Chapter 9. Summary, conclusions, and recommendations

9.1 Introduction
Over the last decades of the 20th century a large number of countries have experienced a substantial increase in materials recycling. During the same period, the international trade of recyclable materials between developed countries and developing countries has grown as well. A specific trade pattern has emerged: waste materials recovered in developed countries are exported to developing countries for recycling.

The aim of this book is to determine the economic and environmental significance of the simultaneous increase in trade and recycling of recyclable materials. Several questions emerge: (1) What are the specific patterns in trade and recycling? (2) What are the underlying causes of these patterns? (3) What are the economic and environmental effects of these patterns in trade and recycling? (4) How can these effects be measured and modelled? and (5) How should policy deal with potential negative externalities resulting from international recycling? Special attention has been paid to differences in recycling in developed and developing countries.

Following the sequence of the above questions, a summary of the main results is provided in Section 9.2. Section 9.2 presents the general conclusions of this book, and finally, Section 9.3 makes a number of policy recommendations.

9.2 Summary
Trends in trade and recycling
Accurate information on trade and recycling is lacking in economic statistics and the scientific literature. Existing studies generally cover a limited number of countries and materials, and mostly focus on a rather short time period. As part of this study, a database for trade and recycling has been constructed covering 9 materials in developed and developing countries over the last three decades. These materials include aluminium, copper, lead, nickel, paper, iron, tin, zinc, and plastics.

Several trends in trade and recycling have been found. Most countries have experienced large increases in the recycling and international trade of secondary materials. A clear distinction, however, can be observed between the recycling markets of developed and those of developing countries. Developed countries have specialised in the recovery of recyclable materials and therefore tend to be net-exporters of secondary materials on the international recycling market. Developing countries have focused on the utilisation of recyclable materials and therefore tend to be net-importers of secondary materials.

Causes of trade and recycling
In Part I of this book, trade theories were evaluated to explain observed patterns and trends in trade and recycling. Rather than providing an all-encompassing explanation of the increased interdependencies in international recycling markets, each trade theory
Conclusions

contributes by explaining specific features of international recycling. According to the Heckscher-Ohlin theorem, developed countries export the abundant factor ‘secondary materials’, while developing countries use the required cheap labour to convert secondary materials into products. Trade theories incorporating environmental elements show that if developing countries have a comparative advantage in environment-intensive products and materials they import relatively more low-grade commodities and waste materials. According to demand-oriented theories, secondary commodities flow to these countries due to consumers demanding lower-quality materials and products in developing countries. According to neo-technology theories, new (recycling) technologies originate and mature in developed countries, after which they gradually diffuse to developing countries. Recycling in the South therefore lags behind the recycling sector in the North. Theories on location, state that because the recycling industry is strongly dependent on forward and backward agents in their vicinity, geographical concentration of industrial clusters is especially important for the recycling sector. Only when the recycling industry is strategically located in relation to the supplying and demanding agents, can economies of scale in this sector be realised. According to the theory on location, the international trade of recyclable materials is only considered a supplementary source of inputs to domestic materials.

The underlying causes of trade and recycling were examined empirically. Regression analyses have been conducted for paper and lead commodities in developed and developing countries. Several general conclusions can be drawn. First, population density is positively related to materials recycling. Land scarcity reduces the option of landfilling, creating an incentive for increased recovery. For hazardous materials, such as lead scrap, however, environmental regulations discourage recycling in densely populated areas. Secondly, the waste of higher-income countries promotes recycling, which can be explained by the economies of scale of waste recovery and increased environmental awareness at the household level. Thirdly, economic growth and recycling are negatively correlated. A possible explanation is that rapidly growing economies utilise the easily accessible primary materials rather than the more ‘laborious’ recyclable materials. Moreover, there is a time lag between the rapid increase in consumption and the discarding of materials. Finally, openness of the economy is found to promote the utilisation of secondary materials. An explanation is that recyclers in open economies are more flexible in composing their input mix from domestic and foreign sources and therefore perform better. Moreover, open economies are generally well equipped with infrastructure, which has spin-off effects on the recycling industry. In a few cases, however, increased foreign competition creates more strenuous market conditions for the recoverer of secondary materials.

Methods and measurement of effects of international recycling

The internationalisation of the recycling market leads to an increased physical interdependence of economic activities. This interdependence occurs at every stage in the life cycle: extraction, production, consumption and solid waste management. To analyse these effects an alternative view on economic and environmental processes is presented. The concept of the international material-product chain (MPC) provides a useful tool for analysing developments in the international trade of materials and products in a comprehensive manner. Taking into account the variations in the factor requirements of the dif-