Studies on the Agricultural and Food Sector
in Central and Eastern Europe

Patrick Zier

# Econometric impact assessment of the Common Agricultural Policy in East German agriculture

LEIBNIZ-INSTITUT FÜR AGRARENTWICKLUNG
IN MITTEL- UND OSTEUROPA

Econometric impact assessment of the

Common Agricultural Policy in East German agriculture

Studies on the Agricultural and Food Sector
in Central and Eastern Europe

Edited by
Leibniz Institute of Agricultural Development
in Central and Eastern Europe
IAMO

Volume 71

# Econometric impact assessment of the Common Agricultural Policy in East German agriculture

by
**Patrick Zier**

IAMO

2013

**Bibliografische Information Der Deutschen Bibliothek**
Die Deutsche Bibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.ddb.de abrufbar.

**Bibliographic information published by Die Deutsche Bibliothek**
Die Deutsche Bibliothek lists the publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the internet at: http://dnb.ddb.de.

This thesis was accepted as a doctoral dissertation in fulfillment of the requirements for the degree "doctor agriculturarum" by the Faculty of Natural Sciences III at Martin Luther University Halle-Wittenberg on 28.06.2012.

| | |
|---|---|
| Date of oral examination: | 12.11.2012 |
| Supervisor and Reviewer: | PD. Dr. M. Petrick |
| Co-Reviewer: | Prof. Dr. T. Herzfeld |
| Co-Reviewer: | Prof. Dr. S. Hüttel |

Diese Veröffentlichung kann kostenfrei im Internet unter <*www.iamo.de/dok/sr_vol71pdf*> heruntergeladen werden.

This publication can be downloaded free from the website <*www.iamo.de/dok/sr_vol71pdf*>.


Leibniz-Institut für Agrarentwicklung in Mittel- und Osteuropa (IAMO)
Theodor-Lieser-Straße 2
06120 Halle (Saale)
Tel.: 49 (345) 2928-0
Fax: 49 (345) 2928-199
e-mail: iamo@iamo.de
http://www.iamo.de
ISSN 1436-221X
ISBN 978-3-938584-73-6

# DANKSAGUNG

Diese Doktorarbeit ist das Ergebnis meiner Forschungstätigkeit im Rahmen des DFG-Projektes "Strukturwandel im Agrarsektor" (SiAg) am Leibniz-Institut für Agrarentwicklung in Mittel- und Osteuropa (IAMO). An dieser Stelle möchte ich mich bei allen bedanken, die mich bei der Arbeit begleitet und unterstützt haben.

An erster Stelle möchte ich mich bei meinem Doktorvater Martin Petrick bedanken. Er hatte immer Vertrauen in mich und unterstützte mich mit entscheidenden und hilfreichen Anmerkungen. Zudem war Martin stets kurzfristig zu sprechen, wenn es mal klemmte; ein Doktorvater, wie man ihn sich nur wünschen kann. Recht herzlich bedanken möchte ich mich auch bei Peter Weingarten, der mich ermutigt hat die Arbeit als wissenschaftlicher Mitarbeiter am IAMO aufzunehmen sowie Gertrud Buchenrieder, Judith Möllers und Klaus Frohberg, die mich insbesondere in den ersten Jahren am IAMO begleitet haben.

Mein Dank gilt weiterhin Thomas Herzfeld und Silke Hüttel für ihre Bereitschaft, diese Arbeit zu begutachten, Franziska Gückelhorn für ihre Hilfe im Rahmen der Datenaufbereitung und Mathias Kloss für seine Unterstützung bei ökonometrischen Fragestellungen. Bedanken möchte ich mich zudem bei allen Projektpartnern der SiAg Forschergruppe für die regelmäßige und kritische Auseinandersetzung mit meinem Thema und die wertvollen Verbesserungsvorschläge, die daraus resultierten.

Ein besonderer Dank gilt dem Ministerium für Infrastruktur und Landwirtschaft in Brandenburg, dem Staatsministerium für Landwirtschaft und Umwelt in Sachsen sowie dem Ministerium für Landwirtschaft und Umwelt in Sachsen-Anhalt für die umfangreiche Bereitstellung der Förderdaten zur Gemeinsamen Agrarpolitik, ohne die diese Arbeit nicht möglich gewesen wäre.

Neben inhaltlichen und fachlichen Hilfestellungen gilt mein Dank auch allen Freunden und Kollegen für ihre persönliche Unterstützung, insbesondere Marten Graubner, der mir bei unserer fast täglichen Kaffeerunde die Spezifika der kleinstrukturierten Landwirtschaft im Erzgebirge näher brachte und damit für ein gesundes Maß an Ablenkung im Wissenschaftleralltag sorgte. Bedanken möchte ich mich auch bei Gabriele Mewes sowie allen anderen Kollegen der Administration, die stets dafür gesorgt haben, dass man sich auf seine eigentliche, die wissenschaftliche Arbeit konzentrieren konnte. Nicht zuletzt danke ich meinen Bürokollegen Florian Ammersdorfer und Martin Freier für die ruhige Arbeitsatmosphäre.

Dank gilt auch meinen Eltern, Bruder und Schwiegereltern, die immer an mich geglaubt und ihr Interesse an meiner Arbeit bekundet haben. Mein größter Dank geht schlussendlich an meine Frau Marianne und unsere Kinder Bennet, Nora und Eric für ihren Rückhalt, besonders während der Endphase meiner Doktorarbeit.

Naumburg (Saale), Juni 2013 Patrick Zier

# ZUSAMMENFASSUNG


Die Agrarpolitik auf nationaler und Europäischer Ebene befindet sich inmitten eines tiefgreifenden Wandlungsprozesses, wobei die traditionelle sektororientierte Markt- und Preispolitik stark infrage gestellt wird. Im Laufe der letzten beiden Jahrzehnte wurden die Direktzahlungen der Gemeinsamen Agrarpolitik (GAP) der Europäischen Union (EU) in Verbindung mit einer sinkenden Agrarpreisstützung zunehmend von der Produktion entkoppelt. Darüber hinaus gewannen Maßnahmen der sogenannten 2. Säule an Bedeutung, die auf die Entwicklung des ländlichen Raumes fokussieren. Zu den wichtigsten Programmen in Deutschland zählen dabei: Maßnahmen zur ländlichen Entwicklung; Agrarumweltmaßnahmen; die Ausgleichszulage für benachteiligte Gebiete; Maßnahmen zur Verbesserung der Marktstruktur und die einzelbetriebliche Investitionsförderung.

Viele Europäer erwarten von der GAP, dass sie Arbeitsplätze im ländlichen Raum sichert oder sogar neu schafft. Folglich greifen Politiker und landwirtschaftliche Interessenvertreter dieses Argument häufig auf, um die Fortführung der GAP gegenüber der Gesellschaft zu rechtfertigen. Es wird in diesem Zusammenhang behauptet, dass die Direktzahlungen und insbesondere die Maßnahmen der 2. Säule unabdingbar für die Sicherung von landwirtschaftlichen Arbeitsplätzen sind. Neben den Beschäftigungseffekten, ist die Wirkung der 1. Säule Maßnahmen der GAP auf die Agrarstruktur von großer Bedeutung. Politische Entscheidungsträger und Interessenvertreter aus der Landwirtschaft argumentieren in diesem Zusammenhang, dass die Einkommensstützung durch Direktzahlungen unumgänglich ist, wenn es darum geht, einen verlässlichen Rahmen für die Landwirte in der EU zu gewährleisten. Diese Erwartungen stehen jedoch im Gegensatz zum andauernden Rückgang der Erwerbstätigen und dem fortschreitenden Strukturwandel in der Landwirtschaft im Verlauf der letzten Jahrzehnte. Daraus ergibt sich die Frage, welche Effekte die Folge staatlicher Zuschüsse sind und ob die Situation ohne die GAP sogar schlechter wäre.

In der vorliegenden Dissertation wird eine ex-post Wirkungsanalyse der GAP basierend auf Regionaldatenfür 69 Kreise zwischen 1997 und 2007 in den drei Ostdeutschen Bundesländern Brandenburg, Sachsen und Sachsen-Anhalt durchgeführt. Die Arbeit verfolgt dabei zwei Hauptziele: Erstens sollen die Effekte des gesamten Portfolios an GAP Maßnahmen auf die Arbeitsnachfrage in der Ostdeutschen Landwirtschaft untersucht werden. Ein besonderer Fokus liegt dabei auf der Entkopplung der Direktzahlungen. Zweitens soll die Wirkung der Direktzahlungen bei einer heterogenen Agrarstruktur analysiert werden. In Anbetracht der

Tatsache, dass empirische Ergebnisse bezüglich dieser Fragestellungen begrenzt sind, hat die vorliegende Arbeit das Ziel, die bestehende Wissenslücke zu füllen.

Die empirische Analyse des gesamten Maßnahmenpaketes der GAP auf die Arbeitsnachfrage in der Ostdeutschen Landwirtschaft zwischen 1999 und 2006 offenbart, dass es nur wenig erwünschte Beschäftigungseffekte gab. Basierend auf einem empirisch motivierten Difference-in-Differences Model kann gezeigt werden, dass einzelbetriebliche Investitionsbeihilfen und die Ausgleichszulage keine Wirkung aufwiesen. Marginal steigende Direktzahlungen sowie deren Entkopplung von der Produktion in 2005 führten zu einem signifikanten Arbeitsplatzabbau. Modernisierungsmaßnahmen im Bereich der Verarbeitung und Vermarktung führten ebenfalls zu Arbeitsplatzverlusten in der Landwirtschaft, welche teilweise mit einer Verzögerung von zwei Jahren auftraten. Fördermaßnahmen für die Entwicklung des ländlichen Raumes reduzierten die Beschäftigung in der Landwirtschaft mit einer Verzögerung von einem Jahr. Demgegenüber zeigen die vorliegenden Ergebnisse, dass die Agrarumweltmaßnahmen dazu tendierten, arbeitsintensive Verfahren zu erhalten oder anzuregen.

Das theoretisch fundierte Regulierungskosten-Model für die Arbeitsnachfrage deutet darauf hin, dass der landwirtschaftliche Arbeitskräfteeinsatz in Ostdeutschland nur langsam an äußere Rahmenbedingungen angepasst wurde. Im Durchschnitt dauerte es etwas mehr als drei Jahre, um einen neuen Gleichgewichtszustand zur Hälfte zu erreichen. Weiterhin bestätigt dieses Model den beschleunigten Arbeitskräfteabbau durch die Entkopplung der Direktzahlungen. Fördermaßnahmen zur ländlichen Entwicklung sowie die Ausgleichszulage, Agrarumweltmaßnahmen und die Direktzahlungen im Allgemeinen zeigten jedoch keine Beschäftigungseffekte. Dagegen weisen dieErgebnisse des Regulierungskosten-Ansatzes darauf hin, dass infolge von Kapitalsubventionen Arbeitsplätze geschaffen wurden.

Unter der Verwendung von Schätzmethoden, die dem aktuellen Stand der Wissenschaft entsprechen, kann in der vorliegenden Dissertation gezeigt werden, dass zumindest einige GAP-Maßnahmen dazu beitrugen, Arbeitsplätze in der Landwirtschaft zu erhalten. Grundsätzlich erscheint die GAP jedoch nicht als ein besonders wirksames Instrument zur Schaffung von Arbeitsplätzen. Von den in dieser Arbeit untersuchten Maßnahmen, zeigte keine einen eindeutig positiven Beschäftigungseffekt. Die Ergebnisse weisen eher darauf hin, dass Entwicklungen außerhalb der Landwirtschaft den größten Einfluss auf den Arbeitskräftebesatz hatten, wie z.B. das durchschnittliche Arbeitnehmerentgelt aller Wirtschaftsbereiche. Um die Wirkung der GAP im Hinblick auf positive Beschäftigungseffekte in der Landwirtschaft zu verbessern, bedarf es zielgerichteterer Maßnahmen. Einerseits würde das den Ausschluss von arbeitssparenden Investitionen und Produktionsverfahren von der Förderung bedeuten. Demgegenüber sollten einzelne Instrument, die explizit Arbeitsplätze erhalten oder neu schaffen, verstärkt unterstützt werden, wie z.B. der biologische Landbau oder Diversifizierungsmaßnahmen.

Die empirische Wirkungsanalyse der 1. Säule Maßnahmen der GAP auf heterogene Betriebsstrukturen in Ostdeutschland zwischen 1997 und 2007 belegt, dass marginal steigende Direktzahlungen zu einer Stärkung mittelgroßer Agrarbetriebe führte. Basierend auf einem SUR-Model für vier unterschiedliche Größenklassen kann gezeigt werden, dass insbesondere die Anzahl der landwirtschaftlichen Betriebe zwischen 200 und 1.000 ha infolge einer steigenden Stützung über die 1. Säule der GAP signifikant zunahm. Im Gegensatz dazu verloren Agrarbetriebe zwischen 10 und 200 ha deutlich an Bedeutung. Sowohl die Anzahl größerer als auch sehr kleiner Landwirtschaftsbetriebe reagierte nicht auf marginale Änderungen der regional verausgabten Direktzahlungen.

Anhand der zuvor entwickelten theoretischen Grundlagen, lässt sich dieser Zusammenhang durch die Ausgangssituation auf dem Bodenmarkt im Hinblick auf die spezifische Kreditrationiertheit von Landwirtschaftsbetrieben in Abhängigkeit von ihrer Größe erklären. Demzufolge profitierten mittelgroße Agrarbetriebe, die zunächst stärkeren Budgetrestriktionen unterlagen, mehr von höheren Zuschüssen infolge einer Verminderung ihrer Kreditrationiertheit. Dadurch stieg die Bodennachfrage dieser Landwirtschaftsbetriebe überproportional im Vergleich zu den Mitbewerbern auf dem Bodenmarkt. Die vorliegenden Ergebnisse weisen diesbezüglich darauf hin, dass der Anstieg der Betriebszahlen zwischen 200 und 1.000 ha insbesondere auf Kosten der nächst kleineren Größenklasse verlief.

Grundsätzlich kann man festhalten, dass die Direktzahlungen in Ostdeutschland nicht dazu führten, die bestehenden Betriebsstrukturen zu konservieren.Weiterhin werden die geplanten Reformender GAP für den Zeitraum nach 2013 in diesem Zusammenhang keine grundlegenden Veränderungen herbeiführen. Die vorliegenden Ergebnisse lassen den Schluss zu, dass nur ein betriebsgrößenunabhängiges, sukzessives Abschmelzen der Flächenprämien langfristig dazu beitragen wird, die bestehenden Verzerrungen zu verringern.

# SUMMARY

Agriculture policy at the national and European level is in the midst of a far reaching process of change in which the traditional sector-oriented market and price policy is strongly questioned. Overthe past two decades, direct payments of the European Unions (EU) Common Agricultural Policy (CAP) have been increasingly decoupled from actual production along with decreasing price support. Moreover, differentiated measures of the so-called CAP’s second pillar gained relevance, which focus on the development of rural areas. The most important schemes in Germany include: rural development measures; agri-environmental measures; compensation for less-favored areas (LFA); measure to improve the market structure; and single-farm investment aids.

Many European citizens expect the EU’s CAP to safeguard or even create jobs in rural areas. Therefore, politicians and farm lobbyists extensively use this argument to justify the enduring necessity of the CAP towards the general public. In this regard, it is commonly claimed that financial support through direct payments and the second pillar measures in particular is indispensable to keep jobs in agriculture. Besides the employment effects, the impact of CAP pillar I payments on farm structure is of major importance. Particularly, political decision-maker and stake-holders argue that an income support via direct payments is indispensable to maintain a reliable framework for farmers in the EU. However, such expectations are contrasting with a persistent decline in agricultural labor force and the ongoing structural change that can be observed for the past decades. Thus the question arises, what effects are due to the disbursed governmental grants and whether the situation would have even been worse without CAP support.

In the present dissertation, an ex-post impact assessment of the CAP is conducted in the three East German Federal States of Brandenburg, Saxony, and Saxony-Anhalt. The analysis is based on regional data for 69 counties observed between 1997 and 2007. The main objective of the study is twofold: First, it is aimed to assess the impact of the whole portfolio of CAP measures on labor demand in East German agriculture with an additional focus on the decoupling of pillar I payments. Second, the impact of the CAP’s first pillar on heterogeneous farm structures is due to be analyzed. Given the fact that empirically based insights on these issues are limited, this research aims at filling this gap.

The empirical analysis of the full package of CAP measures on labor demand in East German agriculture between 1999 and 2006 reveals that there were few desirable effects on job creation or job maintenance. Based on an empirically motivated difference-in-differences model it can be shown that farm investment aids and transfers to LFA had no employment effect at all. Marginally increasing direct payments as well as the decoupling of the respective grants from production in 2005 led to significant labor shedding. Spending on modern technologies in processing and marketing also led to job losses in agriculture, some of which only occur with a delay of two years. Measures aiming at the development of rural areas reduced agricultural employment with a lag of one year. On the other hand, the present results show that agri-environmental measures tended to keep labor intensive technologies in production or induced them.

The theoretically driven adjustment cost model for labor demand in East German agriculture shows that farm labor adjusted slowly to changes in the external environment. On average, it took a bit more than three years to move halfway to the new steady state.Furthermore, the present model supports the thesis of accelerated labor cuts due to the decoupling of direct payments. Measures for the development of rural areas, transfers to LFA, agri-environmental measures, and direct payments in general revealed no employment effects. In contrast, the results of the adjustment cost model provide some evidence that job creation was induced via capital subsidies.

By using estimators that represent the state of the current literature, the evidence from the present dissertation shows that at least some of the CAP measures helped to achieve the political goal of job maintenance in agriculture. However, basically, it seems that the CAP is a not particularly effective tool for active job promotion. Among the measures studied in this dissertation, there is no single policy instrument which has unambiguously positive employment effects. The results rather suggest that economic developments outside agriculture have, via the compensation per employee, the most pronounced impact on the use of farm labor. To enhance the capability of the CAP with regard to positive employment effects in the first sector, the employed measures have to be more specifically geared towards this policy goal. On the one hand, this would include the exclusion of labor-saving investments and production patterns from funding. On the other hand, single instruments, which secure or even create jobs in agriculture, have to be increasingly supported, such as organic farming or diversification measures.

The empirical impact analysis of CAP pillar I payments on heterogeneous farm structures in East Germany between 1997 and 2007 provides evidence that marginally increasing direct payments led to an "appearing middle" in terms of farm size distribution. Based on a SUR model implemented for four distinct size classes it can be shown that particularly the number of farms operating between 200 and 1,000 ha increased subject to rising CAP pillar I support. In contrast, farms of a size between 10 and 200 ha significantly lost in weight. Both, the number of very small and large farms appeared to be unaffected by marginal changes in regionally disbursed direct payments.

Following the developed theoretical framework, this procedure can be explained by the initial situation on the regional land market in terms of the specific credit constraint of farms depending on their size. Accordingly, medium-sized farms, which were initially stronger budgetary constrained, gained relatively more from higher grants due to a relaxation of their credit constraint. As a result, the demand for land of theses farms increased disproportionately compared to the competitors on the land market. Concerning this matter, the present result point towards the fact that the increase in farm numbers operating between 200 and 1,000 ha, particularly, proceeded at the cost of the next smaller size class.

In general, it can be stated that the CAP's first pillar was rather ineffective in conserving farm structures in East Germany. Furthermore, the planned reforms of the CAP for the time after 2013 will not lead to major changes in this regard. It can be concluded from the present results that in the long run, only a gradual decrease in direct income support via per hectare payments without reference to farm size, will help to reduce the current distortions.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| 2SLS | Two-stage least squares |
| 3SLS | Three-stage least squares |
| AB | Arellano-Bond |
| AH | Anderson-Hsiao |
| BB | Blundell-Bond |
| BMELV | Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz |
| CAP | Common Agricultural Policy |
| DBV | Deutscher Bauernverband |
| € | Euro |
| EAGGF | European Agricultural Guidance and Guarantee Fund |
| EAFRD | European Agricultural Fund for Rural Development |
| EC | European Commission |
| Eq. | Equation |
| EU | European Union |
| FADN | Farm Accountancy Data Network |
| FGLS | Feasible Generalized Least Squares |
| FRG | Federal Republic of Germany |
| GAK | Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küstenschutzes |
| GDP | Gross domestic product |
| GDR | German Democratic Republic |
| GLS | Generalized Least Squares |
| GMM | Generalized Method of Moments |
| ha | Hectares |
| i.i.d. | Identically and independently distributed |
| $km^2$ | Square kilometers |
| KULAP | Kulturlandschaftsprogramm |

| | |
|---|---|
| IV | Instrumental Variable |
| LFA | Less-favored areas |
| LSDV | Least square dummy variable |
| LSDVC | Corrected least square dummy variable |
| NUTS | Nomenclature of Territorial Units for Statistics |
| OECD | Organisation for Economic Co-operation and Development |
| OLS | Ordinary least squares |
| OP | Operational Program |
| RDP | Rural Development Plan |
| RDR | Rural Development Regulation |
| SÄBL | Statistische Ämter des Bundes und der Länder |
| SAPARD | Special Accession Program for Agriculture and Rural Development |
| SBA | Statistisches Bundesamt |
| SPS | Single payment scheme |
| SUR | Seemingly unrelated regression |
| SZS | Staatliche Zentralverwaltung für Statistik |
| UAA | Utilized agricultural area |
| U.S. | United States |
| VGRdL | Volkswirtschaftliche Gesamtrechnung der Länder |
| WTO | World Trade Organization |

# 1 INTRODUCTION

Agricultural policy at the national and European level is in the midst of a far reaching process of change in which the traditional sector-oriented market and price policy is strongly questioned. Due to international pressure, particularly arising from the World Trade Organization's (WTO) negotiations, direct payments of the Common Agricultural Policy (CAP) have been increasingly decoupled from actual production along with decreasing price support. Furthermore, policy makers more and more focus on differentiated measures regarding the development of rural areas to meet the changing demands of society. The council regulation 1257/1999 of the European Union (EU) describes a milestone concerning the latter issue in summarizing a comprehensive bundle of various instruments to a single regulation for the first time, resulting in the birth of the EU's CAP second pillar (cf. DWYER et al., 2002).

The agricultural sector of the former German Democratic Republic (GDR) plays a unique role in this concern. After the immediate shock of transition, East German farmers underwent three major reforms of the CAP. However, impact evaluations of EU's agricultural policy measures with a particular focus on East Germany are scarce.[1] This might be due to the fact that agricultural structures in terms of economic size and type of farming cannot be compared with those in Western Europe or the United States (U.S.). Large East German farms are predominantly operated by hired managers and workers, and reveal a high proportion of leased land. Accordingly, the well-known family farm model in the agricultural economics literature cannot be applied without further modification. Therefore, some profound knowledge about the agricultural sector of the former GDR is required. Not least because of the strong connection of the author to the East German agricultural sector, East Germany has been chosen for the research region under study.

In view of the total CAP budget allocated to East Germany, pillar I measures in terms of direct payments have been occupying the lion's share since their inception in the mid-1990s, whereas some one-third goes to the second pillar. Then most important instruments in the range of CAP pillar II measures implemented in East Germany are: measures under the umbrella of rural development; agri-environmental schemes; single-farm investment aids; compensatory allowance for less-favored areas (LFA); and support of processing and marketing of agricultural produce.

---

[1] Some researchers even explicitly obviate the region of the former GDR from their analysis (MANN, 2003b; HUETTEL and MARGARIAN, 2009).

A comprehensive impact assessment of these instruments on structural change in agriculture is of major interest regarding the aspired policy goals. Many European citizens expect the EU's CAP to safeguard or even create jobs in rural areas (EC, 2008a: 7). In times of low economic growth and persistent unemployment in European regions, politicians and farm lobbyists extensively use this argument to justify the enduring necessity of the CAP towards the general public. In this regard it is commonly claimed that financial support through direct payments is indispensable for keeping jobs in agriculture. Furthermore, it is argued that European agriculture has much potential, in addition to its conventional role of producing food and fibre, to also provide environmental services, contribute to the quality of life in rural areas, and supply raw material for energy production. The more recent CAP pillar II instruments are supposed to boost these additional functions. The European Commission insists that they focus on exactly the aim of maintaining existing or even creating new types of jobs in agriculture, despite their otherwise varying goals (EC, 2006). Such expectations are contrasting with a persistent decline in the agricultural labor force observed across most industrialized countries for decades (TRACY, 1993). According to this trend, technological progress and rising off-farm wages have led to a process in which agricultural labor is increasingly substituted by capital. Given the envisioned new roles for farmers, the question thus arises whether the CAP can stop or even reverse this trend. Besides the effect of CAP measures on agricultural employment, the impact of direct payments on farm structure is of major importance. Many politicians and farm lobbyists claim that the first pillar of the CAP is crucial for maintaining a reliable framework for farmers in the EU and Germany accordingly. However, the future design and financial amount of first pillar funds are discussed controversially in view of the pending reform of the CAP (ZIER et al., 2011). It is particularly questioned whether direct payments have the potential to raise farm incomes, and thus increase the probability of farm survival. For instance, CIAIAN and SWINNEN (2009) argue that in theory decoupled payments tend to increase land rents, resulting in a drop in farm income. On the other hand, LEATHERS (1992) suggested that the impact of governmental programs on farm structure cannot be predicted by theory alone, and thus calls for empirical evaluation.

The aim of the present dissertation is to address the above-mentioned issues focusing on the East German agricultural sector. In the following section, an overview on the CAP support to East German farms since the German reunification is provided, including an outline of the major CAP reforms during the period of consideration. Section 1.2 describes the development of agricultural structures in East Germany with a particular focus on agricultural labor and farm structure. Drawing on this background information, Section 1.3 establishes the major research questions of the present dissertation. The following Section 1.4 provides an overview of the existing literature on ex-post policy evaluation in agriculture and attempts to identify gaps in the current knowledge. The final Section 1.5 outlines the structure of the subsequent analysis.

## 1.1 Two decades of CAP support to East German agriculture

In the course of the German reunification, East Germany became a fully integrated part of the EU, and thus CAP was put into force immediately. As a result, the federal states of East Germany have been spending substantial amounts of direct payments, of which 75 % are co-financed by the EU. However, during two decades of CAP support to East German agriculture, the way farmers receive subsidies has changed significantly. Initiated in 1992, several reforms led to a stepwise transformation of price- and product-related support measures to area-based farm payments that are increasingly decoupled from most factor allocation decisions.

### 1.1.1 CAP reforms between 1990 and 2007

As shown in Table 1-1, East German agriculture was subject to three major reforms of the CAP during the period considered in the present study. The MacSharry-reform of 1992 marks the beginning of this reform process. It was characterized by decreasing intervention prices and the introduction of area and headage payments. Furthermore, three accompanying measures were introduced, which include the fields: early-retirement, agri-environment, and afforestation. The MacSharry-reform was followed by the AGENDA 2000 that can be regarded as a continuation of the reforms triggered in 1992. In consequence of the AGENDA 2000, administered and intervention prices were reduced further in connection with increasing compensatory payments to farmers. However, the most considerable contribution of this reform is the implementation of the Rural Development Regulation (RDR) (EC 1257/1999). For the first time, the RDR merged the accompanying measures established by the MacSharry-reform, the compensatory allowance for LFA, and the rural development measures, indicating the birth of the CAPs second pillar. The last major reform of the CAP during the period considered in the present study is the "Luxembourg" or Fischler-reform of 2003. Initially seen as a mid-term review of the AGENDA 2000, this reform described a further milestone in EU support to agriculture. As a result of this reform, the Single Payment Scheme (SPS) was introduced in 2005 and 2006. Consequently, governmental support was calculated on the basis of historic payments which required no longer current production. Furthermore, the cross-compliance regulation was put into force. According to this regulation, EU farmers have to follow certain rules of good agricultural practice in order to receive the full amount of governmental support. In addition, the modulation scheme was established to transfer funds from pillar I to pillar II. The actual degree of decoupling regarding the SPS, however, varies between the member states.[2]

[2] See PETRICK (2008), STEAD (2008) and OECD (2011) for the larger picture of recent CAP reforms.

**Table 1-1: Reforms of the CAP, 1992-2008**

| Period | Name | Main characteristics |
|---|---|---|
| 1992-1999 | MacSharry-reform | • Decreasing intervention prices for cereals and beef<br>• Introduction of the compulsory set-aside scheme<br>• Introduction of the compensation of farmers through direct payments<br>• Introduction of accompanying measures |
| 2000-2002 | AGENDA 2000 | • Further reduction of time also milk<br>• Increase of direct payments<br>• Extension of the accompanying measures to the second pillar of the CAP |
| 2003-2008 | Fischler-reform | • Decoupling of direct payments from production<br>• Introduction of the cross-compliance regulation<br>• Introduction of the modulation scheme |

Source: Author's depiction.

In view of the SPS, Germany opted for a dynamic model which was introduced in 2005 (BMELV, 2005). The dynamic model can be seen as a combination of the historical and the regional model for the distribution of pillar I payments and will result in a regional model in 2013. In the dynamic model, area payments per farm depend on a regional basic premium for arable land and grassland[3] plus a farm-specific top-up or payment entitlement. These entitlements are calculated on the basis of the direct payments received from 2000 to 2002 and the amount of milk quota available on the 31st of March 2005. In 2009 the average value of payment entitlements in Germany amounts to € 339 per hectare, revealing no differences between smaller and larger farms (DBV, 2011: 119). Initiated in 2010, the different values of farm-specific payment entitlements are aligned, resulting in a uniform regional premium of € 344 per hectare on average in 2013 (BMELV, 2011a). Regarding the degree of decoupling, the German model of the SPS can be considered as an almost fully decoupled income support to farmers, given the fact that only some minor product-specific payments have been retained.[4]

[3] The average value of the basic premium amounts to 290 €/ha for arable land and 89 €/ha for grassland (DBV, 2011: 118).

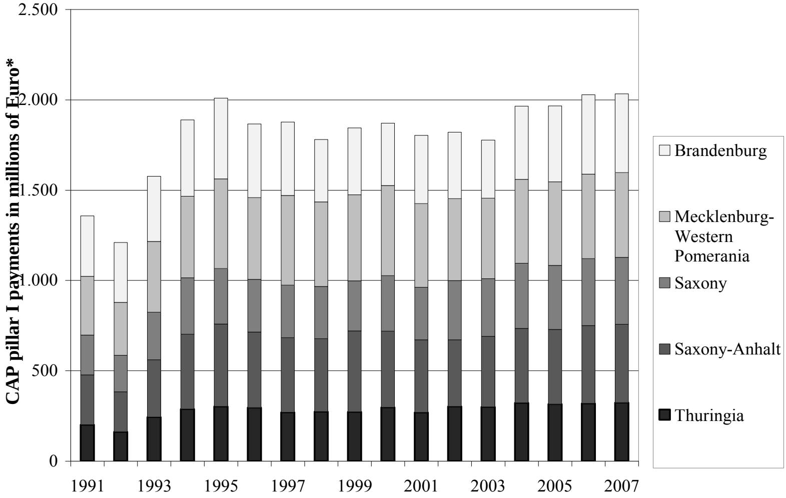
[4] In addition to the SPS product-specific direct payments are granted for protein crops, nuts, energy crops, starch potatoes, dried fodder, hop, and tobacco (BMELV, 2005).

### 1.1.2 CAP support in East German agriculture

Figure 1-1 shows the amount of CAP pillar I payments disbursed in the five East German Federal Sates of Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia between 1991 and 2007. It is apparent from Figure 1-1 that due to the MacSharry-reform direct payments significantly increased in the early 1990s. Between 1992 and 1995, total pillar I payments to East German farmers rose by 66 % from € 1,210 million to € 2,009 million. Thenceforward, the amount of payments rather fluctuated until 2003, though at a lower level compared to 1995. Figure 1-1 provides evidence that the introduction of the Fischler-reform in 2003 led to another more pronounced trend, as the amount of direct payments steadily increased until 2007, even though not as significantly as in conjunction with the MacSharry-reform. Overall, CAP pillar I support in East Germany increased from € 1,777 million in 2003 to € 2,033 million in 2007. The main reasons for this development were raising subsidies for milk production and a level increase of the SPS (EC, 2008a). Given their substantial land and animal stocks per farm, East German farm managers regularly obtain levels of direct payments per farm that are far beyond the amount received by an average family farm in the EU. The disbursed pillar I funds per farm averaged € 66,330 in 2005[5] whereas the EU-25 average ranged from € 7,500 in 2004 to € 8,780 in 2006 (EC, 2008a).

[5] Figure calculated by dividing the total amount of pillar I payments by the total number of farms in East Germany 2005.

**Figure 1-1: CAP pillar I payments in East German agriculture, 1991-2007**




Source: EUROSTAT (2011)

Note: Figures of the Federal State of Berlin not included.
* Figures in millions of Euro from 1999 and millions of ECU up to 1998.

The Federal States of East Germany also implemented a region-specific mix of CAP pillar II measures for the support of rural development and the improvement of agricultural structures. Up to 2006, these instruments were funded by the European Agricultural Guidance and Guarantee Fund (EAGGF) that covers the following fields: investment in agricultural holdings; aid for setting up young farmers and vocational training; aid for early retirement; compensation for LFA; agri-environmental measures; processing and marketing of agricultural products; development and optimal utilization of forests; and development of rural areas. Since East Germany has been categorized as an object 1 region, the aforementioned measures are financed by the EAGGF-Guidance section, except for the compensatory allowances for LFA, early retirement schemes, agri-environmental measures, and measures for the development of forests, which are financed by the EAGGF-Guarantee section[6]. The EAGGF instruments are conducted according to the Rural Development Plans (RDP) of the federal states in the range of Guarantee and the respective Operational Programs (OP) regarding the Guidance measures. In Germany, the second pillar instruments of the CAP are regularly complemented

6 See: http://ec.europa.eu/regional_policy/funds/prord/prords/prdsc_en.htm.

by federal and state funding[7] in the framework of the "Joint Task for the Improvement of Agricultural Structures and Coastal Protection" (GAK) (RUDOLPH, 2005). However, particularly in the field of agri-environmental measures, additional programs of the federal states exist which complement or substitute the measures for market- and site-specific agricultural practices under the umbrella of the GAK. For instance, Saxony and Thuringia established state-specific agri-environmental programs almost completely detached from the GAK.[8] Moreover, Saxony conducted an investment aid scheme complementary to the respective instrument within the GAK.

Regarding the total amount of CAP payments, second pillar measures account for approximately one third of the disbursed budget[9]. It can be seen from Figure 1-2 that the emphasis of these measures in East Germany is on instruments under the umbrella of rural development, which account for approximately one-third of the total payments. These funds are usually disbursed to local municipalities and mostly related to the reallocation of land, rural road-building, and village renewal. The second largest part of CAP pillar II payments goes to agri-environmental measures, which include: promotion of organic farming; extensive use of inputs; widening of the crop-rotation; extensification of farming; upkeep, re-establishment or generation of landscape; and protection of endangered plant species and breeds of farm animals. On average, € 175 million per year were disbursed under the umbrella of agri-environmental measures from 2000 to 2006. In addition, some € 70 million to € 100 million per year were spent on the compensatory allowance for LFA. According to the RDR, LFA are further disaggregated into: mountain areas; other LFA; and areas affected by specific handicaps. In the five federal states considered here, more than 99 % of the payments are disbursed in the field of other LFA. The amount of compensation per hectare thereby depends on the actual degree of discrimination and varies between € 13.10 and € 88.00 (See Table A-2). In terms of the total budget, the compensatory allowance for LFA is closely followed by the promotion of water management measures with average annual expenses of approximately € 67 million. These subsidies were granted for the maintenance and improvement of the rural water management, and thus not directly linked to agriculture except for the promotion of irrigation systems. Furthermore, € 46 million were annually spent on measures to improve

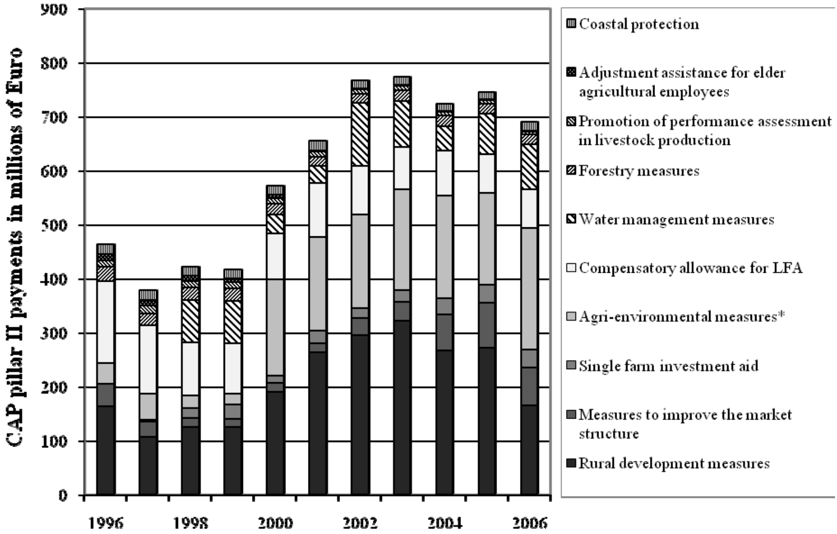
7 The expenditures of the GAK are 60 % federal and 40 % state funded. Exclusions are the costal protection scheme (70 % federal funds) and measures financed by modulation funds (80 % federal funds) (See: http://www.bmelv.de/SharedDocs/Standardartikel/Landwirtschaft/Foerderung/GAK/Erlaeuterungen.html;jsessionid=C26BFA317AD51D7E2937DD20DF562C56.2_cid238).

8 Only Thuringia started to adopt instruments of the market- and site-specific farming practices under the umbrella of the GAK in conjunction with the introduction of the modulation in 2004.

9 As a result of insufficient data on agri-environmental measures in East Germany before 2000, the remainder of this paragraph refers to the funding period 2000 to 2006.

the market structure. In the funding period 2000 to 2006, this assembly of measures consisted of five instruments, which were: improvement of market structure; processing and marketing promotion of organic products; processing and marketing promotion of regional products; promotion under the "Act of Market Structure" (Marktstrukturgesetz); and promotion of processing and market structures in fishery. Accordingly, these measures were only to some extent linked to agricultural farms, as the main focus lies on the downstream sector. Quite the contrary applies to the single farm investment aid, which is one of the GAK-measures that is exclusively adopted at farm-level. The average annual expenses for this instrument amounted to € 25 million and included the following fields of investments: improvement of production and marketing conditions; rationalization and reduction of production costs; environmental protection such as conservation of energy and reduction of emissions; livestock-friendly keeping of animals; organic farming; and diversification. Furthermore, in each case some 1.2 % to 2.5 % of the total CAP pillar II budget which has been disbursed in East Germany from 2000 to 2006 belongs to the fields of: forestry measures; promotion of performance assessment in livestock production; and costal protection. According to Figure 1-2, the adjustment assistance for elder agricultural employees played no major role in the considered period, accounting for less than 1 % of the total pillar II budget.

**Figure 1-2: CAP pillar II payments in East German agriculture, 1996-2006**




Source: Author's calculation based on BMELV (2011b).

Note: FederalState of Berlin not included.
* Figures on agri-environmental measures only include GAK payments prior to 2000. The values for agri-environmental measures between 2000 and 2006 were taken from the ex-post evaluation reports of the EPLR of the respective federal states.

## 1.2 Development of agricultural structures since 1989

In view of the fact that the present dissertation aspires to investigate the impact of the EU's CAP on agricultural structures at the regional level, the particular focus targets on agricultural labor force and farm structure in general. On the one hand, these indicators are amongst the most important factors the CAP measures are aimed at, besides environmental issues, for instance. On the other hand, the empirical analysis of causal relations requires measurable parameters. In this regard, regional figures on employment and farm numbers provide a reliable data base.

Situated on the territory of the former German Democratic Republic (GDR), the five East German Federal States of Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia are characterized by large scale agricultural structures primarily based on hired labor. These farms displayed low productivity and high inefficiency due to inadequate internal organization and incentives. As a result of the immediate shock of transition, production in East German agriculture increased despite widespread labor shedding (KOESTER and BROOKS, 1997). However, recent downward adjustments of agricultural employment were more modest and followed the patterns of the family farm model in West Germany. After the German reunification, many of the former collective farms were transformed into agricultural cooperatives or other corporate business entities (FORSTNER and ISERMEYER, 2000). Even though governmental programs particularly favored private farms and partnerships during the transition, cooperatives remained numerous and still large (KOESTER and BROOKS, 1997). Agriculture in Eastern Germany thus resembles structures in those New Member States of the EU which predominantly kept their large scale farms, such as the Czech and Slovak Republics, Hungary, or parts of Poland.

