REFERENCES

Abd-El-Rahman, K. 1991. Firms' competitive and national comparative advantage as joint determinants of trade composition. *Weltwirtschaftliches rchiv*, 127 (1), pp. 83-97.

Adams, P., M. Horridge, B. Parmenter, and X. Zhang, 1997. *Long-run Effects on China of APEC Trade Liberalization*. Unpublished paper based on a report prepared for the East Asia Analytical Unit, Department of Foreign Affairs and Trade, Canberra, Australia.

Allen, D. S. Makka., K. Merchant, and J. Tafawa. 2007. The Botswana Textile Cluster.

Al-Mawali, N. 2005. Country-specific determinants of vertical and horizontal intra-industry trade of South Africa: an empirical investigation, *South African Journal of Economics*, 73 (3).

Anderson, J.E. 1979. A Theoretical Foundation for the Gravity Equation. *American Economic Review*, 69 (1): 106 – 116.

Anderson, J.E. and van Wincoop, E. 2001. Gravity with gravitas: *A solution to the border puzzle*. National Bureau for Economic research Working Paper 8079. Cambridge MA. National Bureau for Economic Research

Aturupane, C,; S. Djankov and B. Hoekman. 1999. Horizontal and Vertical Intra-Industry Trade between Eastern Europe and the European Union, *Weltwirtschaftliches Archiv*, 135 (1): 62-81.

Balassa, B. 1989a. Outward orientation. *Handbook of development Economic*, In. EDs. H. Chinery and T.N. Srinivansan. Amsterdam: North Holland. 1642-89

Balassa, B. 1989b. *Comparative advantage, trade policy and economic development*. New York: New York University Press.

Balassa. B. 1979. The changing pattern of comparative advantage in manufactured goods. *Review of Economics and Statistics*, 61 (2); 259 - 266.

Balassa. B. 1977. *A stages approach to comparative advantage*. World Bank Staff Working Paper 256. Washington DC.

Balassa, B.1977. Revealed comparative advantage revisited: an analysis of relative export shares of the industrial countries, 1953-1971. *Manchester School of Economic and Social Studies,* 45: 327-344.

Balassa, B. 1966. Tariff reductions and trade in manufacturing among the industrial countries. *American EconomicReview*, 56 (3): 466-473.

Balassa, B. 1965. Trade liberalisation and revealed comparative advantage. *Manchester School of Economic and Social Studies,* 33: 99-123

Balassa, B. 1963. An Empirical Demonstration of Classical Comparative Cost Theory, *Review of Economics and Statistics*, 45(3): 231 - 238

Baltagi, B. 2005. *Economic Analysis of panel Data*. Chichester ; Hoboken, NJ : John Wiley & Sons.

Batra. A. 2004. India's global trade potential: the gravity model approach, Indian Council for Research on International Economic Relations, Working Paper No. 151

Bhatia, H.L. 2006. *International Economics*, Vikas Publishing House Pvt Ltd, Mumbai, India

Bharadwaj . 1962. Structural Linkages in the Indian Economy", 1962, *Economic Weekly*.

Bergstrand, J. 1990. The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis and the Determinants of Bilateral Intra-Industry Trade, *Economic Journal,* 100: 1216-29.

Bergstrand, J. H. 1989. The gravity equation in international trade: Some microeconomic foundations and empirical evidence: *Review of Economics and Statistics*, 71(1): 143 - 153.

Bergstrand, J. H. 1985. The Gravity Equation in International Trade – Some Microeconomic Foundations and Empirical Evidence. *Review of Economics and Statistics*, 67: 474 – 481.

Botswana Institute for Development Policy Analysis (BIDPA). 2006. Consultancy on the viability and long term development strategy for the livestock (beef) sub sector in Botswana. Final report submitted to the Government of Botswana, March 2006, internal document.

Blumenthal, T. 1972. Exports and Economic Growth: The Case of Postwar Japan, *The Quarterly Journal of Economics*, 86(4): 617 – 631.

Bloomfield, A. 1938. The Foreign Trade Doctrines of the Physiocrats. *American Economic Review*, 28(4): 716-735

Botswana Institute for Development Policy Analysis (BIDPA). 2005. Botswana Automotive Sector Study Discussion Draft 1, Gaborone, Botswana

Bowen, H., Learner, E. and Sveikauskas, L. 1987. Multicountry, multi-factor tests of the abundance theory, *American Economic Review*, 77: 791 - 809.

Brue, S. L. 2000. *The evolution of economic thought*. 6th edition. Forth Worth: The Dryden Pree.

Cadot O, Grether J-M, De Melo J, (2000) Trade and Competition Policy-Where do we Stand? *Journal of World Trade* 34(3): 1-20

Canardn. I. 1801. *Principes d'Economie Politiqu*e. In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Carrère, C. 2006. Revisiting the Effects of Regional Trade Agreements on Trade Flows with Proper Specification of the Gravity Model, *European Economic Review*, 50: 223-247.

Chan-Hyun, S. 2001. A Gravity Model Analysis of Korea's Trade Patterns and the Effects of a Regional Trading Arrangement, Korea Institute for International Economic Policy, Working Paper Series Vol. 2001-09.

Cieslik, A. 2007. Bilateral trade volumes, the gravity equation and factor proportions, paper presented at presented at the joint CORE-SEL seminar in Louvain-la-Neuve

Ciuriak. D and S. Kinjo. 2005. Trade Specialization in the Gravity Model of International Trade.Canada.

Cline, W.R. 2002. An index of industrial country trade policy towards developing country. Working paper 14. Centre for Global development. www.cgdev.org/docs

Coakley, George J. 2004. The Mineral Industry of Botswana.

Corden. W. M. 1984. Boming Sector and Dutch Disease Economies: Survey and Consolidation, *Oxford Economic Papers*, 36(3): 359-380

Cruz. M. 2008. Can Free Trade Guarantee Gains from Trade? *United Nations University-World Institute for Development Economic Research (UNU-WIDER), Research paper No. 2008/97*.

Cyrus, T. L. 2002. Income in the gravity model of bilateral trade: does endogeneity matter? *The International Trade Journal*, 16(2): 161-181

Deardorff, A. 1998. Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World? In: Jeffrey F. (9ed). The Regionalism of the World Economy. University of Chicago Press, Chicago.

Deardorff, A. 1995. Determinants of Bilateral Trade: Does Gravity Work in a Classical World? paper presented at a conference on *The Regionalization of the World Economy*, NBER, Woodstock, Vermont.

Deardorff, A. V. 1984.Testing trade theories and predicting trade flows. In R. W. Jones and P. B. Kenen (eds.), *Handbook of lnternational Economics*, Vol. I . ch. 10. North-Holland. Amsterdam,.

Deardorff, A. V. 1980. The general validity of the law of comparative advantage. *Journal Political Economy* 88, 941-957

Deraniyagala, S. and B. Fine. 2001. New Trade Theory Versus Old Trade Policy A Continuing Enigma, *Cambridge Journal of Economics*, *25*:809-825.

Disdier, A. 2009. Gravity equation Methodology lecture (1), World Bank Institute Research Program on Regional Integration and Agricultural Trade Policy, Dakar, Senegal, February 9 to 13, 2009

Dixit, A. K. and A. D. Woodland. 1982. The relationship between factor endowments and commodity trade. *Journal of International Economics,* 13: 201-214.

Dixit, A. K. and V. Norman. 1980. *Theory of international trade*. Nisbet and Cambridge U.P. Cambridge.

Dixit, A. and J. Stiglitz. 1977. Monopolistic competition and optimum product diversity, *American Economic Review*, 67 (3): 297-308.

Dixon, P.B., B.R. Parmenter, J. Sutton, and D.P. Vincent, *ORANI: A Multisectoral Model of the Australian Economy,* North-Holland Publishing Company.

Donges. J . B. and J. Riedel. 1977. The expansion of manufactured exports in developing countries: an empirical assessment of supply and demand issues. *Weltwirtschaftliches Archiv,* 113: 58-87.

Egger, P. 2000. A Note on the Proper Econometric Specification of the Gravity Equation, *Economic Letters*, 66: 25-31.

Eita, J. H and A. C. Jordaan. 2007. Determinants of South Africa's Exports of Leather Products', Working Paper 2007-7, Department of Economics, University of Pretoria, South Africa.
Available at: http://www.up.ac.za/up/web/en/academic/economics/index.html.

Eita, Joel Hinaunye and Andre C. Jordaan. (2007). South Africa Exports of Metal and Articles of Base Metal: A Gravity Model Approach. *Journal of Studies in Economics and Econometrics,* 31(3): 81 - 96.

Evenett, S. J, and Keller, W. 2002. "On Theories Explaining the Success of the Gravity Equation. *Journal of Political Economy*, 110 (21): 281 – 316.

Evenett, S. J, and Keller, W. 1998. On theories explaining the success of thegravity equation, NBER Working Paper N0. 6529

Feder, Gershon. 1982. On Exports and Economic Growth. *Journal of Development Economics,* 12: 59 – 73.

Feenstra, R.C., 2002, *Advanced International Trade. Theory and Evidence*, Princeton University Press, Princeton.

Feenstra, R.C., Markusen, A. and Rose, A.K. 1999. *Using the Gravity Equation to Differentiate Among Alternative Theories Of Trade*, available at http://www.econ.ucdavis/eu/-feenstra and http://haas.berkely.edu/-arose.

Feenstra, R.C., Markusen, A. and Rose, A.K. 1998. *Understanding the Home Market Efficient and the Gravity Equations: The role of Differentiating Goods*, available at http://www.econ.ucdavis/eu/-feenstra and http://haas.berkely.edu/-arose.

Fertő Imre and Lionel J. Hubbard. 2002. Revealed comparative advantage and competitiveness in Hungarian agri-food sectors. Institute of Economics, Hungarian Academy of Sciences. Discussion Papers new series, MT–DP

Food and Agricultural Organization of the United Nations (FAO). 2005. Livestock Sector Brief Botswana. Available at: www.fao.org/AG/AGAINFO/resources/en/publications/sector_briefs/lsb_BWA.pdf., accessed 15/06/07.

