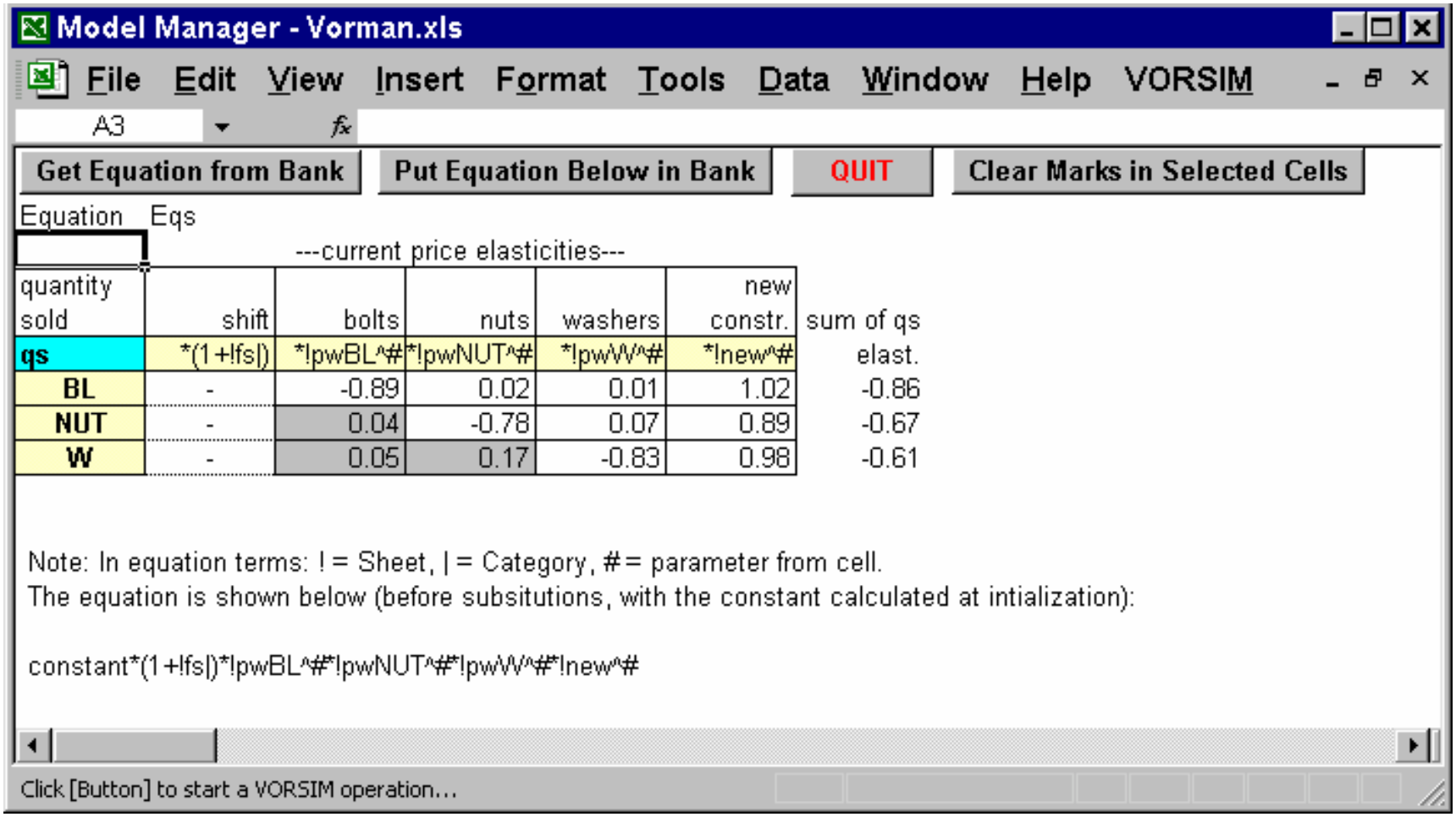
A sample report created from solution values; the report can be updated as needed

Model Manager

The Model Manager control screen offers many model manage-ment 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
DEMOnstration 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
DEMOdata.xls
DEMOdef.xls
DEMOeqp.xls
DEMOhist.xls
DEMOind.xls
DEMOmod.xls
DEMOmodA.xls
DirSummary.xls
Equasum.xls
Indicator.xls
Solution.xls
DEMOcsum.xls
Aggregate.xls
WBSummary.xls
DEMOexog.xls
DEMOdata.bak
DEMOdef.bak
DEMOeqp.bak
DEMOind.bak
DEMOmod.bak
DirSummary.bak
DEMOmodA.bak
DEMOexog.bak
Enew.eqa
Epw.eqa
Eqp.eqa
Eqs.eqa
MCMqs.eqa
WRnew.eqa
WRpw.eqa
WRqp.eqa
WRqs.eqa
DataE.txt
DataMCM.txt
DataWR.txt
Definition.txt
Demoread.txt
MODread.txt
Variables.txt
AnalForm.txt
DEMObase.sol
DEMOfsbl.sol
DEMOhist.sol
DEMObsbw.sol
DEMObadd.sol
fsblbase.lst
histbase.lst
compare.lst
basebsbw.lst
Report.rpt
Nutsales.rpt
Nmovelis.rpt
Report.tmp
Lreport.tmp
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



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