### 1.2.1 Employment in East German agriculture

The agricultural sector of the former GDR was characterized by an over-allocation of labor. However, whereas the actual number of persons employed in primary agriculture slightly decreased between 1980 and 1989, an increasing amount of labor had been employed in the so-called auxiliary production, the field of management and administration, as well as the cultural and social sector (See Table A-1). In the course of the adjustment and restructuring process, a rapid labor shedding occurred in East German agriculture, as shown in Figure 1-3. From a number of approximately 900 thousand employees in agriculture before the German reunification only 300 thousand remained until the end of 1991. This drastic drop in agricultural labor was to a large extent cushioned by specific social and labor market policies by the German government and the EU. In this regard, the following three major components accompanied agricultural transition in East Germany:

1. On the first of July in 1990, the legal and institutional system of the Federal Republic of Germany (FRG) went into force in the federal states that officially acceded on October 3 of the same year. In the context of agriculture, this led to an immediate abolishment of state orders in production, the introduction of an independent management and bankruptcy legislation, and the adoption of the Agricultural Adjustment Law (Landwirtschaftsanpassungsgesetz) which governed the privatization and restructuring of collective farms.[10] Furthermore, a public administration includinga comparatively generous social security system according to the West German standards was installed, and a full currency union with the FRG was put into place overnight.
2. A specific assistance program for East German agriculture was funded from federal and EU budgets, which primarily consists of liquidity support and capital subsidies. This support scheme had a total volume of approximately € 9 billion spent between 1990 and 1995 (KOESTER and BROOKS, 1997: 15).
3. With accession, East Germany became a fully integrated member of the EU, and thus the CAP was put into force immediately. At the time of transition,

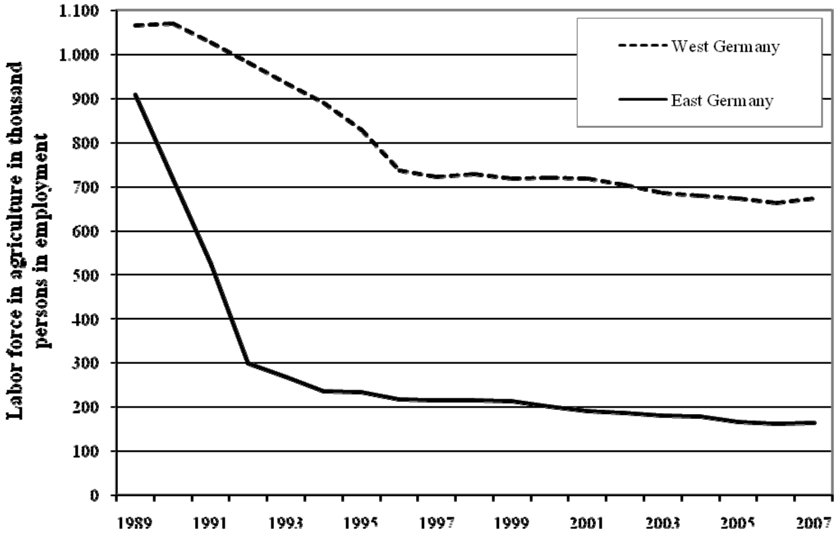
[10] See BECKMANN and HAGEDORN (1997) and KLAGES (2001) for more details.

the CAP was in the midst of the MacSharry-reform, which transformed traditional price supports into area and headage premiums (See Table 1-1).

As a result, 21 % of the former agricultural workforce had gone into early retirement, 18 % were upon unemployment benefits, and 12 % were in vocational training or job creation measures before the end of 1991. At the same time, 14 % had found another job and only 35 % were still working in agriculture (MEHL, 1999).

Moreover, Figure 1-3 provides evidence that the downward adjustment in agricultural employment developed more modestly after the immediate shock of transition. Since the mid-1990s the number of persons employed in East German agriculture declined from an absolute number of 236 thousand in 1994 to 164 thousand in 2007. Though less pronounced, compared to the first half of the 1990s a yet significant labor shedding of more than 5,500 employees on average per year occurred. Furthermore, it is apparent from Figure 1-3 that a comparable trend could be observed for the family farm model in West German agriculture over the last decade under consideration.

**Figure 1-3: Labor force in German agriculture, 1989-2007**



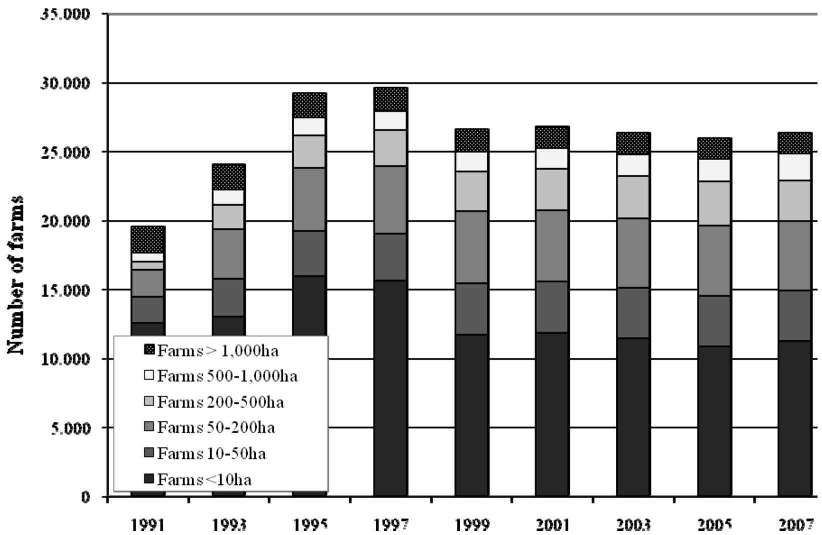

Source: 1989-1991: SZS and SBA (various years); 1992-2006: SÄBL (2011).

Note: Labor use for East Germany in 1988 and 1989 represents stock on September 30, other figures are annual averages. Labor use figures for East Germany in 1990 and 1993 are interpolated.

### 1.2.2 Farm structure and capital market in East German agriculture

Due to the de-collectivization of the large collective farms after the German reunification, farm numbers significantly increased in East German agriculture at the beginning of the 1990s. However, Figure 1-4 provides evidence that this transition process was finished after 1997 when the total number stabilized at around 30,000 farms resulting in a still comparably high average farm size of about 180 ha. In the following years structural change occurred in terms of a shift in the number of farms subject to different size classes, rather than a change in the total number of farms.[11]

**Figure 1-4: Total number of farms according to selected farm size classes, East Germany, 1991-2007**




Source: Author's calculations based on BMELV (various yearsb).

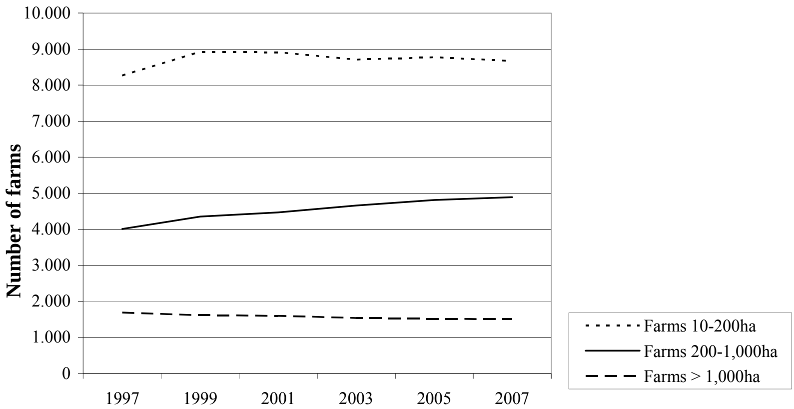
Note: Biannual figures. The lower detection limit for the data on farm numbers was raised from 1 to 2 ha UAA in 1999 (BMELV, 2000: 26)

It is apparent from Figure 1-5 that particularly the share of farms between 200 and 1,000 ha had steadily increased over the last ten years considered. In the same period of time, the share of farms operating more than 1,000 ha slightly decreased. Farm numbers in the size classes between 10 and 200 ha remained rather constant. As a result, the overall development of structural change in East German

[11] The significant drop in farm numbers that occurred between 1997 and 1999 was mainly due to a change in the data collection, as the lower detection limit was raised from 1 to 2 ha UAA in 1999.

agricultural after the reunification points towards an "appearing middle". This suggests a phenomenon, which is quite contrary to the existing literature, where a "disappearing middle" is reported (cf. GARCIA et al., 1987; WEISS, 1999). Investigating a sample of cash grain farms in Illinois, GARCIA et al. (1987) projected that farms smaller than 20 ha (50 acres) and larger than 400 ha (1000 acres) will grow in numbers at the expense of the medium-sized farms. Furthermore, WEISS (1999) identifies two "centers of attraction" with regard to the farm size in terms of the number of livestock in his analysis of individual farms in Upper Austria. He concludes that farms either opt for the part-time farming model and shrink or increase farm size, which is particularly the case for full-time farms.

**Figure 1-5: Total number of farms according to three major farm size classes, East Germany, 1997-2007**



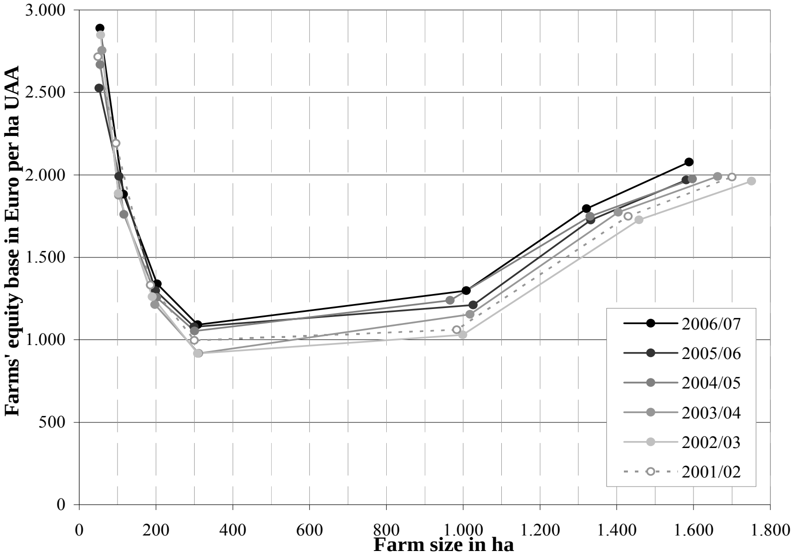

Source: Author’s calculations based on BMELV (various years b).

Note: Biannual figures.

After the German Reunification, the East German agricultural sector was characterized by an enormous need for finance on the one hand and a lack of capital on the other hand.Thereby, the prevailing credit constraint of the farms during transition mainly arose from a serious lack of equity. In the first stage of transition, the short-term liquidity problems of the former collective farms could be alleviated by the immediate provision of liquidity assistance of approximately € 1.5 million and an ahead of time payment of the adjustment assistance funds (WELSCHOF et al., 1993: 30f.). Overall, approximately € 9 billion have been granted to farmers in the former GDR between 1990 and 1995 via the specific assistance program for East German agriculture for the realization of urgently needed investments and to deal with the inherited liabilities (KOESTER and BROOKS, 1997: 15).

Figure 1-6 depicts the development of equity per hectare of utilized agricultural area (UAA) subject to farm size in East Germany after 2000.[12] It is apparent from Figure 1-6 that the equipment with equity per hectare of farmland increased on average during the considered period of time. This development is most pronounced for the medium-sized farms, where the respective figures rose by € 250. The capital endowment of the very large farms increased rather slightly, but gained some momentum in the last year under consideration. In contrast, the situation of farms operating about 100 ha has significantly changed to the worse. As it can be seen from the bolt data points in Figure 1-6, the equipment with equity per ha UAA for farms operating about 100 ha decreased from approximately € 2,200 in 2001/02 to 1,900 in 2005/06.

**Figure 1-6: Equity base in relation to farm size, East Germany, 2001/02-2006/07**




Source: Author's calculations based on BMELV (various yearsa).

Note: The figures on equity base depict average annual values for full-time farms including private partnerships in 3 size classes and in total as well as for limited liability corporations, cooperatives and legal entities in total. The respective figures on farm size are the mean values for the given groups of farms in the respective years.

[12] Unfortunately, no comparable data is available prior to 2000 due to a shift in the data collection.

## 1.3 Research questions

After having outlined the demands and conceptions of stakeholders and the community regarding the EU's CAP on the one hand, and having depicted its introduction in East Germany and the development of agricultural structures since the German reunification on the other hand, the prevailing knowledge gap becomes obvious. Essentially, the impact of the CAP measures on agricultural structures is unclear and cannot be derived by a simple descriptive data analysis. In consequence, the present dissertation is motivated by the fact that a sophisticated impact evaluation of the EU's CAP is required to identify reliable net policy effects. Regarding the CAP in East German agriculture, two central issues are to be addressed:

1. Did the CAP and particularlythe introduction of the RDR in 2000 make jobs in East German agriculture safer or even create new jobs? Which effect did the recent 2003 reform of the CAP, decoupling subsidies from actual production, have on agricultural labor in East Germany?
2. Did the generous support to East German farms via CAP pillar I payments conserve agricultural structures, as suggested by stable figures for the total number of farms in the recent years? If not, which farms benefitted most from the disbursed funds and why?

In the following section, an outline of the literature on the ex-post evaluation of policies related to agricultural labor force and farm structure is presented, identifying controversies and gaps of the current wisdom, and indicating the surplus of the present dissertation.

## 1.4 Literature on agricultural policy evaluation and limitations of the current knowledge

In the field of agricultural economics a vast literature on structural change exists. Regarding this issue, GODDARD et al. (1993) and CHAVAS (2001) provide a sound overview of the main forces driving farm development. Thereby, the latter focuses on the initial structure of the agricultural sector and the impact of imperfect resource mobility. In the seminal paper of GODDARD et al. (1993) eight causative factors are identified and discussed, leading to an ongoing structural change in agriculture, which are: technology, prices, human capital, economic growth, demographics, off-farm employment, market structure, and public programs. Both studies argue that agricultural policies reveal a distinct impact on farm development, though representing only one part in the complex field of structural change.

However, empirical work on the ex-post evaluation of agricultural policies and their impact on the determinants of the agricultural structure are limited, particular regarding the EU agriculture. In view of the research question at hand, the focus of the literature review in the following section lies on studies analyzing employment effects and structural change in agriculture subject to governmental support. The existing research gaps will be highlighted.

### 1.4.1 Employment effects of agricultural policies

FASTERDING and RIXEN (2006) provide a sound review of policy impacts on agricultural employment with a particular focus on Germany. While they stress the inherent tendency of agriculture to shed labor in the process of economic development, they also assess the potential impact of individual measures or policy areas. Based on a literature review of primarily descriptive studies and case studies as well as plausibility arguments, they suggest that organic farming may often display higher labor intensity than conventional farming. Land consolidation and farm investment aid, on the other hand, lead to an increase in labor productivity, and thus have a negative employment effect. The authors argue that the support of production diversification is a reasonable way to develop additional jobs in agriculture. However, the methodological standard of the reviewed studies in FASTERDING and RIXEN (2006) can be considered as rather weak.

One of the early studies that apply econometric methods to evaluate the determinants of farm labor input is the work of BARKLEY (1990). The author investigates labor migration from agriculture in the U.S. using aggregated time series data from 1940 to 1985. His results suggest no unambiguous impact of governmental interventions on the development of the agricultural labor force. However, it is argued that agricultural policies may have reduced the out-migration of farm labor indirectly via increasing land prices due to governmental support. Other recent studies make more systematic use of panel data sets, although only some of them look at agricultural employment. SCHMITT et al. (2004) presented a regression analysis of the EU objective 5b program, based on French regional data. They found positive employment effects in the service sector, while agriculture and manufacturing were negatively affected. ESPOSTI (2007) investigated the impact of the CAP as well as the EU objective 1 program at the NUTS-2 level[13] by estimating a conditional growth convergence model. He confirmed a positive growth impact of the objective 1 program, but did not explicitly refer to employment issues. PUFAHL and WEISS (2009) applied non-parametric difference-in-differences propensity score matching to evaluate the effects of participation in the agri-environmental programs in Germany. Based on accountancy panel data, they provided evidence that farms participating in agri-environmental measures significantly used more on-farm labor. HENNING and MICHALEK (2008) also implemented a matching approach to investigate the impact of the EU pre-accession aid SAPARD in Slovakia. They found that participation in the farm investment aid scheme had a positive effect on farm employment, but negatively influenced labor productivity. Both papers argue that a naïve mean value comparison overestimates

[13] NUTS is a hierarchical classification system for the EU territory (See: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:NUTS).

the policy impact and conclude that considering this fact is crucial for an appropriate policy evaluation.

Two of the most notable studies in the field of agricultural policy evaluation in the EU with regard to employment effects are the recent studies of PETRICK and ZIER (2011b) as well as OLPER et al. (2011). The former analyzed the impact of the whole portfolio of CAP measures on agricultural employment in East Germany between 1999 and 2006. Based on a difference-in-differences model at the county level, the authors identified only few desirable effects on job maintenance or job creation in agriculture. According to their results, solely the agri-environmental scheme of the CAP tended to positively affect agricultural labor force.[14] OLPER et al. (2011) analyzed the effects of CAP payments on inter-sectoral labor reallocation across 153 EU regions[15] between 1990 and 2008. The authors applied a static difference-in-differences estimator based on the work of PETRICK and ZIER (2011b) and an Arellano-Bond (AB) model to their panel data set at hand to identify the net effects of regionally disbursed CAP pillar I and II payments on out-farm migration. Regarding the CAP policy measures, they provided evidence that direct payments significantly reduced out-farm migration. In view of the second pillar instruments, agri-environmental measures and the compensatory allowance for LFA kept labor in agriculture. Investment aids and the sum of other pillar II payments appeared to reveal no significant impact on agricultural employment. Applying a similar approach to the U.S. agricultural sector, D'ANTONI and MISHRA (2010) showed that a relative increase in direct government payments relative to the net farm income over the period from 1940 to 2007 slowed down out-farm migration. The authors concluded that the grant of direct payments in agriculture creates considerable disincentives for farmers to leave the sector.

Referring to a different policy context, AHEARN et al. (2006) focused on the effect of decoupling on labor allocation decisions of US farm operators. They found that direct payments generally had a positive effect on on-farm labor use, contrary to theoretical predictions that decoupled payments are allocation-neutral. KEY and ROBERTS (2009) explained this finding by non-pecuniary benefits from farming. WOLDEHANNA et al. (2000) analyzed the effect of changing support patterns to Dutch cash crop farms due to the MacSharry-reform and the AGENDA 2000 on the decision to work off-farm. The authors argue that the combination of decreased price support and direct income compensation have the potential to increase the participation in off-farm work in the Netherlands, if the respective opportunities for employment are available. More recently, HENNESSY and REHMAN (2008) assessed the impact of decoupled direct payments according to the Fischler-reform on the

---

[14] The results of PETRICK and ZIER (2011b) are kept rather short at this point as this paper constitutes a part of the present dissertation (See Chapter 5.1)

[15] OLPER et al. (2011) investigate the European States of the EU-15 at the NUTS-2 level, except for Germany and the United Kingdom which are reported at the NUTS-1 level.

off-farm labor market participation of Irish farmers. In contrast to the studies of AHEARN et al. (2006) and KEY and ROBERTS (2009), they observed an increased probability to work off-farm as a result of decoupling. OLPER et al. (2011) also investigated the impact of decoupled direct payments on agricultural employment in the EU-15, linked to the introduction of the Fischler-reform in 2005. However, they were not able to identify a clear effect supporting the hypothesis that decoupled payments are neutral to factor allocation.

Overall, the literature on employment effects of the CAP is rather incomplete as many important measures, such as direct payments or policies for the development of rural areas, have not been analyzed at all. The evidence for other measures is inconclusive and suffers from the shortcoming that only single policies were analyzed in isolation. These studies disregard the fact that the various measures of the CAP reflect the partly incompatible policy goals, which possibly results in a mutually neutralization of the instruments (BAUER, 1997). A sound evaluation of the employment effects of the CAP must therefore allow different impacts of the various instruments. At the same time, their effects should be analyzed jointly to avoid that unexpected effects are driven by left-out political instruments. However, European-wide studies are hampered by a lack of relevant disaggregated data (SHUCKSMITH et al., 2005: 203). Furthermore, finding accurate employment indicators in agriculture is plagued by measurement problems, as many farmers work partly off-farm.

Besides the present study, OLPER et al. (2011) were the first to investigate the employment effects of a comprehensive set of CAP measures. However, their approach based on FADN data suffers from the shortcoming that only payments related to individual farms are included. Consequently, rural development measures as well as support granted to the upstream and downstream sector under the umbrella of CAP pillar II payments are missing.[16] By analyzing the employment effects of the entire portfolio of CAP measures simultaneously, the present study will address the existing research gap. Moreover, an advantage of the study region is that the bulk of agricultural labor is hired farm workers. In this regard, it is expected that this increases the accuracy of employment figures, as information about working hours of hired workers is formally recorded by employers.

### 1.4.2 The impact of governmental support on farm structure

Regarding the impact of governmental support on structural change, there are two main strands of the literature, which can be distinguished according to their regional focus and key findings. On the one hand, these are studies that investigated the North American agricultural sector. In this regard, the respective authors came to the conclusion that agricultural subsidies tended to accelerate structural

[16] See Chapter 1.1.2 for more details on the beneficiaries from CAP pillar II payments.

change. On the other hand, authors who analyzed the impact of direct payments on farm structure in Western Europe indicated a definite structure preserving effect.

The work of AHEARN et al. (2005) that applied a three-stage least squares (3SLS) model to a panel data set of 48 states in the U.S., constitutes a representative of the former strand of the literature. They found that increasing commodity payments led to higher farm exit rates in U.S. agriculture, particularly with regard to small farms. The authors concluded that those farms who received direct payments bought out farms who did not. This effect emerged from the specific design of governmental support to agriculture in the U.S. since the participation in farm programs was facultative. Direct payments have historically been aimed at cash grain and cotton farms based on production volume. Accordingly, larger farms who participated in programs had higher average payments. In their analysis of concentration rates of North American farms at the zip code level by means of a semi-parametric generalized additive model, ROBERTS and KEY (2008) argued that from a third up to more than a half of the concentration growth can be tracked back to government payments. Previous studies of these authors (KEY and ROBERTS, 2006; 2007) conducted at the farm-level supported the hypothesis of an accelerating effect of farm programs on structural change. Similar to AHEARN et al. (2005), they proposed that larger farms (> 400 ha) who participated in farm programs grew at the expense of those who did not, which were mainly smaller farms (<20 ha).

Despite the fact of an unbalanced distribution of government payments to farms of varying size classes, differences in terms of the individual farm's credit constraint appear to be a main factor with respect to varying impacts of direct payments on farm performance. ROBERTS and KEY (2008) argued that agricultural subsidies have the potential to relieve borrowing constraints, and thus allowed some farms to grow more quickly than they would have done without governmental support. In their theoretical evaluation of credit market imperfections on the distribution of policy rents, CIAIAN and SWINNEN (2009) were more precise with regard to this issue. In a setting of heterogeneous farms, the authors found that a credit constrained farm benefits more from the introduction of area payments than a less-restricted or unconstrained farm. According to their analytical considerations, area payments increase the farms' land demand for two reasons. First, a general parallel upward shift of the farms' demand function occurs by the level of the subsidy. Second, the credit constraint of farms can be relaxed in course of the financial support. Consequently, the introduction of area payments leads to an increase of the land rent, assuming a fixed land supply. Given heterogeneously credit constrained farms a new equilibrium for the distribution of land in favor of the a priori more budgetary constrained farm occurs. This results from the fact that the reduction of a farm's credit constraint leads to higher marginal land productivity gains, and thus boosts land demand compared to a primarily less-constrained farm.

Empirical analyses of the Western European agricultural sector reveal quite different results in comparison to the studies mentioned previously. Investigating the Swiss agricultural sector by means of a cohort analysis, MANN (2003a) found that higher direct payments slowed down structural change. He observed the same trend if the price and income ratio between farm and non-farm business changed in favor of agricultural activities due to governmental price support. Applying an exit-entry model to 110 regions in 12 Western European states, BREUSTEDT and GLAUBEN (2007) indicated lower farm exit rates between 1993 and 1997 in connection with higher subsidy payments and increasing long-term output prices. Recently, PIET et al. (2012) analyzed the influence of EU agricultural policies on farm size inequalities in France. The authors conducted an Instrumental Variable-Generalized Method of Moments estimator to assess the impact of CAP pillar I and II payments on the Gini coefficient of farm size distribution in 40 NUTS-3 regions between 1970 and 2007. PIET et al. (2012) found that both types of CAP payments led to a decreasing farm size inequality in the French agricultural sector, and thus contributed to a homogenization of the size of farms in terms of cultivated area. A main driver for these contrary results compared to the studies conducted in the U.S. may be the specific agricultural policy design in the EU, as any farm benefits from government support.[17]

It is, however, difficult to transfer the previous findings to the East German agricultural sector offhand (cf. MANN, 2003b; HUETTEL and MARGARIAN, 2009). Although farm structures, with regard to the average farm size, might be comparable to North America, the legal framework of farm support is quite different under the umbrella of the CAP. Moreover, all of these studies refer almost exclusively to agricultural structures dominated by family farms. East German farms predominantly operated by hired managers may be more flexible in terms of factor allocation than family operators owning most of the production factors, and may face a significant risk of bankruptcy. Little is known about the effects of policy reforms in such an agricultural setting. This study is the first to examine the impact of CAP pillar I payments on an EU region dominated by large scale farm structures, including a differentiated evaluation of the effects on various size classes. Therefore, these findings enhance our understanding of the effects of governmental support regarding similar agricultural structures prevailing for instance in parts of Eastern Europe.

[17] The first pillar of the CAP is characterized by an obligatory support to all farms depending on farm size. Prior to 2005, the amount of direct payments received per farm, were mainly determined by the agricultural area allocated to eligible crops as well as animal, slaughter and milk premiums. Those payments were partly decoupled from production, varying from member country to member country (EC, 2008b), and transferred into the SPS with the implementation of the 2003 reform of the CAP in 2005. In Germany, direct payments were fully decoupled despite some exceptions, i.e. tobacco and hop.

## 1.5 Approach of the present dissertation

In view of the research questions at hand and the existing gap in the current wisdom, the main goal of the present study is to identify net policy effects on labor input and farm structure in East German agriculture. Therefore, econometric methods will be applied to a unique regional data panel comprising the three East German Federal States of Brandenburg, Saxony, and Saxony-Anhalt. The utilized data set includes unpublished figures on annually disbursed CAP payments disaggregated according to the single instruments on the level of 69 counties (*Landkreise*) between 1994 and 2007.[18] The empirical ex-post evaluation of CAP instruments is preceded by a theoretical discussion of their impact on agricultural labor use and farm structure. Based on the theoretical fundament, hypotheses are stated and empirically tested.

The overall structure of the present dissertation comprises six chapters, including this introductory chapter. Chapter 2 begins by laying out the theoretical fundament on how the single policy measures of the CAP affect agricultural labor use and farm structure at the regional level, resulting in testable hypothesis on their impact. Subsequently, the theoretical considerations are transferred into an estimable econometric model. The third chapter is concerned with the methodology used for this study and starts with a general debate on treatment effect models versus structural econometric approaches. In the remainder of chapter 3, both methods are discussed thoroughly in connection with the econometric models derived in Chapter 2. The fourth section depicts the data panel utilized in this study, including a descriptive analysis of the regional figures. The empirical work of the present dissertation, sub-divided into three sections, is presented in Chapter 5. In the first part, an empirically motivated treatment effect approach is conducted to assess the CAP impact on agricultural employment. This chapter is followed by the evaluation of labor demand in East German agriculture by means of a structural econometric adjustment costs model. The final section of Chapter 5 deals with the impact assessment of direct payments on heterogeneous farm structures. Finally, the conclusion provides a summary and critique of the findings, including policy recommendations.

[18] This data is not publicly available and the access to it depended on the cooperation of the state ministries. Some efforts have been undertaken to make data for additional federal states available, but without success. The present analysis is therefore limited to these three states.

# 2 THEORETICAL FRAMEWORK

In the following chapter, it is aimed to provide a theoretical foundation for the impact assessment of the EU's CAP on labor demand and farm structure in East German agriculture. Therefore, two models that rest upon neo-classical theory are developed with respect to the particular research question. Based on the theoretical considerations, testable hypotheses will be derived for the empirical analysis. Finally, the empirical strategy for the evaluation of regional policy impacts will be explained.

## 2.1 A theoretical model for labor demand in agriculture

For the analysis of CAP effects on labor demand in East German agriculture, an agricultural farm producing two types of outputs is considered. Therefore, a conventional output $Y^C$, and an environmental output $Y^E$ is specified, which both can be sold in competitive output markets at the prices $p^C$ and $p^E$, respectively. Furthermore, three factors of production, namely labor $L$, capital $K$, and land $\bar{A}$, can be allocated by the farmer. The respective proportions of the inputs allocated to the production of conventional and environmental outputs are labeled with the subscripts $C$ and $E$, respectively. In contrast to $Y^C$, $Y^E$ produces positive environmental externalities, such as: preservation or stimulation of biodiversity; reduction of soil erosions; or just providing a nice landscape. However, it is not explicitly accounted for these externalities in the model. The production factors labor and capital can be allocated without constraints, assuming perfect competition on the factor markets. Contrarily, land is considered to be an allocatable fixed input (SHUMWAY et al., 1884), i.e. the total amount of acreage available for the production of $Y^C$ and $Y^E$ is fixed over a short to intermediate adjustment period, allowing for varying shares regarding the allocation of land to each of the two products. In addition, fixed local environmental conditions denoted by the vectors $Z^C$ and $Z^E$, such as soil and climatic conditions as well as landform configuration, affect the production of $Y^C$ and $Y^E$.

The exemplarily East German agricultural farm is exposed to seven policy measures $\varphi^m$ resembling the portfolio of CAP pillar I and II instruments during the period under consideration:[19]

1. Coupled direct payments, depending on the actual production ($\varphi^1$);
2. Decoupled direct payments for each hectare of farmland ($\varphi^2$);

[19] In the present analysis it is referred to the most important measures, actually affecting the performance of agricultural farms. See Chapter 1.1.2 for detailed information.

3. Agri-environmental payments for each hectare allocated to the environmental output $Y^E$ ($\varphi^3$);
4. Compensatory allowance for LFA subject to some fixed local environmental conditions $Z^C$ and $Z^E$ ($\varphi^4$);
5. Lump-sum transfers to create public goods under the umbrella of "rural development" ($\varphi^5$);
6. The support of processing and marketing in the up- and down-stream sector of agricultural production ($\varphi^6$); and
7. Investment aid in the form of a subsidy per unit of capital ($\varphi^7$).

For simplification, $\varphi^5$ and $\varphi^6$ are assumed to increase the output prices realized by the farmer due to a proportional reduction of the transaction costs for marketing $\tau$ (KEY et al., 2000). This potentially results from an improved transport infrastructure and/or more efficient processing and marketing structures. Despite the considered policy measures, $\tau$ is also affected by a set of fixed local conditions $Z^T$, such as location, so that $\tau(\varphi^5, \varphi^6, Z^T)$; $\tau_{\varphi^5} < 0$ and $\tau_{\varphi^6} < 0$. Regarding the impact of coupled direct payments $\varphi^1$ a similar effect is assumed. Even though direct payments of the CAP after the McSharry-reform and before 2005 have the character of product premiums, and thus do not directly increase output prices, this approach is pursued to clearly distinguish these subsidies from the decoupled pillar I payments granted after 2005. Accordingly, $\varphi^1$ is modeled as a price support scheme and added up to the product prices $p^C$ and $p^E$. In this regard, it is assumed that on average the respective product premiums do not differ between outputs. The compensatory allowance for LFA $\varphi^4$ is a "decoupled" per hectare payment that is granted when the acreage of a farm, either in total or only parts of it, reveals specific adverse properties for farming subject to fixed local environmental conditions $Z^C$ and $Z^E$. The eligible amount of farmland is denoted by $A^{LFA}(Z^C, Z^E)$, with $A^{LFA} \le \overline{A}$.

Under the assumption of profit maximization and a binding land constraint, the Lagrangean for this optimization problem can be written as follows:

$$(1) \quad \begin{aligned} \mathscr{L} = & \sum_{j \in \{C,E\}} \left[ \left( p^j + \varphi^1 - \tau^j \left( \varphi^5, \varphi^6, \mathbf{Z}^T \right) \right) Y^j \left( L^j, K^j, A^j, \mathbf{Z}^j \right) \right] \\ & + \varphi^2 \overline{A} + \varphi^3 A^E + \varphi^4 A^{LFA} \left( Z^j \right) - w \left( L^C + L^E \right) - \left( r - \varphi^7 \right) \left( K^C + K^E \right) + \upsilon_A \left( \overline{A} - A^C - A^E \right) \end{aligned}$$

where $\upsilon_A$ is the shadow price of land. Under the assumption of concave and twice differentiable production functions and $j \in \{C, E\}$, the first-order conditions for the six input allocation decisions can be written as follows:

(2) $\left(p^{j}+\varphi^{1}-\tau^{j}\left(\varphi^{5},\varphi^{6},\boldsymbol{Z^{T}}\right)\right)Y^{j}_{L^{j}}-w=0$ for labor,

(3) $\left(p^{j}+\varphi^{1}-\tau^{j}\left(\varphi^{5},\varphi^{6},\boldsymbol{Z^{T}}\right)\right)Y^{j}_{K^{j}}-\left(r-\varphi^{7}\right)=0$ for capital, and

(4) $\left(p^{j}+\varphi^{1}-\tau^{j}\left(\varphi^{5},\varphi^{6},\boldsymbol{Z^{T}}\right)\right)Y^{j}_{A^{j}}+1^{\{j=E\}}\varphi^{3}-\upsilon_{A}=0$ for land,

where $1^{\{j=E\}}$ is an indicator function that takes the value of 1 if $j=E$ and 0 otherwise.

### 2.1.1 Policy impacts on labor demand in a static environment

In the following, the optimized labor demand function is formulated to evaluate the effects of the seven considered policy instruments on labor input in an agricultural firm:

(5) $$L^{+}=\left\{L\Big|\sum_{j\in\{C,E\}}\left[\left(p^{j}+\varphi^{1}-\tau^{j}\left(\varphi^{5},\varphi^{6},Z^{T}\right)\right)Y^{j}_{L^{j}}\left(K^{j}\left(p,\overline{A},\varphi,Z\right),A^{j}\left(p,\overline{A},\varphi,Z\right)\right)\right]-w=0\wedge L=L^{C}+L^{E}\right\},$$

where $p$ is a vector of product and input prices, $\varphi$ a vector of policy measures, and $Z$ a vector of local conditions, consisting of $Z^{C}$ and $Z^{E}$. The impact of the policy instruments on labor demand are derived by differentiating (5) with respect to $\varphi^{1}$ to $\varphi^{7}$:

(6) $$L^{+}_{\varphi^{1}}=\sum_{j\in\{C,E\}}\left(p^{j}+\varphi^{1}-\tau^{j}\right)\left(Y^{j}_{L^{j}K^{j}}K^{j}_{\varphi^{1}}+Y^{j}_{L^{j}A^{j}}A^{j}_{\varphi^{1}}\right),$$

(7) $$L^{+}_{\varphi^{2}}=0,$$

(8) $$L^{+}_{\varphi^{3}}=\sum_{j\in\{C,E\}}\left(p^{j}+\varphi^{1}-\tau^{j}\right)Y^{j}_{L^{j}A^{j}}A^{j}_{\varphi^{3}},$$

(9) $$L^{+}_{\varphi^{4}}=0,$$

(10) $$L^{+}_{\varphi^{5}}=\sum_{j\in\{C,E\}}\left(p^{j}+\varphi^{1}-\tau^{j}_{\varphi^{5}}\right)\left(Y^{j}_{L^{j}K^{j}}K^{j}_{\varphi^{5}}+Y^{j}_{L^{j}A^{j}}A^{j}_{\varphi^{5}}\right),$$

(11) $$L^{+}_{\varphi^{6}}=\sum_{j\in\{C,E\}}\left(p^{j}+\varphi^{1}-\tau^{j}_{\varphi^{6}}\right)\left(Y^{j}_{L^{j}K^{j}}K^{j}_{\varphi^{6}}+Y^{j}_{L^{j}A^{j}}A^{j}_{\varphi^{6}}\right),$$

(12) $$L^{+}_{\varphi^{7}}=\sum_{j\in\{C,E\}}\left(p^{j}+\varphi^{1}-\tau^{j}\right)Y^{j}_{L^{j}K^{j}}K^{j}_{\varphi^{7}},$$

Decoupled direct payments and the compensation for LFA reveal no employment effects (Eq. (7) and (9)). Regarding the remaining policy instruments, all derivates are theoretically undetermined, allowing for no conclusions on the respective signs (See Table 2-1). They crucially depend on the assumptions about the cross derivatives of the production function, which require an empirical determination. This view is supported by the findings of GUYOMARD et al. (2004), who where not able to rank the policy impacts of income support exclusively on theoretical fundaments, except for a fully decoupled income transfer.

However, the existing empirical evidence on factor complementarities in agriculture is scarce. Particularly, regarding the German agricultural sector no up-to-date estimation is available, whereas the evidence from other countries is inconclusive.[20] Accordingly, hypotheses on the impact of CAP measures on labor demand in East German agriculture are stated, based on plausible assumptions that can be made a priori (See Table 2-1):

1. Coupled direct payments are assumed to increase product prices. Accordingly, positive employment effects result from the granted subsidies if the increase in the value of the marginal product results in a higher optimal labor allocation.The specific policy shift of the CAP in 2005 describes a sharp reduction in coupled support to farmers. In consequence, negative employment effects of the policy reform are possible, if it is accompanied by a reduction of the overall produce of the farm, which in turn results in a lower optimal labor allocation.
2. Based on the assumption that environmental technologies yield higher products of labor per additional hectare of acreage compared to commercial technologies, agri-environmental payments are supposed to reveal positive employment effects. This appears to be reasonable for organic farming, the promotion of broad crop rotations on commercial farms, or landscape preservation services that are provided along with agricultural production.
3. In view of the measures under the umbrella of "rural development" and the support of processing and marketing granted to a specific region, the expected reduction in transaction costs will likely increase the realized output prices of the respective farm. In line with hypothesis (1) this potentially results in a higher optimal labor allocation, and thus induces positive employment effects.
4. In line with the presented theoretical model, decoupled direct payments and the compensatory allowance for LFA are supposed to reveal no impact on labor demand.

[20] For example, SALHOFER (2000) provided a comprehensive review of past studies that estimated elasticities of substitution in European agriculture. Regarding the modelling of effects subject to agricultural policy changes, he came to the conclusion that there is still a significant amount of uncertainty when suitable estimates are to be chosen.

**Table 2-1: Comparative statics of the CAP instruments**

| Policy measures | Theoretically determined employment effect $L_{\varphi^m}$ | Auxiliary assumptions on cross derivatives … | … resulting employment effect |
|---|---|---|---|
| Coupled direct payments ($\varphi^1$) | ? | Gross labor demand increases with higher output value $\left(\sum_{j\in\{C,E\}}\left(Y^j_{L^jK^j}K^j_{\varphi^1}+Y^j_{L^jA^j}A^j_{\varphi^1}\right)>0\right)$ | + |
| Decoupled area payments ($\varphi^2$) | 0 | Gross labor demand decreases with lower output value $\left(\sum_{j\in\{C,E\}}\left(Y^j_{L^jK^j}K^j_{\varphi^2}+Y^j_{L^jA^j}A^j_{\varphi^2}\right)<0\right)$ | – |
| Agri-environmental payments ($\varphi^3$) | ? | Optimal labor intensity per hectare is higher for environmental technology $\left(Y^E_{L^EA^E}>Y^C_{L^CA^C}\right)$ | + |
| Compensatory allowance for LFA ($\varphi^4$) | 0 | – | 0 |
| Rural development measures ($\varphi^5$) | ? | Gross labor demand increases with higher output value $\left(\sum_{j\in\{C,E\}}\left(Y^j_{L^jK^j}K^j_{\varphi^5}+Y^j_{L^jA^j}A^j_{\varphi^5}\right)>0\right)$ | + |
| Marketing support ($\varphi^6$) | ? | Gross labor demand increases with higher output value $\left(\sum_{j\in\{C,E\}}\left(Y^j_{L^jK^j}K^j_{\varphi^6}+Y^j_{L^jA^j}A^j_{\varphi^6}\right)>0\right)$ | + |
| Investment aids ($\varphi^7$) | ? | Labor and capital are cross substitutes $\left(Y^j_{L^jK^j}<0\right)$ | – |

Source: Author's depiction.

### 2.1.2 Theoretical considerations on dynamic labor adjustment

A considerable short-coming of the theoretical model presented above is the neglect of adjustment costs in conjunction with a varying demand for labor at the farm level. Regarding this issue, NICKELL (1986: 473) suggests that the initial size of the workforce and future expectations play an important role besides the current business environment. Accordingly, he concludes that static models perform poorly in explaining labor demand. If this holds true for the agricultural sector, the derived policy impacts from a static model might be inaccurate. In this regard, VASAVADA and CHAMBERS (1986) provided econometric evidence that labor adjusts sluggishly subject to changes in the exogenous environment, and thus should be treated as a quasi-fix input factor. This would imply that the scope for short-term policy impacts on labor use is limited. In the following, it is therefore aimed to extend the theoretical model for labor demand introduced above, explicitly allowing for adjustment costs in conjunction with the adaption of labor.

Based on the approach of a single-output profit maximizing farm, the idea of sluggish labor adjustment will be incorporated in the theoretical model presented above, disregarding the complexity of the CAP instruments and their impact on agricultural employment for a moment. Accordingly, the planning horizon of the farm is assumed to start at time zero and last to infinity. In each period $t$, the farm output is described by a production function $f$ that has the current stock of labor $L_t$ as its only argument. The production function $f$ is assumed to be concave, such that $f' > 0$ and $f'' < 0$. In view of static expectations, prices for output $p$ and labor $w$ are considered to be constant over time. The farm strategy in terms of the factor input allocations is annually adjusted with respect to changing prices and technology. Regarding the adjustment of labor, this process comes along with certain time and effort that can be described by a convex adjustment cost function $C(\dot{L}_t)$, such that $C' > 0$ and $C'' > 0$, with $\dot{L}_t$ denoting the gross change in farm labor per production period. In addition, $C' \neq 0$ as $\dot{L} \neq 0$, and $C(0) = 0$. In every period, the stylized farm considered here projects a desired level of employment $L*$ subject to current prices, technology, and further exogenous determinants, including the aforementioned policy instruments. Therefore, the current stock of labor $L_t$ in the respective production period is adjusted with respect to $L*$, yielding $\dot{L}_t$. However, this process proceeds gradually over time given adjustment in conjunction with a concave cost schedule, so that $\dot{L}_t < (L* - L_t)$. Accordingly, the equilibrium level of labor input is reached only asymptotically.