Frankel, Jeffrey and Andrew Rose. 2002. An Estimate of the Effect of Common Currencies on Trade and Income?, *The Quarterly Journal of Economics*: 437-466.

Frankel, J and A. Rose. 2000. Estimating the Effect of Currency Unions on Trade and Output, Working Paper No. 7857, National Bureau of Economic Research.

Frankel, J. A. and D. Romer. 1999. Does trade cause growth. *American Economic Review*, 89(3): 379-399

Frankel, J. A. 1998. Intoruction to Regionalization of the World Economy, in Frankel, J. A. 1998. "*The Regionalization of the World Economy*", University of Chicago Press, p. 1-6. Avaliable at: http://www.nber.org/chapters/c7817.

Frankel, J amd D. Romer. 1996. Trade and Growth", NBER Working Paper No. 5476, National Bureau of Economic Research.

Gide, C and Rist, C. 1948. A history of economic doctrines: From the time of the physiocrats to the present day, translated by R. Richards and E. Row. London: George G Harrap.

Ghosh, S., and S. Yamarik. 2004. Are preferential trade agreements trade creating? An application of extreme bounds analysis, *Journal of International Economics*, 63: 369-395.

Gouws, A.R. 2005. *The determinants of South African Exports: Critical policy implications*. PhD Thesis, Department of Economics, University of Pretoria, South Africa.

Grimwade, N. 1989. *International Trade: New Patterns of Trade, Production and Investment*, Rout ledge, London.

Greenaway, D., Hine, R. and Milner, C. (1995). Vertical and horizontal intra-industry trade: A cross industry analysis for the United Kingdom. *Economic Journal*, 105: 1505-1518.

Greenaway, D. and Sapsford, D. 1994. Exports, growth and liberalization: and evaluation. *Journal of Policy Modelling*, 16(2).

Greytak. D and R. McHugh. 1977. Linder's Trade Thesis: An Examination. *Southern Economic Journal*, 43(3): 1389 -1389.

Grubel, H. G. and Lloyd, P. J. 1975. *Intra-industry trade: the theory and the measurement of international trade in differentiated products*. New York: John Wiley

Grubel. H. 1967. Intra-industry trade specialization and the pattern of trade. *Canadian Journal of Economics and Political Science*, 33 (3), pp. 374-388.

Hadri, K. 2000. Testing for Stationarity in Heterogeneous Panel Data, *EconometricJournal*, 3(2): 148-161.

Hamal, ferdinand de. 1844.. *Traite Elimentaire D'economie Politique.* . In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Haveman, J and Hummels, D. 2001. Alternative Hypotheses and the Volume of Trade: the Gravity Equation and the Extent of Specialization, *Purdue University Press*, USA.

Head. K. 2003. Gravity for Beginners", University of British Columbia, Vancouver. Available at:
http://www.econ.ubc.ca/nmalhotra/490/Articles/KHead%20on%20gravity.pdf

Helpman, E. 1999. The structure of foreign trade, *Journal of Economic Perspective*, 13: 121 -144.

Helpman E. 1987. Imperfect competition and international trade: Evidence from fourteen industrial countries, *Journal of the Japanese and International Economies*, 1: 62-81.

Helpman, E.1984. The factor content of foreign trade. *Economic Journal,* 94: 84-94.

Helpman, E., 1981, International trade in the presence of product differentiation, economies of scale and monopolistic competition: A Chamberlin - Heckscher - Ohlin approach, *Journal of International Economics*, 11: 305-340.

Helpman, E. and Krugman, P. 1985. *Market Structure and Foreign Trade*, MIIT Press.

Heckscher, E. F and B. Ohlin. 1991. *Hechkscher-Ohlin trade theory,* translated by H Flam and MJ Flanders, MIT Press, Cambridge: MA.

Hertel, T.W. 1997. *Global Trade Analysis: Modeling and Applications,* Cambridge University Press, UK.

Hillman, A. L.: Observations on the relation between "Revealed Comparative Advantage"and comparative advantage as indicated by pre-trade relative prices. *Weltwirtschoftliches Archiv* 116. 315-321. 1980.

Hirsch, S.: Capital or technology? Confronting the neo-factor proportions and neo-technology accounts of international trade. *Weltwirtschaftliches Archiv* 110, 535-563, 1974.

Hobday, Michael. 1995. *Innovation in East Asia: The Challenge to Japan*. London: Edward Elgar.

Hoekman, B. Mattoo, A, and English, P. 2002. Development, Trade and the WTO: A Handbook. World Bank, Washington DC, USA.

Hou, Chi-Ming, and San Gee. 1995. National Systems Supporting Technical Advance in Industry: the Case of Taiwan. In Richard R. Nelson, ed., *National Innovation Systems: A Comparative Analysi*s. New York: Oxford University Press.

Hufbauer. G. C. 1970. The Impact of National Characteristics & Technology on the Commodity Composition of Trade in Manufactured Goods. University of New Mexico and Harvard Development Advisory Service

Hultman, C.W. 1967. Exports and Economic Growth: A Survey. *Land Economics*, 43(2): 148 – 157.

Hummels, D. and J. Levinsohn. 1993. Product differentiation as a source of comparative advantage, *American Economic review*, 83(2): 445 - 449.

Im, K.S., Pesaran, M.H. and Shin, Y. (2003) "Testing for Unit Roots in Heterogeneous Panels", *Journal of Econometrics*, 115: 53-74.

International Trade Administration Commission of South Africa (ITACSA). 2003. SACU's Motor Industries Development Programme (MIDP)

International Trade Centre (UNCTAD/WTO. 2005. TradeSim (third version), a gravity model for the calculation of trade potentials for developing countries and economies in transition, Explanatory notes, Market Analysis Section.

International Trade Centre (UNCTAD/WTO). 2003. TradeSim (second version), A gravity model for the calculation of trade potentials for developing countries and economies in Transition, Explanatory notes, Market Analysis Section.

Isard. W. 1960. *Methods of Regional Analysis: An introduction to Regional Science,* Cambridege Massacusetts: The Massachusets Institute of Technology Press.

Jakab, Z.M. Kovacs, M.A. and Oszlay, A. 2001. How Far has Regional Integration Advanced?: An Analysis of the Actual and Potential Trade of Three Central and European Countries, *Journal of Comparative Economics,* 29: 276-292.

Jaffee David. 1985. Export Dependence and Economic Growth: A Reformulation and Respecification, *Social Forces*, 64(1): 102 – 118.

Jayanthakumaran, K. 2004. An Empirical Assessment of the Impact of Inter-Industry Trade on Employment: Australia 1989/90–2000/01, University of Wollongong.

Jayasinghe, S and R. Sarker. 2007. Effects of Regional Trade Agreements on Trade in Agrifood Products: Evidence from Gravity Modeling Using Disaggregated Data, *Review of Agricultural Economics,* 30(1): 61–81

Jefferis. K. (2005). How Trade Can Help to Revitalise Botswana's Beef and Cattle Sector. Southern Africa Global Competitive Hub Project.

Kalbasi, H. (2001). The Gravity Model and Global Trade Flows, paper in the Conference of EcoMod, Washington DC.

Kalbasi, H 2003. Modelling and Patterns of Intra-Industry Trade: Iran's Case Study. Paper presented at EcoMod2003 International Conference on Policy Modeling Istanbul, Hotel Conrad, July 3-5, 2003.

Kandogan, Y. (2003a). Reconsidering the adjustment costs of the Europe agreements. *Applied Economics Letters*, 10 (2): 63-68.

Kandogan, Y (2003b). Intra-industry trade of transition countries: trends and determinants. *Emerging Markets Review*, 4 (3), pp. 272- 286.

Keesing, Donald B. 1982. *Exporting Manufactured Consumer Goods from Developing to Developed Economies: Marketing by Local Firms and Effects of Developing Country Policie*s. Washington D.C.: World Bank.

Krugman, P. 1982. Trade in differentiated products and political economy of trade liberalization. In Bhagwati, J. (Ed.). *ImportCompetition and Response*. Chicago, University of Chicago Press, pp. 197-208.

Krugman, P. 1981. Intra-industry specialization and the gains from trade. Journal of Political Economy, 89 (5), pp. 959-973

Krugman, P. 1980. Scale economics, product differentiation and the pattern of trade. *American Economic Review*, 70 (5), pp. 950-959.

Krugman, P. 1979. Increasing returns, monopolistic competition and international trade. *Journal of International Economics*, 9 (4), pp. 469-479.

Lall, S. 2002. Transnational Corporations and Technological Flows', In D. Naayar (ED.), *Governing Globalization: Issues and Institutions,* Oxford: Oxford University Press.

Lancaster, K. 1980. Intra-industry trade under perfect monopolistic competition. *Journal of International Economics*, 10(2):151-175.

Lancaster, K. 1979. *Variety, Equity, and Efficiency: Product Variety in An Industrial Society*. Columbia University Press, New York.

Leamer, E. E. 1981. Lets' Take the Con Out of Econometrics, *The American Economic Review*, 73 (1): 31 – 43.

Leroy. B. U. L. 1905. *Traite Theorique et Pratique d'Economie Politique.* In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Leontief, W. W. 1953. *Studies in the structure of the American economy*. New York: Oxford University Press.

Liner, S. B. 1961. *An essay on trade and transformation.* New York: J. Wiley

Linnemann, H. 1967. An Econometric Study of International Trade Flows, *The Economic Journal,* 77, 306: 366-8.

Linneman, H. 1966. An Econometric Study of International Trade Flows, North-Holland, Amsterdam.

Magee, S. 1980. *International Trade*. Addison Wesley, Manila.

Markussen, J. R. and J. R. Melvin. 1995. *International Trade: Theory and evidence*. New York: McGraw-Hill.

Marques. H. 2008. Asymmetries in Heterogeneous Integrated Areas: Evidence from Intra-EU Sectoral Trade, International Network for Economic Research, Working Paper 2008.2

Marques Helena and Hugh Metcalf. 2005. What Determines Sectoral Trade in the Enlarged EU? *Review of Development Economics*, 9(2): 197–231.