Formally, the decision problem of the farm at time zero is to maximize the present value $PV$ of its earnings subject to a given $L_0$:

$$(13) \quad \max_{L_t} PV = \int_0^{\infty} \{pf(L_t) - wL_t - C(\dot{L}_t)\} e^{-rt} dt ,$$

where $r$ is a constant discount rate of future farm profits.

For a solution to this optimization problem the calculus of variations is applied. Accordingly, the first-order condition for an optimal path of $L_t$ depending on Eq. (13) is given in the following Euler equation (HAMERMESH, 1993: 210):

(14) $pf'(L_t) = w + rC'(\dot{L}_t) - \ddot{L}_t C''(\dot{L}_t)$.

For an investigation of this problem, typically, quadratic adjustment costs, as a special case of strictly convex functional form, are assumed,[21] such that $C(\dot{L}) = a|\dot{L}| + b\dot{L}^2$, with $a, b > 0$ (HAMERMESH, 1993: 210). The desired equilibrium labor demand in the long-run steady state $L^*$ is considered to be constant, which is shown by $\dot{L} = \ddot{L} = 0$. Resulting from the quadratic form of the adjustment cost function, it further obeys the following condition:

(15) $pf'(L^*) = w + ra$.

Eq. (15) is the commonly used first-order condition derived from a static profit maximization problem, indicating that the value of the marginal product of labor equals the cost of the respective factor input. However, it further explicitly includes adjustment costs associated with an increase or reduction in workforce, besides the current wage level.

A further convenient implication under the assumption of quadratic adjustment costs is that it provides a direct link to the flexible accelerator or partial adjustment model. This approach has been a widely used basis for empirical work on quasi-fixed factor demand (HAMERMESH, 1993: 211; BOND and VAN REENEN, 2007: 4443). In this particular case Eq. (14) yields a general solution to the Euler equation in the form of a second-order linear differential equation which can be solved for its characteristic roots. Regarding this issue, CHIANG (1992: 110) could prove that characteristic roots yield a solution for the coefficient of adjustment $\lambda$ in the following partial adjustment model:

(16) $\dot{L}_t = \lambda(L^* - L_t)$.

Eq. (16) describes how the farm partially adjusts its labor stock to the steady state through time. As larger adjustment jumps are more costly than smaller ones by assumption (to be discussed momentarily), new equilibriums implied by a changing environment are not reached immediately but in a converging process over time. The speed of adjustment is determined by $0 \leq \lambda \leq 1$ and is decreasing in the level of adjustment costs (NICKELL, 1986: 504).

### 2.1.3 The shape of the adjustment cost function

Adjustment costs are largely determined by the specific organizational and institutional structure of the sector under study and are thus an empirical matter. Because employment protection legislation is relatively strict in Germany (OECD, 2004), there will be significant separating costs due to government regulation. Moreover, causes the specific structure of East German agriculture particular problems when it comes to lay-off workers. Many of the employees in agricultural cooperatives and corporations do own considerable amounts of land that is leased out to the

[21] See NICKELL (1986: 480), who provides an overview of the literature based on this assumption.

company they work for. In case of a layoff, they most likely do not continue expiring lease contracts. Either they rent it out to another farm if possible or even cultivate it by their own. With regard to agricultural cooperatives, firing workers may furthermore have the consequence that these workers withdraw their share in the cooperative, and thus reduce equity. These types of costs increase linearly with the number of fired workers. However, considering that typical farms in the region employ about 30 workers, releasing more than one or two workers per year may lead to significant internal disruption and reorganization costs that increase at the margin. Other important firing costs will be of a social nature, in the sense that farm managers fear a negative reputation in the local public if they fire too many at a time (WELSCHOF et al., 1993: 40). On the other hand, there is now widespread evidence that it is increasingly difficult to find trained and motivated workers in cases where they are to be hired. Recent years have seen significantly decreasing numbers of students leaving secondary schools in East Germany, thus threatening the availability of trainees for "green" jobs (AGRA-EUROPE, 2010). As shown by UHLIG (2008), unemployment levels in the age class below 25 years have recently not been higher in the East German states than elsewhere in Germany. For this reason also hiring costs can be assumed to be substantial and marginally increasing.

Accordingly, the standard assumption of a strictly convex cost schedule is maintained in the following. With regard to the empirical application, this has the advantage of motivating a simple specification of the partial adjustment model.

### 2.1.4 Resulting hypotheses about CAP effects on labor use in a dynamic environment

In order to analyze policy effects on long-term labor demand given model (16), it is crucial to identify how changes in exogenous conditions affect $L*$. The model so far suggests that higher output prices and less productive technology tend to increase optimal labor use, while higher wages and higher one-time adjustment costs reduce it. With a particular focus on the effect of adjustment costs in addition to the potential impacts of CAP payments on labor demand in agriculture stated in Chapter 2.1.1 the following hypothesis can be generated:

1. A short-run reduction in workforce due to a shift from a coupled to a decoupled policy regime, as implied by the CAP reform implemented in 2005, will be less pronounced in presence of high adjustment costs.
2. Besides the fact that most of the public goods investments, both for "rural development" or "processing and marketing", can be assumed to generate higher output prices, some may also reduce adjustment costs by making it easier to hire or release labor. For example, search costs may be lower with better infrastructure, and thus also increase equilibrium labor use. In general, many effects of public goods investment on factor and output prices will be indirect. However, it has to be noted that the identification of these net

effects, by accounting for all direct and indirect effects at the regional level, is a methodological challenge that will be addressed in Chapter 3.

3. Regarding the impacts of Capital subsidies and agri-environmental payments, it can also be hypothesized that if the effects stated in Chapter 2.1.1 occur, they might be smaller in the short-run, accounting for adjustment costs.

Following the discussion in the previous section, it is not unfounded that the EU's CAP may have positive effects on agricultural employment in East Germany. Even though, most of the instruments are primarily related to land and capital rather than employment. Assuming that these factors technologically cooperate with labor, CAP payments will induce labor. Furthermore, the question arises to which extent adjustment costs in conjunction with labor allocation decisions affect the policy outcome. Accordingly, the impact ofthe EU's CAP on labor demand cannot be answered by theory alone, and thus calls for an empirical evaluation that is to be addressed in the remainder of this dissertation.

### 2.1.5 Empirical strategy for the evaluation of regional policy impacts

In the present dissertation it is aimed to estimate the policy impact on agricultural employment by using panel data at the county level for selected federal states in East Germany, which includes annual payment streams for disaggregated policy measures of the CAP. Therefore, the theoretical model introduced in the previous section has to be transferred to the regional level. Given the seven policy instruments described above, let $n^{\varphi^m}\left(Z^{\varphi^m}\right)$ be the number of farms $k$ participating in program $\varphi^m$, depending on regional characteristics $Z^{\varphi^m}$ that are allowed to differ between measures. Consequently, the following data can be observed:

$$(17)\quad \Phi^1 = \sum_{k=1}^{n^{\varphi^1}} \varphi^1 \overline{A}_k \text{, with } n^{\varphi^1} = n^{\varphi^1}\left(Z^{\varphi^1}\right),$$

that is regional expenses on coupled direct payments,

$$(18)\quad \Phi^2 = \sum_{k=1}^{n^{\varphi^2}} \varphi^2 \overline{A}_k \text{, with } n^{\varphi^2} = n^{\varphi^2}\left(Z^{\varphi^2}\right),$$

regional expenses on decoupled direct payments,

$$(19)\quad \Phi^3 = \sum_{k=1}^{n^{\varphi^3}} \varphi^3 A_k^E\left(p, \overline{A}_k, \varphi, Z\right) \text{, with } n^{\varphi^3} = n^{\varphi^3}\left(Z^{\varphi^3}\right),$$

regional expenses on agri-environmental payments,

$$(20)\quad \Phi^4 = \sum_{k=1}^{n^{\varphi^4}} \varphi^4 A_k^{LFA} \text{, with } n^{\varphi^4} = n^{\varphi^4}\left(Z^{\varphi^4}\right),$$

regional expenses on the compensatory allowance for LFA, and

(21) $\Phi^5 = P^{rd}\left(Z^{\varphi^5}\right)\varphi^5$,

regional expenses on rural development, where $P^{rd}$ is the number of projects related to this policy instrument of the CAP within a region. The number of projects is assumed to be endogenous and subject to a vector of regional characteristics denoted by $Z^{\varphi^5}$.

(22) $\Phi^6 = P^{pm}\left(Z^{\varphi^6}\right)\varphi^6$,

are regional expenses for the support of processing and marketing, where $P^{pm}$ is the number of projects related to this policy instrument of the CAP within a region. The number of projects is assumed to be endogenous and subject to a vector of regional characteristics denoted by $Z^{\varphi^6}$.

(23) $\Phi^7 = \sum_{k=1}^{n^{\varphi^7}} \varphi^7 K_k\left(p, \overline{A}_k, \varphi, Z\right)$, with $n^{\varphi^7} = n^{\varphi^7}\left(Z^{\varphi^7}\right)$,

indicates regional expenses on capital subsidies in terms of the CAP investment aid scheme.

In line with these considerations, the following employment function, depending on exogenous variables and regional policy expenditures, can be formulated:

(24) $L_{it} = L\left(\Phi_{it}, p_t, \widetilde{Z}_{it}, \overline{Z}_i\right)$,

where $L_{it}$ is the number of person employed in the agricultural sector in region $i$ at time $t$ and $p_t$ is a vector of prices at time $t$ that is assumed to be constant across regions. The regionally and time varying policy expenses are denoted by the vector $\Phi_{it}$. Let $\widetilde{Z}_{it}$ be a vector of regional characteristics that vary across time and space. Accordingly, $\overline{Z}_i$ denotes a vector of time-invariant regional characteristics, including land endowments. All previously introduced $Z$'s are allocated either to $\widetilde{Z}_{it}$ or $\overline{Z}_i$.

In the presence of strictly convex adjustment costs in conjunction with a reduction or increase in farm labor, $L_{it}$ is considered to equal the projected long-term agricultural employment in region $i$ at time $t$, denoted by $L_{it}*$. Modifying Eq. (24) accordingly yields:

(25) $L_{it}* = L\left(\Phi_{it}, p_t, \widetilde{Z}_{it}, \overline{Z}_i\right)$.

Formulating the partial adjustment model discussed above (Eq. (16)) in discrete time as follows:

(26) $L_t - L_{t-1} = \lambda\left(L_t * - L_{t-1}\right)$,

solving (26) for $L_t$ and inserting (25) yields an estimable reduced-form equation of $L_t$. Linearizing this equation gives the following expression:

(27) $L_{it} = \gamma L_{it-1} + \delta\Phi_{it} + \beta_1 p_t + \beta_2 \widetilde{Z}_{it} + \beta_3 \overline{Z}_i + \varepsilon_{it}$ ,

where $\gamma$, $\delta$, and $\beta$ are parameter vectors to be estimated and $\varepsilon_{it}$ is an identically and independently distributed error term. Note that this partial adjustment model provides an estimate of the coefficient of adjustment, as $\lambda = 1 - \gamma$. Concerning the effects of policy measures on labor demand, short-run and long-run effects have to be distinguished. Policies may affect current labor demand immediately, as measured by $\delta$. However, there is also a long-term effect via the dynamic adjustment process. In the steady state, $L_{it} = L_{it-1}$. Substituting this into Eq. (27) and solving for $L_{it}$ leads to the long-run effect of $\Phi_{it}$, which is $\frac{\delta}{(1-\gamma)} = \frac{\delta}{\lambda}$ . The smaller $\lambda$, the slower is the adjustment of $L_t$ to a new equilibrium and the bigger the effect of $\Phi_{it}$ that can only be observed in the long-run. If $\lambda = 1$ ($\gamma = 0$), adjustment to the steady state is immediate and there is no sluggish adjustment at all. In this particular case, the model reduces to the following static equation for labor demand:

(28) $L_{it} = \delta\Phi_{it} + \beta_1 p_t + \beta_2 \widetilde{Z}_{it} + \beta_3 \overline{Z}_i + \varepsilon_{it}$ .

In Chapter 5.2 of this dissertation, Eq. (27) is to be estimated in order to identify the effects of the elements of $\Phi_{it}$ on $L_{it}$. The analysis in Chapter 5.2 is preceded by a rather empirically motivated treatment effect model in Chapter 5.1, which neglects the existence of adjustment costs by estimating Eq. (28). Methodological challenges and the resulting econometric approaches for both analyses will be discussed in Chapter 3. A critical reflection of the methods will be given in the conclusions of the present dissertation.

## 2.2 A theoretical model for the development of farm structures

The analysis of the EU's CAP on farm structures in the present dissertation will be restricted to pillar I payments. This fact is due to two reasons. On the one hand, direct payments have the particular goal to increase the farm income, and are thus supposed to directly affect the decision of farm survival, growth, or contracting. The portfolio of CAP pillar II measures does not exhibit this direct link. Furthermore, direct payments are the most important instrument given the fact that they occupy the lion's share of the total CAP budget. On the other, the available data for the empirical analysis does not enable an acceptable evaluation of the entire portfolio of CAP instruments.[22] Accordingly, the remainder of this chapter will elaborate on the impact of CAP pillar I payments on farm structure in East Germany.

[22] The bottleneck for the analysis is the available secondary data on regional farm numbers. A detailed overview will be provided in Chapter 4.

In view of the agricultural structures in East Germany, Figure 1-6 provides evidence that particularly those farms operating between 200 and 1,000 ha of land appear to be less equipped with capital as compared to their competitors on the land market. This fact suggests a comparative disadvantage regarding the access to credit of medium-sized farms, and thus should lead to disadvantages on the land market. KÜNSTLING (2010) supports this thesis, as the author argues that particularly in East German agriculture an insufficient equity base is one of the main drivers of restricted access to capital. However, regarding the development shown in Figure 1-5 the opposite appears to be true. A possible explanation is the gain in relevance of object and management credits in East German agriculture (NAWROTH, 2006). These credits increasingly rely on the farms' equipment with production factors and the expected returns from a venture, determined by revenues and subsidies. In consequence, higher anticipated amounts of governmental support lead *ceteris paribus* to lower credit costs. However, this fact would have particularly favored the largest farms, which cannot be confirmed either.

As a starting point for the theoretical model presented in the following serves the work of CIAIAN and SWINNEN (2009), who theoretically investigated the impact of area payments on land rents under credit market imperfections. Their approach is adapted to the requirements of the present study in two ways. In a first work step, the basic model of CIAIAN and SWINNEN (2009) is augmented by coupled direct payments additionally to decoupled payments. By means of this model the impact of governmental support on the demand for land at the farm level given a fixed land supply is investigated. In this regard, particular emphasis is placed on the potential of direct payments to relieve existing borrowing constraints. The discussion starts with the case of homogenously constrained farms. Finally, the impact of pillar I payments on the demand for land of heterogeneously credit constrained farms is examined. In a second step, the approach of CIAIAN and SWINNEN (2009) is transferred into a multi-period framework to account for the underlying pattern of land distribution in East German agriculture. Finally, the compiled theoretical model is converted into an estimable equation based on regional panel data. Regarding the regionalization of the presented approach, the assumption that the farm's credit constraint is on average closely related to its size describes a crucial point. This issue will be discussed at the end of this sub-chapter.

### 2.2.1 The impact of direct payments on farm structure

For the theoretical evaluation of the effect of direct payments on farm structures under imperfect credit markets a profit-maximizing single output farm $k$ is considered. This farm operates in a specific region $i$, where the total amount of available land $\overline{A}_i$ is fixed. The output produced by any farm depends on the amount of land $A$ available for production, the applied non-land input factors $B$, and some time-invariant regional characteristics $\overline{Z}_i$, such as soil quality. Interest rates on loan capital for the purchase of non-land inputs are not considered in the model.[23] Accordingly, the production function of the farm is denoted by $f(A,B,Z)$ with $f_A > 0$, $f_{AA} < 0$, and $f_{AB} > 0$. Furthermore, constant returns to scale are assumed. The profit of any farm $k$ in region $i$ at time $t$ can be shown by:[24]

(29) $\Pi = (p^Y + \varphi^1) f(A,B,Z) - (l - \varphi^2)A - p^B B$ ,

where $p^Y$ and $p^B$ are output and input prices, respectively. The disbursed direct payments are introduced by $\varphi^1$ for coupled payments and $\varphi^2$ for decoupled grants. Regarding the latter, it is therefore assumed that in a specific region the same amount of decoupled pillar I payments $\varphi^2$ per unit of farm land $A$ is granted on average. Agricultural land rents are denoted by $l$. In view of static expectations, $p^Y$ and $p^B$ are assumed to be fixed. In addition, the amount of agricultural loans in the share of total credit use is considered to be small, and thus does not affect the domestic interest rate.

Assuming perfect credit markets, the first-order conditions for the two input allocation decisions can be written as follows:

(30) $(p^Y + \varphi^1) f_A - (l - \varphi^2) = 0$,

(31) $(p^Y + \varphi^1) f_B - p^B = 0$.

Given Eq. (29), this implies that the unconstrained farm opts for a combination of inputs that maximizes its profits under unrestricted input use. Accordingly, Eq. (30) and (31) indicate the farm's demand for land and non-land input factors, respectively. It can be derived that coupled direct payments increase the overall demand for inputs including land, whereas decoupled grants only reveal a direct positive effect on land demand. As a matter of fact, the latter is followed by a proportional increase in the demand for other inputs, if the area under use can be increased.

In the next step, credit market imperfections in terms of a constraint on the total amount of credit per farm will be added to the decision problem of the farm. Following CIAIAN and SWINNEN (2009), the maximum amount of credit $S$ that can be borrowed by a farm, is determined by a set of farm-specific characteristics $W$ that influence the credit-worthiness. Accordingly, the credit constraint can be written as follows:

---

23 CIAIAN and SWINNEN (2009) suggest this procedure when credit market imperfections are modelled as constraints on the total amount of credit. In line with these considerations, the notification can be simplified without changing the results.

24 Subscripts are omitted for simplicity. They will be included again, when they become important for a distinction of heterogeneous farms.

(32) $p^B B \le S(W)$.

Under a binding credit constraint, the decision problem of the profit maximizing farm given in Eq. (29) subject to Eq. (32) can be represented by the following Lagrangean:

(33) $\mathscr{L} = (p^Y + \varphi^1) f(A, B, Z) - (l - \varphi^2)A - p^B B - \upsilon_S (p^B B - S)$.

where $\upsilon_S$ indicates the shadow price of the credit constraint.

The restriction results in the fact that the farm cannot apply the unconstrained optimal level of non-land inputs, such that the respective factor allocation given a binding credit constraint is determined by $B = S(W)/p^B$. Under these assumptions, the first-order conditions, indicating the optimal factor input in presence of a credit constraint $(\upsilon_S > 0)$, can be formulated as follows:

(34) $(p^Y + \varphi^1) f_A - (l - \varphi^2) = 0$,

(35) $(p^Y + \varphi^1) f_B - p^B (1 + \upsilon_S) = 0$.

(36) $p^B B - S = 0$.

It can be shown from Eq. (35) that the marginal value profit of non-land inputs exceeds its marginal costs $p^B$ as $(p^B + \varphi^1) f > p^B$ given $\upsilon_S > 0$. This implies that the farm could increase its profits by applying an additional unit of non-land inputs. However, the factor input is restricted due to the credit constraint. Furthermore, the demand for land is affected via the underlying functional form of the farm's production function $(f_{AB} > 0)$. Consequently, a more pronounced budgetary constraint leads to relatively less usage of non-land inputs per hectare of farmland. This results in lower productivity, and thus decreases the demand for land of the respective farm.

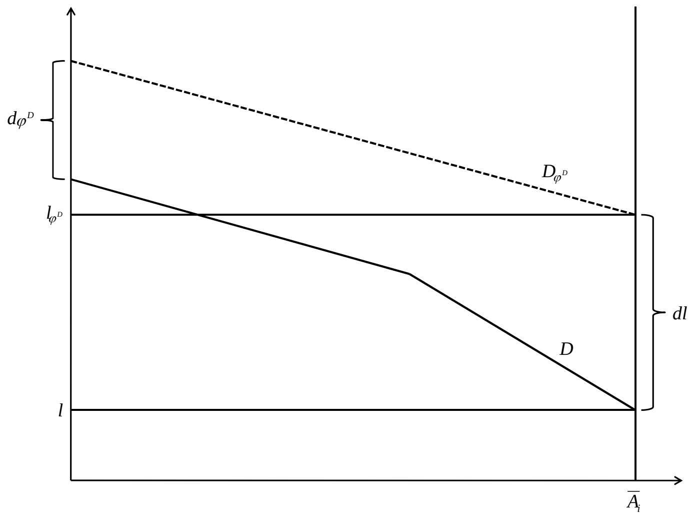
It is now assumed that the farms' credit constraint $S$ can be alleviated in conjunction with the granted CAP pillar I support. For the simplification of the model, direct payments are included in terms of grants per hectare of acreage. In view of coupled pillar I support, it is therefore assumed that the underlying farms are characterized by a steady crop rotation and fixed outputs in conjunction with livestock production, resulting in a fixed amount of coupled payments per hectare of farmland. As a result, no differences between coupled and decoupled grants regarding the impact on the farms' credit constraint are assumed. That is to say that any monetary unit of $\varphi^1$ and $\varphi^2$ possesses the same properties with respect to the alleviation of existing budgetary restrictions at the farm level. Accordingly, the credit constraint subject to the disbursed direct payments can be formulated as follows (cf. CIAIAN and SWINNEN, 2009):

(37) $p^B B \le S = \alpha_W W + \varphi^D A$.

where $\alpha_W$ measures the extent to which any farm gets credit subject to certain farm characteristics $W$. Let $\varphi^D$ be the total amount of CAP pillar I support per hectare, such that $\varphi^D A$ indicates all direct payments received by the farm. This further implies that the credit constrained farm can use the total amount of subsidies to alleviate its constraint. Under static expectations $\alpha_W$ is considered to be constant (and > 0), which implies a linear functional form of $S(W)$, with $dS/dW = \alpha_W$ .

Assuming a fixed land supply, CIAIAN and SWINNEN (2009) provide analytical evidence that land rents increase by more than the subsidy in this particular case, such that $dl/d\varphi^D > 1$. It can be seen from Figure 2-1 that this fact is true for two reasons. First, a parallel upward shift of the farms' demand function for land by $d\varphi^D$ occurs, which is directly induced by the payment of a subsidy given the fixed amount of land in the region. Second, the land rents increase by more than the subsidy as the grants relax the farms' credit constraint $(D \rightarrow D_{\varphi^D})$. Consequently, a priori budgetary constrained farms are able to increase their use of non-land inputs, and thus yield higher marginal returns to land, resulting in a further increase of the demand for acreage.

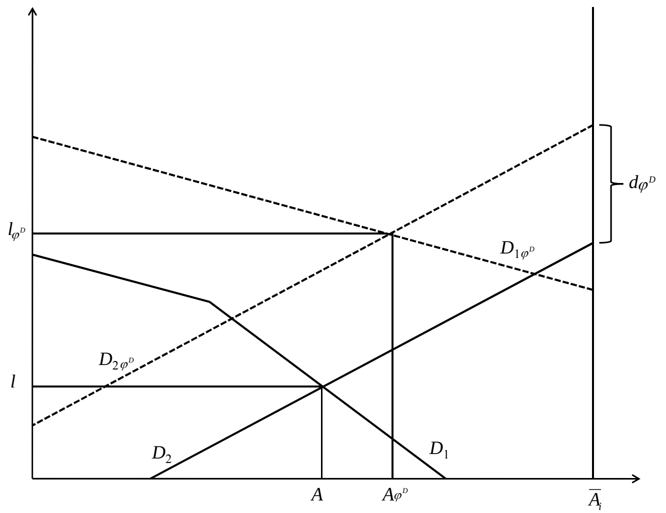
**Figure 2-1: Impact of area payments on farms' credit constraint and land demand, homogeneous farms**




Source: Author's depiction based on CIAIAN and SWINNEN (2009).

So far, the case of homogeneous farms has been investigated. It is now aimed to extend these considerations to heterogeneous farms in terms of their credit constraint within a given region under fixed land supply. For simplicity, a farm (1) operating under a binding credit constraint will be compared with a farm (2) revealing unconstrained access to financial resources. Similarly to Figure 2-1, it is apparent from Figure 2-2 that the introduction of area payments leads to a parallel upward shift of the land demand functions for both farms, the one with a credit constraint $(D_1 \rightarrow D_{1\varphi^D})$ as well as the one without $(D_2 \rightarrow D_{2\varphi^D})$. Moreover, the credit constraint of farm (1) is relaxed in course of the financial support. Given the fixed land supply $\overline{A}_i$, this leads to an increase of the land rent from $l$ to $l_{\varphi^D}$, and thus a new equilibrium for the distribution of land between farm (1) and (2) $(A \rightarrow A_{\varphi^D})$ in favor of the a priori budgetary constrained farm. Accordingly, the alleviation of the credit constraint of farm (1) leads to higher marginal land productivity gains for this farm, and thus boosts land demand compared to the primarily unconstrained farm (2). As a result, it can be concluded that in a setting of heterogeneous farms a credit constrained farm benefits more from marginally increasing direct payments than a less restricted or unconstrained farm. This pattern enables farm (1) to grow in size, whereas farm (2) contracts.

**Figure 2-2: Impact of area payments on farms' credit constraint and land demand, heterogeneous farms**




Source: Author's depiction based on CIAIAN and SWINNEN (2009).

According to the considerations above, the observable farm size $A_{kit}$ of a certain farm $k$ in region $i$ at time $t$ is determined by its own demand for farm land and the respective figures for the competitors on the regional land market. Both depend on the access to capital of the considered farms subject to CAP pillar I support. Furthermore, the farms' land demand is affected by agricultural prices and some fixed regional factors, such as soil quality, slope, and weather conditions, which have an impact on the profit margin that can be realized per hectare of acreage. Consequently, the regional land rent results from the aggregated demand for farm land. According to this, the regional land rent can be considered as an endogenous factor that has no direct bearing on the farm land distribution, but is a result of the parameters that determine it. Given these considerations, the size of a certain farm $A_{kit}$ that faces competition on the regional land market can be formulated as follows:

$$(38) \quad A_{kit} = A\left(\varphi^{D}_{kit}, W_{kit}, W_{cit}, p^{Y}_{it}, p^{B}_{it}, \overline{Z}_{i}\right),$$

where $\varphi^{D}_{kit}$ is the total amount of direct payments received by the considered farm per production period. Farm characteristics that affect the extent of the credit constraint are denoted by $W_{kit}$ for the farm considered and by $W_{cit}$ for the competitors on the land market. The regional agricultural input and output prices are indicated by the vectors $p^{B}_{it}$ and $p^{Y}_{it}$, respectively. Let $\overline{Z}_{i}$ be a vector of time-invariant regional characteristics.

Considering the timing of the introduced determinants affecting the size of a certain farm appears to be very important (CIAIAN and SWINNEN, 2009). In this regard, it is assumed in the present study that the actual farm size is determined by the disbursed subsidies and regional farm structure of the previous production period (to be discussed momentarily). The same also applies to the agricultural prices. Accordingly, Eq. (38) can be reformulated as follows:

$$(39) \quad A_{kit} = A\left(\varphi^{D}_{kit-1}, W_{kit-1}, W_{cit-1}, p^{Y}_{it-1}, p^{B}_{it-1}, \overline{Z}_{i}\right).$$

In line with the notation of Eq. (38), Eq. (39) denotes the actual size of farm $k$ subject to the values of the discussed parameters in the previous production period.

### 2.2.2 Reasoning towards a multi-period approach

The primal model discussed by CIAIAN and SWINNEN (2009) is basically characterized by a static framework, though the authors distinguish between the beginning and the end of the production period. In the present dissertation, their model is going to be transferred in a multi-period setting for several reasons.

The main idea behind this approach is based on the fact that the acreage in a certain region is not newly distributed among farmers year after year. In contrast, agricultural structures are the outcome of historical patterns. Furthermore, the production factor land is predominantly tied up for longer periods of time due to property or long-term lease contracts. Accordingly, it is reasonable to assume that past farm structures impact on future farm development. Recently, HUETTEL and MARGARIAN (2009) were able to provide empirical evidence with regard to this issue. In their analysis of structural change at the regional level in West Germany, the authors suggested a strong link between the initial agricultural structure and the distribution of farms in the future.

Given the relatively stable development of farm numbers in East Germany since the end of the 1990s (See Figure 1-4), no farm entries or exits are taken into account for the following analysis. It is further assumed that land becomes available due to expiring lease contracts, which have to be renegotiated. That is to say, a given number of farms in region $i$ at time $t$ cultivate a certain amount of leasehold. Due to expiring lease contracts, a part of the leasehold becomes available on the rental market. Subsequently, the existing farms in region $i$ compete for the available land. However, not at least due to the account of the statistical offices the resulting change in individual farm size will first be recognizable in the subsequent period of time $t+1$. In between, the determinants identified in the theoretical model presented above impact the decision of farms' to grow or contract.

### 2.2.3 Resulting hypotheses about the impact of CAP direct payments on farm structure and specifics in East German agriculture

For the impact assessment of CAP pillar I payments on farm size given model (39), the underlying regional farm structure with regard to the individual extent of the credit constraint of the considered farms appears to be of major importance. The model suggests so far that more constrained farms grow on the expense of less constrained farms in conjunction with the disbursed direct payments. Furthermore, agricultural output prices and resource costs affect the general demand for land at the farm level. The expected signs of the respective coefficients are discussed in the hypothesis stated in the following:

1. Direct payments of the CAP are assumed to have a positive effect on the farm size of the most credit constrained farms in a region. Contrarily, they are expected to negatively affect the farm size of less constrained farms.
2. Regarding the initial farm structure within a region, a high heterogeneity among farms will enable a more pronounced structural change. Accordingly, the existence of relatively unrestricted farms will positively affect the farm size of the constrained farms and *vice versa*. For instance, it is assumed that an increasing number of less credit constrained (smaller) farms on the regional land market has a positive impact on the farm size of a given number of restricted (medium-sized) farms, as the opportunities for growth increase. On the other hand, a large number of farms that reveal rather equal restrictions regarding the uptake of capital, and thus indicate a homogenous farm structure, will slow down structural change due to a lack of growth opportunities.

3. Impairing business conditions characterized by decreasing agricultural output prices as well as increasing input prices, decrease farm profits (See Eq. (29)) and are assumed to accelerate structural change. In contrast, favorable business conditions will lead to stabilized farm structures.

According to the discussion presented in Section 2.2.1, the thesis that the generous support to East German farms conserved farm structures cannot be supported. Instead, the theoretical model suggests that stronger credit constrained farms appeared to gain relatively more from the disbursed grants compared to others. However, the interaction of CAP pillar I payments and the general business conditions for farming on this pattern is inconclusive. Consequently, the impact of governmental payments on farm structure cannot be predicted by theory alone. In the following section, an empirical model will be derived from the theoretical considerations presented above to address the remaining question.

### 2.2.4 An econometric model of regional structural change in agriculture

Following the approach of the evaluation of policy impacts on labor demand in East German agriculture, it is aimed to assess the effect of CAP pillar I payments on farm structures by using panel data at the county level for selected federal states in East Germany. Accordingly, the presented theoretical model will be transferred in an estimable equation of regional farm structures. With regard to this issue, a crucial point is how to approximate the individual credit constraint $S$ of the considered farms subject to observable farm characteristics $W$. Following the considerations of KÜNSTLING (2010), the capital base at the farm level has a considerable impact on $S$, particularly in East German agriculture. Consequently, $S$ can bemeasured by equity per hectare of farmland. Furthermore, it is possible to associate these figures with the average farm size of the observed farms (See Figure 1-6). In view of the empirical approach, it is therefore assumed that the average credit constraint of farm $k$ in region $i$ at time $t$ can be approximated by its farm size $A_{kit}$.

To transfer these considerations on the regional level further assumptions have to be defined. First, farms of a comparable size in terms of operated farmland reveal a similar individual credit constraint. This enables a second step, in which appropriate farm size groups $g$ are created that exhibit different properties regarding their access to capital. Accordingly, agricultural farms that operate within a certain range of size, and thus under similar budgetary constraints, are aggregated. Let $F_{git}$ be the regional number of farms in the respective size classes at a particular point in time. Finally, it is assumed that $F_{git}$ is directly related with the acreage per region that is operated by on average similarly credit constrained farms. Regarding this assumptions, the dependent variable $A_{kit}$ can be substituted by $F_{git}$ at the regional level. Accordingly, the farm characteristics that determine the individual credit constraint of the considered farms $W_{kit-1}$ and the competitors on the rental market $w_{cit-1}$ in the past can be approximated by $F_{git-1}$ and $F_{cit-1}$, respectively. Inserting in Eq. (39) yields the following equation:

$$(40) \quad F_{git} = F\left(\Phi^D_{it-1}, F_{git-1}, F_{cit-1}, p^Y_{it-1}, p^B_{it-1}, \overline{Z}_i\right),$$

where $\Phi^D_{it-1}$ is a vectorof regionally disbursed direct payments in the previous production period. Let $F_{git-1}$ and $F_{cit-1}$ denote past regional farm structures that characterize the competitive situation on the rental market with respect to certain budgetary restrictions. The incorporated agricultural output prices and resource costs for the previous production period are indicated by the vectors $p^Y_{it-1}$ and $p^B_{it-1}$, respectively. Time-invariant regional characteristics are denoted by the vector $\overline{Z}_i$. In line with these considerations, the following linearized multi-equation model can be formulated for the case of $G$ farm size clusters:

$$
\begin{aligned}
(41) \quad F_{1it} &= \rho_{11}F_{1it-1} + \rho_{21}F_{2it-1} + \ldots + \rho_{G1}F_{Git-1} + \delta_1\Phi^D_{it-1} + \beta_{11}p^Y_{it-1} + \beta_{21}p^B_{it-1} + \beta_i\overline{Z}_i + \varepsilon_{1it}, \\
F_{2it} &= \rho_{12}F_{1it-1} + \rho_{22}F_{2it-1} + \ldots + \rho_{G2}F_{Git-1} + \delta_2\Phi^D_{it-1} + \beta_{12}p^Y_{it-1} + \beta_{22}p^B_{it-1} + \beta_i\overline{Z}_i + \varepsilon_{2it}, \\
\vdots \quad &\vdots \qquad\qquad\qquad \vdots \\
F_{Git} &= \rho_{1G}F_{1it-1} + \rho_{2G}F_{2it-1} + \ldots + \rho_{GG}F_{Git-1} + \delta_G\Phi^D_{it-1} + \beta_{1G}p^Y_{it-1} + \beta_{2G}p^B_{it-1} + \beta_i\overline{Z}_i + \varepsilon_{Git},
\end{aligned}
$$

where $\rho$, $\delta$, and $\beta$ are parameter vectors to be estimated. Let $\rho$ measure the extent to which past farm structures in terms of differently credit constrained farms affect the development of farms in a given size class, whereas $\delta$ indicates the marginal impact of CAP pillar I payments. The error terms $\varepsilon_{git}$ of the single equations are assumed to be contemporaneously correlated due to the fact that the number of farms in the various size classes adds up to the total number of farms, and thus the single equations are almost certainly not independent from each other.

In Chapter 5.3 of this dissertation, Eq. (41) is to be estimated in order to identify the impact of CAP direct payments on farm structure in an environment of heterogeneously credit constrained farms. Methodological challenges and the resulting approach applied in the present study will be discussed in Chapter 3.

# 3 METHODOLOGICAL ISSUES IN THE QUANTITATIVE EX-POST EVALUATION OF AGRICULTURAL POLICIES

The following chapter will elaborate on methodological issues in the estimation of policy impacts. Based on a general discussion of approaches for an ex-post policy evaluation, appropriate methods to answer the present research questions will be deduced. The properties, strengths, and weaknesses of the chosen methods are to be discussed, accordingly.

The central problem studied in the evaluation literature is the impact assessment of a certain policy treatment geared towards a set of units with regard to some outcome. Concerning this matter, it is ideally aimed to compare the outcomes for the same unit with apolicy treatment and without. However, the first problem arises from the fact that in reality at most one of these outcomes can be observed. Accordingly, distinct units under different levels of treatment have to be compared to evaluate the policy impact (IMBENS and WOOLDRIDGE, 2009: 6). Following, HECKMAN and VYTLACIL (2007: 4782) this requires the construction of a "counter-factual". This means that the unobserved case, which is mainly the development of the examined unit without policy treatment, has to be modeled and compared with the observed case. The second fundamental problem in policy evaluation is the selection bias that arises in conjunction with voluntary program participation (HECKMAN and VYTLACIL, 2007: 4785). Regarding this issue, some unobserved individual characteristics of program participants may influence the outcome independent from the policy treatment, and thus lead to a systematically biased estimate of the policy impact.

Consequently, two central methodological issues concern the literature on policy evaluation. These are, how can reasonable counter factuals be constructed and in which way can the unobserved selection bias in relation to program participation be considered. In recent years, there has been a proliferation of the economics literature, discussing various evaluation methods to account for these problems.[25] Following the work by HECKMAN and VYTLACIL (2005), the bulk of studies can be generally condensed into two competing paradigms, namely the treatment effect approach and the structural econometric approach.

The treatment effect approach that emerged from the statistical literature is almost exclusively concerned with the ex-post evaluation of a policy in place, based on the comparison of an observed treated group with a non-treated group (HECKMAN

[25] For a review of the existing methods, see BLUNDELL and COSTA DIAS (2009) as well as IMBENS and WOOLDRIDGE (2009).

and VYTLACIL, 2005: 670). Thereby, the approach to identify causal effects subject to a policy treatment originates from the analysis of randomized experiments. In economics social experiments, natural experiments, discontinuity design methods, and matching methods fall in this strand of literature (BLUNDELL and COSTA DIAS, 2009: 566). Regarding these methods, the main focus lies on the estimation of the so-called potential outcome of a policy treatment. Therefore, pairs of outcomes for the same unit of observation subject to a different level of treatment are defined. A comparison of the respective outcomes leads the researcher to the net effect of the policy in place (IMBENS and WOOLDRIDGE, 2009: 7). Given the fact that the estimated treatment parameter is defined in a specific environment, the issue of selection bias can be neglected. Furthermore, the treatment effect approach relies on fewer assumptions about the functional form and the exogeneity of the used parameters. However, this comes not without costs as the economic tasks such as out of sample forecasting and ex-ante analysis of policy reform proposals are not feasible (HECKMAN and VYTLACIL, 2005: 670). Treatment effect models a rarely applied in the literature on agricultural policy evaluation. Exceptional cases are the studies of HENNING and MICHALEK (2008) and PUFAHL and WEISS (2009) that investigated the SAPARD measures in Poland and the CAP's agri-environmental scheme in Germany, respectively. Thereby, the authors applied matching methods to identify net policy effects. Furthermore, SINABELL and STREICHER (2004) evaluated the impact of rural development programs in Austria by means of a difference-in-differences model.[26]

The structural econometric approach strongly rests upon economic theory. Within this strand of literature, carefully designed theoretical models are applied to investigate an observable phenomenon. Thereby, the basic idea is to improve the understanding of the causes producing the effects (HECKMAN and VYTLACIL, 2007: 4787). The instrumental variable and control function methods applied in the economics literature can be assigned to this approach. These methods aim at modeling the decision rule of program participation in order to control for the selections bias based on observable data (BLUNDELL and COSTA DIAS, 2009: 566). Accordingly, structural econometric approaches rely on an estimation equation that is derived from an a priori well defined theoretical model. Based on this model, the endogenous and exogenous variables are determined and hypothesis on their impact can be formulated. Besides the ex-post evaluation of policy instruments, this approach enables the forecast of policy impacts in an environment that is different from the one actually investigated. Additionally, it allows for a prediction about the effects of new policy instruments. However, the structural econometric approach typically requires comparably strong assumptions about the underlying functional form as well as the selection of parameters to be estimated and their exogeneity. All of these assumptions have to be theoretically well founded to ensure a reliable impact

[26] The difference-in-differences model belongs to the field of natural experiments (BLUNDELL and COSTA DIAS, 2009: 567).

evaluation of the considered policy measure (HECKMAN and VYTLACIL, 2005: 669) or as BLUNDELL and COSTA DIAS (2009: 566) state: "Just as an experiment needs to be carefully designed, a structural economic model needs to be carefully argued."

Compared to the treatment effect models, structural econometric approaches have gained far more attention in the field of agricultural policy evaluation. In recent years, many studies have been published that focused on an impact evaluation of the shift from coupled to decoupled direct payments. Corresponding analysis that investigated this issue in conjunction with the implementation of the 1996 Farm Act in the U.S. deal with the effects on agricultural production (ADAMS et al., 2001; GOODWIN and MISHRA, 2006; SERRA et al., 2006), land markets (ROBERTS et al., 2003; LENCE and MISHRA, 2003; SHAIK et al., 2005), and labor allocation (AHEARN et al., 2006; KEY and ROBERTS, 2009). Furthermore, the decoupling of CAP pillar I payments in the EU due to the Fischler-reform has been investigated, applying structural econometric approaches. In this context, SCKOKAI and MORO (2006; 2009) analyzed production effects for arable farms in Italy. The impact of the 2003 reform of the CAP on land rental values due to the capitalization of the grants has been investigated by PATTON et al. (2008) for Northern Ireland and KILIAN et al. (2012) in the case of Bavaria. The effects of decoupled direct payments on labor allocation at the farm level have been evaluated by HENNESSY and REHMAN (2008) for a sample of Irish farms. However, the structural econometric literature concerning the CAP’s pillar II measures is rather limited. The few exceptions include the work of BRÜMMER and LOY (2000) and PETRICK (2004a; 2004b) on investment support programs in Northern Germany and Poland, respectively. Moreover, SALHOFER and STREICHER (2004) evaluated the impact of various agri-environmental measures on the production intensity of Austrian farms. However, the extent to which the theoretical foundation is clarified strongly varies among the analyses mentioned above. In this regard, it is common to keep the respective considerations merely sketched and at a rather general level.