Marques Helena. 2004. Is Intra-EU Sectoral Trade Symmetric – and does it matter? Loughborough University, UK

Mathur, S.K. 1999. Pattern of International Trade, New Trade Theories and Evidence from Gravity Equation Analysis, *The Indian Economic Journal*, 47(4): 68-88.

McCorriston, S and I.M. Sheldon. 1991. Intra-Industry Trade and Specialization in Processed Agricultural Products: The Case of the US and the EC, *Review of Agricultural Economics*, 13(2): 173-184

McDonal, S. and Welmsley, T.L. 2003. *Bilateral Free Trade Agreements and Customs Unions: The Impact of the EU Republic of South Africa Free Trade Agreement on Botswana.* GTAP Working Paper No 29.

Mika Widgrén. 2005. Revealed Comparative Advantage in the Internal Market *Turku School of Economics, The Research Institute of the Finnish Economy (ETLA), CEPR and CESifo*

Molinari Andrea. 2003. Sectoral Border Effects: Analysing Implicit EU Trade Integration, University of Sussex.

Moosa.I. A. 2004. *"International Finance",* MaGraw-Hill Australia Pty Ltd, NSW, Australia.

Mun, T. 1664. England's treasure by foreign trade. Available at: http://socserv2.socsci.mcmaster.ca

Nijkamp, P. 1975. Reflections on Gravity and Entropy Models" *Regional Science and Urban Economics,* 5: 203-225

Ohlin, B. 1991. *The theory of trade*. Cambridge MA: Harvard University Press.

Ohlin, B. 1933. *Interregional and international trade*. Cambridge MA: Harvard University Press

Overseas Development Institute (ODI). 2007. Analysis of the Economic and Social Effects of Botswana's Loss of Preferential Market Access for Beef Exports to the European Union, Final Study, London, United Kingdom

Paas, T. 2000. Gravity Approach for Modeling Trade Flows between Estonia and the Main Trading Partners, *Working Paper,* No. 721, Tartu University Press, Tartu.

Page, P. F. 1801. *Traite d'Economie Politique et de Commerce des Colonies*. In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Perin. C. H. 1896. P*remiers Principes d'Economie Politique*. In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Poyhonen, P. 1963. A Tentative Model for the Volume of Trade between Countries, *Weltwirtschaftliches Archiv,* 90: 23-40.

Ragin, C., and J. Delacroix. 1979. Comparative Advantage, the World Division of Labour, and Unemployment, *Comparative Social Research*, 1: 181 – 214.

Rahman, M.M. 2003. A Panel Data Analysis of Bangladesh's Trade: The Gravity Model Approach, Department of Economics, University of Sydney, Australia.

Rahman, M., Bin Shadat, W and N. C. Das. 2006. Trade Potential in SAFTA: An Application of Augmented Gravity Model. Centre for Policy Dialogue (CPD), Bangladesh

Ram, Y and B. C. Prasard. 2007. Assessing Fiji's Global Trade Potential Using The Gravity Model Approach, School of Economics at University of the South Pacific, Working Paper No. 2007/05.

Ricardo, D. 1815. An essay on the influence of the price of corn on the profit of stock. Printed for John Murray, Albemarle Street, London.
Available at: http://socserv.mcmaster.ca/econ/ugcm/3ll3/ricardo/profits.txt.

Republic of Botswana .2008. Botswana National Export Strategy: Final Report. Paper presented at the National Trade Policy (NTP), Gaborone Sun, Gaborone, Botswana on the 31st July 2008.

Rodrick, D. 1999. *Five simple principles for world trade*. Harvard's John F. Kennedy School of Government

Rojid, S .2006. COMESA Trade Potential: A Gravity Approach, *Applied Economic Letters*, 13:947-951.

Rose, A. K. 2005. The Foreign Service and Foreign Trade: Embassies as Export Promotion, NBER Working Paper No. 11111. Available at: http://www.nber.org/papers/w11111

Saint-Chamanasu, G . P. 1824, de. *Nouvelle Essai sur la Richesse des Nations.* In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Salm, A., Grant, W., Haycock, J., Kennedy, K and M. Rubin. 2004. Botswana Textile and Apparel Sub Sector Study. Discussion Draft. Produced in conjuction with World Bank, BEDIA and BIDPA.

Samuels, W. 1962. The Physiocratic Theory of Economic Policy. *Quarterly Journal of Economics*, 76(1):145-162

Sharma. K. 2000. Pattern and determinants of intra-industry trade in Australian manufacturing, *Australian Economic Review,* 33 (3): 245 - 255.

Say, J. B. 1948. *Oeuvres Diverses de*. In Bloomfield. A. I. 1989. Aspects of the Theory of International Trade in France: 1800-1914, *Oxford Economic Papers*, New Series, 41(3): 619 - 639

Schumpeter. J. A. 1954. *History of Economic analysis.* London: George Allen and Unwin

Sentsho, J. (2003). Export Revenues as Determinants of economic Growth: Evidence from Botswana, *University of Botswana*. Paper presented at the Economic Society of South Africa (ESSA) Conference.

Shafaeddin, S. M. 2005. Trade Liberalization and Economic reform in Developing Countries: Structural Change or Deindustrialization?' UNCTAD Discussion Papers No. 179. Geneva.

Smith David M. 1971. *Industrial Location*. New York: John Wiley & Sons

Smith. A. 1776. *An enquiry into the nature and cause of wealth of nation*. London 1776

Soloaga, I. and A. Winters. 2001. Regionalism in the Nineties: What Effect on Trade? CEPR Discussion Paper 2183. Centre for Economic Policy Research, London.

Tatemoto, M. and S. Ichimura. 1959. Factor proportions and foreign trade: the case of Japan, *Review of Economics and Statistics,* 41, 442–46

Tinbergen, J. 1962. An Analysis of World Trade Flows'. In Tinbergen, J. (ed) *Shaping the World Economy.* New York: The Twentieth Century Fund.

Todaro, M. P. and Smith, S.C. 2006. *Economic Development, 9th ed',* Pearson Education Limited, England.

van Eyden, Reneé. 2007. Panel Data Econometrics and Unit root testinng Lecture, Department of Economics, University of Pretoria, South Africa.

Verdoon, P. 1960. The intra-bloc trade of Benelux. In Robinson, E. (Ed.). *Economic Consequences of the Size of Nations*. Macmillan, London, pp. 291-329.

Vernon. R. 1966. International investment and international trade in the product cycle. *Quarterly Journal of Economics*, 80: 190 – 207.

Viner, J. 1937. *Studies in the Theory of international Trade*. New York and London, Harper and Brothers.

Wood, A and J. Mayer. 1998. Africa's export structure in a comparative perspective: African development in a comparative perspective, Study No. 4. Geneva: UNCTAD

Websites references

www.cso.gov.bw
www.timeanddate.com
www.tips.org.za
www.worldbank.org
www.sacu.int
www.sadc.int.
www.agoa.info.

APPENDICES

1 PAIRWISE GRANGER CAUSALITY TEST

There is generally no consensus about the direction of causality between exports and GDP. Therefore, the question of whether exports (*Exp*) cause GDP growth (*Y*) or vice versa in Botswana is investigated empirically using the pairwise Granger causality test. Through Granger causality tests, one can proceed to test for the direction of causality between the two series. The standard Granger (1986) causality test examines the role of past changes in export growth (*Exp*), in explaining the current variations in GDP (*Y*). On the other hand, a reversed causality direction is determined by experimenting with variables Exp and *Y* interchanged, using the following equations to determine whether or not *Exp* the Granger causes Y_t and vice versa, respectively.

$$Exp_t = \sum_{i-1} \beta_i Exp_{t-1} + \sum_{i-1} \alpha_i Y_{t-1} + \mu_t \qquad \text{(A1)}$$

$$Y_t = \sum_{i-1} \alpha_i Y_{t-1} + \mu_t + \sum_{i-1} \beta_i Exp_{t-1} + V_t \qquad \text{(A2)}$$

In terms of interpretation, Y_t is said to be Granger-caused by Exp_t if exports help in the prediction of Y_t, or equivalently if the coefficient on the lagged values of exports are statistically significant. In our case, there are four possible causal relationships between exports (Exp) and GDP (Y):

i. *Unidirectional causality from Exp to Y* is indicated in the case were the estimated coefficients on lagged *Exp* in equation (A2) are statistically different from zero as a group (i.e., $\sum \beta_i \neq 0$) and the set of estimated coefficients on the lag of Y in equation (A1) is not statistically different from zero (i.e., $\sum \alpha_i = 0$)

ii. Conversely, *unidirectional causality from Y to Exp* exists if the set of lagged Y coefficients in equation (A2) is not statistically different from zero (i.e., $\sum \beta_i = 0$) and the set of lagged Y coefficients in equation (A1) is statistically different from zero (i.e., $\sum \alpha_i \neq 0$).

iii. *Bidirectional, or feedback causality,* is suggested when *Exp* causes *Y* and vice versa. That is, when the sets of *Exp* and *Y* coefficients are statistically significantly different from zero in both regressions.

iv. Finally, *independence* is suggested when there is no causal relationship between *Exp* and *Y*. That is, when the sets of Exp and Y coefficients are not statistically significant in both regressions.

The null hypothesis postulated in each case is that the variable under consideration does not "Granger-cause" the other variable.

The results of the Granger causality test are presented in Table A1. The results suggest bidirectional (or feedback) causality between exports (Exp) at aggregate level and GDP (Y) for the period 1980 to 2008.

Table A1: Pairwise Granger Causality test (Sample 1980 – 2008)

Null Hypothesis	**Obs**	**F-Statistic**	**Probability**
LogEXP does not Granger Cause LogGDP	27	2.78774	0.04672
LogGDP does not Granger Cause LogEXP		2.34139	0.09170

2 ROBUSTNESS CHECK FOR HIIT AND VIIT

This part of the Appendices provides robust check by using different values of **α** in equation (4) and equation (5).