In the present dissertation it is aimed to combine the treatment effect approach and the structural econometric approach to analyze the impact of the CAP on selected structural parameters in East German agriculture. Given the fact that the evaluation will be done at the regional level and that within these regions any of the considered policy measures of the CAP are implemented, the selection problem will be of minor concern. Accordingly, the main issue that is to be dealt with in the present study is the evaluation problem, and thus the construction of a reasonable counterfactual. Therefore, in the first stage a regional difference-in-differences estimator will be derived, originating from a simple multiple regression model. This approach can be considered as a natural experiment and belongs to the field of treatment effect models (BLUNDELL and COSTA DIAS, 2009: 567). In a further step, this difference-in-differences model will be integrated in two structural econometric models for labor demand and structural change in agriculture.

## 3.1 The treatment effect model

In general, the evaluation problem to be addressed in the present study can be written as follows (BLUNDELL and COST DIAS, 2009: 570):

(42) $y_i = \delta\Phi_i + \varepsilon_i$ .

where $y_i$ indicates the outcome variable that should be influenced by the policy treatment observed for a sample of $i = 1...n$ regions. The policy treatment in region $i$ is given by the vector $\Phi_i$ of metric variables, allowing for multiple measures. Let $\varepsilon_i$ be the unobserved component of $y_i$. Given the fact that Eq. (42) can be considered as a very general model, imposing no functional form or distributional assumptions on the parameters, such acomparison would at least require two regions exposed to different levels of treatment. However, the assumption that no other variable affects the outcome is crucial for the isolation of the policy effect $\delta$, which seems implausible outside of controlled experiments.

It is therefore common to use multiple regression models to control for other covariates than the policy treatment, such as in the following equation, which can be regarded as a generalized function of Eq. (28):

(43) $y_i = \delta\Phi_i + x_i'\beta + \varepsilon_i$ ,

where, $x_i$ denotes a vector of control variables with its respective coefficient estimates $\beta$, so that $\delta$ indicates the average treatment effect. In the case of continuous (rather than binary) treatment, $\delta$ denotes the marginal impact of the policy measures on the outcome.

As a special case of treatment effect models, Eq. (43) is estimated for a pooled sample of regions with different policy treatments. Although Eq. (43) mimics an experimental setting by controlling for multiple factors influencing the outcome, an identification of the net policy effect is still based on a number of assumptions. An assumption that has been the key characteristic for classifying models in the recent program evaluation literature is that units of observation differ only with regard to observable variables (IMBENS and WOOLDRIDGE, 2009).[27] This approach hence falls in the class of models based on "selection on observables".[28] This assumption is denoted with (i) in the following. In the present context, several determinants of agricultural structure can be measured relatively easily, such as prices or factor stocks. However, unobserved climatic or soil conditions or the

---

27 The typical application in this literature is the effects of employment programs on labor market outcomes.

28 Alternatively, in the program evaluation literature, the characteristic assumption in this class of models has been called "unconfoundedness" or "exogeneity", see IMBENS and WOOLDRIDGE (2009: 7). SMITH (2004) provides an accessible overview of the literature and links it to the analysis of regional policies.

human capital in a region are important latent determinants of structural change in agriculture that are not controlled by an analysis based on Eq. (43). Further assumptions of this approach follow directly from Eq. (43), namely: (ii) that treatment effects are linear; (iii) they are additively separable; and (iv), because $\delta$ is assumed constant across regions and time, they are homogenous for all units observed (the so-called common effects assumption). A core aim of the recent literature has been to relax one or several of these assumptions (BLUNDELL and COSTA DIAS, 2009; IMBENS and WOOLDRIDGE, 2009).

In the field of models based on selection on observables, an increasingly popularized alternative to estimating Eq. (43) by conventional regression methods is propensity score matching, in which individual outcomes from a treated and a non-treated population are compared to yield the respective policy impact (ROSENBAUM and RUBIN, 1983; Smith 2004: 299).[29] Thereby, the basic idea is to identify a non-treated unit that is as similar as possible to a treated unit, based on some matching variables. As a result, any restrictions on the underlying functional form of the treatment process are circumvented, which relaxes assumptions (ii) to (iv). However, this advantage does not come without cost. First, the method crucially hinges on finding appropriate units for comparison. This becomes increasingly difficult, when the matching variables include continuous parameters or a large number of discrete variables. Accordingly, datasets must be suitably rich to include the relevant characteristics on which observations are matched to calculate a viable propensity score (SMITH, 2004: 299). Second, the selection of variables on which to base the propensity score is often ad-hoc and still based on assumption (i).[30] Finally, and most important in the context of the present study, matching requires the formation of subsamples based on participation or non-participation in a policy treatment. In consequence, there is no natural way to study the effects of several continuously measured policy measures simultaneously. Attempts to extend this method to multiple or continuous treatments are still in their infancy (IMBENS and WOOLDRIDGE, 2009: 72) and seem difficult without imposing further structure on the treatment process.

A methodological advancement of the aforementioned multiple regression models, particularly in dealing with the issue of latent factors, is provided by the panel data treatment effect models. These longitudinal methods relax the assumption of selection on observables (i), because they allow for repeated observations of the same region in several periods. A corresponding regression analysis is run of the structural parameter of interest on some predefined covariates, including the policy treatment. Additionally, the regression model includes dummy variables for each region and time period considered. In this regard, the regional dummies

[29] This metric is often based on a regression model for program participation.

[30] An exception are matching approaches based on first differences (HECKMAN et al. 1997; PUFAHLand WEISS, 2009).

control for enduring differences regarding the outcomes among regions, whereby the time dummies control for aggregated macro effects. These considerations result in the following panel data model that allows for a "selection on unobservables" (BLUNDELL and MCCURDY, 1999: 1608; SMITH 2004: 304):

(44) $y_{it} = \delta\Phi_{it} + x_{it}'\beta + \alpha_i + \mu_t + \varepsilon_{it}$ .

where $\alpha_i$ defines the latent, regional fixed effect that is allowed to be correlated with elements in $x$. Let $\mu_t$ denotethe unobservable macro or time effect that impacts all regions at time $t$ in the same way. Differencing each observation from group means leads to:

(45) $y_{it} - \bar{y}_i = \delta(\Phi_{it} - \overline{\Phi}_i) + (x_{it} - \bar{x}_i)'\beta + (\mu_t - \bar{\mu}) + \varepsilon_{it} - \bar{\varepsilon}_i$ ,

which shows that the influence of latent characteristics of regions, as far as they are time invariant, as well as any other linear separable selection bias is "swept out" of the equation. In this model, $\delta$ denotes a "difference-in-differences" estimator of the policy impact, because it compares relative differences in the development of variables within one group over time.[31] Alternatively, it has been called a "natural experiment" approach, as it exploits naturally occurring variation in treatment of observed groups (BLUNDELL and COSTA DIAS, 2009: 578; IMBENS and WOOLDRIDGE, 2009: 67). Consequently, it represents a powerful method to deal with unobserved heterogeneity, as it replaces assumption (i) that there generally are no unobserved characteristics or shocks that affect outcomes by the much less restrictive assumption (denoted (i')) that these unobserved characteristics are not both group-specific and temporary (BLUNDELL and COSTADIAS, 2009: 579). In other words, $\Phi_{it}$ is assumed to be exogenous given the inclusion of fixed effects into the equation (BESLEY and CASE, 2000).

BESLEY and CASE (2000) emphasize the importance of regional political variables that may have a bearing on regional policy design, and thus would lead to endogenous policy treatments. This determinant can be largely ruled out in the present study, as the underlying political decisions are mostly made at the level of the EU, with only some leverage left at the federal states, but not at the county level. Whereas the procedures for calculating and administrating direct payments are mostly settled at the EU and national level, federal states have freedom to allocate funds within their RDP and OP. Accordingly, the programs of the federal states are focusing on agri-environment and farm structures. Furthermore, federal state governments can decide how to use funds from the modulation of direct payments.

[31] The fixed effect estimator controls both observed and unobserved heterogeneity. This property is an advantage compared to other approaches that control only observed heterogeneity, for example by conditioning the covariates on size variables, such as land resources or number of farms, or by using growth rates. It also avoids the choice of an arbitrary conditioning variable.

However, there is practically no decision power related to the CAP at the county level, which is the unit of observation in the study at hand. The underlying assumption that the unobserved characteristics modeled by regional and time dummies are not both group-specific and temporary is therefore regarded a weak supposition in the present context. Given these payment levels set by policymakers, the volume of actual payment streams depends on cropping decisions of farmers for the direct payments and their participation decisions in certain programs, such as investment support or agri-environmental schemes. It is assumed that these decisions are completely determined by the given natural resources and the human capital of a region in the sense of a time-invariant, average absorption capacity. This source of endogeneity can thus be differenced out. Transfers that are not paid on the basis of voluntary participation of farmers, such as public good investments or measures affecting the downstream sector, are exogenous to the model per se.

The assumptions that treatment effects are linear and additively separable are restrictive in the sense that they impose much *a priori* structure on the model. At the same time, these considerations are the basis for relaxing the assumption that units of observation differ only with regard to observable variables, as complex interactions among variables or non-linear functional forms would preclude to difference out fixed effects (See Eq. (45)). The linearity assumption is very common in the literature and there is no obvious alternative; it is therefore kept.

According to the considerations presented above, the discussed difference-in-differences treatment effect model can be considered as powerful tool to identify net policy effects in a predefined environment. However, it has to be kept in mind that treatment effect models neither allow for a generalization of the results nor enable forecasts on future impacts. Nevertheless, Eq. (44) will be estimated to evaluate the impact of disaggregated CAP pillar I and II payments on labor demand in East German agriculture, due to the advantageous properties with regard to the ex-post evaluation of policy measures. In the framework of the study at hand, the treatment effect approach forms step one of two with regard to the assessment of employment effects. A detailed model specification, the applied data, and empirical results are presented in Chapter 5.1.

## 3.2 Structural econometric models of agricultural policy evaluation

The following two sections will deal with methodological issues in the estimation of the econometric models for labor demand and structural change derived in Chapter 2.1.5 and 2.2.4, respectively. Thereby, the particular focus of this paragraph lies on the identification of appropriate econometric methods for a sophisticated estimation of the theoretically motivated models.

### 3.2.1 The adjustment costs model for labor demand

Dynamic aspects of factor adjustment are widely neglected in agricultural policy evaluation (cf. PUFAHL and WEISS, 2009; PETRICK and ZIER, 2011b). However, as shown in Chapter 2.1 the uptake of additional labor and release of workers in East German agriculture comes not without certain costs of adjustment. Accordingly, these theoretical aspects will be taken into consideration in the study at hand. The treatment effect model presented above is therefore augmented with a dynamic component, resulting in the following dynamic fixed effects model, which can be regarded as a generalized function of Eq. (27):

$$(46)\quad y_{it} = \gamma y_{it-1} + \delta\Phi_{it} + x_{it}{}'\beta + \alpha_i + \mu_t + \varepsilon_{it}\,,$$

where $y_{it}$ depicts the lagged dependent variable capturing the idea that factor adjustment is sluggish, and thus follows a path dependent process. Under the assumption that Eq. (46) can be seen as a reduced form of a flexible accelerator or partial adjustment model written as (GREENE, 2008: 679):

$$(47)\quad y_{it} - y_{it-1} = (1-\gamma)\left(y_{it}^{*} - y_{it-1}\right)\,,$$

where $y^*$ is the desired or long-run equilibrium level of the outcome. $\lambda \equiv 1-\gamma$ may be defined as coefficient of adjustment (cf. HAMERMESH, 1993: 211), where $0 \le \lambda \le 1$. A coefficient of $\lambda$ close to one implies quick adjustment, while a negative $\lambda$ (implied by $\gamma > 1$) would lead to an explosive process with no convergence to a long-run equilibrium level of $y^*$ at all.

It is well known that the difference-in-differences or Least Square Dummy Variable estimator (LSDV) for Eq. (46) is not consistent for finite *T* even if *N* is considered to be large (NICKELL, 1981). Accordingly, the LSDV approach only performs well when the time dimension of the panel tends to infinity. In view of the panel dataset at hand, the LSDV estimates would be seriously biased. GREENE (2008: 340f) argues that for *T* values from 5 to 15, the relative bias in estimation of $\gamma$ could reach up to 60 %. JUDSON and OWEN (1999) find that even with a quite large time dimension of 30 observations the bias accounts for 20 % of the true value of the coefficients.

A number of consistent Instrumental Variable (IV) and Generalized Method of Moments (GMM) estimators have been proposed to estimate Eq. (46) when T is moderate. ANDERSON and HSIAO (1981) (AH) suggest an approach based on first-differences to eliminate the unobserved individual heterogeneity. They apply two IV estimators that use the second lags of the dependent variable, either differenced or in levels, as an instrument for the differenced one-time lagged dependent variable. ARELLANO and BOND (1991) extended the AH approach in terms of efficiency by allowing for a greater number of internal instruments leading them to a GMM estimator for the first-differenced model. The AB estimator can be applied as a one-step or two-step procedure depending on whether the error terms are homoscedastic or not (BOND, 2002). ARELLANO and BOVER (1995) as well as BLUNDELL and BOND (1998) report Monte Carlo evidence of a downward bias in the AH solution, they propose a system GMM estimator using additional moment restrictions estimator when the true dynamic coefficient is equal to or greater than 0.8. As a solution, they propose a system GMM estimator using additional moment restrictions, supported by the structure of panel data, as superior alternatives.

However, a considerable shortcoming of IV and GMM estimators is that their properties rely on large *N*. Thus, their application can lead to severely biased coefficients in panel datasets with a moderate number of cross-sectional units (BRUNO, 2005b). Recently, alternative approaches based upon the bias-correction of LSDV have become popular in the econometric literature. JUDSON and OWEN (1999) compared the performance of pooled Ordinary Least Squares (OLS), LSDV, AH, AB (one-step and two-step estimator), and a LSDVC estimator derived in KIVIET (1995) regarding the coefficients of $\gamma$ and $\beta$ by means of a Monte Carlo experiment with *T* values between 5 and 30. They provided evidence that the LSDVC approach consistently outperforms the other estimators. BUDDELMEYER et al. (2008) analyzed the performance of the same range of estimators on a more complex indicator that summarizes the properties of a vector of fixed effects coefficients in a similar Monte Carlo simulation. They confirm the findings of JUDSON and OWEN (1999) that when *N* (=20) and *T* (=5) are small the LSDVC estimator outperforms all other estimators[32].

BRUNO (2005a) extends the literature[33] on corrected LSDV estimators for samples with small or moderate *T* to unbalanced panels. The author augments Eq. (46) to a more general version that allows for missing observations in the interval [0, *T*] for some regions. The author defines a dynamic selection rule $s(r_{it}, r_{it-1})$ to identify those observations that are usable for the dynamic model:

$$(48) \quad s_{it} = \begin{cases} 1 & \text{if } (r_{it}, r_{it-1}) = (1,1) \\ 0 & \text{otherwise,} \end{cases}$$

where $r_{i,t}$ is the selection indicator such that $r_{it} = 1$ if $(y_{it}, x_{it})$ is observed and $r_{it} = 0$ otherwise. Following BRUNO (2005a), the unbalanced dynamic panel model can be written as:

$$(49) \quad s_{it} y_{i,t} = s_{it}\left(\gamma y_{it-1} + \delta\theta_{it} + x_{it}{}'\beta + \alpha_i + \mu_t + \varepsilon_{it}\right).$$

According to BUN and KIVIET (2003) three possible bias approximations emerge. First, the bias of the LSDV estimator of order $O(T^{-1})$ for $N \to \infty$, which has been examined by NICKEL (1981). Second, KIVIET (1995; 1999) developed two approximations of the LSDV bias in dynamic panels where both $N$ and $T$

---

[32] The only exception is the case when the true value of the dynamic parameter γ is equal to 0.8. Than OLS reveals the best performance.

[33] Cf. KIVIET (1995; 1999), and BUN and KIVIET (2003).

are moderate or small. This enhanced approach relies on the strategy that certain extra terms are added to the approximation formula identified by NICKEL (1981). The resulting bias approximations are of order $O(N^{-1}T^{-1})$ and $O(N^{-1}T^{-2})$. In general, the stated bias approximations reveal an increasing accuracy from the leading term of the LSDV bias $B_1$ of order $O(T^{-1})$ to the successive higher-order terms $B_2$ $O(N^{-1}T^{-1})$ and $B_3$ $O(N^{-1}T^{-2})$. However, BUN and KIVIET (2003) showed that the leading term $B_1$ already comprises 90 % or more of the true bias and the higher-order terms only lead to minor improvements. BRUNO (2005a) could prove that the bias approximations derived in BUN and KIVIET (2003) can be applied to unbalanced panels with a strictly exogenous selection rule as well. Thus, LSDVC could theoretically be obtained by subtracting any of the above mentioned bias approximation terms from LSDV.

In practice, however, those approximations are unfeasible to calculate, given the unknown parameters for the actual bias of the error terms and the real coefficients for $y_{it-1}$. BRUNO (2005a) circumvents this issue by identifying estimators for a consistent estimation of these parameters, namely the AH, AB and Blundell-Bond (BB) estimator. This leads him to an individually corrected estimator for each order of bias approximation and choice of initial estimator:

(50) $LSDVC_b^a = LSDV - \hat{B}_b^a$; $a$ = AH, AB, BB and $b$ = 1, 2, 3.

Recently, FLANNERY and HANKINS (2011) were the first to also investigate how the choice of the estimator affects the estimates of the exogenous variables in addition to the coefficient for the lagged dependent variable. In their simulation study based on short panels of corporate finance data, the LSDV and LSDVC model performed best regarding the estimation of the explanatory variables. BB and AB also performed well, whereat the BB estimator is generally more accurate in terms of the estimates for the lagged dependent variable, while AB provides better results for the explanatory variables. The authors, however, conclude that the LSDVC model should be the first choice for the estimation of short dynamic panels whenever it is feasible.

In the present study, the LSDVC model proposed by BRUNO (2005a,b) is applied to estimate Eq. (46) for the impact evaluation of first and second pillar CAP payments on dynamic labor demand in East German agriculture (Chapter 5.2). According to the methodological considerations discussed above, this estimator represents the state-of-the-art in dynamic panel data modeling when $T$ and $N$ are moderate. In view of the CAP effects on dynamic labor demand, furthermore, results for the BB estimator will be presented. Complementary to the treatment effect approach applied in Chapter 5.1 the particular focus of this analysis lies on the estimation of the adjustment coefficient. Therefore, the BB model reveals high accuracy.

### 3.2.2 The structural econometric model for regional farm structure

According to the theoretical considerations discussed in Chapter 2.2, it is aimed to evaluate the impact of CAP direct payments based on a system of regression equations approach as shown by Eq. (41). This approach rests upon the assumption that the parameter vectors are allowed to differ among the chosen farm size clusters, and thus allow for heterogeneous treatment effects. However, these parameter vectors are assumed to be constant over time. For an elaboration on the methodological issues in the estimation of such models, a more generalized function of Eq. (41) is formulated in the following:

$$(51)\quad \begin{aligned} y_{1it} &= \rho_{11}y_{1it-1} + \rho_{21}y_{2it-1} + \ldots + \rho_{G1}y_{Git-1} + \delta_1\Phi_{it-1} + x_{it-1}{}'\beta_1 + \alpha_i + \varepsilon_{1it}, \\ y_{2it} &= \rho_{12}y_{1it-1} + \rho_{22}y_{2it-1} + \ldots + \rho_{G2}y_{Git-1} + \delta_2\Phi_{it-1} + x_{it-1}{}'\beta_2 + \alpha_i + \varepsilon_{2it}, \\ &\vdots \\ y_{Git} &= \rho_{1G}y_{1it-1} + \rho_{2G}y_{2it-1} + \ldots + \rho_{GG}y_{Git-1} + \delta_G\Phi_{it-1} + x_{it-1}{}'\beta_G + \alpha_i + \varepsilon_{Git}, \end{aligned}$$

where $y_{git}$ is the number of farms in a certain size class $g$ $(g = 1,\ldots,G)$ observed in region $i$ at time $t$. Accordingly, $\rho_{gg}$ is a $G \times G$ matrix of coefficients to be estimated, controlling for the impact of past farm structures in terms of the initial situation on the regional land market. Let $\Phi_{it}$ be a vector of regionally disbursed subsidies, denoting the amount of policy treatment, so that $\delta_g$ indicates the marginal impact of the subsidy on farm numbers in size class $g$. Furthermore, $x_{it}$ is a vector of regional prices for agricultural inputs and outputs, whereby $\alpha_i$ controls for regional fixed effects. Let $\varepsilon_{git}$ be the unobserved component of the outcome $y_{git}$.

Two major methodological challenges arise in the estimation of Eq. (51). First, a separately estimation of the single equations leads to consistent but inefficient coefficients as the error terms $\varepsilon_{git}$ are assumed to be contemporaneously correlated. This emerges from the fact that the number of farms in the various size classes adds up to the total number of farms, and thus the single equations are almost certainly not independent from each other. Accounting for this information increases the efficiency of the estimation. Second, the endogeneity of the lagged dependent variables has to be considered.This arises from the fact that on the one hand, the number of farms in a certain size class is the outcome variable of interest. On the other hand, the respective figures lagged by one period in any of the chosen farm size clusters are included as an exogenous variable in the model.

ZELLNER (1962) proposed a seemingly unrelated regression (SUR) model to overcome the issue of contemporaneous correlation among the error terms $\varepsilon_{git}$. In theory, the SUR model is a Generalized Least Squares (GLS) estimator of the stacked model in Eq. (51), based on the covariance matrix of the error terms (See

GREENE, 2008: 254ff.). However, in practice the covariance matrix of the error terms is not known. Accordingly, ZELLNER (1962) suggested a two-stage procedure. Thereby, the residuals resulting from the OLS estimations of the single equations are used to consistently estimate the elements of the covariance matrix in the first step. In a second step, the Feasible Generalized Least Squares (FGLS) estimator is calculated by means of the *a priori* estimated covariance matrix of the error terms. Regarding the present structural model for regional farm structure, GREENE (2008: 269) argues that the SUR model can be extended to panel data applications in terms of a fixed effects model without further modification. The only shortcoming arises from the additionally estimation of $G$ parameters for $\alpha_i$.

To account for the endogeneity issue in multi-equation models, ZELLNER and THEIL (1962) developed a 3SLS estimator of a SUR system. Thereby, the first two steps of the 3SLS SUR estimator equal those of a two-stage least squares (2SLS) estimator. Accordingly, step one includes the substitution of the endogenous variables in each equation by instrumented values. These instruments can be regarded as the predicted values resulting from a regression of each endogenous variable on all exogenous variables in the system. In step two, the covariance matrix for the error terms is consistently estimated by means of the residuals from the 2SLS estimation of each structural equation. The final step of the 3SLS SUR approach is the FGLS estimation using the covariance matrix generated in step two.[34] However, the typical case of endogeneity in terms of SUR models is, if a certain regressor in one of the equations is the dependent variable of another equation or the sum of an exogenous and an endogenous variable. This does not hold true for the set of Eq. (51) at hand. In this regard, HAYASHI (2000: 279) could show that the regressors can therefore be considered as predetermined, which enables a simplification of the 3SLS model to the SUR model.

In general, the efficiency gain of the FGLS over the OLS estimator emerges from the linkage of the disturbances via the *a priori* estimated covariance matrix. However, three particular cases exist when the advantage of the SUR model is negligible compared to a separately estimation of the single equations, these are: if the equations are unrelated; if the equations have identical regressors; or if the explanatory variables in one block of equations are a subset of those in another (GREENE, 2008: 257). As a special case, in the present analysis identical regressors can be observed. Therefore, a Breusch-Pagan test of independence among the equations will be carried out to decide whether or not a SUR model approach is reasonable.

A limitation of the SUR approach is that no direct conclusions on the movement of farms between the considered size classes can be drawn. Accordingly, a further popular strand in the agricultural economics literature on structural change that explicitly allows for this issue will be discussed, namely the Markov chain analysis.

---

[34] See DAVIDSON and MACKINNON (1993: 651ff.) and GREENE (2008: 380ff.) for more details.

The main idea of this approach is the estimation of transition probabilities $p_{gg}$, regarding the movement of farms between farm type categories $g$, such as farm size classes. Thereby, the number of farms in a certain size class at any point of time $t+1$ only depends on the state $g$ at time $t$. If the Markov chain is regular, the process converges towards some steady state, which is independent of the initial farm size distribution. Following the labeling above, the Markov chain is thoroughly determined by the Markov transition matrix $P\ (G \times G)$, if the process is constant over time (cf. BICKENBACH and BODE, 2001):

$$(52)\quad P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1G} \\ p_{21} & p_{22} & \cdots & \\ \vdots & \vdots & \ddots & \\ p_{G1} & p_{G2} & \cdots & p_{GG} \end{bmatrix},\ p_{gg} \geq 0,\ \sum_{g=1}^{G} p_{gg} = 1.$$

The single transition probabilities $p_{gg}$ are generated by a maximum likelihood estimation of the following equation:

$$(53)\quad p_{gg} = \frac{m_{gg}}{\sum_{g=1}^{G} m_{gg}},$$

where $m_{gg}$ depicts the number of farms shifting between certain farm type categories $g$ during the considered period of time. In general, the Markov chain approach requires the availability of micro-data for the movements of individual farms over time, which is in many cases hard to realize. Regarding this issue, TELSER (1963) was the first to develop a model for the estimation of transition probabilities from aggregated macro data based on OLS.

So far the discussed approach can be considered as a stationary model, assuming that the transition probabilities do not change over time. This holds true if any other determinants of farm structure are also considered to be constant in the meantime, which is quite implausible in reality.[35] As a result, an econometric model, accounting for changing exogenous variables is required. Accordingly, the non-stationary transition probabilities are estimated as a function of some exogenous regressors (ZIMMERMANN et al., 2006). However, the estimation of non-stationary transition probabilities is complex given the non-negativity and steady state conditions regarding the respective values.

This results in the fact that the existing applications in the literature on structural change in agriculture reveal some shortcomings, particularly with regard to the

[35] As matter of fact, the impact of this assumption strongly depends on the considered period of time for the analysis, being of minor importance in the short-run. Furthermore, it is rather applicable for parameters like soil quality and land consolidation, but a strong assumption with regard to agricultural prices and the amount governmental support.

research question at hand. First, the implementation of policy measures in such models did not go beyond with or without treatment approaches, yet. That is to say that either a policy dummy has been included as an exogenous variable (e.g. ZEPEDA, 1995; STOKES, 2006) or the period before and after the introduction of a policy has been compared (HUETTEL and JONGENEEL, 2011). Second, to some extend *ad hoc* assumptionson the movement of farms have to be formulated to enable a regression analysis.[36] Third, most of the analyses refer only to a specific region not allowing for cross-country comparisons (e.g. ZEPEDA, 1995; STOKES, 2006).[37] Fourth, large transition probability matrices and missing data points are troublesome for the implementation of a regression analysis, leading to the so-called ill-posed problem (ZIMMERMANN et al., 2006).[38]

In view of the research question at hand and the available data to address it, it appears to be challenging to conduct a Markov chain approach. Particularly, the problem of an ill-posed analysis persists, if non-stationary transition probabilities are to be estimated. Regarding the present data panel of 69 regions, an analysis of at least three size categories plus an absorbing class (cf. ZIMMERMANN et al., 2006) will lead to 16 parameters to be estimated per region and period. Given the fact that the variation in farm numbers is already small due the regionally disaggregated level of observation a sophisticated analysis based on Markov chains appears to be not promising. Furthermore, the integration of a fixed-effects approach, accounting for latent regional factors based on dummy variables, would even impair this issue. Beyond that, the implementation of continuously disbursed pillar I payments poses further problems, which have not been addressed so far in Markov chain approaches.

Following the discussion in the present chapter, it is aimed to evaluate the impact of CAP pillar I payments on heterogeneous farms based on the SUR model. Accounting for the underlying methodological issues that are to be addressed and given the available data, this approach appears to be superior to the Markov chain model. The only limitation arises from the fact that no direct conclusions on the movement of farms between size classes can be drawn. However, the structure of the model enables the deduction of indirect correlations. A detailed model specification, the applied data, and empirical results are presented in Chapter 5.3.

---

36 See ZIMMERMANN et al. (2006: 14 ff.) for a review of Markov chain models applied in the agricultural economics literature and the imposed restrictions on farm movements.

37 The first cross-country analysis based on Markov chain models for four countries was conducted by JONGENEEL et al. (2005). Recently, HUETTEL and MARGARIAN (2009) went beyond this, analyzing 327 NUTS-3 regions in West Germany.

38 Amongst others, HUETTEL and JONGENEEL (2011) provided a remedy for these problems by aggregating the single transition probabilities into mobility indices. Furthermore, they applied a parametric model based on the generalized maximum entropy principle that has been developed by GOLAN et al. (1996) to account for the relatively large number of parameters to be estimated compared to the amount of data observed.

# 4 DATA

A key question concerning the present study was which data aggregation level to use. Regarding the aim for a sound evaluation of the CAP, including support schemes not directly linked to farms, the decision was made to use regional data at the NUTS-3 level. The regional level of NUTS-3 corresponds to the German counties and is the most disaggregated level for which the required data could be obtained. Compared to farm-individual data, for example originating from the commonly used FADN, regional data suffers from the obvious disadvantage of hiding-farm specific details and structures due to aggregation. The advantages, however, prevail given the focus of the present study. First of all, regional data represents the entire account of CAP expenditures in the observed region, not only the funds received by a sample of farms. Accordingly, problems of biased sample selection inevitably arising from an FADN dataset are avoided. Beyond this fact, FADN datasets are often lacking a sufficient coverage of the key variables. For example, SHUCKSMITH et al. (2005: 66) could only use data for agri-environmental schemes and compensatory allowance for LFA from the EU-wide analysis of FADN data. In contrast, the present study utilizes the entire set of CAP measures compiled from one consistent source, including those schemes not directly paid to farmers, such as development of rural areas and processing and marketing support. Furthermore, regional data reflects the entire population regarding the dependent parameters, like for instance the number of farms or employees in agriculture, and not just a sample of it. As a result, the regionally estimated policy effects in the present study are assumed to depict a more accurate picture of their actual impact.

## 4.1 Policy measures of the CAP

Data on CAP payments was collected from paying agencies of the Ministry of Rural Development, Environment and Consumer Protection in Brandenburg, the Saxon State Ministry of Environment and Agriculture as well as the Ministry of Agriculture and Environment in Saxony-Anhalt. This data is not publicly available and the access to it depended on the cooperation of the state ministries. Some efforts have been undertaken to make data for additional federal states available, but without success. The present analysis is therefore limited to these three states.

The delivered data from the paying agencies includes unbalanced yearly figures on the disbursed governmental support under the umbrella of the EAGGF, the

EAFRD[39] as well as direct payments for 69 counties in the Federal States of Brandenburg, Saxony, and Saxony-Anhalt. All figures are applied in real terms, using the GDP deflator for Germany and taking 2000 as a base year.[40] In case of data has been made available for a certain county and year, any single CAP measure conducted during that period of time is given in the data.[41] Accordingly, aggregates of policy measures have been defined, as a simultaneous empirical evaluation of all measures comes along with some shortcomings.[42] On the one hand, the varying implementation of the CAP measures at the level of the federal states leads to serious problems, if the analysis is to be conducted jointly for the three federal states. This issue arises from the fact that some of the instruments are not implemented across all federal states considered in the present study or vary in their specific design. Accordingly, an aggregation of the single instruments to comparable policy schemes allows for a simultaneous impact evaluation of the respective aggregates across all federal states in the dataset. On the other hand, would the high number of policy instruments cause a significant loss in degrees of freedom for the empirical analysis, and thus reduce the efficiency.

CAP payments of the first pillar have been further distinguished in coupled and decoupled direct payments. Naturally, the latter ones are particularly important in the years after 2005 when the SPS went into force. Coupled payments were additionally split into area-based payments and premiums in conjunction with animal husbandry (See Figure A-1, Figure A-2, and Figure A-3). Overall it can be seen from Figure A-1, Figure A-2, and Figure A-3 that the disbursed direct payments per county slightly increase over the period of consideration, whereby the absolute amount differs subject to the actual size of the county and its specific agricultural structure. Accordingly, large counties with a comparably strong focus on cattle production such as the Uckermark (See Figure A-1), the Altmarkkreis Salzwedel and Stendal (See Figure A-3) reveal the highest amounts of CAP pillar I payments. Contrarily, the district-free cities receive the lowest grants. A further interesting point that is apparent from Figure A-1, Figure A-2, and Figure A-3 is that the increase in CAP pillar I payments is more pronounced in counties that receive high grants in conjunction with animal husbandry such as the counties Ostprignitz-Ruppin and Prignitz.

---

39 The EAFRD displaced the EAGGF in 2007 (See: http://europa.eu/legislation_summaries/agriculture/general_framework/l60032_en.htm).

40 The GDP deflator for Germany is calculated by dividing the GDP measured in current prices by the same aggregate measured in constant prices. The deflator is provided by EUROSTAT (2011) and rescaled so that 2000=100. The values for 1994 to 2007 are shown in Table A-2.

41 About 50 different instruments have been in place between 2000 and 2006 in Brandenburg, Saxony and Saxony-Anhalt.

42 A detailed overview of the measures considered and the composite of the policy aggregates is given in Table A-3.

The second pillar instruments were aggregated according to the RDPs of the federal states in the range of Guarantee and the respective OPs regarding the Guidance measures. Three guidance schemes are distinguished: measures for the adoption and development of rural areas (See Figure A-4, Figure A-5, and Figure A-6); support of processing and marketing of agricultural produce (See Figure A-7, Figure A-8, and Figure A-9); and single farm investment aids (See Figure A-10, Figure A-11, and Figure A-12), following regulation (EC) 1257/1999. Guarantee funds are aggregated as the compensatory allowance for LFA (See Figure A-13, Figure A-14, and Figure A-15) and agri-environmental measures (See Figure A-16, Figure A-17, and Figure A-18). Some of the GAK instruments shown in Figure 1-2 are not included in the panel data set for the empirical analysis, which are: the coastal protection scheme; forestry measures; the adjustment assistance for elder agricultural employees; and the promotion of performance assessment in livestock production. These measures are either not implemented in the three federal states considered, such as the coastal protection scheme, or the regionally disbursed payments are negligible.

The disbursed payments under the umbrella of rural development at the level of the counties in Brandenburg (See Figure A-4), Saxony (See Figure A-5), and Saxony-Anhalt (See Figure A-6) reveal a high annual variation, which is due to the nature of this support scheme, focusing on single projects or project groups. It becomes further apparent from Figure A-5 and Figure A-6 that the two funding periods of the EAGGF can be clearly distinguished as a result of a significant drop of the granted support in 2000, when the second period started. As a matter of fact, the disbursed payments for the development of rural areas are negligible in the district-free cities, whereas the highest funds have been raised in large agrarian counties such as Ostprignitz-Ruppin (See Figure A-4) and Salzwedel (See Figure A-6).

As shown in Figure A-7, Figure A-8, and Figure A-9, the support of processing and marketing of agricultural produce at the level of the considered counties is generally at a comparable low level with some counties not raising any related funds in certain years. However, two interesting outliers exist. These are the County of Kamenz and the Burgenlandkreis, both revealing extraordinary high subsidies regarding this support scheme. In the case of Kamenz the disbursed payments can, with a high degree of certainty, be linked to the investment of the Theo Müller GmbH & Co. KG group in a new dairy in Leppersdorf. This venture was strongly criticized in the public press in view of its impact on the labor market and the huge amount of EU and federal support.[43] Regarding the Burgenlandkreis, the extension of the specialties cheese dairy of the Burgenlandkäserei Bad Bibra e.G.,

---

[43] See http://www.bund.net/nc/presse/pressemitteilungen/detail/archiv/2005/juli/zurueck/archiv/artikel/mueller-milch-streicht-trotz-subventionen-arbeitsplaetze-bund-fordert-strenge-umwelt-und-sozialst/.

which has been co-financed by the EAGGF, has contributed to large amounts to the observed figures.[44]

The disbursed single farm investment aids per county are shown in Figure A-10, Figure A-11, and Figure A-12. Compared to the granted support under the umbrella of rural development, the data on investment aids reveals a moderate variation over the considered period of time except for Saxony (See Figure A-11). This might be due to the fact that Saxony launched a state-specific support scheme complementary to the investment aid funded via the EAGGF. As the investment aid program is exclusively target at farms the disbursed amount clearly depends on the number of farms per region. Accordingly, the total amount varies subject to the county's size and the respective farm structure. Moreover, the figures for Saxony-Anhalt (See Figure A-12) provide evidence that the amount of support slightly decreased in the second funding period.

In view of the compensatory allowance for LFA, it is apparent from Figure A-13, Figure A-14, and Figure A-15 that some counties have not been granted support at all. This fact is due to the legislation, which indicates factors characterizing adverse natural conditions for farming that make regions eligible for the compensatory allowance. Consequently, prime locations for agriculture, mainly concerning the counties in West Saxony, the Magdeburger Börde region, and South Saxony-Anhalt, receive no LFA payments. In contrast, any county in Brandenburg is compensated through this support scheme.

As Figure A-16, Figure A-17, and Figure A-18 show, there is a significant difference regarding the total amount and annual variation of agri-environmental payments at the level of the counties subject to the federal state considered. Particularly in Saxony, where an agri-environmental support scheme has been implemented that is almost completely detached from the GAK, the figures strongly vary between the years observed (See Figure A-17). In addition, Saxony spent the highest amount of payments related to agri-environmental measures on average. From the data in Figure A-16, it is apparent that Brandenburg also has a strong focus on agri-environmental measures. Compared to Saxony-Anhalt (See Figure A-18) the total amount of grants is significantly higher. This arises from the fact that Brandenburg reveals a high proportion of organic farms. Furthermore, the climate and soil conditions favor extensive production methods, where as Saxony-Anhalt is characterized by intensive agricultural production.

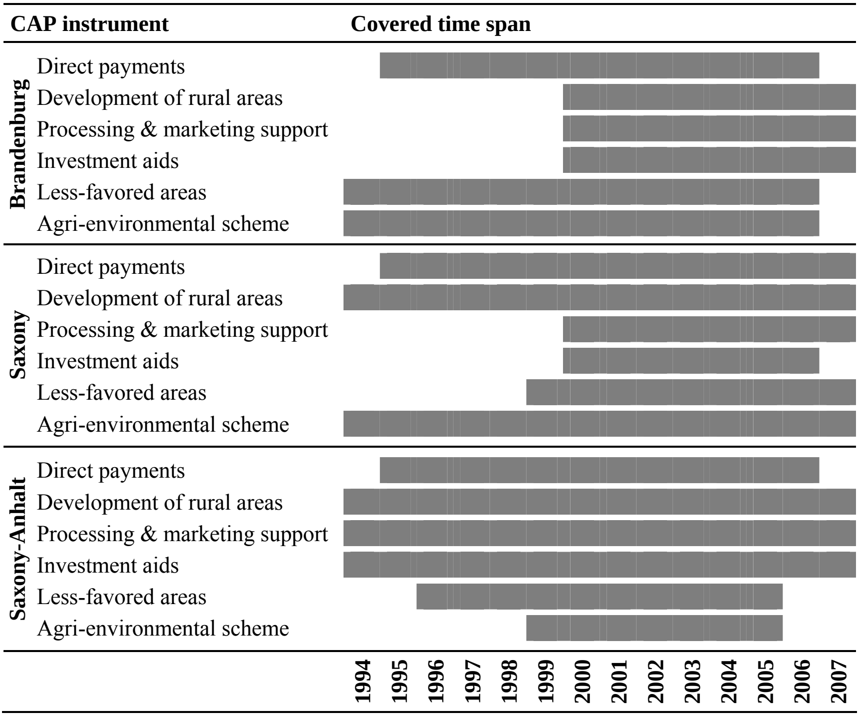
Figure 4-1 summarizes the time coverage of the aggregated policy measures as made available by the paying agencies of the respective ministries. It can be seen that the best data availability could be achieved for figures on CAP pillar I payments, covering the time span from 1995 to 2006 for Brandenburg and Saxony-Anhalt as well as up to 2007 for Saxony. Within the range of the EAGGF and EAFRD data

---

44 See http://www.sachsen-anhalt.de/index.php?id=31614.

availability varies between the federal states and policy aggregates. In Brandenburg data on EAGGF-Guidance measures, namely development of rural areas, processing and marketing, and investment aids are available from 2000 to 2007. Policy aggregates under the umbrella of the EAGGF-Guarantee, which are the compensatory allowance for LFA and agri-environmental measures, are on hand from 1994 to 2006. In Saxony, figures on measures for the development of rural areas and the agri-environmental scheme are available from 1994 to 2007. Data on the compensatory allowance for LFA covers the time span from 1999 to 2007. Payments for the support to processing and marketing of agricultural produce and investment aids in Saxony are available as of 2000, whereas the latter are only available up to 2006. The Ministry of Agriculture and Environment in Saxony-Anhalt provided a comprehensive dataset on EAGGF-Guidance measures comprising the time span from 1994 to 2007. Furthermore, figures on the compensatory allowance for LFA and agri-environmental measures are available as of 1996 and 1999, respectively. Payments for both support schemes are, however, only on hand up to 2005. Accordingly, a sound evaluation of the CAP measures will be restricted to the periods from 1999 to 2005 in Saxony-Anhalt and 2000 to 2006 in Brandenburg and Saxony.