2.1 Horizontal IIT and Vertical IIT with different values of α

Table 4 presents the results for HIIT and VIIT in which the calculation was done with both small and large dispersion values of α and compared to a value α = 0.15 whose results are presented in the main text. Panel *A* of Table A2 in this section shows the results when a smaller value of α, 0.10, is used. The results are exactly the same with those in which a value α =0.15 has been used. Tabulated results in both panels *B* and *C*, where values of α, 0.20 and 0.25 have been used, are nearly the same. When α is either 0.20 or 0.25, the results shows that it is only trade with Belgium where the share of HIIT and VIIT have equally dominated trade between Botswana and the former country for the period under review. The results did not change at all for trade with Israel, while HIIT dominated trade with South Africa in 2001 when α=0.20, and both in 2000 and 2001 when α=0.25. In the case when α=0.30 is used in the calculations, the results are the same with the situation when α=0.25 is employed. Overall, one can conclude that in the case of Botswana, the HIIT/VIIT results are almost the same for diamond sector when one uses either a smaller dispersion, α=0.10, or a larger dispersion, α=0.30.

Table A2: HIIT and VIIT in the Diamond sector with different dispersion

Panel A: (α=0.10)

Year / Country	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	HIIT	VIIT	VIIT	VIIT	VIIT	VIIT	na	VIIT
Israel	HIIT	VIIT	VIIT	VIIT	Na	Na	na	VIIT
South Africa	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT	VIIT

Panel B: (α=0.20)

Year / Country	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	HIIT	VIIT	VIIT	VIIT	HIIT	VIIT	na	VIIT
Israel	HIIT	VIIT	VIIT	VIIT	na	Na	na	VIIT
South Africa	VIIT	VIIT	HIIT	VIIT	VIIT	VIIT	VIIT	VIIT

Panel C: (α=0.25)

Year / Country	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	HIIT	HIIT	VIIT	VIIT	HIIT	VIIT	na	VIIT
Israel	HIIT	VIIT	VIIT	VIIT	na	Na	na	VIIT
South Africa	VIIT	HIIT	HIIT	VIIT	VIIT	VIIT	VIIT	VIIT

Panel D: (α=0.30)

Year / Country	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	HIIT	HIIT	VIIT	VIIT	HIIT	VIIT	na	VIIT
Israel	HIIT	VIIT	VIIT	VIIT	na	Na	na	VIIT
South Africa	VIIT	HIIT	HIIT	VIIT	VIIT	VIIT	VIIT	VIIT

3 ROBUSTNESS CHECK ON COEFFICIENTS OF EXPLANATORY VARIABLES

The coefficient values for the explanatory variables for each of the gravity trade models presented in Table A3 to Table A5 shows that they do not significantly change, in the case where they change. For instance, the range of the coefficient values (from the FEM equation (13)) of Botswana's mining GDP in the diamond gravity trade model is between 1.7 and 1.9 (with the actually coefficient value reported in the main text being within this range, with a value of 1.76) whether more potential explanatory variables are added or deleted. This lower range shows that the model is robust and can be relied upon for any interpretation or any further inferences. The same trend is also recorded for the coefficient of the other explanatory variables in the diamond gravity model, and also for the explanatory variables in both textiles, and meat and meat products gravity equations.

In summary, the results reported from robustness estimations indicates that the coefficients of the explanatory variables for each of the three gravity trade models are relatively stable and can therefore be relied upon both for inference and further application, in this case, in the analysis of untapped export potentials.

Table A3: Robustness check on Diamond gravity model

Variable/Model	Pooled Model – Equation (13)			Fixed Effects Model – Equation (13)		
Botswana mining GDP	5.2 (2.1)**	4.9 (1.4)	5.3 (1.9)*	1.8 (1.96)**	1.9 (2.7)**	1.7 (3)***
Importer GDP	1.4 (2.9)***	1.7 (3.1)***	2.3 (2.8)***	0.92 (2.01)**	1.2 (1.9)**	2.1 (2.0)**
Importer population	-----------	7.4 (1.8)*	6.5 (3.8)***	-----------	5.2 (4.7)***	4.8 (1.7)*
Exchange rate		1.3 (2.1)**	2.3 (1.6)	0.9 (2.1)**	2.1 (1.2)	1.7 (1.9)*
Hafbauer index	-----------	----------	49.2 (1.9)*	-----------	-----------	52 (2.4)**
Adjusted – R^2	0.61	0.62	0.66	0.66	0.67	0.60
F-Test	5.7	5.3	5.9	4.8	4.67	3.87
Total obs	48	48	48	48	48	48

Notes: [***], [**], [*] significant at 1%, 5%, 10% level
t-statistics in parenthesis

Table A4: Robustness check on Textiles gravity model

Variable/Model	Pooled Model – Eqn (13)			Fixed Effects Model – Eqn (13)		
Botswana manf sector GDP	2.6 (2.0)**	1.97 (5.3)***	2.97 (5.3)***	1.03 (2.7)**	1.28 (4.1)***	1.08 (2.04)*
Importer GDP	0.8 (0.58)	0.97 (2.6)**	0.95 (3.6)***	1.6 (1.37)	1.5 (2.8)**	1.5 (2.5)**
Importer	1.07 (3.1)***	0.49 (4.7)***				

population			0.42 (2.18)**	2.17 (1.9)*	2.6 (1.5)	2.7 (3.9)**
RCAI for textiles	-----------	0.57 (1.9)*	0.49 (2.9)**	-----------	0.47 (2.1)*	0.49 (2.17)*
Importer Inflation	-----------	------------	0.01 (3.2)***	-----------	----------	0.08 (1.93)*
Exchange rate	0.09 (1.2)	0.5 (2.3)**	0.18 (0.5)	0.1 (2.1)**	0.4 (0.3)	0.3 (1.9)*
Adjusted – R^2	0.59	0.66	0.65	0.60	0.62	0.65
F-Test	18.1	12.6	16.44	5.6	9.7	9.26
Total obs	192	192	192	192	192	192

Notes: [***], [**], [*] significant at 1%, 5%, 10% level

t-statistics in parenthesis

Table A5: Robustness check on Meat and meat products gravity model

Variable/Model	Pooled Model – Eqn (13)			Fixed Effects Model – Eqn (13)	
Botswana agric sector GDP	2.2 (8.51)***	1.9 (4.5)***	2 (4.0)***	1.8 (3.4)***	1.3 (5.1)***
Importer GDP	0.49 (2.46)**	0.49 (2.5)**	0.49 (2.4)**	0.6 (5.2)***	0.57 (4.7)***
Importer Inflation	-0.96 (-2.8)**	-0.97 (-3)***	-0.98 (-2.8)***	-0.16 (-2)**	-0.15 (-0.2)
Exchange rate	1.0 (2.1)**	0.87 (1.4)	0.2 (19)*	0.23 (2.3)**	0.2 (1.4)
RCAI for meat	----------	0.59 (0.92)	0.70 (1.0)	------------	0.29 (2.2)**
Cotonou dummy	1.2 (2.1)**	1.9 (1.2)	0.8 (2.5)**	----------	--------
Botswana agric K/L ration	-----------	---------	2.6 (0.4)	----------	--------
Adjusted – R^2	0.61	0.62	0.61	0.65	0.66
F-Test	13.2	9.1	6.76	9.3	8.6
Total obs	88	88	88	88	88

Notes: [***], [**], [*] significant at 1%, 5%, 10% level

t-statistics in parenthesis

4 BOTSWANA'S SECTORAL TRADE POTENTIAL

This part of the Appendices presents countries and regions with which Botswana has both unrealized and exhausted export potential for each of the three sectoral exports (diamond, textiles; and meat and meat products).

Note:
For all Tables in this Appendices section:
UP – means unrealized trade potential
EP – implies exceeded trade potential

4.1 Diamond Sector

Table A6: Countries with unrealized potential for expansion of diamond export trade

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
Israel	1.3	1.8	0.2	0.1	0.2	0.4	3.1	1.6	**UP**
South Africa+	2.1	22.9	1.6	1285	11.9	0.0	0.0	0.3	**UP**
Switzerland	0.0	0.0	1336	48	58	52	7.6	1345	**UP**

Table A7: Countries where Botswana's diamond has exceeded its export trade potential

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
Belgium	3.8	29.0	5.0	0.0	0.1	0.0	0.0	0.0	**EP**
United Kingdom	2.0	9.2	0.3	0.0	0.0	0.0	202225	0.2	**EP**
U.S.A	4.9	7.3	0.4	0.1	2.8	8987	0.0	0.1	**EP**

Table A8: Regional distribution of countries with untapped diamond export potential

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
European Union (EU)									
Switzerland	0.0	0.0	1336	47.8	57.7	52.2	7.6	1345	**UP**
SADC									
South Africa+	2.1	22.9	1.6	1285.3	11.9	0.0	0.0	0.3	**UP**

Note: "+" Both a SADC and SACU member country

Table A9: Regional distribution of countries with exceeded diamond export potential

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
European Union (EU)									
Belgium	3.8	29.0	5.0	0.0	0.1	0.0	0.0	0.0	**EP**
United Kingdom	2.0	9.2	0.3	0.0	0.0	0.0	202 225	0.2	**EP**
America									
U.S.A	4.9	7.3	0.4	0.1	2.8	8 987	0.0	0.1	**EP**

4.2 Textile Sector

Table A10: Countries with unrealized potential for expansion of textile export trade

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
Belgium	0.6	0.7	0.8	0.8	1.0	0.6	1.9	1.8	**UP**
Canada	1.1	0.8	0.8	0.8	1.4	0.9	1.5	1.2	**UP**
Denmark	2.0	2.7	0.7	0.7	0.9	2.3	1.1	1.7	**UP**
Finland	1.6	1.5	1.7	0.7	0.9	1.4	0.9	1.7	**UP**
Ghana	1.2	1.4	1.6	1.2	2.5	1.9	1.1	1.7	**UP**
Mozambique	1.2	1.3	2.4	2.5	1.2	1.3	1.4	3.3	**UP**
Saudi Arabia	3.0	2.2	1.9	0.8	0.9	1.0	1.0	2.8	**UP**
Spain	0.9	3.1	2.2	1.1	0.9	1.0	2.1	3.7	**UP**
Swaziland	1.9	1.2	2.0	1.8	2.8	1.5	0.9	0.8	**UP**
Switzerland	1.9	2.0	1.6	0.7	0.8	0.9	2.3	1.7	**UP**
Tanzania	1.9	0.6	0.6	1.3	2.8	2.3	0.7	3.6	**UP**

Table A11: Countries where Botswana's textile has exceeded its export trade potential

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
France	1.0	2.3	3.1	0.8	0.9	0.8	2.9	0.8	**EP**
Germany	0.9	0.8	0.7	0.8	0.8	0.8	0.7	0.8	**EP**
Lesotho	0.8	0.8	1.8	1.7	1.0	1.1	0.9	0.8	**EP**

Malawi	0.7	0.8	1.3	0.8	1.1	1.1	0.9	0.8	**EP**
Mauritius	0.4	1.8	1.1	0.6	1.1	0.4	0.4	0.4	**EP**
Namibia	0.6	0.6	2.1	0.9	0.8	0.8	0.8	0.7	**EP**
Netherlands	0.9	3.3	2.1	0.8	0.9	0.8	1.2	0.6	**EP**
Norway	1.4	2.8	0.8	0.7	0.7	2.2	0.7	1.8	**EP**
South Africa	0.97	0.98	0.99	0.96	0.99	0.99	0.98	0.98	**EP**
United Kingdom	0.7	0.7	0.7	0.7	0.9	0.7	0.7	0.6	**EP**
USA	1.00	1.02	1.11	1.00	1.04	0.97	0.92	0.97	**FP**
Zambia	0.9	0.6	0.6	0.9	1.0	1.0	0.9	0.9	**EP**
Zimbabwe	0.6	0.7	0.7	1.0	1.0	0.9	0.8	1.1	**EP**

Table A12: Regional distribution of countries with potential for textile trade expansion

Country/Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Overall**
European Union (EU)									
Belgium	0.6	0.7	0.8	0.8	1.0	0.6	1.9	1.8	**UP**
Denmark	2.0	2.7	0.7	0.7	0.9	2.3	1.1	1.7	**UP**
Finland	1.6	1.5	1.7	0.7	0.9	1.4	0.9	1.7	**UP**
Spain	0.9	3.1	2.2	1.1	0.9	1.0	2.1	3.7	**UP**
Switzerland	1.9	2.0	1.6	0.7	0.8	0.9	2.3	1.7	**UP**
SADC									
Mozambique	1.2	1.3	2.4	2.5	1.2	1.3	1.4	3.3	**UP**
Swaziland+	1.9	1.2	2.0	1.8	2.8	1.5	0.9	0.8	**UP**
Tanzania	1.9	0.6	0.6	1.3	2.8	2.3	0.7	3.6	**UP**

Note: "+" Both a SADC and SACU member country

Table A13: Regional distribution of countries with exceeded textile trade potential

Country/Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Overall**
European Union (EU)									
France	1.0	2.3	3.1	0.8	0.9	0.8	2.9	0.8	**EP**
Germany	0.9	0.8	0.7	0.8	0.8	0.8	0.7	0.8	**EP**
United Kingdom	0.7	0.7	0.7	0.7	0.9	0.7	0.7	0.6	**EP**

Netherlands	0.9	3.3	2.1	0.8	0.9	0.8	1.2	0.6	**EP**
SADC									
Lesotho+	0.8	0.8	1.8	1.7	1.0	1.1	0.9	0.8	**EP**
Malawi	0.7	0.8	1.3	0.8	1.1	1.1	0.9	0.8	**EP**
Mauritius	0.4	1.8	1.1	0.6	1.1	0.4	0.4	0.4	**EP**
Namibia+	0.6	0.6	2.1	0.9	0.8	0.8	0.8	0.7	**EP**
South Africa+	0.97	0.98	0.99	0.96	0.99	0.99	0.98	0.98	**FP**
Zambia	0.9	0.6	0.6	0.9	1.0	1.0	0.9	0.9	**EP**
Zimbabwe	0.6	0.7	0.7	1.0	1.0	0.9	0.8	1.1	**EP**
America									
U.S.A	1.00	1.02	1.11	1.00	1.04	0.97	0.92	0.97	**EP**

Note: "+" Both a SADC and SACU member country

4.3 Meat and meat products sector

Table A14: Countries with unrealized potential for meat and meat export trade

Country/Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Overall**
Italy	3.57	2.36	6.20	12.55	3584	5.94	10992	7254	**UP**
Mauritius	144	59.1	0.30	0.12	1.15	128	501.30	0.19	**UP**
Namibia	250.3	132	335	902	5.28	2.83	1.28	59.9	**UP**
Norway	0.03	0.03	0.04	0.22	0.26	35.73	1879.40	1.03	**UP**

Table A15: Countries with exceeded meat and meat products export trade

Country/Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Overall**
Germany	41968	0.07	0.70	0.53	0.70	0.19	0.09	0.16	**EP**
Greece	0.06	0.04	0.09	0.04	0.08	0.10	0.03	0.03	**EP**
Netherlands	0.31	0.31	5455	1.25	2126	0.28	0.17	1.26	**EP**
Reunion	0.01	0.01	0.05	0.05	0.23	0.02	0.01	0.02	**EP**
South Africa	0.18	0.24	0.18	0.71	0.26	1.05	0.08	0.04	**EP**
United Kingdom	0.06	0.08	0.08	0.08	0.11	0.12	0.06	0.05	**EP**
Zimbabwe	0.01	39.35	0.06	41.60	1.60	0.03	3.40	0.02	**EP**

Table A16: Regional distribution of countries with potential meat and meat products trade expansion

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
European Union (EU)									
Italy	3.57	2.36	6.20	12.55	3583.55	5.94	10991.53	7254.41	**UP**
SADC									
Mauritius	143.92	59.06	0.30	0.12	1.15	127.50	501.30	0.19	**UP**
Namibia+	250.25	131.83	335.30	901.69	5.28	2.83	1.28	59.85	**UP**

Note: "+" Both a SADC and SACU member country

Table A17: Regional distribution of countries with exceeded meat and meat products trade

Country/Year	1999	2000	2001	2002	2003	2004	2005	2006	Overall
European Union (EU)									
Germany	41967.55	0.07	0.70	0.53	0.70	0.19	0.09	0.16	**EP**
Netherlands	0.31	0.31	5454.57	1.25	2125.84	0.28	0.17	1.26	**EP**
United Kingdom	0.06	0.08	0.08	0.08	0.11	0.12	0.06	0.05	**EP**
SADC									
South Africa+	0.18	0.24	0.18	0.71	0.26	1.05	0.08	0.04	**EP**
Zimbabwe	0.01	39.35	0.06	41.60	1.60	0.03	3.40	0.02	**EP**

Note: "+" Both a SADC and SACU member country

Table A18: List of sample countries for each sector

Diamond	Textile	Meat and Meat products
Belgium	Belgium	Germany
Israel	Canada	Greece
South Africa	Denmark	Italy
Switzerland	Finland	Mauritius
United Kingdom (UK)	France	Namibia
United States of America (USA)	Germany	Netherlands

Belgium	Ghana	Norway
Israel	Lesotho	Reunion
	Malawi	South Africa
	Mauritius	United Kingdom
	Mozambique	Zimbabwe
	Namibia	
	Netherlands	
	Norway	
	South Africa	
	Saudi Arabia	
	Spain	
	Swaziland	
	Switzerland	
	Tanzania	
	United Kingdom	
	USA	
	Zambia	
	Zimbabwe	

5 F-TEST FOR TESTING THE JOINT VALIDITY OF FIXED EFFECTS

This section of the Appendices presents both the steps that are used in calculating the F-test used to test the joint validity of fixed effects as well as the empirical results of the F-test for the three sectoral equations.

a) F-test steps

The null hypothesis of no individual effects can be tested with an applied Chow or F-test by combining the Residual Sum of Squares (RSS) for the regression both with constraints (under the null) and without (under the alterative). In this test, the following steps are done.

i. Null and alternative hypotheses

The null and alternative hypotheses to be tested should be stated. According to Baltagi (2005), the null and alternative hypotheses are expressed as follows:

H_0: H_0: $\mu_1 = \mu_2 = \ldots = \mu_{N-1} = 0$ (no individual effects; same intercept for all cross sections)

H_A: Not all μ_i are equal to zero

ii. F-test specification

$$F = \frac{(RRSS - URSS)/(N-1)}{URSS/(NT - N - K)} = F(N-1),(NT-N-K)$$

where: RRSS = restricted residual sum of squares

URSS = unrestricted residual sum of squares

N = number of cross section panel units (countries in this thesis)

K = parameters in each gravity equation to be estimated

T = the length of the panel (e.g., months, years etc)

iii. **Decision rule**

Reject null hypothesis of no individual fixed effects in favour of fixed effects, i.e. heterogeneity of cross-sections if and only if the calculated F value (from the above F-test formula) is greater that the critical value of F (usually provided at the back of most econometric textbooks)[31].

[31] In this section, all the critical values of F are taken from Gujarati (2005)

iv. **Implementation of the F-test**

Instead of doing the manual calculations of the F value using the formula in (ii) above, an Eviews program can be utilized to get the same value of F. This Eviews run program is the one utilized in this section of the analysis (though the printouts of the program outputs are not presented here).

b) F-Test results

i. Diamond equation

The calculated value of F is contained in the Eviews run program, $F_{calculated} = 6.6$. The critical value of $F_{critical}$, given from the textbook figures is $F_{5,36} = 2.45$.