**Figure 4-1: Time coverage of the data on CAP instruments**

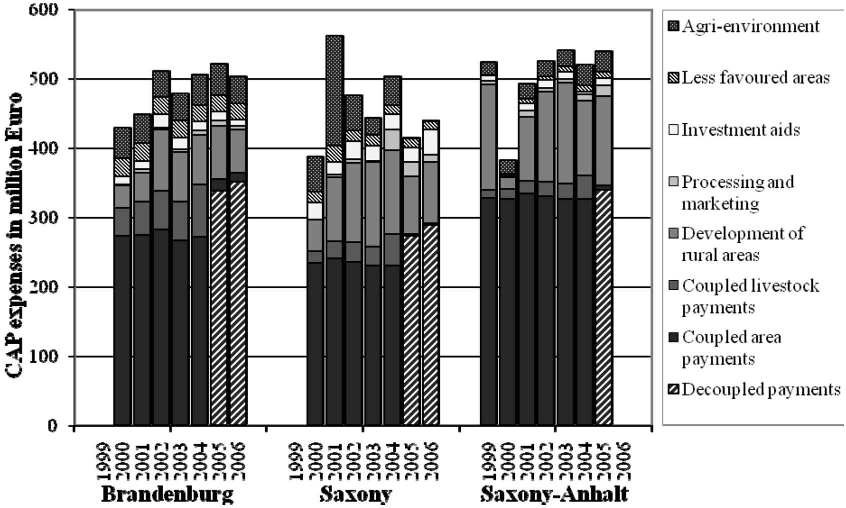



Source: Author's depiction.

Figure 4-2 depicts the aggregated amount of payments disbursed per year in the three East German Federal States of Brandenburg, Saxony and Saxony-Anhalt. As already mentioned above only those years where all support schemes are available for each federal state are presented to provide comparable figures. Consequently, the utilized dataset accounting for the complete range of CAP measures comprises the years from 1999 to 2005 for Saxony-Anhalt and 2000 to 2006 for Brandenburg and Saxony.

It can be seen from Figure 4-2 that about two thirds of the CAP budget in the study region is allocated to direct payments. Between 2000 and 2006 more than 900 million Euros of direct payments per year were paid to farmers in Brandenburg, Saxony, and Saxony-Anhalt. Comparably to the situation in the total East German agricultural sector (See Figure 1-1), the three federal states considered reveal steadily increasing amounts of CAP pillar I support during the observed period. This fact follows from raising subsidies in the range of cattle husbandry and a gradual level increase in area payments, particularly in consequence of the implementation of the SPS in 2005 (EC, 2008b). The remaining third of the CAP budget is granted to the second pillar measures according to the RDR.

**Figure 4-2: CAP expenses and main policy aggregates in the research region, 1999-2006**




Source: Authors' calculations based on unpublished data of State paying agencies.

Table 4-1 summarizes the region-specific mix of CAP pillar II measures as implemented by the Federal States of Brandenburg, Saxony, and Saxony-Anhalt. The distribution of second pillar payments aggregated from county-level data is generally comparable to the figures of East Germany in total as shown in Figure 1-2. However, it becomes apparent from Table 4-1 that the three federal states considered placed different emphasis on the various instruments. In Saxony-Anhalt measures under the umbrella of rural development appeared to be of major importance. The average annual expenses accounted for nearly 70 % of the total CAP pillar II budget compared to less than 50 % in Brandenburg and Saxony. On the other hand, Brandenburg and Saxony placed higher emphasis on the single farm investment aid program. In relative terms, both states allocated about twice as much of their CAP pillar II budget in the respective measures in comparison with Saxony-Anhalt. The share is particularly high in Saxony, accounting for 11.2 % on average per year. This fact is partly due to a state-specific investment aid program that Saxony conducted complementary to the investment aid scheme of the GAK. The share of support granted for the improvement of processing and marketing structures is comparable across the federal states considered in the data set at hand, varying between 3.0 % and 5.2 %. In view of the compensatory allowance for LFA, disbursed payments clearly depend on the natural conditions for farming in the respective regions. Consequently, the share in total pillar II budget disbursed per federal state and year is the smallest in Saxony-Anhalt accounting for 5.3 % followed by Saxony with 8.1 %. Brandenburg allocated by far the highest share of second pillar funds for compensation payments subject to LFA, amounting to 16.4 %. With regard to the agri-environmental measures, Brandenburg and Saxony spent approximately 28 % of their average annual CAP pillar II budget, indicating a high relevance of the respective instruments. Accounting for 16.4 % on average, Saxony-Anhalt disbursed the smallest share of annual available second pillar funds to agri-environmental measures across the federal states considered.

**Table 4-1: Average annual expenses of CAP pillar II measures in the research region, 2000-2005**

| | Unit | Development of rural areas | Processing and marketing | Investment aids | LFA | Agri-environment | CAP pillar II in total |
|---|---|---|---|---|---|---|---|
| Brandenburg | million € | 64.2 | 4.5 | 14.5 | 24.6 | 41.9 | 149.8 |
| | % | 42.9 | 3.0 | 9.7 | 16.4 | 28.0 | 100.0 |
| Saxony | million € | 96.3 | 10.4 | 22.3 | 16.2 | 54.8 | 200.0 |
| | % | 48.1 | 5.2 | 11.2 | 8.1 | 27.4 | 100.0 |
| Saxony-Anhalt | million € | 103.9 | 7.8 | 8.0 | 6.2 | 24.7 | 150.7 |
| | % | 68.9 | 5.2 | 5.3 | 4.1 | 16.4 | 100.0 |

Source: Author's calculations based on unpublished data of State paying agencies.
Note: Yearly averages from 2000 to 2005.

## 4.2 Regional data on agricultural structure

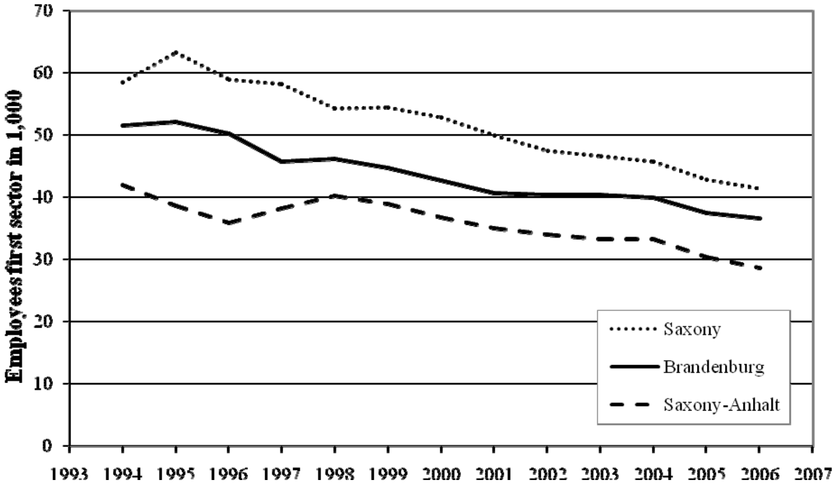
Regarding the impact assessment of CAP payments on East German agriculture, the particular focus of the present study lies on agricultural employment and farm structure. Regional figures on agricultural employment where collected from the series "Volkswirtschaftliche Gesamtrechnung der Länder" (VGRdL) published by the statistical offices of the federal states (SÄBL). Based on this data a panel data set for 69 counties in Brandenburg, Saxony and Saxony-Anhalt has been created including figures on employment in the first sector from 1994 to 2006.[45] Figure A-19, Figure A-20, and Figure A-21 show the development of agricultural employment at the county-level over the period under consideration.

[45] The first sector of the national accounts includes agriculture, forestry and fishery. As the two latter are of minor importance for the three federal states considered here, the first sector is assumed to represent agricultural employment.

These figures suggest that agricultural labor force decreased since the end of the 1990s across all counties. However, this process is differently pronounced. Whereas in Saxony (See Figure A-20) the figures appear to decrease moderately, except for the Weißeritzkreis, the data for Brandenburg depicts a considerable drop in agricultural labor force in many of the regions. The figures regarding the development of agricultural labor force in Saxony-Anhalt (See Figure A-21) reveal a comparable trend to those of Saxony. Interestingly, the County of Mansfelder Land shows a remarkable increase in agricultural employment in the recent years. Furthermore, some counties depict at least a relatively stable development compared to the otherwise decreasing numbers on employment. Examples are the Counties of: Potsdam-Mittelmark, Bautzen, Döbeln, Leipziger Land, Stollberg, Torgau-Oschatz, Zwickauer-Land, Bördekreis, Halberstadt, Jerichower Land, Ohrekreis, Schönebeck, and Saalkreis. These counties, including the Mansfelder Land, are characterized by favorable conditions for an intensive agricultural production in terms of land consolidation and soil quality.

Figure 4-3 provides an aggregated picture of the county-level data. From this follows that the number of persons employed in agriculture significantly dropped since the mid-1990s. In 2006, slightly more than 100 thousand people remained employed in the agricultural sector of Brandenburg, Saxony, and Saxony-Anhalt compared to approximately 150 thousand ten years earlier. The observed trend concerning this matter reveals a similar pattern across the federal states considered. The absolute values, however, differ subject to the actual size of the federal state and its vital branches of production. Consequently, Saxony exhibits the highest number of employees in agriculture due to a stronger orientation towards intensive livestock production, although being the smallest federal state of the three considered. On the other hand, Saxony-Anhalt, which is characterized by capital intensive crop production, reveals the lowest amount of agricultural labor.

**Figure 4-3: Agricultural employment in the research region, 1994-2006**




Source: Author's calculations based on SÄBL (2010a)

However, Figure 4-3 suggests that much information is hidden due to aggregation compared to the figures at the county-level (See Figure A-19, Figure A-20, and Figure A-21). The following empirical analysis will show whether some of the specifics in the development of agricultural employment, as described above, can be linked to the disbursed CAP subsidies per county.

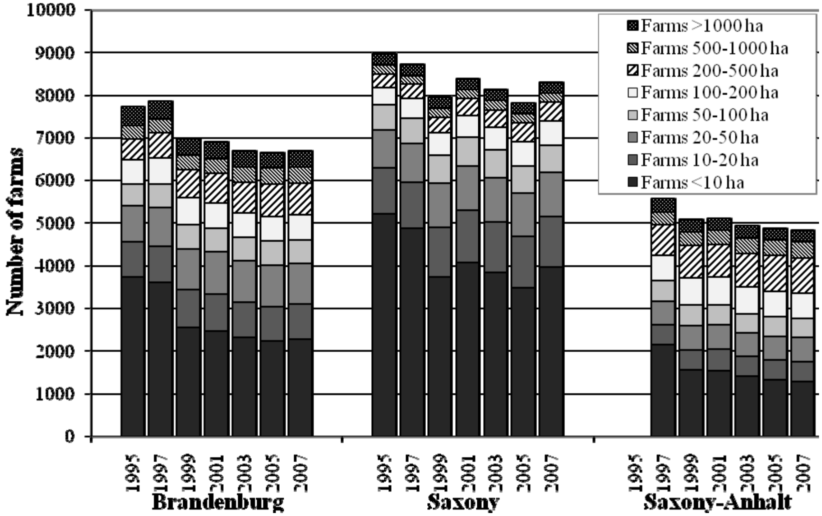
Besides the figures on agricultural employment, detailed data on farm numbers with a particular focus on the regional farm size distribution is required for the present analysis. With regard to the official statistics provided by SÄBL, two short-comings emerge. First, the respective data is only available on a biannual basis. Second, the officially published distribution of farm size classes at the NUTS-3 level is inapplicable for the East German agricultural structures, given the fact that the largest farm size cluster indicated are farms operating more than 50 ha. Whereas the issue of biannual data could not be circumvented, the statistical offices of Brandenburg, Saxony and Saxony-Anhalt have been successfully contacted for more detailed data on regional farm structures to overcome the latter problem. Based on the provided data, it was possible to generate a data panel on the regional distribution of farms in the considered states according to the following eight size classes: farms smaller 10 ha; farms operating from 10 to less than 20 ha; farms operating from 20 to less than 50 ha; farms operating from 50 to less than 100 ha; farms operating from 100 to less than 200 ha; farms operating from 200 to less than 500 ha; farms operating from 500 to less than

1,000 ha; and very large farms operating equal to or more than 1,000 ha.[46] Biannual data for Brandenburg and Saxony has been provided from 1995 to 2007. The data for Saxony-Anhalt starts as of 1997.

Figure 4-4 depicts the development of total farm numbers and the variation in the distribution of farm size classes at the level of the federal states considered from 1995 to 2007. It can be seen that the general trend follows the pattern of farm structure development for the entire area of the former GDR as shown in Figure 1-4. However, some differences between the Federal States of Brandenburg, Saxony, and Saxony-Anhalt can be observed. Whereas, total farm numbers in Brandenburg and Saxony-Anhalt slightly and consistently decreased after a peak in 1997, the development in Saxony reveals more variation. Furthermore, Figure 4-4 suggests that the total number of farms is strongly determined by changes in the number of farms smaller ten hectares. This fact is not astonishing as the respective size class comprises one third of all farms in the research region. Comparably to the entire area of East Germany, farms operating between 200 and 1,000 hectares gain in relevance over the period under consideration, particularly in Brandenburg and Saxony-Anhalt.

[46] Data on farms smaller than ten hectares has been made available at an even more disaggregated level. However, it is not shown here for reasons of clarity.

**Figure 4-4: Total number of farms and distribution of farm size classes in the research region, 1995-2007**




Source: Author's calculations based on unpublished data collected from the statistical offices of Brandenburg, Saxony and Saxony-Anhalt.

Note: Yearly averages from 2000 to 2005.

For the empirical analysis in the remainder of this dissertation the farm size clusters as shown above have been further aggregated to ensure a sufficient variation in the county-level data. Therefore, four size classes have been determined: very small farms in the East German context, operating less than 10 ha; small farms, operating 10 to less than 200 ha; medium-sized farms, operating 200 to less than 1,000 ha; and large farms that cultivate equal to or more than 1,000 ha of arable land. These size classes have been chosen for two reasons. On the one hand, farm size clusters, which reveal a similar development of farm numbers over the considered period of time, have been merged. On the other hand, the four determined size classes represent farms, which reveal a similar equipment with equity per hectare of farmland (See Figure 1-6), and thus a comparable level of budgetary restrictions.

The development of farm numbers in the size class of very small farms at the county-level is shown in Figure A-22, Figure A-23, and Figure A-24. The figures indicate that the respective farm numbers slightly decreased from 1997 to 2007, whereas this trend appears to be more pronounced in the counties of Brandenburg (See Figure A-22). Interestingly, in some counties the number of very small farms moderately increases again in 2007, which is particularly the case for Brandenburg (See Figure A-22) and Saxony (See Figure A-23). Besides the fact that the total number of farms in this size class is the smallest for Saxony-Anhalt, the variation in the figures is also comparably low (See Figure A-24).

Regarding the number of farms operating 10 to less than 200 ha shown in Figure A-25, Figure A-26, and Figure A-27 it can be seen that development over time is relatively stable with only little variation. However, in some regions a slight increase in farm numbers can be observed, for example in the counties: Freiberg, Muldentalkreis, and Torgau-Oschatz, which are all located in Saxony. In contrast, farm numbers in the size class of small farms moderately decreased until 2007 in the counties: Havelland, Prignitz, Uckermark, and Altmarkkreis Salzwedel.

Figure A-28, Figure A-29, and Figure A-30 provide evidence for generally increasing farm numbers in the medium-sized farm cluster. Particularly in Brandenburg, the number of farms in this size class increased over the considered period of time, except for the County of Spreewald-Neiße, where the number at least remained relatively stable (See Figure A-28). The figures for Saxony-Anhalt vary between stable and slightly increasing number of farms operating from 200 to 1,000 ha, whereas the County of Stendal reveals a remarkable strong increase in farm numbers (See Figure A-29). Compared to the considered counties in Brandenburg and Saxony-Anhalt, the figures for Saxony are rather constant except for the County of Torgau-Oschatz, where the number of medium-sized farms significantly increased up to 2007. Furthermore, the total number of farms in this size class is comparably small in Saxony (See Figure A-30).

In view of the large farms, cultivating 1,000 ha and more of farmland, constant or slightly decreasing farm numbers can be observed (See Figure A-31, Figure A-32, and Figure A-33). Moreover, the figures suggest that large-scale farm structures are more pronounced in Brandenburg and Saxony-Anhalt given the total number of farms in this farm size cluster per county. However, the number of large farms developed relatively stable in Saxony, though at a lower level (See Figure A-32). Particularly in Brandenburg, farm numbers in this size class significantly dropped in some counties, such as Märkisch-Oderland and Potsdam-Mittelmark (See Figure A-31).

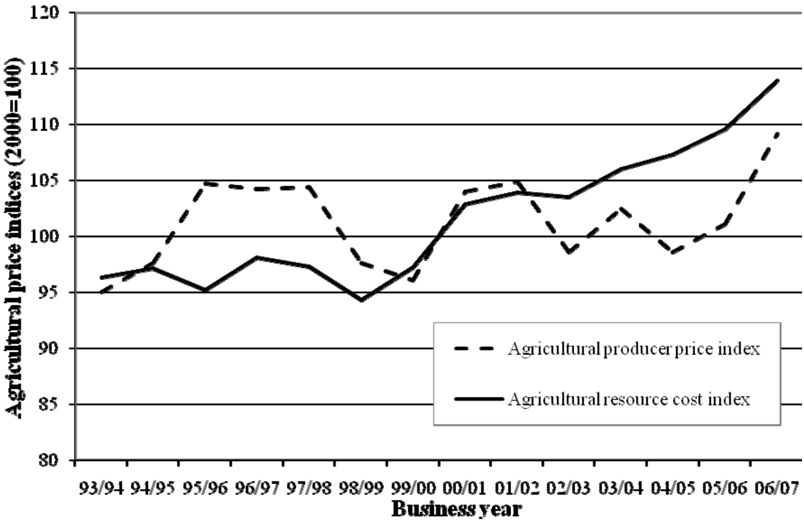
It can be concluded from the detailed figures on farm structure at the county-level that, particularly the cluster of medium-sized farms gained importance in East German agriculture from 1997 to 2007. As already mentioned above, this fact is quite astonishing as the respective group of farms appears to be less equipped with equity (See Figure 1-6), resulting in comparative disadvantages on the factor market. Therefore, the resulting question is, whether the disbursed CAP pillar I support had the potential to boost factor demand for this group of farms, and thus led to the observed development of farm numbers. This issue and the role of past regional farm structures will be empirically investigated in Chapter 5.3 of the present dissertation.

## 4.3 Agricultural prices and further regional determinants

Besides figures on policy measures of the EU's CAP some further regional determinants potentially influencing the development of agricultural structures are required for a sound impact analysis. Following the theoretical framework discussed in Chapter 1 and the identified econometric models for an ex-post policy evaluation at the regional level in Chapter 3, the particular focus lies on determinants that vary over time and between the regions. Accordingly, it was aspired to augment the given data panel by agricultural factor and output prices as well as determinants that represent the regional labor market.

Figures on agricultural prices have been collected from the statistical yearbooks of the BMELV (various years b). This source provides annual data on agricultural producer price and resource cost indices for whole Germany on the level of the single inputs and agricultural products. In the present study the aggregated agricultural producer price and resource cost indices are applied. A further distinction on the NUTS-3 level was not possible. Accordingly, it is assumed that agricultural prices do not vary across regions on average. Figure 4-5 provides evidence that farmers in East Germany face steadily increasing resource costs since the mid-1990s. Regarding the prices for agricultural produce the picture is ambiguous, resulting in no clear trend over the period of consideration.

**Figure 4-5: Agricultural producer price and resource cost indices, Germany, 1993/94-2006/07**




Source: Author's calculations based on BMELV (various years b).

In addition to data on agricultural prices, regional figures on the average annual compensation per employee (See Figure A-34, Figure A-35, and Figure A-36) and the population density (See Figure A-37, Figure A-38, and Figure A-39) at the level of the counties were collected to augment the panel data set at hand by factors that determine the regional labor market. The former is chosen instead of gross wages as it includes all monetary transfers to the employee, including the employers' social contributions (cf. SÄBL, 2010b). It can be seen from Figure A-34, Figure A-35, and Figure A-36 that the total amount of compensation per employee is comparable across the counties considered in the present study, whereas a slight increase can be observed. As a matter of fact, the population density in the district-free cities considered is significantly higher compared to the counties and reveals stronger dynamics (See Figure A-37, Figure A-38, and Figure A-39).

The following analyses of CAP impacts on labor demand and structural change in East German agriculture will access the panel data set presented in this section. Due to missing values, the actual sample size applied to the respective analyses will differ with respect to the period under consideration and the frequency of data availability. A detailed explanation of the utilized dataset will be presented in conjunction with any analysis.

# 5 EMPIRICAL RESULTS ON CAP IMPACTS IN EAST GERMAN AGRICULTURE

The following chapter presents the results of the empirical evaluation of CAP impacts on agricultural labor demand and farm structure in the three East German Federal States of Brandenburg, Saxony, and Saxony-Anhalt. Each section in this chapter consists of a definition of the utilized data from the data panel described in the previous chapter, including the specification of the econometric model in line with the theoretical considerations presented in Chapter 1. The results are derived from the application of the methods discussed in Chapter 3.

The structure of this chapter reflects the discussion of the empirical approach in Chapter 3. Accordingly, Chapter 5.1 presents an empirically motivated treatment effect model for labor demand (See Chapter 3.1), which neglects the occurrence of certain costs in conjunction with labor adjustment. As an extension to this approach, the results of an stronger theoretically motivated adjustment costs model for labor demand (See Chapter 3.2.1) are given in Chapter 5.2. Chapter 5.3 switches the issue to the impact of CAP pillar I payments on farm structure and presents the results of the structural econometric model for regional farm structure discussed in Chapter 3.2.2.

## 5.1 A difference-in-differences approach to labor demand in East German agriculture[47]

In this section a difference-in-differences panel data estimator is applied to analyze the employment effects of the entire portfolio of CAP measures in East German agriculture simultaneously. Thereby, the territorial approach of the present dissertation allows for an inclusion of policies not directly related to individual farms, such as support to processing and marketing or development of rural areas. Controlling for latent regional and time effects enables the identification of net policy impacts by exploiting the variation within counties across years. Along with the results of the difference-in-differences model, the coefficient estimates of a "naïve" OLS regression will be presented to illustrate advantageous properties of the difference-in-differences approach.

### 5.1.1 Data and model specification

The regional data panel illustrated in Chapter 4 is accessed for the present analysis. To allow for the entire portfolio of CAP instruments, the applied sample actually comprises the years from 2000 to 2006 for Brandenburg and Saxony as well as

---

[47] The results of this section are based on PETRICK and ZIER (2011b).

from 1999 to 2005 for Saxony-Anhalt (See Figure 4-1). Consequently, seven years of observation are available ($T = 7$) for each of the 69 counties, resulting in a total number of 483 observations.

In the following analysis direct payments of the CAP's first pillar are further distinguished in coupled and decoupled grants. Naturally, the latter ones are particularly important in the years after 2005. Coupled payments were split into area-based and headage-based grants. Furthermore, a dummy variable taking the value of one for the years 2005 and 2006 and zero otherwise is included in the regression analysis. By this variable, it is expected to isolate the structural effects of decoupling that cannot be captured by a mere increase of transfers alone as measured by the monetary value of decoupled direct payments. In line with the difference-in-differences approach deduced in Chapter 3.1, separate annual dummy variables for the years 2000 to 2004 were also included.

Two sets of variables that plausibly do vary across regions and in time are the prices of land and labor as well as the local demographic structure.[48] Land and labor markets are typically local because of the inherent immobility of these factors. Therefore it is attempted to include county data on land prices and compensation per employees into the applied regression analysis. Unfortunately, it was impossible to obtain land price data with sufficient coverage.[49] Accordingly, only results for the compensation per employee variable are presented. In addition, net migration out of rural areas has been particularly strong in the age class between 18 and 29 years and may have led to local shortages of labor (UHLIG, 2008).[50] It also may have wider implications in terms of public goods provision by the government. Consequently, these trends are captured by also including data on regional population density.

The dependent variable for the regression analysis is the number of employees in agriculture taken from the VGRdL (SÄBL, 2010a). From another series of the same source (SÄBL, 2010b) average yearly compensations per employee were collected. Figures on the regional population density were taken from Genesis online database (SÄBL, 2011). Table 5-1 displays some descriptive statistics.

---

48 Agricultural output prices and resource costs are assumed to be time-variant, but constant across regions. Their impact on agricultural employment is thus captured in the time dummies.

49 The statistical offices of the federal states have been inquired for the respective data at the NUTS-3 level. However, no annual data could be made available for the considered period of time. Saxony provided the most comprehensive data set, covering biannual data on agricultural land rents at the county-level, whereas disaggregated data for Brandenburg and Saxony-Anhalt was only available for 1999.

50 Migration and commuting behavior of the rural population in East Germany thus counteracted the local fragmentation of labor markets. However, important differences in wage levels remain, as the further analysis shows.

**Table 5-1: Descriptive statistics of the data panel for static labor demand**

| | | Mean | Std. Dev. | Min | Max | Obs. |
|---|---|---|---|---|---|---|
| Employees in agriculture | Persons | 1,754.30 | 972.68 | 109 | 4,962 | 483 |
| Coupled area payments | Million € | 9.43 | 9.22 | 0.00 | 39.88 | 483 |
| Coupled livestock payments | Million € | 1.12 | 1.60 | 0.00 | 10.52 | 483 |
| Decoupled direct payments | Million € | 3.30 | 7.79 | 0.00 | 46.85 | 483 |
| Development of rural areas | Million € | 4.00 | 3.24 | 0.00 | 22.30 | 531 |
| Processing and marketing aid | Million € | 0.31 | 1.46 | -0.74[a] | 23.19 | 531 |
| Investment aid | Million € | 0.67 | 0.73 | 0.00 | 4.05 | 531 |
| Compensatory allowance for LFA | Million € | 0.66 | 0.81 | 0.00 | 3.35 | 483 |
| Agri-environmental measures | Million € | 1.63 | 1.88 | 0.00 | 11.74 | 483 |
| Population density | Persons/km² | 288.18 | 380.90 | 41.36 | 1,912.12 | 483 |
| Annual compensation per employee | Thousand € | 24.62 | 1.40 | 21.21 | 29.15 | 483 |

Source: Author's calculations.

Note: [a] There was occasional overpayment in some regions, which led to negative expenses in subsequent years. All monetary values expressed in real terms, using the GDP deflator for Germany.

A question that arises with regard to policy measures that are aiming at long-term changes in factor allocation, such as development of rural areas and investment subsidies, is whether their impact is temporary or permanent. Furthermore, because adjustment to long-term changes may take time, effects of these policies may occur not instantaneously but only with a time lag. This question is treated rather lightly in the evaluation literature focusing on labor market outcomes. However, it can relatively easily be addressed in the model for labor demand used here (See Eq. (28)) by including lags of $\Phi_{it}$ into the model and testing their significance empirically. If a payment made at time $t$ creates permanent employment effects in periods $t$, $t+1$, …, $t+s$, a significant effect should show up in each of the parameters of $\Phi_{it}$ to $\Phi_{it-s}$. Alternative ways to estimate the dynamics of labor demand based on Eq. (27) are discussed in Chapter 3.2.1 and empirically tested in Chapter 5.2.

### 5.1.2 Estimation results and discussion

In the following, results for three different specifications of Eq. (28) are reported: a "naïve" regression approach based on Eq. (43) using pooled data (denoted model (A)) and two versions of the difference-in-differences model stated in Eq. (45).[51] Regarding the latter, a static version is presented, which only allows instantaneous policy effects (denoted model (B)) and a dynamic version that also includes lags of the measures on the development of rural areas, processing and marketing support, as well as investment aids (denoted model (C)). As each lag reduces the number of observations available for the estimation in the relatively short panel

[51] Estimations were carried out by using the routines reg and xtreg implemented in Stata 12.

that is available for the analysis, the number of lags is limited to two.[52] All reported standard errors are robust to serial correlation within groups.

For illustrative purposes, the impact evaluation of CAP payments on labor demand is started with an analysis of the "naïve", pooled OLS model without fixed effects. In this model (A), coefficients are highly significant and positive for coupled area payments, decoupled direct payments, investment aids, payments for LFA, and agri-environmental measures (Table 5-2). Accordingly, these results provide evidence that payments under the CAP mostly go into regions where many people are employed in agriculture. As such, these figures show interesting correlations. However, they are not useful for analyzing policy impacts, as regional heterogeneity in the size and structure of the agricultural sector as well as annually varying determinants, such as agricultural prices, are not included in the model.

[52] Lagged values of the respective policy instruments for the years 1997 and 1998 were available, and thus included for the 24 counties in Saxony-Anhalt.

## Table 5-2: Regression estimates: CAP impacts on employment in agriculture

| Explanatory variables | pooled OLS model (A) | | d-i-d model (B) | | d-i-d model with lagged effects (C) | |
|---|---|---|---|---|---|---|
| Coupled area payments | 51.262 | *** | -33.256 | ** | -34.051 | ** |
| | (4.897) | | (13.288) | | (13.974) | |
| Coupled animal payments | 38.346 | | -43.438 | * | -43.167 | * |
| | (28.438) | | (22.371) | | (22.934) | |
| Decoupled direct payments | 43.497 | *** | -36.972 | *** | -37.787 | ** |
| | (5.111) | | (14.035) | | (15.282) | |
| Development of rural areas | 7.639 | | 2.388 | | 5.121 | |
| | (10.334) | | (3.797) | | (4.771) | |
| Lag 1 | – | | – | | -7.643 | * |
| | | | | | (4.397) | |
| Lag 2 | – | | – | | -7.725 | |
| | | | | | (5.689) | |
| Processing and marketing | 10.002 | | -11.166 | *** | -6.718 | * |
| | (14.283) | | (3.993) | | (3.431) | |
| Lag 1 | – | | – | | -1.900 | |
| | | | | | (3.465) | |
| Lag 2 | – | | – | | -4.170 | * |
| | | | | | (2.306) | |
| Investment aid | 285.093 | *** | 13.599 | | 15.236 | |
| | (38.196) | | (11.218) | | (15.428) | |
| Lag 1 | – | | – | | 20.482 | |
| | | | | | (14.753) | |
| Lag 2 | – | | – | | 15.844 | |
| | | | | | (15.117) | |
| Compensatory allowance | 279.665 | *** | 8.662 | | -38.856 | |
| for LFA | (44.650) | | (109.982) | | (148.551) | |
| Agri-environmental measures | 71.281 | *** | 13.723 | | 14.445 | * |
| | (16.129) | | (8.413) | | (8.600) | |
| Decoupling (2005/06 = 1) | -202.971 | | -280.836 | *** | -229.054 | ** |
| | (133.153) | | (90.538) | | (114.025) | |
| Population density | 0.024 | | -1.103 | | -0.461 | |
| | (0.080) | | (0.866) | | (0.997) | |
| Average annual compensation | 11.705 | | -96.452 | ** | -95.271 | ** |
| per employee | (18.349) | | (39.340) | | (46.865) | |
| Year = 2000 | 94.159 | | -12.176 | | 10.423 | |
| | (123.868) | | (60.828) | | (54.490) | |
| Year = 2001 | -209.154 | * | -110.152 | * | -75.061 | |
| | (122.956) | | (62.909) | | (55.623) | |
| Year = 2002 | -190.980 | | -146.798 | ** | -137.571 | |
| | (116.724) | | (67.557) | | (90.756) | |
| Year = 2003 | -152.364 | | -171.432 | ** | -136.860 | |
| | (116.450) | | (76.719) | | (100.325) | |
| Year = 2004 | -181.326 | | -163.516 | * | -119.274 | |
| | (121.391) | | (91.452) | | (114.027) | |
| $R^2$ | 0.774 | | 0.464 | | 0.430 | |
| N | 483 | | 483 | | 393 | |

Source: Author's calculations.

Notes: *** (**,*): significant at the 1 % (5 %, 10 %) level. All models also include a constant. Standard errors in parentheses are robust to serial correlation within groups.

Model (B) removes group means, and thus controls observed and unobserved heterogeneity. As detailed in Chapter 3.1, this model can much more credibly be used for policy impact analysis, and indeed the picture changes completely. The coefficients of all the direct payments as well as support of processing and marketing change into highly significant, negative effects. The impacts of compensatory allowance and investment aid disappear. The *p*-value of the agri-environmental measures rises to 0.11 (not shown in Table 5-2). Furthermore, an expected negative sign on the general wage level can be found. At the same time, a drop in $R^2$ is observed, which measures the explanatory power of the group deviations ("$R^2$ within") in models (B) and (C). As some variation is removed by group wise demeaning, this is not surprising.

A further interesting result is that subsidies for investment in processing and marketing now have a significantly negative effect on employment. These subsidies primarily increased the capital intensity in the downstream sector, for example by supporting investment in egg and fruit handling and processing. It seems plausible that these investments were mainly made in labor saving technologies, and thus led to employment losses.

Model (C) allows the analysis of lagged effects due to the measures that aim at long-term structural changes. With regard to processing and marketing aids, the effect seems indeed to be of a lasting nature, as the two-years lag turns out to be significant. According to these estimates, a million euro spent in processing and marketing aids costs about seven jobs in the short run and an additional five jobs in the longer run. Furthermore, in contrast to the zero contemporaneous effect, measures aimed at the development of rural areas also reduced agricultural employment if a one-year lag is allowed. Better infrastructure in rural areas hence appears to accelerate labor cuts in agriculture. No effects could be isolated for the investment aids directly geared to farms. Given the significance of these lagged parameters, model (C) seems the most appropriate specification in the present case.

In addition, agri-environmental measures again have a positive sign which is significant at the 10 %-level. The share of this measure in the total CAP budget of the federal states varies between 5 and 15 %. Agri-environmental payments in the federal states studied here were particularly increasing in the support of conversion to organic farming. These results are consistent with the view that labor intensity increased in regions where payments stimulated organic farming, which is also in line with the findings of PUFAHL and WEISS (2009) and OLPER et al. (2011). According to the estimate in model (C), transfers of on average € 69 thousand annually are necessary to create one full-time job by agri-environmental support.[53]

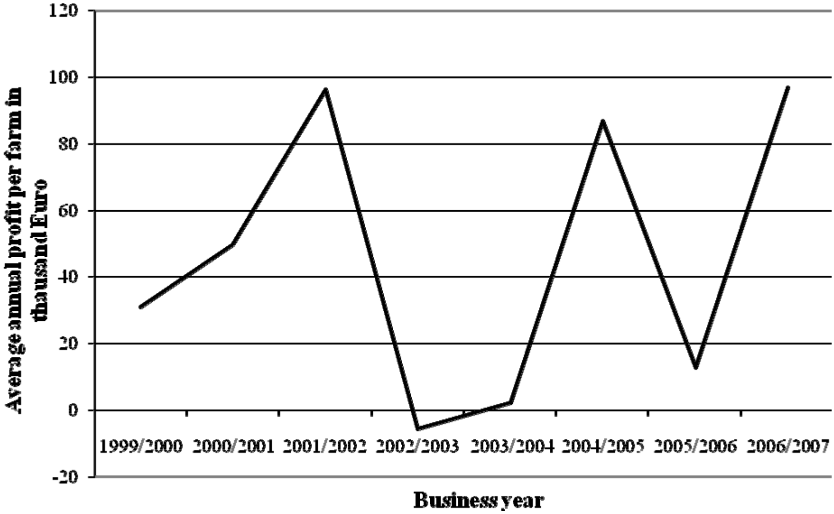
[53] One additional million euro create 14.45 jobs, so that 69.2 = 1000/14.45 thousand € are necessary for one additional job.

This magnitude is considerably higher than the average annual compensation per employee of € 25 thousand (Table 5-1).

Both models (B) and (C) provide evidence in favor of a significantly negative effect of decoupling on farm employment. A plausible explanation is as follows: while the stepwise decoupling led to higher area payments, it also induced shedding of excess labor, as payments were made increasingly independent of the level of production. This applies to both crop and livestock production. Farms could reduce labor input (and hence output) without risking the loss of transfer payments.

The results presented in Table 5-2 suggest that there are two effects of this policy reform. One is a general effect occurring in the years after SPS introduction, as measured by the indicator variable "decoupling". This variable allows a shift in employment for observations in 2005 and 2006. The other is tied to the increase of payments, which occurred simultaneously. To what extent the effect of the former can indeed be linked to decoupling depends on the potential relevance of other macro shocks that occurred in the same period. Figure 5-1 shows the profit situation of farms operated as corporate entities in Eastern Germany based on farm accountancy data, hence the situation of typical large farms in this region. Generally, profits were quite volatile, so that no obvious relationship to the constant decrease in labor use as shown in Figure 4-3 can be established. According to Figure 5-1, there was a downward spike in 2005, whereas profits recovered notably in 2006. Insofar, it cannot be ruled out that labor releases in 2005 were partly fuelled by worsening economic conditions. However, splitting the "decoupling" variable into two year dummies also produces two highly significant, negative parameters. These are -223.96 for 2005, significant at 10 %, and -250.59 for 2006, significant at 5 % in model (C). Note that no significant annual macro effects are present in model (C) for any other year. It seems therefore likely that decoupling as such had an important effect.

**Figure 5-1: Average annual profit of farms operated as legal entities, East Germany, 1999/2000-2006/2007**




Source: BMELV (2010a).

Note: Mean profit in this period: € 46.31 thousand per farm. Accounting years run from July 1 to June 30.

Whether decoupling is also responsible for the negative signs on the level of payments cannot be ultimately resolved here. As can be seen from Figure 4-2, direct payments constantly increased over the observed period. At the same time, price support was reduced. This gradual decoupling effect may have led to the release of labor no longer necessary for maintaining production levels. However, liquidity injections due to direct payments may also have altered the input mix in other ways. One hypothesis is that increased direct payments allow more labor-saving investments on credit-constrained farms. Empirical analysis of this hypothesis is left for future research.

Finally, models (C) and (B) suggest that a rising overall compensation per employee in the considered regions drives down agricultural employment. The reported marginal effects imply an elasticity of labor use with respect to the average annual compensation per employee of -1.35 and -1.34, respectively. The regional economic environment responsible for the general level of compensation per employee is thus an additional important determinant of agricultural labor use.

## 5.2 CAP effects on dynamic labor use in East German agriculture[54]

This section deals with the econometric impact assessment of multiple, continuous policy treatment in the framework of a dynamic labor adjustment model. The model is both informed by theory and takes into account the methodological issues important in quantitative impact evaluation. Particular emphasis is placed on consistently estimating the labor adjustment process along with the effects of the entire set of policy measures within CAP. A linearized dynamic labor demand equation augmented by the full set of CAP policy instruments serves as a workhorse for the conducted analysis. The dynamic structure of the model has been theoretically motivated in Chapter 2.1 and applies fixed effects and instrumental variable techniques to account for problems arising from latent heterogeneity and endogeneity as discussed in Chapter 3.2.1.

### 5.2.1 Data and model specification

For the analysis of EU CAP payments on dynamic labor demand, the utilized data panel described in Chapter 5.1.1 is augmented by figures on agricultural input and output price indices, as described in Chapter 4.3. Regarding the dependent variable, additional data on regional agricultural employment have been included to account for the lag-structure of the model. Accordingly, the applied data panel is slightly unbalanced covering a period of 7 years in the right-hand variables, whereas the actual time span covered differs by one year subject to the federal state. Furthermore, the number of lags available for the dependent variable varies between federal states.[55] Following the previous approach, eight different policy measures are distinguished, which are: coupled area payments; coupled livestock payments; decoupled direct payments, introduced via the SPS in 2005; development of rural areas; processing and marketing support; single farm investment aids; compensatory payments to LFA; and payments within the agri-environmental scheme. A dummy variable, capturing the effects of the SPS introduction not due to volume payments, is also kept in the present model (See Chapter 5.1.1). In contrast to the approach in Chapter 5.1, year dummies are omitted in the present analysis due to use of country figures on agricultural prices to account for macro shocks. Descriptive statistics of the variables are given in Table 5-3.

---

[54] Results of this section are based on PETRICK and ZIER (2012)

[55] County figures on persons employed in agriculture are available as of 1994 for Brandenburg and Saxony-Anhalt, and as of 1996 for Saxony.

**Table 5-3: Descriptive statistics of the data panel for dynamic labor demand**

| | | Mean | Std. Dev. | Min | Max | Obs. |
|---|---|---|---|---|---|---|
| Employees in agriculture | Persons | 1,913.10 | 1,089.41 | 109 | 5337 | 815 |
| Coupled area payments | Million € | 9.43 | 9.22 | 0.00 | 39.88 | 483 |
| Coupled livestock payments | Million € | 1.12 | 1.60 | 0.00 | 10.52 | 483 |
| Decoupled direct payments | Million € | 3.30 | 7.79 | 0.00 | 46.85 | 483 |
| Development of rural areas | Million € | 3.91 | 3.24 | 0.00 | 22.30 | 483 |
| Processing and marketing aid | Million € | 0.33 | 1.52 | -0.74[a] | 23.19 | 483 |
| Investment aid | Million € | 0.67 | 0.72 | 0.00 | 4.05 | 483 |
| Compensatory allowance for LFA | Million € | 0.66 | 0.81 | 0.00 | 3.35 | 483 |
| Agri-environmental measures | Million € | 1.63 | 1.88 | 0.00 | 11.74 | 483 |
| Population density | Persons/km² | 288.18 | 380.90 | 41.36 | 1,912.12 | 483 |
| Annual compensation per employee | Thousand € | 24.62 | 1.40 | 21.21 | 29.15 | 483 |
| Agricultural output price index | 2000=100 | 100.7 | 3.1 | 96.1 | 104.9 | 483 |
| Agricultural resource cost index | 2000=100 | 103.6 | 4.0 | 94.3 | 109.6 | 483 |

Source: Author's calculations.

Note: [a]There was occasional overpayment in some regions, which led to negative expenses in subsequent years. All monetary values expressed in real terms, using the GDP deflator for Germany.