Inference

Since the calculated F value (=6.6) is greater that the critical value of F (=2.45), the null of no individual fixed effects is rejected in favour of fixed effects. That is, for the diamond gravity model, trade partner countries are heterogeneous and thus fixed effects must be allowed.

ii. Textile equation

The calculated value of F is contained in the Eviews run program, $F_{calculated} = 8.23$. The critical value of $F_{critical}$, given from the textbook figures is $F_{23,168} = 1.57$.

Inference

Since the calculated F value (=8.23) is greater that the critical value of F (=1.57), the null of no individual fixed effects is rejected in favour of fixed effects. That is, for the textile gravity model, trade partner countries are heterogeneous and thus fixed effects must be allowed.

iii. Meat and meat products equation

The calculated value of F is contained in the Eviews run program, $\boldsymbol{F_{calculated}}$ = 7.1. The critical value of $F_{critical}$, given from the textbook figures is $\boldsymbol{F_{21,154}}$ = 1.62.

Inference

Since the calculated F value (=7.1) is greater that the critical value of F (=1.62), the null of no individual fixed effects is rejected in favour of fixed effects. That is, for the meat and meat products gravity model, trade partner countries are heterogeneous and thus fixed effects must be allowed.

6 HAUSMAN TEST FOR EXOGENEITY AND MISSPECIFICATION

This section of the Appendices presents the Hausman test

a) Purpose and underlying principles of Hausman test

The purpose and underlying principles of the Hausman test is to test for exogeneity of independent (X_{it}) variables (and misspecification). Hausman test is necessitated by the assumption normally made in one-way error component models that $E(u_{it}/X_{it})$[32]=0 (where $u_{it} = u_i \ t \ v_{it}$). Nevertheless, in empirical investigations, the one-way error component, u_{it}, normally contains individual invariant effects (the u_i) which are unobserved and maybe correlated with the X_{it}. Thus the Hausman will test this relationship between u_i and X_{it}.

[32] In Equations (13) and (14), μ_{it} is represented by ε_{ij}

i. Null and alternative hypotheses are

$H_0 : E(u_{it}|X_{it}) = 0$; No misspecification (or no correlation between u_{it}) and X_{it} are exogenous

$H_A : E(u_{it}|X_{it}) \neq 0$; u_{it} and X_{it} are correlated, i.e., X_{it} is endogenous

ii. Procedure to calculate the test statistic

There are four (4) equivalent test statistics suggested by Hausman & Taylor (1981) which can be employed to calculate the test statistic.

a) $\hat{q}_1 = \hat{\beta}_{GLS} - \tilde{\beta}_w$

b) $\hat{q}_2 = \hat{\beta}_{GLS} - \hat{\beta}_B$

c) $\hat{q}_3 = \tilde{\beta}_w - \hat{\beta}_B$

d) $\hat{q}_4 = \hat{\beta}_{GLS} - \hat{\beta}_{OLS}$

iii. Distribution of the test statistic

The test statistic has a Chi-Square distribution, with *k* degrees of freedom, i.e., χ^2_k under the null, and this distribution is represented as follows:

$$m_3 = \hat{q}_3' V_3^{-1} \hat{q}_3 \sim \chi^2(6)$$

where

$\hat{q}_3 = \tilde{\beta}_{WITHIN} - \hat{\beta}_{BETWEEN}$

$V_3 = \text{var}(\hat{q}_3)$

iv. Deriving statistical inference

The calculated value of m_3 (from the above formula) will compared with the critical $\chi^2(k^{33})$. If the value of m_3 is greater than the value of $\chi^2(k)$, the null of no misspecification will be rejected, and the conclusion will be that the model specification suffers from misspecicification and the regressors are not exogenous. On the other hand, if the value of m_3 is less than the value of $\chi^2(k)$, the null of no misspecification will not be rejected, and the conclusion will be that the model specification does not suffers from misspecicification, and that the regressors are exogenous.

v. Implementation of the Hausman Test

Instead of doing the manual calculations of the Hausman test's m_3 using the formula presented above, an Eviews program can be utilized to get the m_3 values. This Eviews program is the one utilized in this section of the analysis, although the printouts of the program outputs are not presented here.

b) Hausman test results

i. Diamond gravity equation

The critical value of χ^2 from the textbook tables is $\chi^2(5)=11.1$. The calculated value of Hausman test m_3 from the Eviews run program, $m_3 = 0.14$.

<u>Inference</u>

Since the Hausman test m_3 (=0.14) is less than the critical value $\chi^2(5)$ (=11.1), the null hypothesis is NOT rejected. The conclusion therefore is that the X-regressor is exogenous and that there is no misspecification problem.

[33] 'k' is the number of non-dummy explanatory variables

ii. Textile gravity equation

The critical value of χ^2 from the textbook tables is $\chi^2(5)=11.1$. The calculated value of the Hausman test m_3 from the Eviews run program, $m_3 = 2.17$

Inference

Since the Hausman test m_3 (=2.17) is less than the critical value $\chi^2(5)$ (=11.1), the null hypothesis is NOT rejected. The conclusion therefore is that the X-regressor is exogenous and that there is no misspecification problem.

iii. Meat and meat products equation

The critical value of χ^2 from the textbook tables is $\chi^2(5)=11.1$. The calculated value of the Hausman test m_3 from the Eviews run program, $m_3 = 0.6$

Inference

Since the Hausman test m_3 (=0.6) is less than the critical value $\chi^2(5)$ (=11.1), the null hypothesis is NOT rejected. The conclusion therefore is that the X-regressor is exogenous and that there is no misspecification problem.

7 THEORETICAL DEVELOPMENT OF SECTORAL GRAVITY MODEL

Although the basic gravity trade model used in most empirical studies has been developed from Equation (11) presented in Chapter 3 of the main thesis, theoretical developments for sectoral gravity models are still scarce. One notable study which developed a sectoral gravity model which is adopted in this thesis is by Marques (2004).

Following Marques (2004), Botswana and its trading partners are considered to be composed of a finite number (h) of export sectors, which export to a number of destinations. When analyzing Botswana, it is paramount to note that exports of these sectors are compounded among other things by both non-spatial and spatial components of trade costs. Non-spatial costs includes import duties and non-tariff barriers (NTBs) and these costs can be reduced (or eliminated) by means of entering into a regional trade agreement with relevant trading partners. The second component of trade costs is purely spatial and depends on country pair-specific distance. Although these costs can be reduced by improvements in trade-related infrastructure, they can not be totally eliminated. Spatial trade costs are denoted by $\tau_{ij}d_{ij}$, with d being the distance between countries i and j, and $\tau_{ij}>0$ denoting a parameter which measures the quality of infrastructures in that country-pair. Thus the total cost of trade between two countries i and j is:

$$T_{ij} = t + \tau_{ij} d_i \qquad \text{(A3)}$$

Each country is assumed to have a finite number (h) of industrial export sectors which uses two factors of production in its production activities. These factors are unskilled labour (L^U) and industry-specific skilled labour (L^S), and an agricultural sector that only employs unskilled labour. The agriculture sector is assumed to be perfectively competitive and employing unskilled labour and arable land under constant returns to scale to produce a homogeneous product which will be traded at a cost of zero and this product will be also used as a numeraire. In the model, the price of the homogeneous good (pY) and the wage of unskilled labour (w^U) are both assumed to be equal to unit across all the countries. On the other hand, imperfect competition underpins production and trade in the h increasing returns to scale industrial sectors (X_h) where both unskilled and skilled labour in different proportions are employed to produce both final and intermediate differentiated goods. Product variety is categorized according to quality and rational consumers prefer quality since it increases their utility. Incorporating a utility weight function $\theta(k)=k^{\eta}$, where $\eta<1$ is the elasticity of the consumer's valuation of quality with respect to the quality index k, the utility function for a consumer in country i can be written as:[34] [35]

[34] Though there are many countries in the model, we will use a generic country subscript i as we assume that all countries share a preference structure with a CES functional form.

[35] The assumption of a share of manufacturers in consumption not higher than 1/3 ensures that, even if all industry is concentrated in a single country, the other country also has some agriculture, and thus equilibrium industrial wages equal equilibrium agricultural wages in each country. In this model the

$$U_t = \left[\prod_h (X_{ih})^{\gamma_h}\right]^{\rho} \left(Y_i^{1-\rho}\right), \quad 0 < \gamma_h < 1, \quad \sum_h \gamma_h = 1, \quad 0 < \rho \leq 1/3 \qquad \text{(A4)}$$

with each of the increasing returns to scale composite good formed as follows:

$$X_{ih} = \left[\int_0^{N_h} \left(k^{\eta} x_{ihk}\right)^{\frac{\sigma-1}{\sigma}} dk\right]^{\frac{\sigma-1}{\sigma}}, \text{ h = 1, 2, } \sigma > 1 \qquad \text{(A5)}$$

where x_{ihk} is the quantity consumed of each variety *k* produced in sector *h* in country *i*, N_h is the number of varieties effectively produced in sector *h*, σ is the elasticity of substitution among varieties of the same good, γ is the share of expenditure on each differentiated good, and ρ is the share of expenditure on all the differentiated goods. Further, assume n_{ih} to be the total number of varieties of differentiated goods of sector *h* effectively produced in country *i*, *pi* the free-on-board (FOB) prices in the producer's location *i*, and i_i the individual income in country *i*. The budget constraint faced by a consumer in country *i* can then be written as:

$$p_i Y_i + \sum_{j=ROW} \sum_h \int_0^{n_{jh}} T_{ij} p_{jhk} x_{ihk} dk = i_i \qquad \text{(A6)}$$

where ROW = Rest of the world

Consumers maximize utility Equation (A4) subject to the budget constraint represented by equation (A6)[36]. Assume that the price index P_i of each industry's

equality applies to unskilled labour only since skilled labour is specific to industry. Thus wage determination can be treated as if there was one single factor of production in the model.

[36] Each consumer allocates to good Y a share 1-ρ of individual income. In addition, solving for the first order conditions returns the demand functions in market *i* for a variety k of each sector X_h. These are represented by the first term in the total demand equation (A9).

aggregate good in country i is the same for inputs as for final products and is expressed as:[37]

$$P_{ih} = \left[\sum_{j=ROW} \int_0^{n_{jh}} \left(\frac{T_{ij} p_{jhk}}{k^{\eta}} \right)^{1-\sigma} dk \right]^{\frac{1}{1-\sigma}} \quad \text{(A7)}$$

Venables (1999) argues that inter-industry linkages are sufficiently weaker than intra-industry linkages to be ignored. On the other hand, Forslid (1999) point out that labour is categorized according to fixed costs (skilled labour engaged in research) and marginal costs (unskilled labour employed in production) such that skill-intensive industries have a higher degree of scale economies. Additionally, fixed costs become a function of quality, their natural limit being provided by the total supply of skilled labour available. As a consequence countries with more skilled labour are able to achieve higher quality levels. Using a fixed cost function $\varphi(k) = k^{\delta}$, where $\delta > 1$ is the elasticity of the firm's fixed cost of quality with respect to the quality index k, the minimum cost function for producing a variety k in country i will then be:

$$TC_{ihk} = (P_{ih})^{\mu} \left[(w_i^s)^{\alpha} k^{\delta} + (w^U)^{1-\alpha-\mu} \right] cx_{ihk} \quad \text{(A8)}$$

with w^S and w^U the wage rates for skilled and unskilled labour, respectively, α the share of skilled labour in total cost, μ the share of intermediates in total cost, c the marginal cost, and x the equilibrium output. The total demand from consumers and firms of both sectors faced in market i by a firm producing variety k in country j is represented by:

$$X_{ijhk} = [P_{jhk}]^{-\sigma} \left[\frac{T_{ij}}{k^{\eta} P_{ih}} \right]^{1-\sigma} E_{ih} \quad \text{(A9)}$$

with E_{ih} the expenditure function given by:

[37] The procedure for the derivation of the CES demand functions and the corresponding price index is fully described in Fujita et al. (2000).

$$E_{ih} = \gamma_h \rho I_i + \mu \int_0^{n_{i1}} TC_{i1k} dk \qquad \text{(A10)}$$

where I_i is the total income in country *i*. The profit maximizing price is a mark-up over marginal cost:

$$p_{ihk} = \left(\frac{\sigma}{\sigma - 1}\right)\left(w^U\right)^{1-\alpha-\mu}\left(P_{ih}\right)^{\mu} c \qquad \text{(A11)}$$

The zero profit condition can be solved for the firm's equilibrium output:

$$x_{ihk} = (\sigma - 1)\frac{k^{\delta}\left(w_i^s\right)^{\alpha}}{c\left(w^U\right)^{1-\alpha-\mu}} \qquad \text{(A12)}$$

The firm's demand for labour is:

$$w_i^s \lambda_{ih}^S = \sigma\alpha\left(w_i^S\right)^{\alpha}\left(P_{ih}\right)^{\mu} + \int_0^{n_{ih}} k^{\delta} dk \qquad \text{(A13)}$$

with λ^S_{ih} being the share of country *i*'s skilled labour endowment working in manufacturing sector *h*. According to this condition, the equilibrium wage bill of skilled workers is equal to their share of the equilibrium revenue.[38] In addition, with quality differences firms are no longer symmetric and it is the mass of firms that determines total production[39]. Finally, due to the assumption of non-substitutability of labour skills, wages are determined independently: the skilled wage is determined in the differentiated goods sector by (A13) and the unskilled wage is determined in the

[38] In equilibrium the zero profit condition applies and thus the equilibrium total revenue must equal the equilibrium total cost. Hence it is indifferent to think in terms of share in revenue or in costs.

[39] The mass of firms is described by the "quality integral". Since firms differ in the quality of their products according to some distribution function, it is the total mass of firms that is relevant and not just their number. Obviously if firms are symmetric the distribution is uniform and we obtain the special case that is currently treated in the literature in which the mass of firms depends directly on the number of firms.

homogeneous goods sector. Unskilled wages are always constant and equal to unity, skilled wages will be denoted by *w*.

The demand equation (A9) represents the total quantity demanded from a firm producing variety *k* in country *j* by consumers and firms of both sectors in market *i*. According to this equation, the quantity of variety *k* flowing from country *j* to country *i* depends on, among other variables, the total expenditure of country *i* in the sector to which that variety belongs. Expenditure as defined in equation (A10) depends on total cost as given by equation (A8). The latter in turn depends on the equilibrium output of the firm producing variety *k* as defined in equation (A10). After substituting (A12) into (A8) and the resulting expression into (A10), equation (A9) becomes:

$$x_{ijhk} = \left[P_{jhk}\right]^{-\sigma}\left[\frac{T_{ij}}{k^{\eta}P_{ih}}\right]^{1-\sigma} E_{ih} \qquad \text{(A14)}$$

as E_{ih} the expenditure function is now given by:

$$E_{ih} = \left[\gamma_h \rho I_i + \frac{\sigma\mu}{\delta+1}\left(w_i^S\right)\left(P_{ih}\right)^{\mu}\left(n_{ih}\right)^{\delta+1}\right] \qquad \text{(A15)}$$

Hence exports of variety *k* of sector *h* from country *j* to country *i* (x_{ijhk}) are a function of the relative price of the variety (p_{jhk}) with respect to country *i*'s price index in sector *h* (P_{ih}), the barriers to trade between countries *i* and *j* (T_{ij}), the consumer's quality index k^{η}, the number of firms in market *i* ($n_{i1}+n_{i2}$), and the income of market *i* (I_i) that depends on the skilled wage and the skilled labour force[40]. This relationship resembles a sectoral gravity equation that is presented and described in section 3.3.3 of the main thesis.

[40] Note that, in the model's set-up, the total income of country i is a function of both the skilled and unskilled labour force, and of wages. However, as it is assumed that the number and reward of unskilled workers is the same in all markets, a market's income is really determined by the number and reward of skilled workers.

8 HUFBAUER 1970 INDEX

The Hufbauer's (1970) index of product differentiation is one of the possible variables used to represent intra-industry trade (IIT) emanating from the product differentiation or increasing returns to scale theories in a gravity model equation. The index is constructed in the form of the coefficient of variation in unit export values as follows:

$$PD = \frac{U_n}{V_n} \quad \text{(A16)}$$

where PD denotes product differentiation, U_n is the standard deviation export unit values for shipments of Botswana's diamond product to different trading partner countries; and V_n, denotes the unweighted mean of these unit values.

9 REVEALED COMPARATIVE ADVANTAGE

Revealed comparative advantage (RCA) was pioneered by Bella Balassa (1965). The approach emanated from difficulties in measuring an industry's actual comparative advantage in production and trade. Given the difficulties in (i) accounting for all the factors which influence an industry's comparative advantage, and (ii) actually measuring and comparing these factors between countries and industries, Balassa argued that the revealed performance of an industry's trade pattern would serve as a reasonably adequate indicator of that industry's comparative advantage (Hamilton and Svensson, 1984).

RCA states that if a country can produce a good at a lower cost relative to other countries, then with international trade, that country should devote more of its scare resources to the production of that good. Through trade, that country can obtain other goods at a lower price (opportunity cost), in exchange for the good in which it has a comparative advantage. Thus according to the predictions of RCA, if a country has a comparative advantage in the production of a good, it should be found to export a higher proportion of that good relative to other countries.

Following Balassa's (1965), revealed comparative advantage index (RCAI) formulation is expressed as follows:

$$RCAI_{ij} = \left(X_{ij} / X_i \right) / \left(X_{wj} / X_w \right) = \left(X_{ij} / X_{wj} \right) / \left(X_i / X_w \right) \quad \text{(A17)}$$

where: $RCAI_{ij}$ = country i's revealed comparative advantage for good j

X_{ij} = i^{th} country's exports of commodity (or industry) j

X_i = i^{th} country's total exports

X_{wj} = world exports of commodity (or industry) j

X_w = total world exports

$RCAI_{ij}$ measures a country's exports of a sector (or commodity or industry) relative to its total exports and to the corresponding world exports. A comparative advantage is "revealed", if $RCAI_{ij} > 1$. On the other hand, if $RCAI_{ij}$ is less than unity, the country is said to have a comparative disadvantage in the commodity/industry.

10 DIFFERENT TYPES OF PANEL UNIT ROOT TEST STATISTICS

This section of the Appendices presents the six panel unit root tests that are normally employed in testing the stationarity of a panel data set.

Table A19: Different types of panel unit root tests statistics

Test	**H_0**	**H_A**	**Assumption of the unit root process (Common/ individual)**	**Test statistic**	**When to reject H_0 and associated inference in this case**
Levin, Lin, Chu (LLC) (2002)	Each individual time series contains a unit root	Each time series is stationary	Common	Adjusted (standardised) ***t*-statistic** t_ρ^* on pooled regression:	$p<0.05$; panel is stationary

				$\tilde{e}_{it} = \rho \tilde{v}_{i,t-1} + \tilde{\varepsilon}_{it}$	
Breitung (2000)	Each individual time series contains a unit root	Each time series is stationary	Common	Adjusted (standardised) ***t*-statistic** on pooled regression: $e^*_{it} = \rho v^*_{i,t-1} + \varepsilon^*_{it}$	p<0.05; panel is stationary
Im, Pesaran, Shin (2003)	Each individual time series contains a (series specific) unit root, $\rho_i = 0 \ \forall_i$	Some (but not all) of the individual series have unit roots, i.e., $p_i<0$ for at least one i.	Individual	Weighted, standardised ***t*-statistic** based on t-stats of individual ρ_i coefficients (individual ADF statistics)	p<0.05; panel is stationary
ADF-Fisher (Madala & Wu 1999; Choi 2001)	Each individual time series contains a (series specific) unit root, $\rho_i = 0 \ \forall_i$	Some (but not all) of the individual series have unit roots, i.e., $p_i<0$ for at least one i.	Individual	**Combined information on *p*-values** of individual unit root tests: $P = -2\sum_{i=1}^{N} \ln p_i$	p<0.05; panel is stationary
PP-Fisher Madala & Wu 1999; Choi 2001)	Each individual time series contains a (series specific) unit root, $\rho_i = 0 \ \forall_i$	Some (but not all) of the individual series have unit roots, i.e., $p_i<0$ for at least one i.	Individual	**Combined information on *p*-values** of individual unit root tests: $P = -2\sum_{i=1}^{N} \ln p_i$	p<0.05; panel is stationary
Hadri (2000)	No unit roots in any of the series in the panel	All series contain unit roots	Common	Two standardised ***Z*-statistics** (based on two *LM* statistics, where one allows for heteroskedastisity accros *i*)	p<0.05; panel is non-stationary

Source: author compilation

11 DESCRIPTIVE STATISTICS AND CORRELATION MATRIX

This part of the Appendices presents the descriptive statistics and correlation metrics for all the data used in the empirical analysis done in this thesis.