### 5.2.2 Estimation results and discussion

Table 5-4 shows the results for three different dynamic fixed effects specifications of Eq. (27). The LSDV model (D) with a first order autoregressive lag as a naïve reference model is presented along with the BB estimator (E). Furthermore, results for a LSDV Cestimator (F) by using the BB results for initialization are shown.[56] The LSDV and BB models use cluster robust standard errors based on

[56] Estimations were carried out by using the routines xtreg and xtdpdsys implemented in Stata 12, as well as the user-written routine xtlsdvc due to BRUNO (2005b). The latter was modified to accommodate the xtdpdsys results for initialisation.

the county variable, which controls for both serial correlation and heteroscedasticity in the LSDV model (CAMERON and TRIVEDI, 2005: 707). The BB model reports heteroscedasticity-robust standard errors due to WINDMEIJER (2005) and robust tests for serial correlation due to ARELLANO and BOND (1991). The tests present no evidence of second-order autocorrelation.[57] The LSDVC model uses bootstrapped standard errors. The hypothesis that estimated parameters are all zero was clearly rejected in the LSDV and BB models, as indicated by the *F*- and $\chi^2$-statistics. Furthermore, a test for panel-specific unit roots in the employment variable following the work of IM et al. (2003) has been examined. Assuming *T* is fixed, which seems appropriate considering the short panel data set at hand, and allowing for a time trend, the reported standardized test statistic ($Z_{\tilde{t}bar} = -5.699$) led to a rejection of the hypothesis that the panels were all non-stationary at the 1 % significance level.[58]

[57] Note that there is no established procedure for testing overidentification restrictions that is consistent with heteroscedasticity-robust standard errors (ARELLANO and BOND, 1991). We used a Sargan test based on conventional standard errors for the BB model, which gave no evidence of misspecification.

[58] The test was carried out by using the xtunitroot command in Stata 12.

**Table 5-4: Regression estimates: Dynamic employment in agriculture**

| Explanatory variables | LSDV model (D) | | BB model (E) | | LSDVC model using BB (F) | |
|---|---|---|---|---|---|---|
| Ag employment (lagged one year) | 0.645 | *** | 0.733 | *** | 0.786 | *** |
| | (0.052) | | (0.146) | | (0.037) | |
| Coupled area payments | 3.800 | | 34.458 | | 9.769 | |
| | (7.172) | | (28.420) | | (6.614) | |
| Coupled animal payments | -6.539 | | 17.995 | | 1.805 | |
| | (11.469) | | (26.290) | | (11.071) | |
| Decoupled direct payments | -1.235 | | 26.226 | | 4.878 | |
| | (7.277) | | (26.507) | | (6.341) | |
| Development of rural areas | 0.802 | | -2.706 | | 1.323 | |
| | (2.899) | | (3.662) | | (2.851) | |
| Processing and marketing aid | -4.964 | | -0.108 | | -5.440 | |
| | (3.093) | | (3.120) | | (4.313) | |
| Investment aid | 18.789 | ** | 23.117 | *** | 20.968 | |
| | (9.262) | | (7.941) | | (14.822) | |
| Compensatory allowance for LFA | 5.524 | | 1.894 | | 3.219 | |
| | (52.174) | | (52.084) | | (32.634) | |
| Agri-environmental measures | 0.213 | | -1.053 | | -1.421 | |
| | (3.306) | | (5.670) | | (4.642) | |
| Decoupling (2005/06 = 1) | -69.204 | ** | -42.721 | * | -71.094 | ** |
| | (32.716) | | (25.411) | | (28.513) | |
| Population density | 0.036 | | 0.583 | | 0.244 | |
| | (0.467) | | (0.526) | | (0.465) | |
| Annual compensation | -58.275 | *** | -64.129 | * | -50.188 | *** |
| per employee | (19.142) | | (33.254) | | (17.783) | |
| Agricultural output price index | -4.004 | | -2.887 | | -5.590 | ** |
| | (3.349) | | (6.180) | | (2.563) | |
| Agricultural resource cost index | 0.716 | | 1.293 | | 4.734 | |
| | (5.722) | | (11.971) | | (3.114) | |

Source: Author's calculations.

Notes: *** (**,*): significant at the 1 % (5 %, 10 %) level. Standard errors in parentheses. Total number of observations=483. LSDV and BB also include a constant.
LSDV: Estimates based on deviations from group means. $R^2$ (within)=0.722. F-value (14,68)=80.38. p-value<0.001. Standard errors adjusted for 69 clusters.
BB: Variables transformed into first differences. Lags of order two back to the maximum possible are used as GMM-type instruments for the lagged dependent variable in the differenced equation using the two-step procedure. Lagged differences used as GMM-type instruments for the lagged dependent variable in the level equation. First differences of all right-hand variables used as standard instruments. Total number of instruments is 78. Wald test of jointly zero coefficients $\chi^2$ (14)=1758.5. p-value<0.001. Arellano-Bond test for zero autocorrelation: p-value of order 1=0.013, p-value of order 2=0.152. Standard errors adjusted for 69 clusters using WINDMEIJER's (2005) procedure.
LSDVC: Standard errors bootstrapped with 100 replications. Correction procedure is based on BRUNO (2005a, b).

The particular interest of this section of the present study focuses on the evidence concerning lagged adjustment and the effects of policy measures. All models show that labor adjustment is sluggish, with a highly significant coefficient of adjustment. However, the reported levels differ. The result of the LSDV model (D) is notably lower than the other two, which is in accordance with the known downward bias of this estimator (NICKELL, 1981). The BB result (E) is close to the LSDVC result (F), which implies that the coefficient of adjustment is at approximately 25 %. As noted earlier, the use of methods robust to highly persistent data is thus warranted. The estimate means that, after a shock, it takes a bit more than three years to move halfway to the new steady state.[59] Adjustment is thus similar to the rate reported in CHANG and STEFANOU (1988) for Pennsylvania dairy farms and a bit slower than found by STEFANOU et al. (1992) for German family farms, but considerably faster than estimated, e.g. by VASAVADA and CHAMBERS (1986) for aggregate US data and PIETOLA and MYERS (2000) for Finnish hog farmers. The results of OLPER et al. (2011) present an outlier in this regard. In their analysis of out-farm migration in the EU-15, they reported coefficients for the lagged dependent variable smaller than 0.10, resulting in an adjustment coefficient above 90 %.

With regard to policy effects, there is some evidence on positive employment effects of investment support, which is significant at 5 % in the LSDV model (D) and at the 1 %-level in the BB model (E). According to the latter estimate, € 1 million of investment aid per region creates about 23 jobs in agriculture in the short run. For this short run effect, approximately € 44.5 thousand annually are required to create one additional job. Given the logic of the applied model, full adjustment to a new employment equilibrium takes time, so that the full effects are visible only in the long-run. Using the adjustment coefficient of the BB model, the long run effect is 86 jobs in the steady state per an additional € 1 million of investment aid paid now. The estimate of the LSDVC model (F) for this parameter is of a similar magnitude as the BB estimate, but the precision is much lower so that it fails to pass the 10 %-level of significance.

Overall, the results shown in Table 5-4 suggest that the CAP has very limited impact on job creation or maintenance in agriculture. While this conclusion is also drawn in Chapter 5.1, the evidence presented here clearly suggests that accounting for the dynamic aspects of labor adjustment is a crucial point. Furthermore, the positive effects of agri-environmental programs on labor use found by PUFAHL and WEISS (2009), OLPER et al. (2011), and in the previous section of the present study were not supported by the dynamic approach. On the other hand, also the negative effects arising from direct payments, rural development measures as well as processing and marketing aids were not borne out here. In line with the

---

[59] The median length of the lag can be obtained by solving for $t^*$ in $\gamma^{t^*} = 0.5$ (HAMERMESH, 1993: 248), which is $t^* = \log_\gamma 0.5$.

results presented for the static approach, it has been found evidence in favor of the view that the introduction of the SPS in 2005 led to labor shedding. The decoupling dummy reported in Table 5-4 turned out to be significant in any of the models. This is a plausible result if decoupling allowed the release of labor no longer necessary to maintain the production levels previously required to obtain crop- and livestock-related subsidies. According to the estimates from the LSDVC model, decoupling reduced average employment by 71 workers per county in the short-run, or approximately 3.7 % of the average agricultural labor force per county. The estimated long-run effect is 332 workers, or 17.4 % of the work force. Taken together, the presented more complete dynamic specification of CAP employment impacts supports the global picture of limited or even negative policy effects drawn by earlier analysis, except for the work of OLPER et at. (2011), where the authors identified positive effects on farm labor across the majority of CAP instruments.

A result that is supported with high precision and similar magnitude by any of the three estimators is the negative effect of the average annual compensation per employee for all sectors on labor use in agriculture. The short- and long-run wage elasticities at sample means implied by the three models are reported in Table 5-5.

**Table 5-5: Short- and long-run labor demand elasticities subject to the compensation per employee**

| | LSDV | BB | LSDVC |
|---|---|---|---|
| Short-run elasticity | -0.75 | -0.83 | -0.65 |
| Long-run elasticity | -2.11 | -3.09 | -3.02 |

Source: Author's calculations.

Note: Elasticities computed at sample means. Compensation per employee is annual average compensation per employee in all sectors per county.

The negative sign is consistent with the theory presented earlier in this section. The level of the estimates indicates that labor adjustment is inelastic in the short-run but will be much more elastic in the longer run. Although not the main focus of this study, this result identifies the general level of compensation per employee in all sectors, which is mainly driven by the respective figures for the manufacturing and service sector, as an important driver of labor use in agriculture.[60] On the other hand, the regional population density does not have an impact on agricultural employment. The coefficient estimates for country-level figures on agricultural output prices, suggest a negative impact on labor demand, which is particularly supported in the LSDVC model (F). Accordingly, it cannot be confirmed that a rising production value comes along with an increasing demand for farm labor.

[60] Between 1999 and 2006, the share of agricultural employment in the considered federal states varied from 2 to 4 %.

By contrast, the demand for farm labor decreases subject to rising agricultural prices. Furthermore, the price changes of farm inputs do not affect the agricultural workforce. One conclusion to be drawn from this outcome is that developments in exogenous prices at the national or macro level are of relatively little relevance for regionally specific employment adjustments.

## 5.3 The impact of CAP pillar I payments on heterogeneous farm structures in East German agriculture[61]

The present section evaluates the impact of CAP pillar I payments on farm structures in East German agriculture. Based on the theoretical model for structural change developed in Chapter 2.2, it will be assessed whether direct payments had the potential to relief existing budgetary constraints, and thus led to a boost in land demand for certain farms in the research region. Contrary to the view of a structure conserving effect of direct payments in European agriculture (cf. MANN, 2003a; BREUSTEDT and GLAUBEN, 2007; PIET et al., 2012), this pattern will have a distinct impact on structural change if farms are heterogeneous. For the econometric analysis four different farm size clusters in terms of their access to capital have been identified, using the equity base subject to farm size as a proxy. These are: farms operating less than 10 ha; farms operating from 10 to less than 200 ha; farms operating from 200 to less than 1,000 ha; and farms operating 1,000 ha and more. The empirical model is estimated by means of a SUR model to account for contemporaneously correlated error terms across the single equations as discussed in Chapter 3.2.2.

### 5.3.1 Data and model specification

Data from three different sources were combined to generate the data panel for East German agriculture applied in the present analysis (See Chapter 4). Unpublished figures on CAP first pillar payments at the county level were collected from the paying agencies of the state agricultural ministries. Furthermore, biannual data on the number of farms per county and the distribution of farm size classes between 1995 and 2007 were collected from the statistical offices of the federal states. Concerning the distribution of farm numbers at the NUTS-3 level according to the size classes described above, no data could be made available for Brandenburg and Saxony-Anhalt in 1995. Furthermore, the observations for the district-free cities of Cottbus and Frankfurt (Oder) had to be dropped completely due to missing data. Additionally, the respective figures for the County of Potsdam-Mittelmark in 2007 had to be excluded as a result of altering data collection methods. To further account for general economic conditions for farming indices on agricultural producer prices and resource costs at the level of Germany were included from BMELV (various years b).The slightly unbalanced data panel utilized for the regression analysis in the following comprises 67 counties of the three Federal States of Brandenburg,

[61] This section is based on the previous work of ZIER and PETRICK (2010a and b)

Saxony, and Saxony-Anhalt covering biannual figures from 1995 to 2007. Descriptive statistics are given in Table 5-6.

**Table 5-6: Descriptive statistics of the data panel for farm structure**

| Variable | Unit | Mean | Std. Dev. | Min | Max | Obs. |
|---|---|---|---|---|---|---|
| Farms < 10 ha | n | 124.54 | 85.62 | 3.00 | 502.00 | 430 |
| Farms 10 < 200ha | n | 123.04 | 83.03 | 3.00 | 380.00 | 430 |
| Farms 200 < 1,000ha | n | 39.62 | 37.74 | 0.00 | 192.00 | 430 |
| Farms ≥ 1,000ha | n | 13.68 | 10.75 | 0.00 | 52.00 | 430 |
| Coupled direct payments | Million € | 11.21 | 10.03 | 0.00 | 43.50 | 402 |
| Decoupled direct payments | Million € | 2.48 | 7.03 | 0.00 | 46.85 | 402 |
| Agricultural output price index | 2000=100 | 102.28 | 3.08 | 96.10 | 104.90 | 402 |
| Agricultural resource cost index | 2000=100 | 101.53 | 5.29 | 95.20 | 109.60 | 402 |

Source: Author's calculations.

In the following analysis, the number of farms in any of the four size classes shown in Table 5-6 serves as the dependent variable in one equation of the empirical model (41), respectively. Past farm structures are denoted by the lagged figures of the four farm size clusters, that is to say the number of farms two years prior to the year of observation. Following the theoretical considerations explained in Chapter 2.2.2, the values for the disbursed direct payments and price indices that enter the empirical model are the annual figures for the years in-between the observations for the respective farm numbers. For example, the regional number of farms in size class $g$ in 2005 is determined by the regional structures with regard to all farms in 2003 and the disbursed CAP pillar I payments and agricultural prices in 2004. As a result of the explained lag structure in the empirical model the number of observations available for the regression analysis reduces to 363.

### 5.3.2 Empirical results and discussion

The estimation results for the impact assessment of CAP pillar I payments on the number of farms in four distinct size classes based on Eq. (41) applying a SUR approach are presented inTable 5-7.[62] A Breush-Pagan test for contemporaneously independent error terms led to a rejection of the hypothesis at the 1 % significance level, as indicated by the $\chi^2$-statistics ($\chi^2(6)$= 102.792), which provided strong evidence in favor of the conducted SUR approach.[63] The estimated model includes 67 regional dummies to account for latent fixed effects. To provide a more reliable assessment of the model fit, Table 5-7 shows values for the $R^2$ (within) derived from the LSDV model of the single equations instead of the reported values from the SUR model.[64] Given the relatively low variation in the regional data (See

[62] Estimations were carried out by using the routine sureg in Stata 12. Small-sample adjustment has been implemented by the dfk option (See STATA, 2011: 1835)

[63] The test was carried out by using the corr option along with the sureg routine.

[64] This approach has been chosen, as the xtreg routine for the LSDV model considers the effects of the groups to be fixed. Accordingly, the unestimated quantities are subtracted out

Figure A-22 to Figure A-33), the considered SUR model performs quite well in explaining the development of farm numbers in the considered farm size clusters.

**Table 5-7: SUR model estimates: Policy impact on regional farm numbers**

| | **SUR estimation for the number of farms in the size classes -** | | | |
|---|---|---|---|---|
| | < 10ha | 10 to < 200ha | 200 to < 1,000ha | ≥ 1,000ha |
| Explanatory variables | (G) | (H) | (I) | (J) |
| Number of farms < 10ha | 0.325*** | 0.044** | -0.004 | 0.003 |
| (2-year lag) | (0.044) | (0.019) | (0.007) | (0.003) |
| Number of farms 10 to < 200 ha | 0.115 | 0.590*** | 0.030* | 0.001 |
| (2-year lag) | (0.101) | (0.043) | (0.016) | (0.006) |
| Number of farms 200 to < 1,000 ha | 0.196 | -0.182 | 0.445*** | -0.032 |
| (2-year lag) | (0.351) | (0.150) | (0.057) | (0.020) |
| Number of farms ≥ 1,000 ha | -0.097 | -0.533 | -0.196 | 0.337*** |
| (2-year lag) | (1.107) | (0.474) | (0.179) | (0.064) |
| Coupled direct payments | -0.986 | -0.856** | 0.263* | -0.057 |
| (1-year lag) | (0.961) | (0.412) | (0.155) | (0.055) |
| Decoupled direct payments | -0.580 | -0.874** | 0.237 | -0.033 |
| (1-year lag) | (0.946) | (0.405) | (0.153) | (0.055) |
| Agricultural producer price index | -0.725** | -0.380*** | 0.082* | -0.029* |
| (1-year lag) | (0.294) | (0.126) | (0.048) | (0.017) |
| Agricultural resource cost index | -0.631** | 0.141 | 0.097** | -0.018 |
| (1-year lag) | (0.245) | (0.105) | (0.040) | (0.014) |
| $R^2$ (within) | 0.386 | 0.487 | 0.629 | 0.377 |

Source: Author's calculations.

Note: *** (**, *): significant at the 1 % (5 %, 10 %) level. Standard errors in parentheses. Total number of observations=363. All models include a constant.

Table 5-7 provides evidence that the regionally disbursed CAP pillar I payments in East German agriculture between 1997 and 2007 affected farms of various size classes differently. It can be seen from column (H) that the number of farms per county that operate from 10 to 200 ha significantly decreased subject to increasing direct payments. In contrast, the number of farms operating between 200 and 1,000 ha (I) significantly increased due to a marginal rise of coupled pillar I support. Regarding this issue, the coefficient for decoupled payments barely missed to pass the 1 % significance level, revealing a $p$-value of 0.121 (not shown in Table 5-7). Furthermore, the development of farm numbers in the smallest (G) and largest (J) size cluster appeared to be unaffected by marginal changes in CAP pillar I support.

Regarding the impact of the situation on the land market denoted by past farm structures, Table 5-7 suggests that the number of farms in a certain size class

of the model before the fit is performed. This is not the case for the sureg routine where the regional dummies are considered for the calculation of the model fit, which leads to an overestimation of the $R^2$.

strongly depended on the respective number of farms in the prior period of observation. That is to say, a more homogeneous situation on the land market, indicated by a larger number of farms with a similar size, had a significantly positive impact on the development of farm numbers in the considered size cluster. Moreover, the columns (H) and (I) suggest that the number of farms operating from 10 to 200 ha and between 200 and 1,000 ha increased if the number of farms in the next lower size class has been relatively higher in the past. This result points towards the fact that the former farms grew in numbers at cost of the latter. However, in turn, Table 5-7 provides no evidence that past farm numbers in the next higher size class had a negative impact on the number of farms in lower size clusters. Moreover, it can be stated in general terms that the development of farm numbers in the smallest (G) and largest (J) size cluster did not react to changes in the remaining farm size groups.

Furthermore, it is apparent from Table 5-7 that the coefficient estimates for agricultural producer prices reveal an ambiguous picture. Surprisingly, the numbers of farms operating less than 200 ha and more than 1,000 ha are significantly negative correlated with a marginal increase in producer prices. By contrast, indicating a significantly positive impact of output prices on farm numbers the respective coefficient shows the expected sign with regard to the number of farms operating between 200 and 1,000 ha. Generally, the impact of agricultural resource costs on farm numbers appears to be less pronounced. However, it can be seen from Table 5-7 that a marginal increase in input prices led to a drop in farm numbers in the smallest size cluster (G). Furthermore, an unexpected effect can be observed regarding the impact of varying agricultural resource costs, as the number of farms operating from 200 to 1,000 ha significantly increases subject to rising values. A possible explanation therefore could be the realization of scale economies.

The results of the present analysis indicate that the regionally disbursed direct payments between 1997 and 2007 did not conserve farm structures in the three East German Federal States of Brandenburg, Saxony, and Saxony-Anhalt. Though the total number of farms developed rather stable during the considered period of time, considerable adjustment processes occurred with regard to the size of the existing farms subject to governmental support and economic conditions for farming. Consequently, the presented results are in line with earlier studies that analyze the effect of governmental payments in the U.S., indicating that some farms gain more from agricultural subsidies than others (AHEARN et al., 2005; KEY and ROBERTS, 2006 and 2007; ROBERTS and KEY, 2008). In contrast, empirical evidence against the opinion of a structure conserving impact of CAP pillar I payments for Western European countries (MANN, 2003a; BREUSTEDT and GLAUBEN, 2007; PIET et al., 2012) has been found. The latter can be partly explained by the fact that farm structures in East Germany cannot be compared with those of the studies mentioned above, both in terms of farm size and legal status.

Moreover, the present results suggest that heterogeneous farms, in terms of their individual credit constraint approximated by the farms' size, are differently affected by marginally increasing CAP pillar I payments. It could be shown that particularly farms operating between 200 and 1,000 ha gained in importance, though these farms were worst equipped with equity per hectare of farm land. Consequently, the theoretically deduced hypothesis that a priori stronger budgetary constrained farms gain most from rising grants due to a disproportionately increase in land demand could be confirmed. Those farm size clusters with a comparably superior capital endowment either stabilized in numbers (farms larger 1,000 ha) or faced even significant comparative disadvantages on the land market subject to increasing CAP pillar I support (farms 10 to 200 ha). As a consequence of this progression an "appearing middle" can be observed in East German agriculture since the mid-1990s. Though the "middle", as denoted in the present study, is comparably large, the findings at hand are contrary to former studies reporting a "disappearing middle" (cf. GARCIA et al., 1987; WEISS, 1999).

In view of the initial agricultural structure, the present results provide evidence that particularly the two considered clusters of farms operating between 10 and 1,000 ha were positively affected by a comparably high number of farms in the next lower farm size class in the past period. This result suggests that smaller farms obviously grew in size, and thus moved up into the next larger size cluster. Two patterns are conceivable to explain this development. First, farms in the considered size classes simply merged. Second, a farm at the lower end of the size class shrunk, due to the fact that expiring lease contracts could not be renewed. The available land was then leased by a farm, which was a priori situated at the upper end of the respective size class. In consequence of the newly acquired acreage the respective farm moved up by one size cluster. The latter development can also be explained by the heterogeneous access to capital of the considered farms, whereas the demand for land of the larger farm relatively increased, due to a relief of its budgetary constraint, compared to the smaller one. In consequence, the larger farm was able to outbid the smaller farm with regard to the renegotiation of lease contracts. The second approach would also explain the rather stable development of total farm numbers, whereas the first one would come along with decreasing figures.

Regarding the impact of agricultural prices, some surprising effects could be observed, which did not support the hypotheses that increasing output prices and decreasing resource costs favor all farms identically. It has been found that farms operating less than 200 ha and those operating more than 1,000 ha were able to better cope with marginally decreasing producer prices, whereas the number of farms operating from 200 to 1,000 ha dropped under equal conditions and *vice versa*. A reasonable explanation for this issue is that the economic prospects of the latter strongly depended on the realized revenues from production due to a relative lack of capital. Accordingly, these farms were more strongly affected during low price periods. As a result, the remaining farms relatively gained in these situations. Furthermore, it has been found that the number of medium-sized farms increased subject to increasing resource costs, whereas farms operating from 10 to 200 ha and more than 1,000 ha appeared to be unaffected, which also describe astonishing effects. A possible explanation is that, in general, operational inputs can be reduced within a certain range and the purchase of investment goods can be postponed. Accordingly, the significantly positive coefficient estimate for the number of farm operating between 200 and 1,000 ha would imply that these farms benefitted most from comparable situations. However, it is difficult to draw profound conclusions, given the fact that data on agricultural prices could not be made available at the regional level.

# 6 CONCLUSIONS

The present dissertation was designed to assess the effects of the EU's CAP in East German agriculture. The particular focus lay on the quantitative impact evaluation of the whole portfolio of first and second pillar measures on labor demand between 1999 and 2006. Furthermore, the structural effects of CAP pillar I payments on heterogeneous farm structures in the period from 1997 to 2007 were due to be analyzed. The empirical analysis of this dissertation was preceded by a theoretical approach to the issue and a profound discussion of appropriate econometric methods. For the implementation of the theoretically deduced evaluation strategy a unique data panel of yearly disbursed payments at the county-level for the Federal States of Brandenburg, Saxony, and Saxony-Anhalt has been created. Subsequently, the identified state-of-the-art econometric models have been adopted to identify net policy effects on agricultural labor demand and farm structure. The following section summarizes the major results of the present dissertation. In Chapter 6.2 policy recommendations are deduced and discussed in light of the pending CAP reform. Section 6.3 concludes with suggestions for future research.

## 6.1 Main findings of the study

The empirically motivated treatment effect approach for the impact evaluation of CAP payments in the three Federal States of Brandenburg, Saxony, and Saxony-Anhalt conducted in Chapter 5.1 of the present study revealed that there were few desirable effects on job maintenance or job creation in East German agriculture. Based on a difference-in-differences model implemented at the county level, it has been found that farm investment aids and transfers to LFA had no marginal employment effect at all. Increases in direct area payments on average led to labor shedding. In 2005 and 2006, full decoupling made transfer payments largely independent of factor allocation. It has been proved that in these years, there was a significant reduction in agricultural employment, holding constant other influences. Spending on modern technologies in processing and marketing also led to job losses in the first sector, some of which only occur with a delay of two years. Measures aiming at the development of rural areas reduced agricultural employment with a lag of one year. Agri-environmental measures, on the other hand, tended to keep labor intensive technologies in production or induced them.

Chapter 5.2 extends the above-mentioned static model with lagged exogenous regressors to a real dynamic approach accounting for adjustment costs in agricultural labor demand. In this section, results of three specifications of a dynamic employment equation with fixed effects, estimated on East German county level data, are presented. A consistent finding across the different estimators is that agricultural employment adjusts slowly to changes in the external environment. With an annual adjustment rate of approximately 25 %, it takes a bit more than three years to move halfway to the new steady state. Direct payments, measures for the development of rural areas, transfers to LFA and agri-environmental measures had no employment effect in any of the models. Two specifications suggest that job creation in the CAP framework was possible via capital subsidies. These subsidies were mostly used to finance buildings or machinery. Apparently, increases in capital use were sufficiently complementary to labor that they slowed down labor cuts. According to the presented estimates, approximately € 45 thousand of subsidies were required annually to create one additional job in the short-run. However, capital subsidies are more effective in the long-run, as they also affect the steady state equilibrium labor demand. The results are consistent with the view proved in Chapter 5.1 that the introduction of decoupled direct payments in 2005 accelerated labor cuts. A reasonable interpretation of this finding is that workers were no longer necessary to maintain production levels required for receiving payments. A further finding was that a rising average annual compensation per employee in all sectors of the economy reduced labor use in agriculture. In the long run, a 1 % rise in the wage level led to job losses in agriculture in the range of 2.1 to 3.1 %.

The results of Chapter 5.2 indicate that the explicitly dynamic specification of the model is a step forward compared to the more or less static approach to the econometric evaluation of CAP effects on labor use in Chapter 5.1. By using estimators that represent the current state of the methodological literature, the evidence from this study suggests that at least some of the CAP measures helped to achieve the political goal of job maintenance in agriculture. However, in general, it seems that the CAP is not a particularly effective tool for active job promotion in agriculture. Among the measures studied here, there is no single policy instrument which has unambiguously positive employment effects. Furthermore, adjustment takes time, so that short-term successes in job creation are unwarranted. The results rather suggest that economic developments outside agriculture have, via the average annual compensation per employee, the most pronounced effect on labor use in the farm sector.

Chapter 5.3 investigates the impact of CAP pillar I payments on the development of regional farm numbers in Brandenburg, Saxony, and Saxony-Anhalt. Based on a SUR model implemented for four distinct farm size classes, it has been found evidence that marginally increasing direct payments led to a significant structural change in the research region between 1997 and 2007. The results point towards an "appearing middle" subject to the disbursed CAP pillar I support at the county level, as particularly the number farms operating between 200 and 1,000 ha increased. In contrast, farms of a size between 10 and 200 ha significantly lost in weight, whereas very small farms and farms operating 1,000 ha and more appeared to be unaffected from marginal changes in CAP pillar I support.

The empirical findings of Chapter 5.3 reinforce the underlying theoretical model for structural change in East German agriculture, which has been developed in Chapter 2.2. Accordingly, medium-sized farms were able to strengthen their position on the land market subject to marginally increasing CAP pillar I payments. The respective farms gained relatively more from higher grants due to a relaxation of their budget constraint and the resulting disproportionate increase in land demand compared to the competitors on the market for land. The consideration of the initial situation on the land market, in terms of past farm structures, has provided further evidence that the increase in farm numbers operating between 200 and 1,000 ha proceeded at the cost of the next lower size clusters.

## 6.2 Policy recommendations

So which factors drive regional employment in agriculture? Based on the East German sample at hand, it is postulated that the influence of agricultural policy has been modest, whereas regional (but not national) developments on factor markets (labor) played an important role. In addition, the highly significant autoregressive parameter in the dynamic model for labor demand indicates a strong path dependency in labor adjustments; after all last year's labor stock is the best predictor of this year's employment level. It seems likely that on-farm organizational as well as legal constraints of labor restructuring as indicated in Section 2.1.3 limit the managers' leeway to freely adjust employment levels according to annual fluctuations in the farms' external environment. As a result, the relevant decision-maker should reconsider whether the CAP in its post-Agenda 2000 form is a useful policy to promote job creation in agriculture. Particularly in light of the recent debates about additional modulation, the present dissertation calls into question whether an expansion of second pillar measures is a reasonable way to use the modulated funds.

Nevertheless, the identified positive aspects of the single farm investment aid program and the agri-environmental scheme provide a basis to build up. Thereby, the former appears to describe a regional phenomenon, as from theory one would expect capital and labor to be substitutes. However, given the comparably large agricultural farms in East Germany, which are already equipped with modern technology, obviously labor-saving investments do not played a major role between 1999 and 2006. In view of the positive impact on the number of farm workers, the subsidized investments were mostly of the nature that they created or at least secured jobs in agriculture, such as extensions in livestock farming or diversification in new branches of production (cf. PETRICK and ZIER, 2011a). Regarding the future design of the single farm investment aid program, the relevant decision-maker should take this into consideration, if their goal is to promote jobs in agriculture. For instance, it would be conceivable and given the high technological standard in German agriculture quite consistent to exclude labor-saving investment projects from the single farm investment aid scheme. However, this has to be decided at the regional level and cannot be transferred to the EU in total.

Furthermore, it seems plausible that activities funded under the umbrella of the agri-environmental scheme are rather labor intensive, such as organic farming (cf. PETRICK and ZIER, 2011a). Accordingly, more emphasize has to be placed on the respective instruments to yield positive employment effects via agri-environmental programs in the future. In view of the pending CAP reform, some efforts have already been undertaken to strengthen the position of organic farms, though not directly by means of the CAP's second pillar. According to the regulation proposal for the CAP after 2013 (EC, 2011), the redesigned pillar I payments will consist of a basic component and an environmental bonus for the so-called "greening", whereas the latter accounts for 30 % of the totally disbursed funds. The environmental bonus is linked to the compliance with three distinct farming practices, which are: crop diversification; maintenance of permanent grassland; and the designation of at least 7 % of the farm's UAA as ecological focus area. In this regard, organic farms are particularly favored as they are by implication entitled for these bonus payments. Given the presented results, this can be considered as a step in the right direction to promote jobs in agricultural.

Moreover, the proposal for the CAP after 2013 contains a further crucial point, which is particularly important for large East German farms. According to the EC (2011) it is intended to gradually decrease pillar I payments per farm and year, if the total amount received per farm lies between €150,000 and 300,000, whereas an absolute payment cap beyond this amount is considered. However, it is also stated that the absolute amount of payments, from which the gradual degression of aids starts, is adjusted by the effectively paid salaries of the respective farm in the year before. This may have two consequences at the farm level. First, it provides incentives to invest in labor-intensive production processes, such as livestock farming (SAHRBACHER et al., 2011). Second, the salary of the existing farm workers could be increased up to a certain amount, given the fact that the additional costs are covered via the surplus of direct payments. Particularly, the former describes a questionable development, as this effect can be clearly regarded as production-distorting, and thus does not comply with the green box requirements under the WTO agreement.[65]

The effect of the new direct payments regime, proposed for the CAP after 2013, describes the exact opposite of the decoupling efforts initiated by the 2003 reform of the CAP. Though, the presented results provide evidence that the introduction of the SPS in 2005 led to significant labor shedding in East German agriculture, a critical discussion of the respective reform step is not at issue. This is not at least due the positive effects with regard to the agricultural negotiations of the WTO. Furthermore, it is reasonable to assume that this policy shift will only lead to minor

---

65 See http://www.wto.org/english/tratop_e/agric_e/agboxes_e.htm.

labor shedding in the future. Given the fact that the direct payments disbursed to German farmers were already fully decoupled in 2005 (See Chapter 1.1.1), the greatest drop in farm labor due to an abandonment of certain non-competitive branches of production occurred in the early years after the SPS went into force; the time that was covered by the present analysis. In view of the fact that further decoupling steps are not to be expected in Germany, significant labor shedding subject to decoupling is unlikely. Furthermore the present results suggest that the likely decrease of direct income support via the CAP's first pillar in Germany, due to a re-allocation of funds among the member states of the EU (EC, 2011), will positively affect the development of farm labor.

Summarizing the potential impact of the proposed reform for a CAP after 2013 on labor demand in East German agriculture, one can conclude that the positive effects prevail. Furthermore, some minor adjustments to the design of the agri-environmental and investment aid scheme are conceivable to reinforce the positive effect on the number of employees in agriculture. However, the employment component of the proposed direct payments regime is questionable, particularly in view of the green box requirements of the WTO.

Did the disbursed CAP pillar I payments conserve farm structures in East German agriculture? The presented analysis of regional farm numbers in the Federal States of Brandenburg, Saxony, and Saxony-Anhalt between 1997 and 2007 provided evidence for the opposite. Though the total number of farms developed rather stable after 2000, a significant shift of farm numbers between four distinct farm size classes subject to the disbursed CAP pillar I payments could be proven. Accordingly, one could argue that the CAP's direct payment regime missed its goal to provide an equally distributed income support to all farms, and thus conserve farm structures. In reality the opposite appears to be true, as only a specific group of farms realized net-benefits from the disbursed grants.

In view of the actual policy debate on payment caps for EU-farms, the presented results suggest that the situation of large East German farms would change to the worse. As already mentioned above, the regulation proposal of the EC (2011) seeks to gradually decrease pillar I payments per farm, if the total amount received per year lies between € 150,000 and 300,000. Furthermore, an absolute payment cap beyond this amount is considered. Disregarding the employment component for the calculation of the eligible subsidies per farm in the first place, this would imply decreasing area payments starting at a farm size of 500 ha with an absolute payment cap for farms larger than 1,000 ha, assuming an average amount of approximately € 300 per ha farmland.[66] Given the fact that this development would no longer only describe a marginal change in CAP pillar I support, but a

[66] The exact value is 301.30 € per ha, calculated by dividing the total amount of CAP pillar I payments in Brandenburg, Saxony and Saxony-Anhalt in 2005by the total agricultural area of the same year.

significant drop, a negative impact on the number of farms operating 1,000 ha and more is to be expected. Beyond that, farms larger than 500 and smaller 1,000 ha would also lose ground on the land market. According to this fact, the identified positive impact of CAP pillar I payments on the number of medium-sized farms will be reduced or even disappear. On the other hand, the situation of farms smaller than 500 ha reinforces. Particularly, the position of very small farms would improve significantly as the considered implementation of a flat rate payment to these farms enables them to realize higher payments per hectare of farmland compared to larger farms.

However, if the considered employment component for the calculation of the total amount of eligible direct payments per farm and year enters into force, only a marginal impactof the degression and capping will occur (SAHRBACHER et al., 2011). Consequently, it can be considered that the pattern of the "appearing middle" found in the present dissertation will remain in East German agriculture. Not with standing this fact, the shown results disproved the argument that large cooperatives are less dependent on governmental support compared to smaller farms, which is a frequently stated argument of the EC in order to justify the declining support to the former group of farms (cf. AGRA-EUROPE, 2011). Following these considerations, the respective decision-maker are recommended to gradually decrease the income support via direct payments for all farms to the same extent. This appears to be the most convincing way to avoid the current distorting effects in the long run (cf. BMELV, 2010b).

## 6.3 Recommendations for future research

The econometric impact evaluation of the CAP in East German agriculture conducted in the present dissertation has extended the knowledge on the effects of agricultural policies in a setting of large-scale production structures primarily based on hired labor compared to prior studies. However, during the work on the research question at hand limitations of the pursued approach became obvious and new questions emerged. The aim of this final section is to outline these issues and provide suggestions for future research activities.

As already stated by SHUCKSMITH et al. (2005), a considerable shortcoming with regard to agricultural policy evaluation is the availability of adequate data. Though, a comprehensive data panel was available for the present study, a broader (additional federal states) and longer (additional years) data set could improve the analysis in several ways. First, observations for additional federal states would generally increase the between variation in the data. This arises from the fact that a larger number of counties increases the variance regarding the individual implementation of the different CAP measures. In case of some CAP instruments investigated, this might have helped to pass the applied significance levels. However, such extensions also entail the risk that specific effects are overlooked.[67] Therefore, it is advisable to limit the data panel to East German federal states, given the comparable agricultural structure and expected policy outcomes. Second, a longer time span of observations accompanied by an increase in the within variation of the available data could facilitate a more precise investigation of the effects arising from shifts in the policy regime. On the one hand, additional data for the time before 2000 could enable a distinct impact assessment of the introduction of the CAP's second pillar due to the AGENDA 2000 reforms. On the other hand, more recent data allow for a greater clarity with respect to the impact of decoupling. Finally, a deeper analysis of the CAP instruments could be enabled. It can be seen from Table A-3 that payments streams have been made available on a very detailed level. Accordingly, a higher number of observations in total could facilitate a detailed analysis of more disaggregated policy measures. Particularly, in the area of agri-environmental measures and single farm investment aids it might thus be possible to identify those instruments that created jobs in agriculture. Any of these issues would enable to deduce more profound policy recommendations.

Moreover, the strengths of the data panel at hand are the weaknesses at the same time. Though, policy instruments not directly linked to agricultural farms can be taken into account in a regional approach, many determinants at the farm level have to remain unconsidered. In terms of the adjustment of agricultural workforce, it is clear that the presented approach cannot sort out all of the micro determinants, such as managerial plans and abilities on the farms, differences in the farm labor force due to age and education, and the local availability of sufficiently qualified potential entrants. Future research using different types of data, including qualitative approaches, may shed further light on this issue.

Furthermore, the impact analysis of CAP pillar I payments on regional farm structures has shown that strong interrelations between imperfect factor markets and the disbursed direct payments exist. Regarding this issue, the presented approach relies on strong assumptions with regard to the link between farm size, capital endowment, access to finance, and land demand. However, these relations are reproduced rather indirectly by the applied empirical model. Actually, it was not possible to provide empirical evidence for the assumptions that were made, which was not at least due to the available data. Further efforts are needed in this particular area to substantiate the identified effects. Ideally, future research should be based on farm-level data or data on factor markets to address the unsolved questions.

---

[67] Also investigating employment effects of several CAP measures, OLPER et al. (2011) find quite contrary results to those presented here. A reasonable explanation is the applied research region of the EU-15. Regarding the fact, that East German agricultural structures rather describe an outlier in European terms, the specific effects are outweighed by those of the remaining regions.

In view of the development of farm structures in East German agriculture, also some specifics exists that cannot be considered in a quantitative approach based on regional data. These arise not at least from the fact that a high proportion of farms belongs the group of legal entities. For instance, if a cooperative or limited liability corporation has been adjudged insolvent, it is very likely to be absorbed by another farm of this type. This possibly leads to a situation where the preexisting farm continuous to operate under the same name with the acquiring farm holding the majority of shares in the company. As a result, no changes appear in the secondary data of the statistical offices leading to the fact that farm exits might be underestimated by this data. Under this assumption, the same applies to the actual size of the acquiring farm. Due to a lack of data, it has not been possible to explicitly account for these effects in the present analysis. However, understanding these mechanisms appears to be crucial for a profound analysis of structural change in East German agriculture. An in-depth investigation of this issue provides an interesting field for future research, which also requires rather qualitative approaches.

Besides the opportunities and limitations that originate from the type and coverage of the available data, some methodological issues remain. The assumptions and constraints of the quantitative approach applied in the present study have been discussed in Chapter 3. A particularly strong assumption in the presented models is the fact that the estimated policy treatment effects are considered to be linear. As a matter of fact, this makes the estimation itself convenient. However, a theoretical justification for this approach can hardly be given. Recently, non- and semi-parametric methods have been developed to relax the linearity assumption. For instance, FLORENS et al. (2008) applied a non-parametric structural econometric approach to assess heterogeneous effects of a continuous, endogenous policy treatment. However, fully non-parametric methods rely on huge data sets (ICHIMURA and TODD, 2007), and are thus rather inappropriate for the research question at hand. Therefore, semi-parametric models have been suggested that combine both parametric and non-parametric techniques (YATCHEW, 2003). So far, the application of semi-parametric approaches to agricultural policy analysis is rather limited (cf. OUDE LANSINK and PIETOLA, 2005; ROBERTS and KEY, 2008). Given this background, it is worth pushing research in this area forward to enhance the understanding of policy impacts in agriculture.

Furthermore, the common effects assumption has been debated widely in the labor market literature, where treatment effects are supposed to systematically differ between treated and untreated groups. However, the literature has focused on the case of binary treatment, whereas the continuous and multiple treatment case relevant here has only very recently been addressed (cf. FLORENS et al., 2008). There are no established methods available (yet) to study this case. The question whether continuous group-specific treatment effects are empirically important in agriculture, is thus left for future work.

# REFERENCES


ADAMS, G., WESTHOFF, P., WILLOTT, B., YOUNG II, R. E. (2001): Do "decoupled" payments affect U.S. crop area? Preliminary evidence from 1997-2000. *American Journal of Agricultural Economics, 83(5):* 1190-1195.

AGRA-EUROPE (2010): "Grüne" Berufe suchen Bewerber. *Nr. 17/10 (26.04.2010): Länderberichte: 5-6.*

AGRA-EUROPE (2011): Deckelung der Direktzahlungen soll bei 150.000 Euro beginnen. *Nr. 33/11 (15.08.2011): EU-Nachrichten: 1-2.*

AGRARBERICHT (1991): Agrar- und ernährungspolitischer Bericht der Bundesregierung. Bonner Universitäts-Buchdruckerei, Bonn.

AHEARN, M. C., EL-OSTA, H., DEWBRE, J. (2006): The impact of coupled and decoupled government subsidies on off-farm labour participation of U.S. farm operators. *American Journal of Agricultural Economics*, *88(2):* 393-408.

AHEARN, M. C., YEE, J., KORB, P. (2005): Effects of differing farm policies on farm structure and dynamics. *American Journal of Agricultural Economics*, *87(5):* 1182-1189.

ANDERSON, T. W., HSIAO, C. (1981): Estimation of dynamic models with error components. *Journal of the American Statistical Association*, *76(375):* 598-606.

ARELLANO, M., BOVER, O. (1995): Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics, 68(1):* 29-51.

ARELLANO, M., BOND, S. (1991): Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies, 58(2):* 277-297.

BARKLEY, A. P. (1990): The determinants of the migration of labor out of agriculture in the United States, 1940-85. *American Journal of Agricultural Economics*, *72(3):* 567-573.

BAUER, S. (1997): Politik zur nachhaltigen Entwicklung ländlicher Räume. *German Journal of Agricultural Economics*, *46(7):* 245-250.

BECKMANN, V., HAGEDORN, K. (1997): Decollectivisation and privatisation policies and resulting structural changes of agriculture in Eastern Germany. in: SWINNEN, J. F. M., BUCKWELL, A., MATHIJS, E. (eds.): Agricultural privatisation, land reform and farm restructuring in Central and Eastern Europe. Ashgate, Aldershot: 105-160.

BESLEY, T., CASE, A. (2000): Unnatural experiments? Estimating the incidence of endogenous policies. *Economic Journal, 110(467):* F672-F694.

BICKENBACH, F., BODE, E. (2001): Markov or not Markov – This should be a question. *Kiel Working Paper No. 1086,* Kiel Institute of World Economics, Kiel. URL: http://www.ifw-members.ifw-kiel.de/publications/markov-or-not-markov-this-should-be-a-question/kap1086.pdf.

BLUNDELL, R., COSTA DIAS, M. (2009): Alternative approaches to evaluation in empirical microeconomics. *Journal of Human Resources, 44(3):*565-640.

BLUNDELL, R., MCCURDY, T. (1999): Labor supply: A review of alternative approaches. in: ASHENFELTER, O., CARD, D. (eds.): Handbook of labor economics, Vol. 3. Elsevier, Amsterdam: 1559-1695.

BLUNDELL, R., BOND, S. (1998): Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87(1):* 115-143.

BOND, S. (2002): Dynamic panel data models: A guide to micro data methods and practice. The Institute for Fiscal Studies, Department of Economics, UCL. URL: http://www.cemmap.ac.uk/wps/cwp0209.pdf.

BOND, S., VAN REENEN, J. (2007): Microeconometric models of investment and employment. in: HECKMAN, J. J., LEANER, E. E. (eds.): Handbook of econometrics. Vol. 6A. Elsevier/North Holland, Amsterdam: 4417-4498.

BREUSTEDT, G., GLAUBEN, T. (2007): Driving forces behind exiting from farming in Western Europe. *Journal of Agricultural Economics, 58(1):* 115-127.

BRUNO, G. S. F. (2005a): Approximating the bias of the LSDV estimator for dynamic unbalanced panel data models. *Economics Letters, 87(3):* 361-366.

BRUNO, G. S. F. (2005b): Estimation and inference in dynamic unbalanced panel-data models with a small number of individuals. *The Stata Journal*, *5(4):* 473-500.

BRÜMMER, B., LOY, J.-P. (2000): The technical efficiency impact of farm credit programmes: A case study of Nothern Germany. *Journal of Agricultural Economics*, *51(3):* 405-418.

BUN, M. J. G., KIVIET, J. F. (2003): On the diminishing returns of higher-order terms in asymptotic expansions of bias. *Economics Letters*, *79(2):*145-152.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (2000): Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten. Landwirtschaftsverlag GmbH, Münster-Hiltrup.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (2005): Meilensteine der Agrarpolitik – Umsetzung der europäischen Agrarreform in Deutschland. BMELV, Berlin.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (2010a): Ergebnisse der Testbetriebe 2006/07: Juristische Personen in den neuen Ländern. URL: http://www.bmelv-statistik.de.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (2010b): EU-Agrarpolitik nach 2013 – Plädoyer für eine neue Politik für Ernährung, Landwirtschaft und ländliche Räume. BMELV, Berlin.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (2011a): Informationen zur Einbeziehung weiterer Beihilfen in die Betriebsprämienregelung im Jahr 2012 und zur Anpassung der Werte der Zahlungsansprüche. URL: http://www.bmelv.de/SharedDocs/Downloads/Landwirtschaft/Foerderung/Direktzahlungen/BetriebspraemienWeitereBeihilfen.pdf?__blob=publicationFile.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (2011b): Statistik und Berichte des BMELV, Berichte zur ländlichen Entwicklung. URL: http://www.bmelv-statistik.de/de/laendl-entwicklung-und-direktzahlung/berichte-zur-laendlichen-entwicklung/.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (various years a): Buchführungsergebnisse der Testbetriebe (various years). BMELV, Bonn.

BUNDESMINISTERIUM FÜR ERNÄHRUNG, LANDWIRTSCHAFT UND VERBRAUCHERSCHUTZ (BMELV) (various years b): Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten (various years). Landwirtschaftsverlag GmbH, Münster-Hiltrup.

CAMERON, A., TRIVEDI, P. (2005): Microeconometrics. Methods and applications. Cambridge University Press, Cambridge.

CHANG, C.-C., STEFANOU, S. (1988): Specification and estimation of asymmetric adjustment rates for quasi-fixed factors of production. *Journal of Economic Dynamics and Control*, *12(1):* 145-151.

CHAVAS, J.-P. (2001): Structural change in agricultural production. in: GARDNER, B., RAUSSER, G. (eds.): Handbook of agricultural economics, Volume 1. Elsevier Science, Amsterdam: 263-285.

CIAIAN, P., SWINNEN, J. F. M. (2009): Credit market imperfections and the distribution of policy rents. *American Journal of Agricultural Economics*, *91(4):* 1124-1139.

DAVIDSON, R., MACKINNON, J. G. (1993): Estimation and inference in econometrics. Oxford University Press, New York.

DEUTSCHER BAUERNVERBAND (DBV) (2011): Situationsbericht 2011 – Trends und Fakten zur Landwirtschaft. Deutscher Bauernverband, Berlin.

DWYER, J., BALDOCK, D., BEAUFOY, G., BENNETT, H., LOWE, P., WARD, N. (2002): Europe's rural futures – The nature of rural development: Rural development in an enlarging European Union. Land Use Policy Group of Great Britain and WWF Europe with the Institute for European Environmental Policy, Brussels.

ESPOSTI, R. (2007): Regional growth and policies in the European Union: Does the Common Agricultural Policy have a counter-treatment effect? *American Journal of Agricultural Economics*, *89(1):* 116-134.

EUROPEAN COMMISSION (EC) (2006): Putting rural development to work for jobs and growth. European Commission, Directorate-General for Agriculture and Rural Development, Special Edition Newsletter.

EUROPEAN COMMISSION (EC) (2008a): Europeans, agriculture and the Common Agricultural Policy. European Commission, Directorate-General for Agriculture and Rural Development, Special Eurobarometer.

EUROPEAN COMMISSION (EC) (2008b): Overview of the implementation of direct payments under the CAP in Member States. European Commission, Directorate-General for Agriculture and Rural Development. URL: http://ec.europa.eu/agriculture/markets/sfp/pdf/2008_01_dp_capFVrev.pdf.

EUROPEAN COMMISSION (EC) (2011): Proposal for a regulation of the European Parliament and the Council establishing rules for direct payments to farmers under support schemes within the framework of the Common Agricultural Policy. COM(2011) 625 final/2, Brussels.

EUROSTAT (2011): Eurostat online database. URL: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/.

FASTERDING, F., RIXEN, D. (2006): Arbeitseinsatz in der deutschen Landwirtschaft und Beschäftigungseffekte politischer Maßnahmen. *Berichte über Landwirtschaft, 84(2):* 243-263.

FLANNERY, M. J., HANKINS, K. W. (2011): Estimating dynamic panel models in corporate finance. *Working Paper Series,* University of Florida and University of Kentucky. URL: http://ssrn.com/abstract=1108684.

FLORENS, J.-P., HECKMAN, J. J., MEGHIR, C., VYTLACIL, E. (2008): Identification of treatment effects using control functions in models with continuous, endogenous treatment and heterogeneous effects. *Econometrica, 76(5):* 1191-1206.

FORSTNER, B., ISERMEYER, F. (2000): Transformation of agriculture in East Germany. in: TANGERMANN, S. (ed.): Agriculture in Germany. DLG Verlag, Frankfurt (Main): 61-90.

GARCIA, P., OFFUT, S. E., SONKA, S. T. (1987): Size distribution and growth in a sample of Illinois cash grain farms. *American Journal of Agricultural Economics, 69(2):* 471-476.

GODDARD, E., WEERSINK, A., CHEN, K., TURVEY, C. G. (1993): Economics of structural change in agriculture. *Canadian Journal of Agricultural Economics, 41(4):* 475-489.

GOLAN, A., JUDGE, G., MILLER, D. (1996): Maximum entropy econometrics: Robust estimation with limited data. John Wiley and Sons, Chichester, UK.

GOODWIN, B. K., MISHRA, A. K. (2006): Are "decoupled" farm program payments really decoupled? An empirical evaluation. *American Journal of Agricultural Economics, 88(1):* 73-89.

GREENE, W. H. (2008): Econometric analysis, $6^{th}$ ed., Pearson Prentice Hall, Upper Saddle River, NJ.

HAMERMESH, D. (1993): Labor demand. Princeton University Press, Princeton, NJ.

HAYASHI, F. (2000): Econometrics. Princeton University Press, Princeton, NJ.

HECKMAN, J. J., VYTLACIL, E. (2005): Structural equations, treatment effects, and econometric policy evaluation. *Econometrica, 73(3):* 669-738.

HECKMAN, J. J.,VYTLACIL, E. (2007): Econometric evaluation of social programs, Part I: Causal models, structural models, and econometric policy evaluation. in: HECKMAN, J. J., LEAMER, E. E. (eds.): Handbook of econometrics. Volume 6B. Elsevier/North-Holland, Amsterdam: 4779-4874.

HECKMAN, J. J., ICHIMURA, H., TODD, P. (1997): Matching as an econometric evaluation estimator: Evidence from evaluating a job training program. *The Review of Economic Studies, 64(4):* 605-654.

HENNESSY, T. C., REHMAN, T. (2008): Assessing the impact of the "decoupling" reform of the Common Agricultural Policy on Irish farmer's off-farm labour market participation decisions. *Journal of Agricultural Economics, 59(1):* 41-56.

HENNING, C., MICHALEK, J. (2008): Ökonometrische Methoden der Politikevaluation: Meilenstein für eine sinnvolle Politik der 2. Säule oder akademische Fingerübung? *German Journal of Agricultural Economics, 57(3/4):* 232-242.

HUETTEL,S., MARGARIAN, A. (2009): Structural change in the West German agricultural sector. *Agricultural Economics* 40 (s1): 759-772.

HUETTEL, S., JONGENEEL, R. (2011): How has the EU milk quota affected patterns of herd-size change? *European Review of Agricultural Economics, 38(4):* 497-527.

ICHIMURA, H., TODD, P. (2007): Implementing nonparametric and semiparametric estimators. in: HECKMAN J. J., LEAMER E. E. (eds.): Handbook of econometrics. Volume 6B. Elsevier/ North-Holland, Amsterdam: 5369-5468.

IM, K., PESARAN, M. H., SHIN, Y. (2003): Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115(1):* 53-74.

IMBENS, G., WOOLDRIDGE, J. (2009): Recent developments in the econometrics of program evaluation. *Journal of Economic Literature, 47(1):* 5-86.

JONGENEEL, R., LONGWORTH, N., HUETTEL, S. (2005): Dairy farm size distribution in East and West: Evolution and sensitivity to structural and policy variables: Case studies of the Netherlands, Germany, Poland, and Hungary. Paper prepared for presentation at the 11th Congress of the EAAE, Copenhagen, Denmark, 24-27 August, 2005.

JUDSON, R. A., OWEN, A. L. (1999): Estimating dynamic panel data models: A guide for macroeconomists. *Economics Letters*, *65(1):* 9-15.

KEY, N., ROBERTS, M. J. (2006): Government payments and farm business survival. *American Journal of Agricultural Economics, 88(2):* 382-392.

KEY, N., ROBERTS, M. J. (2007): Do government payments influence farm size and survival? *Journal of Agricultural and Resource Economics, 32(2):* 330-349.

KEY, N., ROBERTS, M. J. (2009): Nonpecuniarybenefits to farming: Implications for supply response to decoupled payments. *American Journal of Agricultural Economics, 91(1):* 1-18.

KILIAN, S., ANTÓN, J., SALHOFER, K., RÖDER, N. (2012): Impacts of 2003 CAP reform on land rental prices and capitalization. *Land Use Policy, 29(4):* 789-797.

KIVIET, J. F. (1995): On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics, 68(1):* 53-78.

KIVIET, J. F. (1999): Expectations of expansions for estimators in a dynamic panel data model: Some results for weakly exogenous regressors. in: HSIAO, C., LAHIRI, K., LEE, L.-F., PESERAN, M. H. (eds.): Analysis of panels and limited dependent variable models, Inhonour of G.S.Maddala. Cambridge University Press, Cambridge: 199-225.

KLAGES, B. (2001): Die Privatisierung der ehemals volkseigenen landwirtschaftlichen Flächen in den neuen Bundesländern. Shaker, Aachen.

KOESTER, U. E., BROOKS, K. M. (1997): Agriculture and German reunification. *World Bank Discussion Paper No. 355,* World Bank,Washington D.C.

KÜNSTLING, D. (2010): Kein Geld ohne Plan. *Neue Landwirtschaft, 21(2):*17-20.

LEATHERS, H. D. (1992): The market for land and the impact of farm programs on farm numbers. *American Journal of Agricultural Economics*, *72(2):* 291-298.

LENCE, S. H., MISHRA, A. K. (2003): The impacts of different farm programs on cash rents. *American Journal of Agricultural Economics, 85(3):* 753-761.

MANN, S. (2003a): Bestimmungsgründe des landwirtschaftlichen Strukturwandels. *Agrarforschung, 10(1):* 32-36.

MANN, S. (2003b): Theorie und Empirie agrarstrukturellen Wandels? *German Journal of Agricultural Economics, 52(3):* 140-148.

MEHL, P. (1999): Transformation of the social security system in agriculture in East Germany: Lessons for Central and Eastern European Countries. in: FROHBERG, K., WEINGARTEN, P. (eds.): The significance of politics and institutions for the design and formation of agricultural policies. *Studies on the Agricultural and Food Sector in Central and Eastern Europe, Vol. 2,* Wissenschaftsverlag Vauk, Kiel: 139-156.

NAWROTH, G. (2006): Agrarkredit im Wandel? *Neue Landwirtschaft, 17(4):* 20-23.

NICKELL, S. J. (1981): Biases in dynamic models with fixed effects. *Econometrica, 49(6):* 1417-1426.

NICKELL, S. J. (1986): Dynamic models of labour demand. in: ASHENFELTER, O., LAYARD, R. (eds.): Handbook of labor economics, Vol. 1. Elsevier, Amsterdam: 473-522.

OLPER, A., RAIMONDI, V., CAVICCHIOLI, D. , VIGANI, M. (2011): Does Common Agricultural Policy reduce farm labor migration? A panel data analysis across EU regions. Paper prepared for presentation at the EAAE 2011 Congress, Zurich, Switzerland, August 30 to September 2, 2011.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD) (2004): OECD employment outlook. Chapter 2: Employment protection regulation and labour market performance. OECD, Paris.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD) (2011): Agricultural policy reforms in the European Union. OECD, Paris.

OUDE LANSINK, A., PIETOLA, K. (2005): Semi-parametric modeling of investments in heating installations: The case of the Dutch glasshouse industry. *Journal of Agricultural Economics 56(3):* 433-448.

PATTON, M., KOSTOV, P., MCERLEAN, S., MOSS, J. (2008): Assessing the influence of direct payments on the rental value of agricultural land. *Food Policy, 33(5):* 397-405.

PETRICK, M. (2004a): A microeconometric analysis of credit rationing in the Polish farm sector. *European Review of Agricultural Economics, 31(1):* 77-101.

PETRICK, M. (2004b): Farm investment, credit rationing, and governmentally promoted credit access in Poland: A cross-sectional analysis. *Food Policy, 29(3):* 275-294.

PETRICK, M. (2008): The co-evolution of semantics and policy paradigms: 50 years of Europe’s Common Agricultural Policy. *Intereconomics, 43(4):* 246-252.

PETRICK, M., ZIER, P. (2011a): Beschäftigungseffekte der Gemeinsamen Agrarpolitik in der ostdeutschen Landwirtschaft. *IAMO Policy Brief Nr. 1,* IAMO, Halle (Saale).

PETRICK, M., ZIER, P. (2011b): Regional employment impacts of Common Agricultural Policy measures in Eastern Germany: A difference-in-differences approach. *Agricultural Economics, 42(2):* 183-193.

PETRICK, M., ZIER, P. (2012): Common Agricultural Policy effects on dynamic labour use in agriculture. *Food Policy, 37(6):* 671-678.

PIET, L., LATRUFFE, L., LE MOUËL, C., DESJEUX, Y. (2012): How do agricultural policies influence farms size inequality? The example of France. *European Review of Agricultural Economics, 39(1):* 5-28.

PIETOLA, K., MYERS, R. (2000): Investment under Uncertainty and Dynamic Adjustment in the Finnish Pork Industry. *American Journal of Agricultural Economics, 82(4):* 956-967.

PUFAHL, A., WEISS, C. R. (2009): Evaluating the effects of farm programs: Results from propensity score matching. *European Review of Agricultural Economics, 36(1):* 79-101.

ROBERTS, M. J., KEY, N. (2008): Agricultural payments and land concentration: A semiparametric spatial regression analysis. *American Journal of Agricultural Economics, 90(3):* 627-643.

ROBERTS, M. J., KIRWAN, B., HOPKINS, J. (2003): The incidence of government program payments on agricultural land rents: The challenges of identification. *American Journal of Agricultural Economics, 85(3):* 762-769.

ROSENBAUM, P., RUBIN, D. (1983): The central role of the propensity score in observational studies for causal effects. *Biometrika, 70(1):* 41-55.

RUDOLPH, M. (2005): Agrarstrukturpolitik im vereinten Deutschland. Eine Analyse der Gemeinschaftsaufgabe "Verbesserung der Agrarstruktur und des Küstenschutzes" im Lichte der neuen politischen Ökonomie. Shaker, Aachen.

SAHRBACHER, C., BALMANN, A., OSTERMEYER, A., SCHÖNAU, F. (2011): GAP-Reformvorschläge der EU-Kommission: Was sind die Auswirkungen einer Kappung der Direktzahlungen? *IAMO Policy Brief Nr. 5,* IAMO, Halle (Saale).

SALHOFER, K. (2000): Elasticities of substitution and factor supply elasticities in European agriculture: A review of past studies. *Diskussionspapier Nr. 83-W-2000 des Instituts für Wirtschaft, Politik und Recht der Universität für Bodenkultur,* Wien.

SALHOFER, K., STREICHER, G. (2004): Self-selection as a problem in evaluating agri-environmental programs. in: ORTNER, K. M. (ed.): Assessing rural development policies of the Common Agricultural Policy. WissenschaftsverlagVauk, Kiel: 203-213.

SCHMITT, B., LOFREDI, P., BERRIET-SOLLIEC, M., LEPICIER, D. (2004): Impact evaluation of the EU program for rural development in Burgundy: Correction for selection bias. *Revised version of Working Paper 2003/6,* CEASAER (UMR INRA-ENESAD), Dijon.
URL: http://www2.dijon.inra.fr/esr/pagesperso/schmitt/BS_PL_MBS_DL_NewV.pdf.

SCKOKAI, P., MORO, D. (2006): Modeling the reform of the Common Agricultural Policy for arable crops under uncertainty. *American Journal of Agricultural Economics, 88(1):* 43-56.

SCKOKAI, P., MORO, D. (2009): Modelling the impact of the CAP Single Farm Payment on farm investment and output. *European Review of Agricultural Economics, 36(3):* 395-423.

SERRA, T., ZILBERMAN, D., GOODWIN, B. K., FEATHERSTONE, A (2006): Effects of decoupling on the mean and variability of output. *European Review of Agricultural Economics, 33(3):* 269-288.

SHAIK, S., HELMERS, G. A., ATWOOD, J. A. (2005): The evolution of farm programs and their contribution to agricultural land values. *American Journal of Agricultural Economics, 87(5):* 1190-1197.

SHUCKSMITH, M., THOMSON, K. J., ROBERTS, D. (eds.) (2005): The CAP and the regions. The territorial impact of the Common Agricultural Policy. CABI, Wallingford.

SHUMWAY, C. R., POPE, R. D., NASH, E. K. (1984): Allocatable fixed inputs and jointness in agricultural production: Implications for economic modeling. *American Journal of Agricultural Economics, 66(1):* 72-78.

SINABELL, F., STREICHER, G. (2004): Programme evaluation with micro-data: The use of FADN data to evaluate effects on the market situation of programme participants. in: ORTNER, K. M. (ed.): Assessing rural development policies of the Common Agricultural Policy. WissenschaftsverlagVauk, Kiel: 267-280.

SMITH, J. (2004): Evaluating local economic development policies: Theory and practice. in: OECD (ed.): Evaluating local economic and employment. OECD, Paris: 287-332.

STATA (2011): Stata 12 base reference manual. Stata Press, College Station.

STATISTISCHE ÄMTER DES BUNDES UND DER LÄNDER (SÄBL) (2010a): Volkswirtschaftliche Gesamtrechnung der Länder. Reihe 2, Kreisergebnisse Bd. 1: Bruttoinlandsprodukt, Bruttowertschöpfung in den kreisfreien Städten und Landkreisen Deutschlands 1992 und 1994 bis 2009. URL: http://www.vgrdl.de/Arbeitskreis_VGR/ergebnisse.asp.

STATISTISCHE ÄMTER DES BUNDES UND DER LÄNDER (SÄBL) (2010b): Volkswirtschaftliche Gesamtrechnung der Länder. Reihe 2, Kreisergebnisse Bd. 2: Arbeitnehmerentgelt in den kreisfreien Städten und Landkreisen Deutschlands 1996 bis 2009. URL: http://www.vgrdl.de/Arbeitskreis_VGR/ergebnisse.asp.

STATISTISCHE ÄMTER DES BUNDES UND DER LÄNDER (SÄBL) (2011): Regionaldatenbank Deutschland. URL: https://www.regionalstatistik.de/genesis/online.

STATISTISCHES BUNDESAMT (SBA) (various years): Statistisches Jahrbuch für die Bundesrepublik Deutschland. W. Kohlhammer GmbH, Stuttgart und Mainz.

STAATLICHE ZENTRALVERWALTUNG FÜR STATISTIK (SZS) (various years): Statistisches Jahrbuch der Deutschen Demokratischen Republik. Staatsverlag der Deutschen Demokratischen Republik, Berlin.

STEAD, D. R. (ed.) (2008): Special section on the Common Agricultural Policy at fifty. *Euro-Choices,* 7(2): 4-29.

STEFANOU, S., FERNANDEZ-CORNEJO, J., GEMPESAW, C., ELTERICH, J. (1992): Dynamic structure of production under a quota: The case of milk production in the Federal Republic of Germany. *European Review of Agricultural Economics, 19(3):* 283-299.

STOKES, J. R. (2006): Entry, exit, and structural change in Pennsylvania's dairy sector. *Agricultural and Resource Economics Review, 35(2):* 357-373.

TELSER, L. G. (1963): Least-squares estimation of transition probabilities. in: CHRIST, D. F. (ed.): Measurement in economics: Studies in mathematical economics and econometrics, In memory of Yehuda Grunfeld. Stanford University Press, Stanford: 270-292.

TRACY, M. (1993): Food and agriculture in a market economy. An introduction to theory, practice and policy. *Agricultural Policy Studies,* La Hutte, Belgium.

UHLIG, H. (2008): The slow decline of EastGermany. *Journal of Comparative Economics, 36(4):* 517-541.

VASAVADA, U., CHAMBERS, R. (1986): Investment in U.S. agriculture. *American Journal of Agricultural Economics, 68(4):* 950-960.

WEISS, C. R. (1999): Farm growth and survival: Econometric evidence for individual farms in Upper Austria. *American Journal of Agricultural Economics, 81(1):* 103-116.

WINDMEIJER, F. (2005): A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, 126(1): 25-51.

WELSCHOF, J., SCHMIDT, D., KLAUS, H. (1993): Eine empirische Untersuchung der Entwicklungshemmnisse landwirtschaftlicher Unternehmen in den neuen Bundesländern. in: LANDWIRTSCHAFTLICHE RENTENBANK (ed.): Entwicklungshemmnisse landwirtschaftlicher Unternehmen in den neuen Bundesländern, Frankfurt/Main: 13-55.

WOLDEHANNA, T., OUDELANSINK, A., PEERLINGS, J. (2000): Off-farm work decisions on Dutch cash crop farms and the 1992 and Agenda 2000 CAP reforms. *Agricultural Economics, 22(2):* 163-171.

YATCHEW, A. (2003): Semiparametric regression for the applied econometrician. Cambridge University Press, Cambridge.

ZELLNER, A. (1962): An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American Statistical Association, 57(298):* 348-368.

ZELLNER, A., THEIL, H. (1962): Three-stage least squares: Simultaneous estimation of simultaneous equations. *Econometrica, 30(1):* 54-78.

ZEPEDA, L. (1995): Asymmetry and nonstationarity in the farm size distribution of Wisconsin milk producers: An aggregate analysis. *American Journal of Agricultural Economics, 77(4):* 873-852.

ZIER, P., PETRICK, M. (2010a): Direct payments, farm survival, and strategic farm creation: The case of large-scale agricultural structures in East Germany. Poster prepared for presentation at the AAEA, CAES, and WAEA Joint Annual Meeting, Denver, Colorado, USA, July 25 to 27, 2010.

ZIER, P., PETRICK, M. (2010b): CAP reform and the effects of direct payments on heterogeneous farm structures in East Germany. Paper prepared for presentation at the 50th Annual Conference of the GEWISOLA, Braunschweig, Germany, September 29 to October 1, 2010.

ZIER, P., PETRICK, M., GLAUBEN, T. (2011): Aspekte der Agrarpolitik 2010. *German Journal of Agricultural Economics, 60 (Supplement):* 1-20.

ZIMMERMANN, A., HECKELEI, T., PÉREZ, I. (2006): Working paper – Literature review of approaches to estimate structural change. *SEAMLESS Report No. 16.* URL: http://www.seamless-ip.org/Reports/Report_16_PD3.6.6.pdf.

# APPENDIX

**Table A-1: Agricultural workforce in the former GDR, 1980 and 1989**

| | 1980 | 1989 | Rate of change |
|---|---|---|---|
| | 1000 persons in employment | | in % |
| Total work force | 780.2 | 819.6 | 5.05 |
| thereof: | | | |
| Primary production | 576.3 | 548.2 | -4.88 |
| Auxiliary production | 86.1 | 127.1 | 47.62 |
| Management and administration | 84.4 | 101.2 | 19.91 |
| Cultural and social sector | 33.4 | 43.1 | 29.04 |

Source: Author's calculation based on AGRARBERICHT (1991: 139).

**Table A-2: Average compensation per hectare for LFA in East Germany, 2000-2006**

| | Average amount of compensation for LFA (EC) 1257/1999 Art. 19, Euro per hectare | | | | | | |
|---|---|---|---|---|---|---|---|
| Federal State of | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| Brandenburg | 35.6 | . | 34.0 | 34.4 | 33.5 | 33.9 | 34.4 |
| Mecklenburg-West Pomerania | 43.5 | . | 52.0 | 46.1 | 84.6 | 58.5 | 57.5 |
| Saxony | 47.6 | . | 67.0 | 62.7 | 29.5 | 28.1 | 15.1 |
| Saxony-Anhalt | 50.2 | . | 63.0 | 13.1 | 56.5 | 51.1 | 44.4 |
| Thuringia | 88.0 | . | 80.0 | 52.8 | 76.5 | 66.0 | 77.9 |

Source: Author's calculation based on BMELV (2011b)

Note: . no data available.

**Table A-3: CAP policy aggregates and their components**

| Aggregate policy measure | Components |
|---|---|
| | CAP pillar I |
| Coupled area payments | until 2004:<br>Aid for peas and beans, lineseed, rapeseed, sunflower seed, and soybean, grain (without maize), industrial maize; obligatory and facultative set-aside acreage; additional aid for industrial durum (EEC 1765/92, EC 1872/94 and EC 1251/1999);<br>Aid for specific grain legumes (lentils, chick peas, vetches) (EC 1577/96)<br>Aid for flax and hemp (EEC 1308/70, EEC 619/71, EEC 620/71, EEC 1172/71, EEC 1430/82, EEC 2059/84 andEC 1673/2000).<br>from 2005:<br>Additional amount of aid; protein crop premium; aid for energy crops; aid for starch potato (EC 1782/2003). |
| Coupled livestock payments | until 2004:<br>Special premium male cattle; suckler cow premium; slaughter premium; cattle premium; milk premium (EC 1254/1999); ewe premium (EC 2529/2001).<br>from 2005:<br>No payments. |
| Decoupled direct payments | 2005 and 2006:<br>Payments according to the single payment scheme (EC 1782/2003). |
| | CAP pillar II |
| Development of rural areas | Aid for tourism; development of rural areas; village renewal; integrated rural development; improvement of rural infrastructure; land consolidation; environmental and nature protection (EC 1257/1999, Art. 33). |
| Processing and marketing of agricultural products | Improvement of market structure; aid for processing and marketing of agricultural products (EC 1257/1999, Art. 25). |
| Investment aid | Investment in agricultural holdings, aid for direct marketing, aid for horticulture, aid for livestock production (EC 1257/1999, Art. 4); setting up of young farmers (EC 1257/1999, Art. 8); state specific investment aid Saxony. |
| Compensation for LFA | Aid for less favored areas and areas with environmental restrictions (EC 1257/1999, Art. 18-20). |
| Agri-environmental measures | Organic farming; aid for extensive use of agricultural land and perennial crops; extensive use of grassland; provision of breed and gene reserves; contract nature protection scheme (EEC 2078/92, EC 1257/1999 Art. 22); Natura 2000; KULAP 2000; cultivation under environmental protection; modulation measures for crop diversification, tillage and extensive use of grassland. |

Source: Author’s depiction based on information by state paying agencies.

Table A-3 presents the components of the eight policy aggregates used in the present study. Note that the three federal states did not implement all measures offered within the CAP. Furthermore, in the period under investigation, Saxony offered a fully state-funded farm investment scheme that was included in the respective aggregates. Brandenburg and Saxony offered a state-funded agri-environmental program for the extensive use of agricultural land (KULAP 2000). Direct payments under the CAP were split into the three aggregates coupled area payments, coupled livestock payments, and decoupled payments. The single measures listed in regulation EC 1257/1999 were aggregated according to the Operational Programs and Rural Development Plans of the states. The accompanying measures prior to 1999 have been aggregated following the policy schemes of the funding period 1999 to 2006. Due to the fact that the two pillar structure of the CAP was introduced with the regulation EC 1957/1999, measures that were in place beforehand are correspondingly assigned to the two pillars.

**Table A-4: GDP deflator, Germany, 1994-2007**

| Year | GDP deflator |
|---|---|
| 1994 | 98.7 |
| 1995 | 103.3 |
| 1996 | 101.9 |
| 1997 | 99.3 |
| 1998 | 99.7 |
| 1999 | 100.7 |
| 2000 | 100.0 |
| 2001 | 101.2 |
| 2002 | 102.6 |
| 2003 | 103.9 |
| 2004 | 104.8 |
| 2005 | 105.5 |
| 2006 | 106.1 |
| 2007 | 108.1 |

Source: EUROSTAT (2011).

## Table A-5: Sample of counties by federal state

| Acronym | County | Federal State of |
|---|---|---|
| BAR | Landkreis Barnim | Brandenburg |
| CB | kreisfreie Stadt Cottbus | Brandenburg |
| DS | Landkreis Dahme-Spreewald | Brandenburg |
| EE | Landkreis Elbe-Elster | Brandenburg |
| FF | kreisfreie Stadt Frankfurt(Oder) | Brandenburg |
| HVL | Landkreis Havelland | Brandenburg |
| LOS | Landkreis Oder-Spree | Brandenburg |
| MOL | Landkreis Märkisch-Oderland | Brandenburg |
| OHV | Landkreis Oberhavel | Brandenburg |
| OPR | Landkreis Ostprignitz-Ruppin | Brandenburg |
| OSL | Landkreis Oberspreewald-Lausitz | Brandenburg |
| PM | Landkreis Potsdam-Mittelmark | Brandenburg |
| PR | Landkreis Prignitz | Brandenburg |
| SPN | Landkreis Spreewald-Neiße | Brandenburg |
| TF | Landkreis Teltow-Fläming | Brandenburg |
| UM | Landkreis Uckermark | Brandenburg |
| ANA | Landkreis Annaberg | Saxony |
| AU | Landkreis Aue-Schwarzenberg | Saxony |
| BZ | Landkreis Bautzen | Saxony |
| C | kreisfreie Stadt Chemnitz | Saxony |
| C_L | Landkreis Chemnitzer Land | Saxony |
| DD | kreisfreie Stadt Dresden | Saxony |
| DL | Landkreis Döbeln | Saxony |
| DW | Weißeritzkreis | Saxony |
| DZ | Landkreis Delitzsch | Saxony |
| FG | Landkreis Freiberg | Saxony |
| GR | kreisfreie Stadt Görlitz | Saxony |
| HY | kreisfreie Stadt Hoyerswerda | Saxony |
| KM | Landkreis Kamenz | Saxony |
| L | kreisfreie Stadt Leipzig | Saxony |
| L_L | Landkreis Leipziger Land | Saxony |
| LÖB | Landkreis Löbau-Zittau | Saxony |
| MEI | Landkreis Meißen | Saxony |
| MEK | Mittlerer Erzgebirgskreis | Saxony |
| MTK | Muldentalkreis | Saxony |
| MW | Landkreis Mittweida | Saxony |
| NOL | Niederschlesischer Oberlausitzkreis | Saxony |
| PIR | Landkreis Sächsische Schweiz | Saxony |
| PL | kreisfreie Stadt Plauen | Saxony |
| RG | Landkreis Riesa-Großenhain | Saxony |
| STL | Landkreis Stollberg | Saxony |
| TO | Landkreis Torgau-Oschatz | Saxony |
| V | Vogtlandkreis | Saxony |
| Z | kreisfreie Stadt Zwickau | Saxony |
| Z_L | Landkreis Zwickauer Land | Saxony |

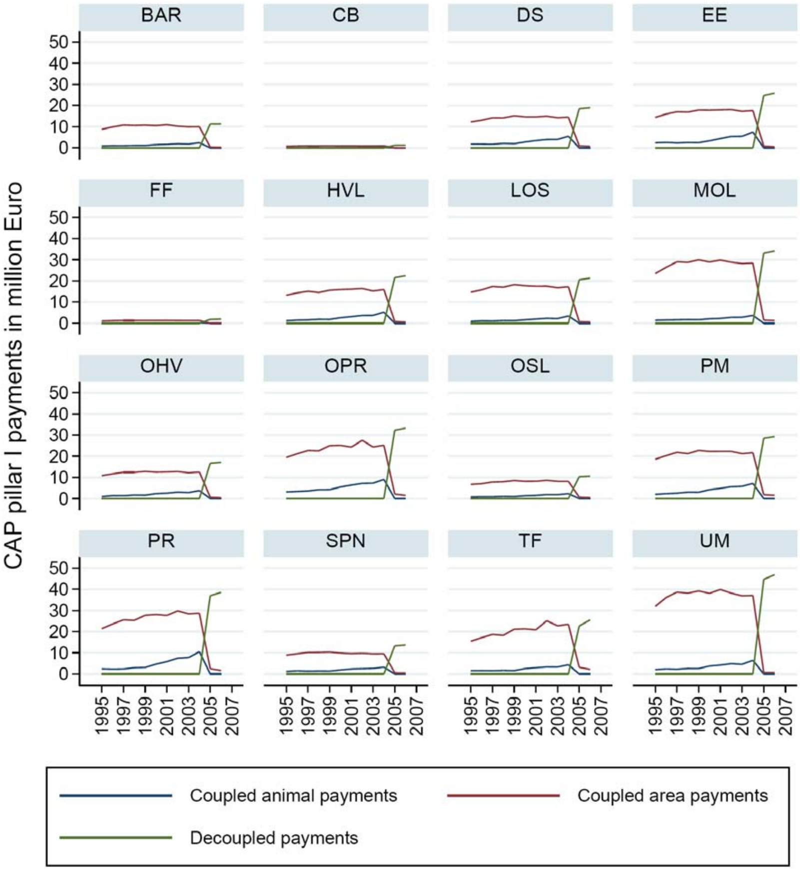
**Table A-5: Sample of counties by federal state (continued)**

| Acronym | County | Federal State of |
|---|---|---|
| ASL | Landkreis Aschersleben-Staßfurt | Saxony-Anhalt |
| AZE | Landkreis Anhalt-Zerbst | Saxony-Anhalt |
| BBG | Landkreis Bernburg | Saxony-Anhalt |
| BLK | Burgenlandkreis | Saxony-Anhalt |
| BÖ | Bördekreis | Saxony-Anhalt |
| BTF | Landkreis Bitterfeld | Saxony-Anhalt |
| DE | kreisfreie Stadt Dessau | Saxony-Anhalt |
| HAL | kreisfreie Stadt Halle | Saxony-Anhalt |
| HBS | Landkreis Halberstadt | Saxony-Anhalt |
| JL | Landkreis Jerichower Land | Saxony-Anhalt |
| KÖT | Landkreis Köthen | Saxony-Anhalt |
| MD | kreisfreie Stadt Magdeburg | Saxony-Anhalt |
| ML | Landkreis Mansfelder Land | Saxony-Anhalt |
| MQ | Landkreis Merseburg-Querfurt | Saxony-Anhalt |
| OK | Ohrekreis | Saxony-Anhalt |
| QLB | Landkreis Quedlinburg | Saxony-Anhalt |
| SAW | Altmarkkreis Salzwedel | Saxony-Anhalt |
| SBK | Landkreis Schönebeck | Saxony-Anhalt |
| SDL | Landkreis Stendal | Saxony-Anhalt |
| SGH | Landkreis Sangerhausen | Saxony-Anhalt |
| SK | Saalkreis | Saxony-Anhalt |
| WB | Landkreis Wittenberg | Saxony-Anhalt |
| WR | Landkreis Wernigerode | Saxony-Anhalt |
| WSF | Landkreis Weißenfels | Saxony-Anhalt |

Source: Author’s depiction based on data of the state ministries.

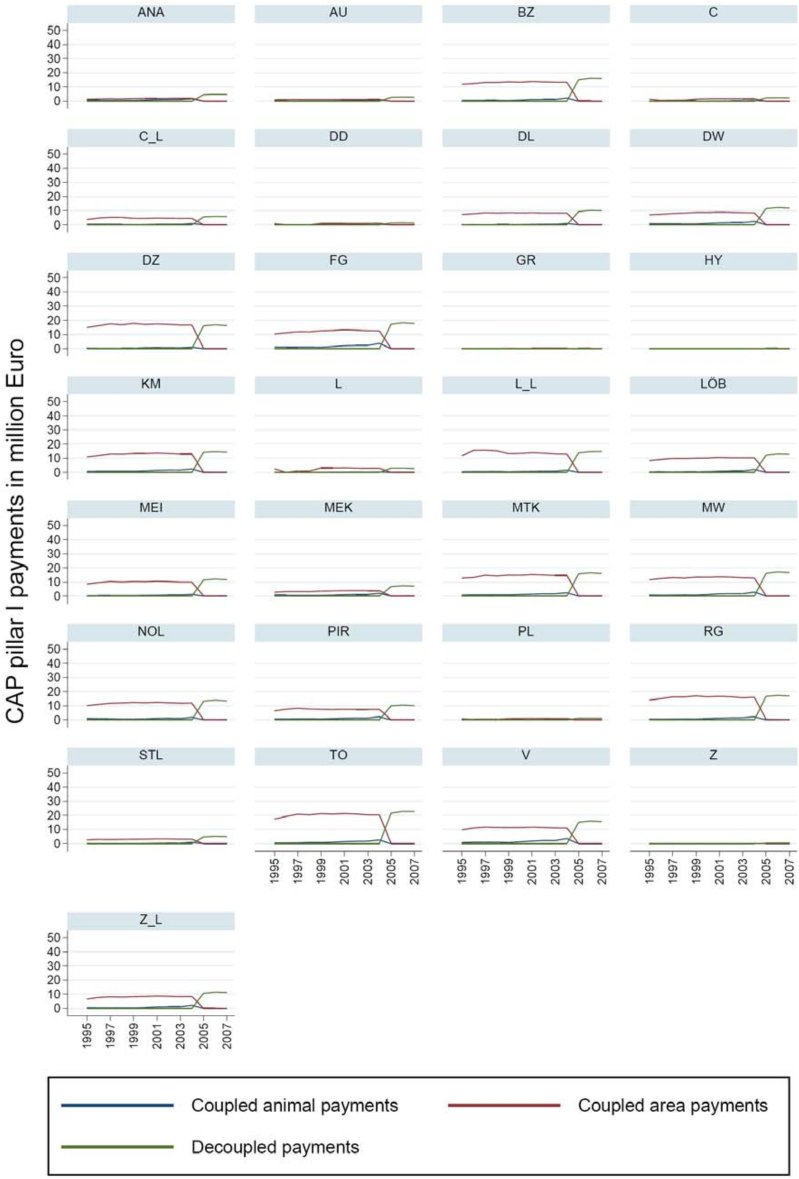
Note: The applied territorial status is the one resulting from the district reforms of 1993 in Brandenburg, 1994 in Saxony-Anhalt, as well as 1994 and 1996 in Saxony. The latest district reforms of 2007 in Saxony-Anhalt and 2008 in Saxony are disregarded.