11.1 Descriptive statistics

Table A20: Descriptive statistics for data used in Diamond gravity equation

	EXPO	MGDP	GDP	POP	KLR	HF
Mean	14.05474	7.930801	6.345557	3.292091	11.22658	0.437681
Median	15.04852	7.963398	5.681327	3.07074	11.25675	0.412326
Maximum	21.91819	8.232632	9.491341	5.702832	11.45475	0.511659
Minimum	2.302585	7.566206	4.684767	1.783559	10.87953	0.410188
Std. Dev.	5.754608	0.215639	1.600522	1.383991	0.160668	0.041068
Skewness	-0.66497	-0.19428	0.870327	0.51756	-0.89052	1.105667
Kurtosis	2.605734	1.937462	2.346994	1.916484	3.413526	2.311427
Jarque-Bera	3.848413	2.559934	6.912586	4.490962	6.686191	10.72827
Probability	0.145992	0.278046	0.031546	0.105877	0.035327	0.004682
Sum	674.6277	380.6785	304.5868	158.0204	538.876	21.00868
Sum Sq. Dev.	1556.429	2.185518	120.3985	90.0253	1.213264	0.07927
Observations	48	48	48	48	48	48
Cross sections	6	6	6	6	6	6

Key:

EXPO =Botswana's sectoral exports (e.g., diamond); MFGDP = Botswana's Mining sector GDP; GDP = GDP for importing partners; POP = Importer population; KLR = Botswana's sectoral capital labour ratio; HF = Haufbauer index

Table A21: Descriptive statistics for data used in the Textiles gravity equation

	EXPO	MFGDP	GDP	POP	INFL	KLR	RCAIT
Mean	9.643426	5.620694	4.251186	2.652099	17.48281	-4.98542	0.4
Median	10.04765	5.610141	5.150801	2.665883	3.2	-4.98115	0.3
Maximum	18.38125	5.848947	9.491341	5.702832	1016.7	-4.71538	0.7
Minimum	2.484907	5.40178	-0.35811	0.002996	-1.3	-5.2064	0.2
Std. Dev.	4.499969	0.169522	2.748404	1.317023	83.50559	0.189688	0.166265
Skewness	0.081166	0.049875	-0.07258	0.065477	9.81236	0.066433	0.657843
Kurtosis	1.831717	1.285236	1.700168	2.633269	111.0763	1.25018	1.950413
Jarque-Bera	11.1299	23.60292	13.68506	1.213121	96524.94	24.6362	22.66129
Probability	0.00383	0.000007	0.001067	0.545223	0	0.000004	0.000012
Sum	1851.538	1079.173	816.2278	509.2031	3356.7	-957.2	76.8
Sum Sq. Dev.	3867.696	5.488932	1442.761	331.2988	1331878	6.872464	5.28
Observations	192	192	192	192	192	192	192
Cross sections	24	24	24	24	24	24	24

Key:

MFGDP = Botswana's Manufacturing sector GDP; INFL = importer inflation; RCAIT = revealed comparative index for textiles exports; and Other variables as defined before

Table A22: Descriptive statistics for data used in the Meat gravity equation

	EXPO	AGDP	GDP	INFL	KLR	RCAIM
Mean	12.16171	5.028592	4.663977	1.387487	0.067614	2.6375
Median	13.74886	5.031871	5.2	1.047165	0.042414	2.55
Maximum	17.47221	5.267081	7.97	6.924317	0.275323	3.9
Minimum	2.995732	4.828882	1.14	-0.91629	0.024971	1.9
Std. Dev.	4.434024	0.159274	2.427602	1.37706	0.079629	0.599101
Skewness	-0.75575	0.082359	-0.23071	2.145219	2.191995	0.848736
Kurtosis	2.133224	1.40014	1.490931	7.819477	5.952492	2.957224
Jarque-Bera	11.1318	9.484504	9.130736	152.6624	102.4341	10.57187
Probability	0.003826	0.008719	0.010406	0	0	0.005062
Sum	1070.231	442.5161	410.43	122.0989	5.95005	232.1
Sum Sq. Dev.	1710.47	2.207029	512.7129	164.9776	0.551641	31.22625

Observations	88	88	88	88	88	88
Cross sections	11	11	11	11	11	11

Key: AGDP = Botswana's Agriculture sector GDP; RCAIM = revealed comparative index for meat and meat products exports; and Other variables as defined before.

11.2 Correlation matrix

Table A23: Correlation matrix for data used in the diamond gravity equation

	EXPO	MGDP	GDP	POP	KLR	HF2
EXPO	**1.000000**	0.180545	-0.146745	-0.085143	0.352907	-0.042973
MGDP	0.180545	**1.000000**	-0.449021	-0.905168	0.030495	-0.330805
GDP	-0.146745	-0.449021	**1.000000**	0.270814	-0.651643	0.225288
POP	-0.085143	-0.905168	0.270814	**1.000000**	-0.651710	0.202821
KLR	0.352907	0.030495	-0.651643	-0.651710	**1.000000**	-0.713597
HF2	-0.042973	-0.330805	0.225288	0.202821	-0.713597	**1.000000**

Table A24: Correlation matrix for data used in the textiles gravity equation

	EXPO	MFGDP	GDP	POP	INFL	KLR	RCAIT
EXPO	**1.000000**	0.415545	-0.271713	-0.254188	0.064899	-0.040412	-0.167879
MFGDP	0.415545	**1.000000**	0.364825	0.399216	0.206567	-0.640943	0.625790
GDP	-0.271713	0.364825	**1.000000**	0.767978	0.112810	-0.431685	0.544788
POP	-0.254188	0.399216	0.767978	**1.000000**	0.400535	-0.642989	0.470745
INFL	0.064899	0.206567	0.112810	0.400535	**1.000000**	-0.539600	0.340592
KLR	-0.040412	-0.640943	-0.431685	-0.642989	-0.539600	**1.000000**	-0.943110
RCAIT	-0.167879	0.625790	0.544788	0.470745	0.340592	-0.943110	**1.000000**

Table A25: Correlation matrix for data used in the meat gravity equation

	EXPO	AGDP	GDP	INFL	KLRLEV	RCAIM
EXPO	**1.000000**	0.006901	-0.174699	0.232189	0.256941	-0.070196
AGDP	0.006901	**1.000000**	-0.842904	-0.580477	-0.781264	-0.356644
GDP	-0.174699	-0.842904	**1.000000**	0.393880	0.425880	0.394706
INFL	0.232189	-0.580477	0.393880	**1.000000**	0.247504	-0.173933
KLR	0.256941	-0.781264	0.425880	0.247504	**1.000000**	0.411824
RCAIM	-0.070196	-0.356644	0.394706	-0.173933	0.411824	**1.000000**

12 USE OF GRAVITY LAWS IN SOCIAL SCIENCE AND ECONOMICS

According to Paas (2000), there are various considerations regarding the application of a gravity approach to social phenomena and modeling of international trade flows. These considerations are generalized in the main stages of the development of theoretical background of the gravity approach in social science and economics. Thus according to this author the theoretical foundations underpinning the use of gravity models in social sciences in general, and economics in particular, can be traced to disciplines such as regional science, economic geography, microeconomics and general equilibrium, among others. Table A26 therefore presents some of the theoretical background and main concepts of the use of gravity laws in social sciences and economics.

Table A26: Theoretical foundations and main concepts of the use of gravity laws

Theoretical background	**The main aspects**	**Authors**
Regional science, economic geography	Measurement of intra-regional relationships and their influence on the behaviour of individual units. Regions are conceived as a mass. The location of the firm is guided by two fundamental forces: 1) economies of scale at the factory level, and 2) trade	Carey (1858), Reilly (1929), Steawart (1948), Isard and Freutel (1954), Hammer and Ikle (1957), Isard (1960), Harvey (1969), Nijkamp and Reggiani (1992), Krugman (1991, 1998), Davis and Weinstein (1996), Fujita et al

	costs.	(1999).
Microeconomics, utility maximization, general equilibrium	An optimal allocation of the given budget can be obtained by postulating a utility function for the decision-marker that reflects relative preferences. Assuming the budget constraint is linear; the volume of transactions between two points can be stated as a utility maximizing problem. A model using gravity theory could be derived from a utility maximizing function.	Linnemann (1996), Niedercorn and Bechdolt (1969), Golob and Beckman (1971), Nijkamp (1975), Bergstrand (1985), Nijkamp and Reggiani (1992)
Trade theories, which differ in the way product specialization is obtained in equilibrium: 1) technology differences across countries in the Ricardian model, 2) variations in terms of countries' differencing factor endownments in the Heckscher-Ohlin (H-O) model, 3) increasing returns at the firm level in the increasing returns to scale (IRS) models.	A gravity model for trade, considers three main functions: 1) the total potential supply (or exports) of a country to the world market; 2) the total potential demand (or imports) of a country to the world market; and 3) those factors that create a resistance to trade and thus affect the degree of trade intensity.	Tinbergen (1962), Poyhonem (1963), Linnemann (1966), Anderson (1979), Bergstrand (1985), Helpman and Krugman (1985), Deadorff (1995), Evenett and Keller (1998), Eichengreen and Irwin (1998), and Evenett and Killer (2002).

Source: Paas (2000, p 17-19)