**Figure A-1: Disbursed CAP pillar I payments, Brandenburg, 1995-2006**



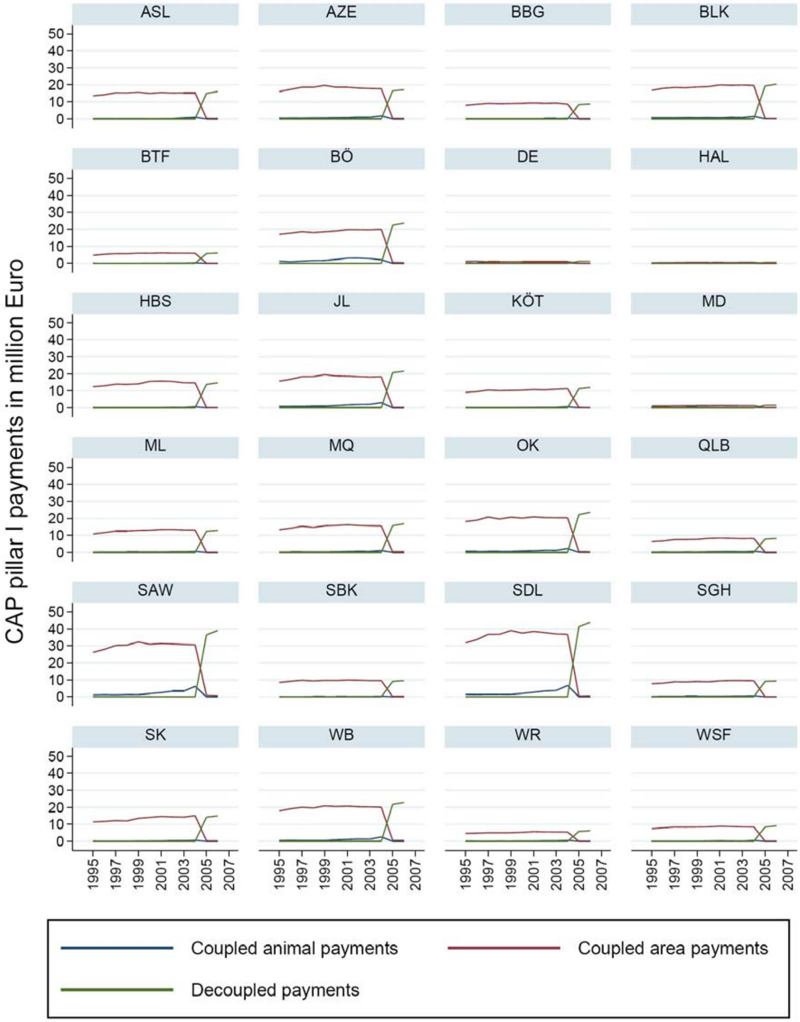

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-2: Disbursed CAP pillar I payments, Saxony, 1995-2007**



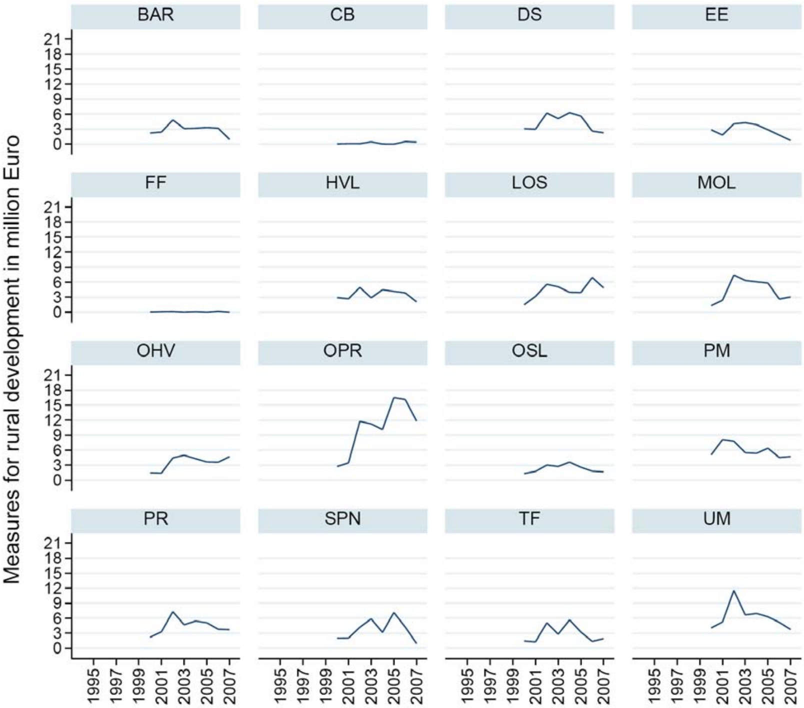

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-3: Disbursed CAP pillar I payments, Saxony-Anhalt, 1995-2006**



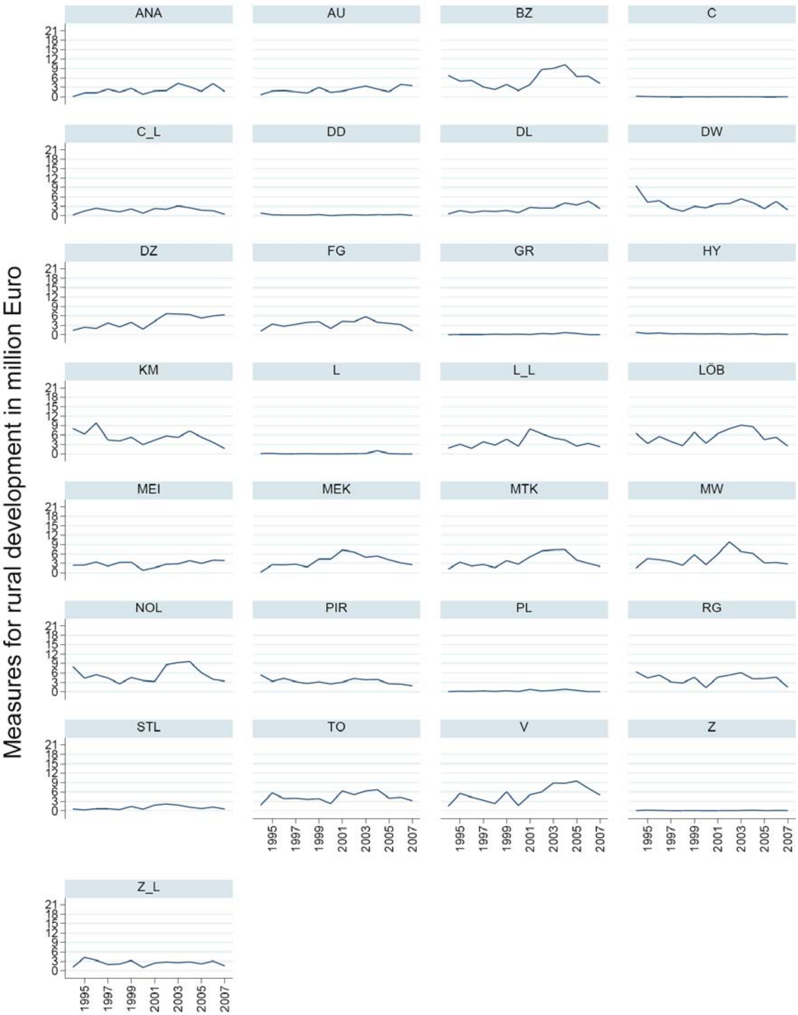

Source: Author’s calculations based on unpublished data of the state ministries.

**Figure A-4: Disbursed payments for the development of rural areas, Brandenburg, 2000-2007**



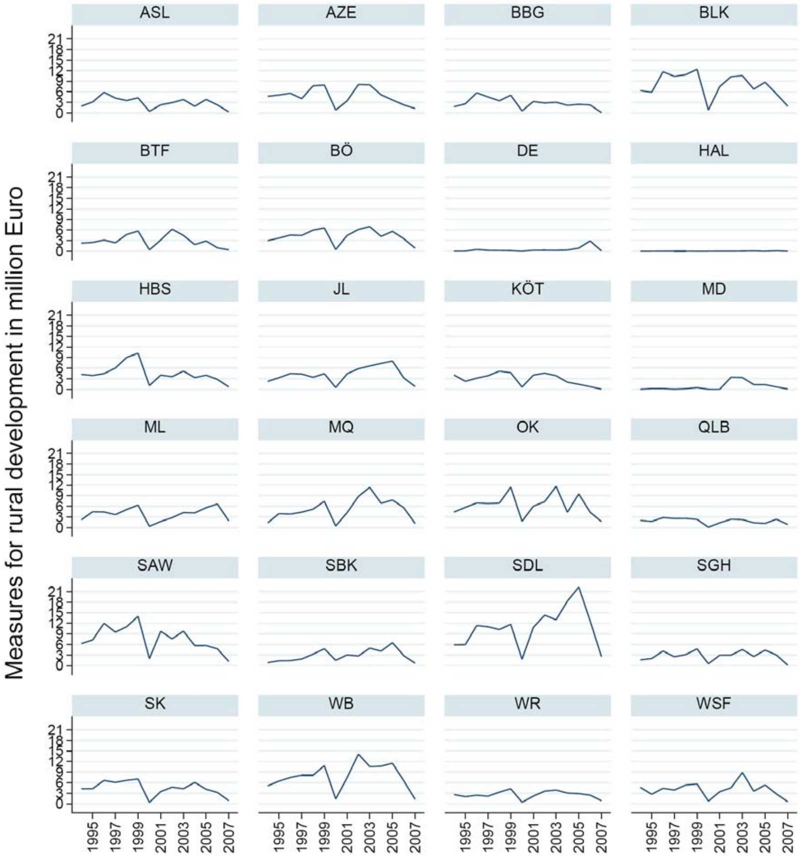

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-5: Disbursed payments for the development of rural areas, Saxony, 1994-2007**



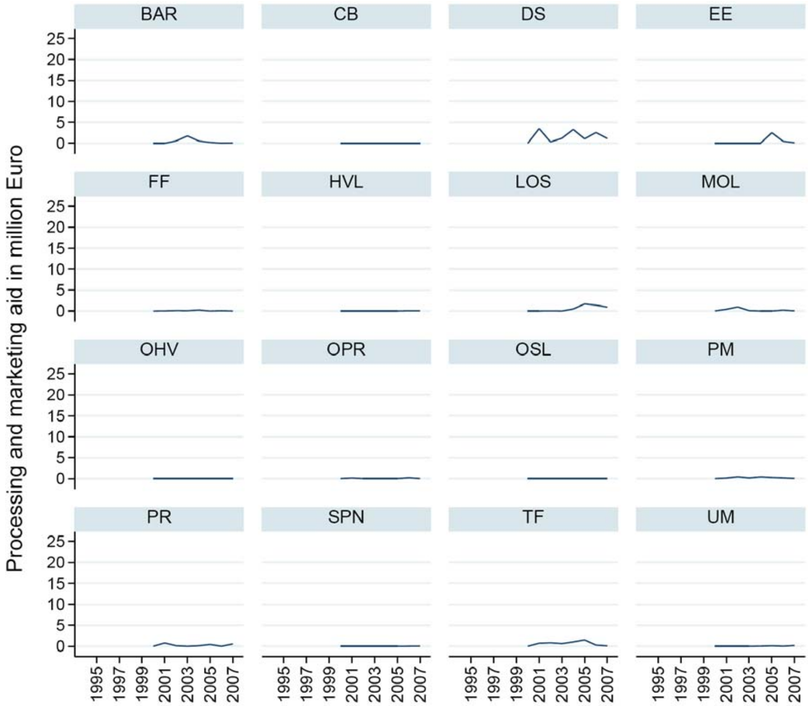

Source: Author’s calculations based on unpublished data of the state ministries.

**Figure A-6: Disbursed payments for the development of rural areas, Saxony-Anhalt, 1994-2007**



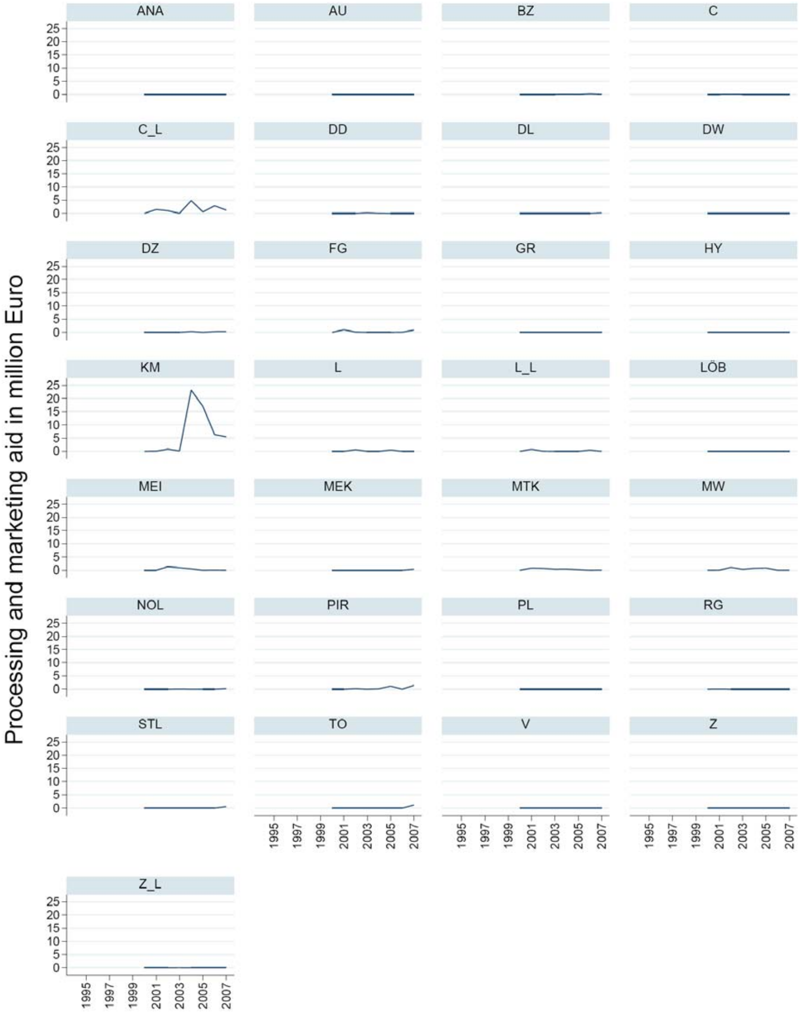

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-7: Disbursed processing and marketing aid, Brandenburg, 2000-2007**



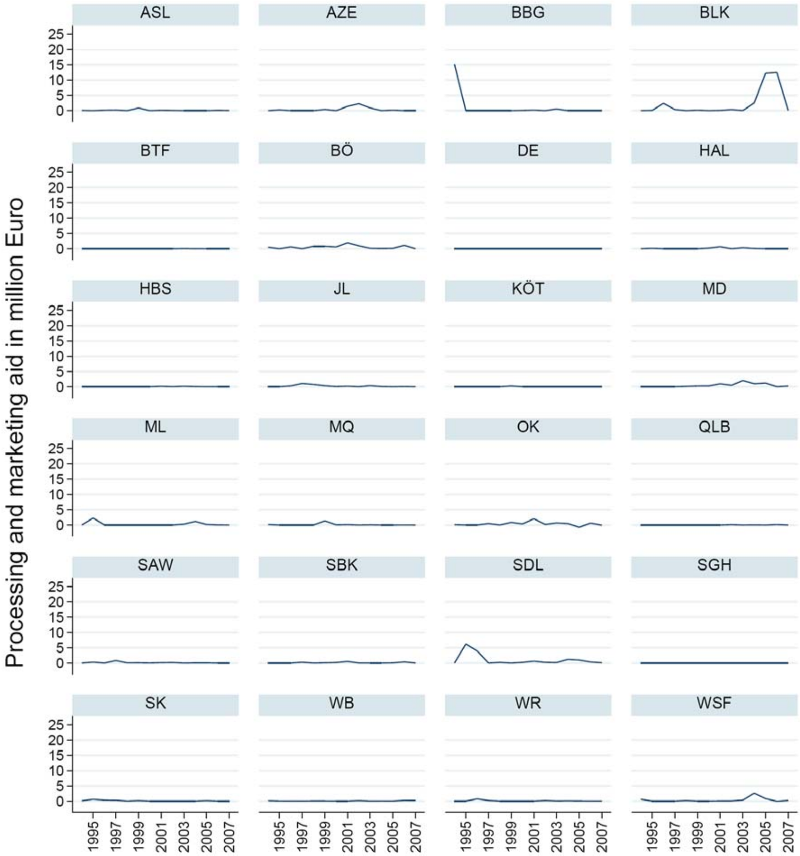

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-8: Disbursed processing and marketing aid, Saxony, 2000-2007**



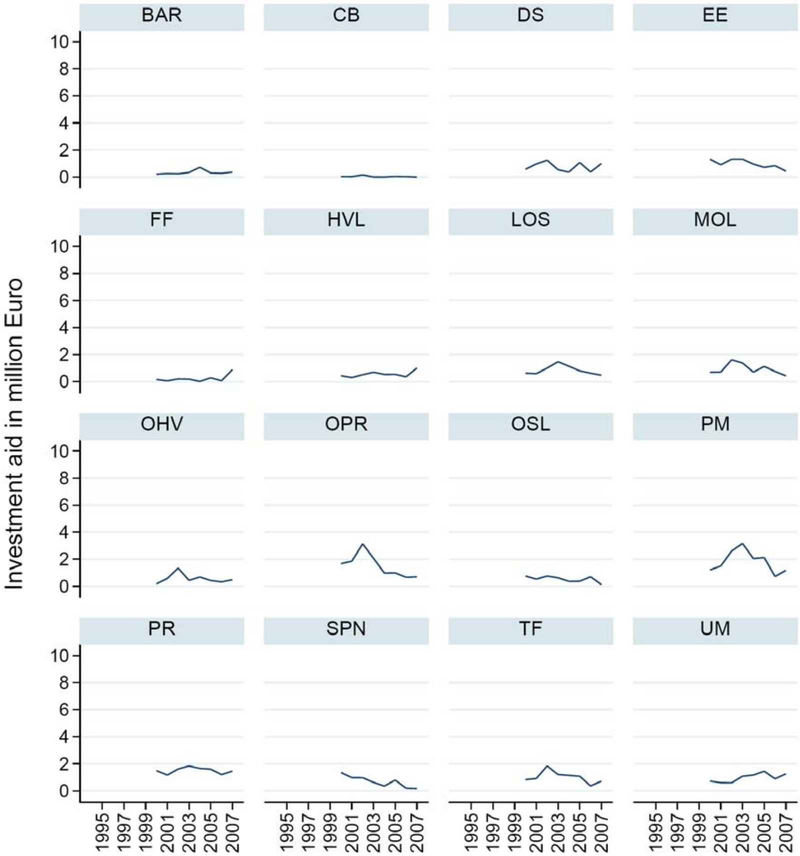

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-9: Disbursed processing and marketing aid, Saxony-Anhalt, 1994-2007**



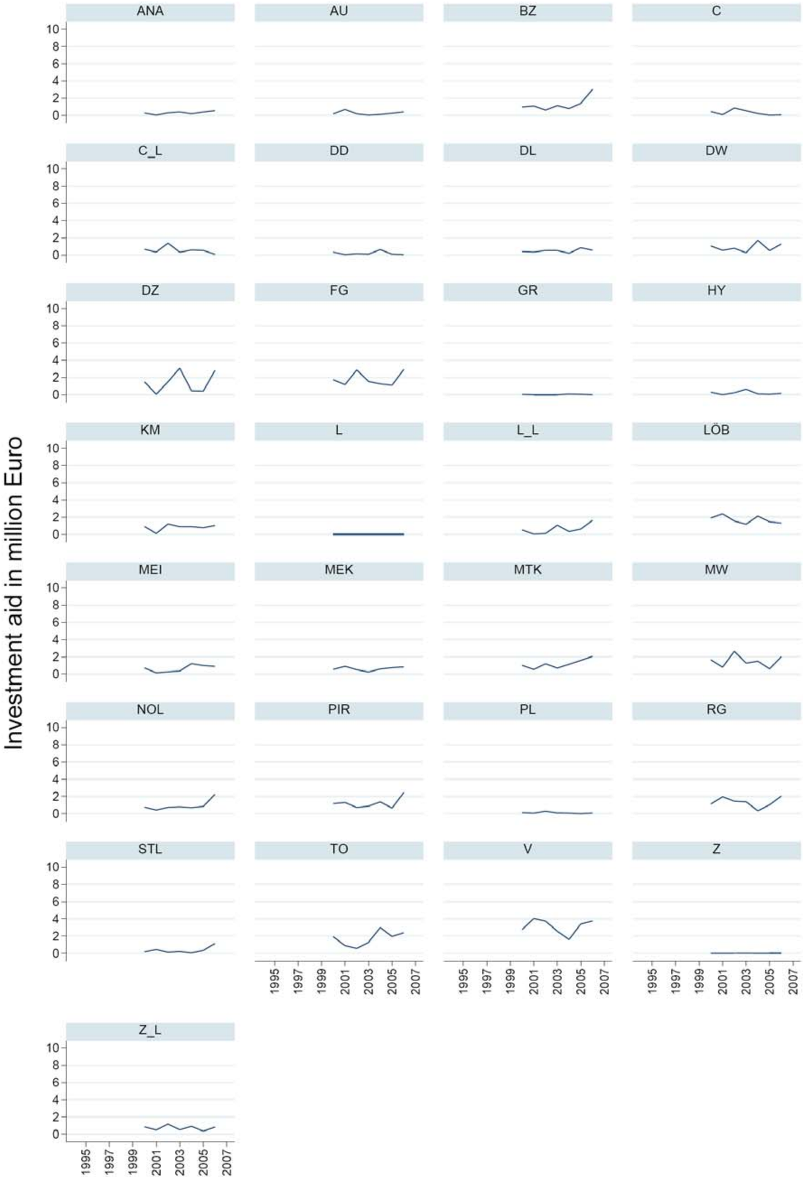

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-10: Disbursed investment aids, Brandenburg, 2000-2007**



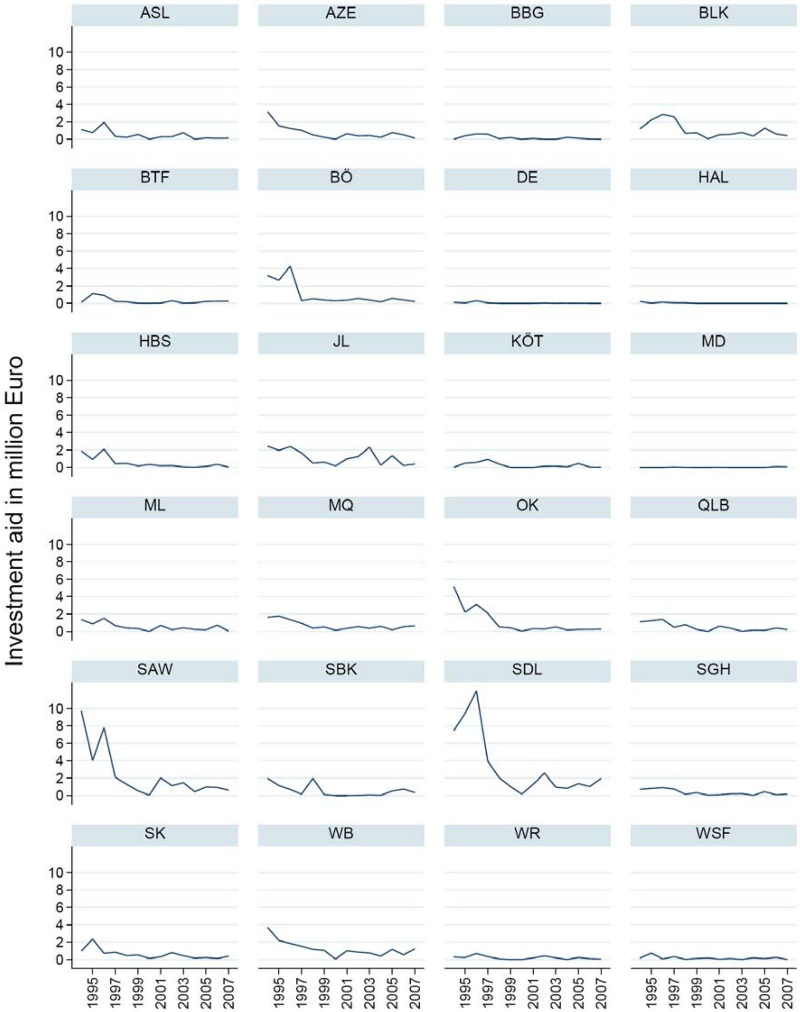

Source: Author’s calculations based on unpublished data of the state ministries.

**Figure A-11: Disbursed investment aids, Saxony, 2000-2006**



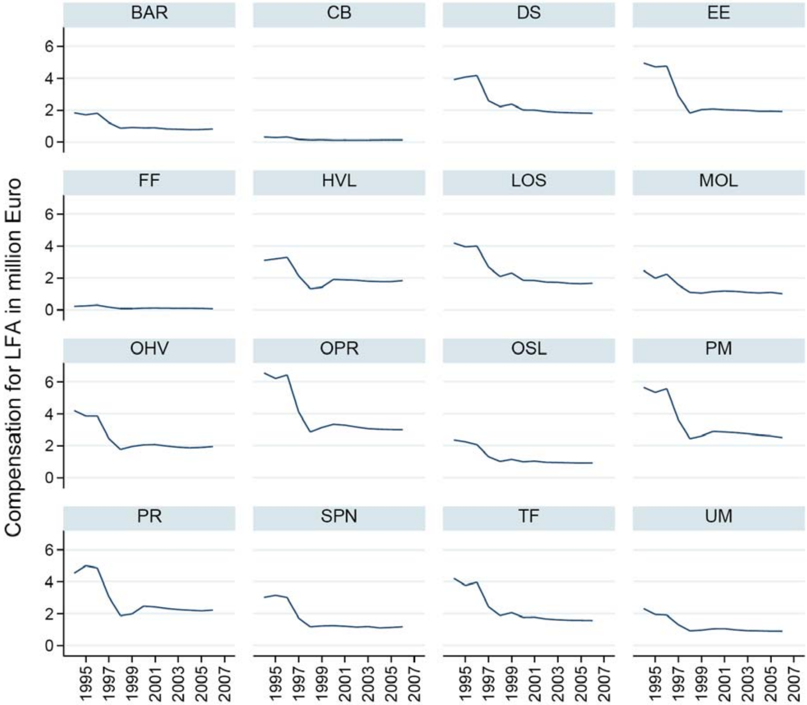

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-12: Disbursed investment aids, Saxony-Anhalt, 1994-2007**



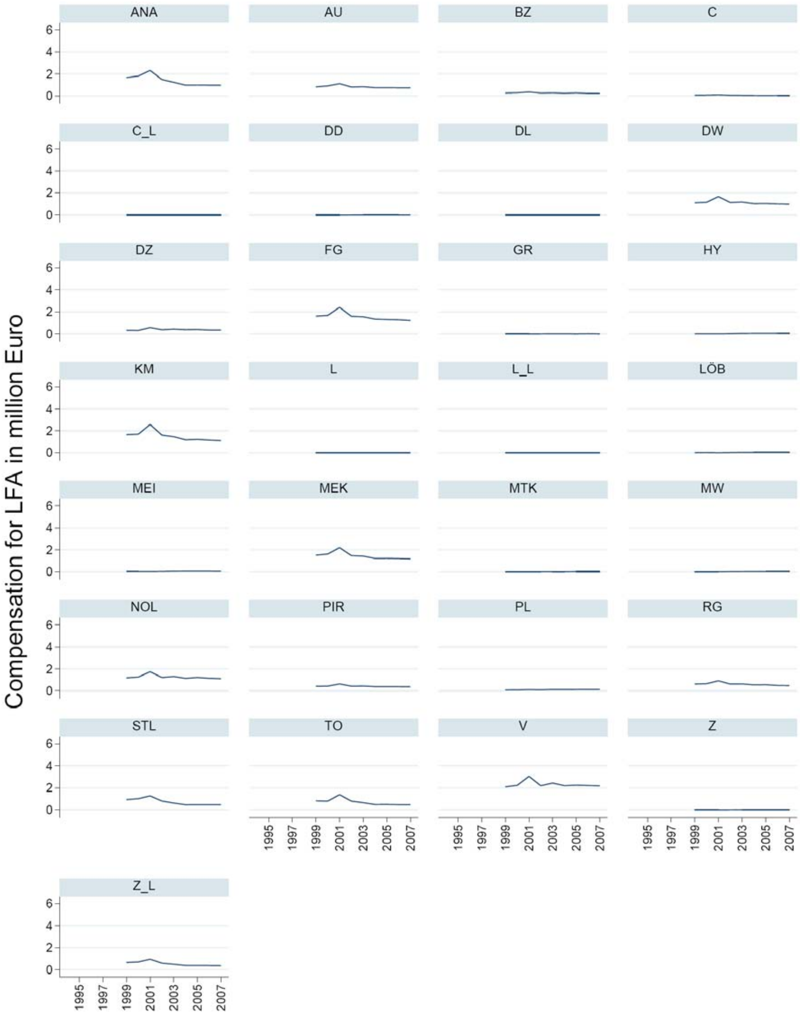

Source: Author’s calculations based on unpublished data of the state ministries.

**Figure A-13: Disbursed compensation for LFA, Brandenburg, 1994-2006**



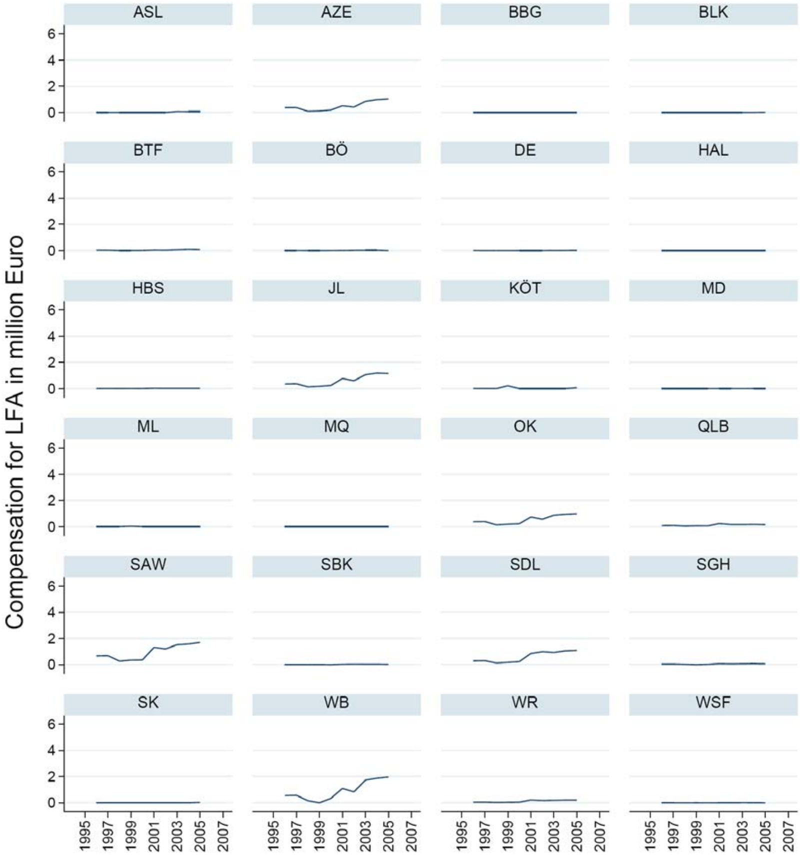

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-14: Disbursed compensation for LFA, Saxony, 1999-2007**



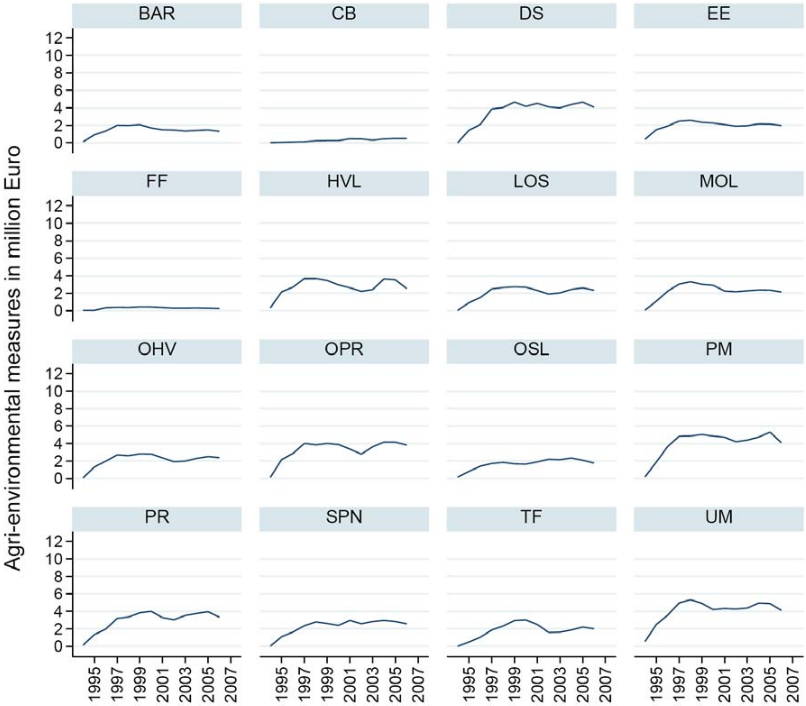

Source: Author’s calculations based on unpublished data of the state ministries.

**Figure A-15: Disbursed compensation for LFA, Saxony-Anhalt, 1996-2005**



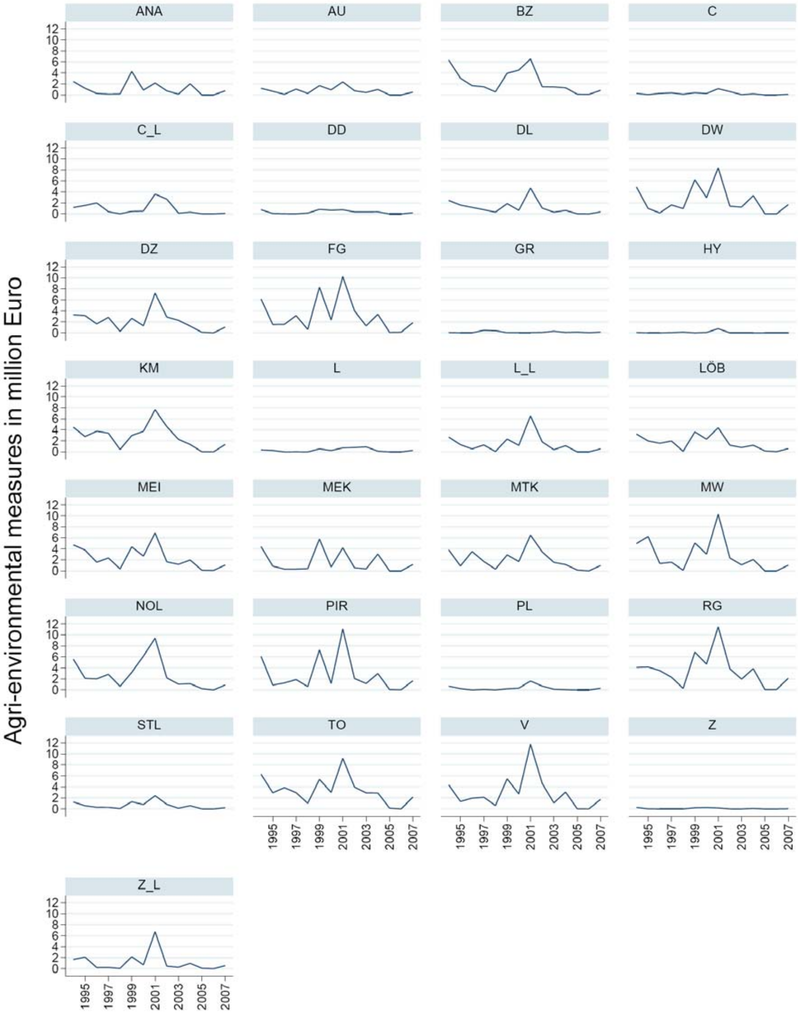

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-16: Disbursed payments for agri-environmental measures, Brandenburg, 1994-2006**



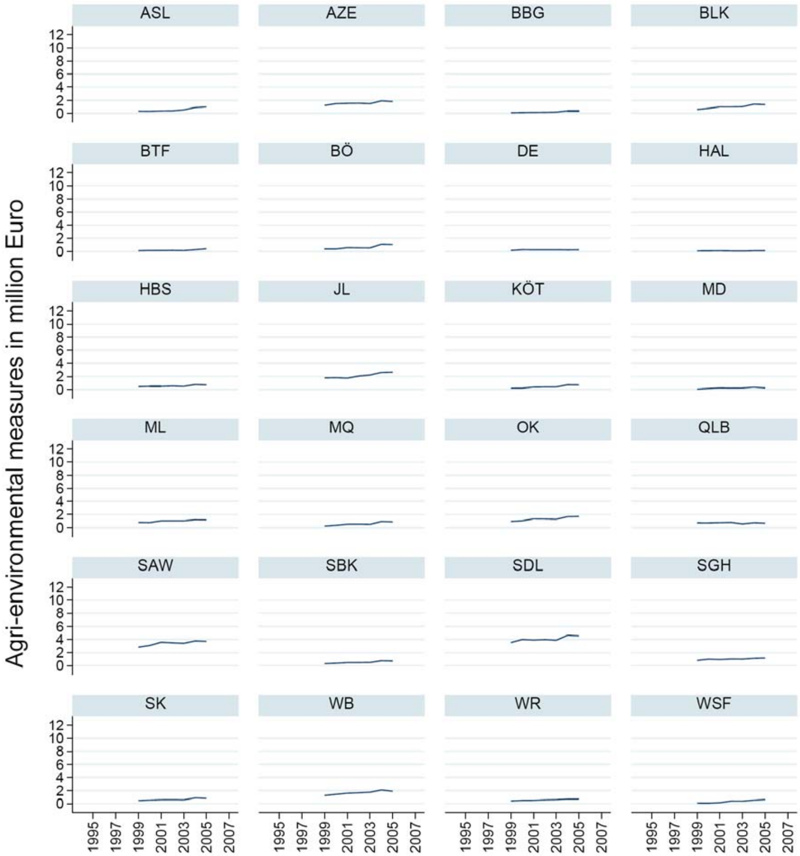

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-17: Disbursed payments for agri-environmental measures, Saxony, 1994-2007**



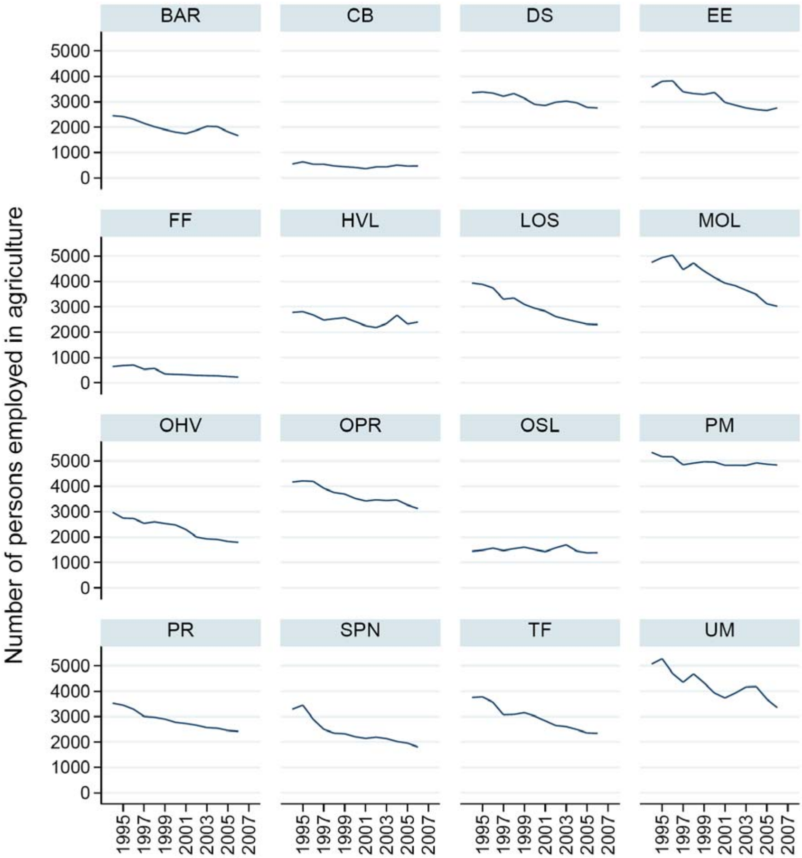

Source: Author'scalculations based on unpublished data of the state ministries.

**Figure A-18: Disbursed payments for agri-environmental measures, Saxony-Anhalt, 1999-2005**



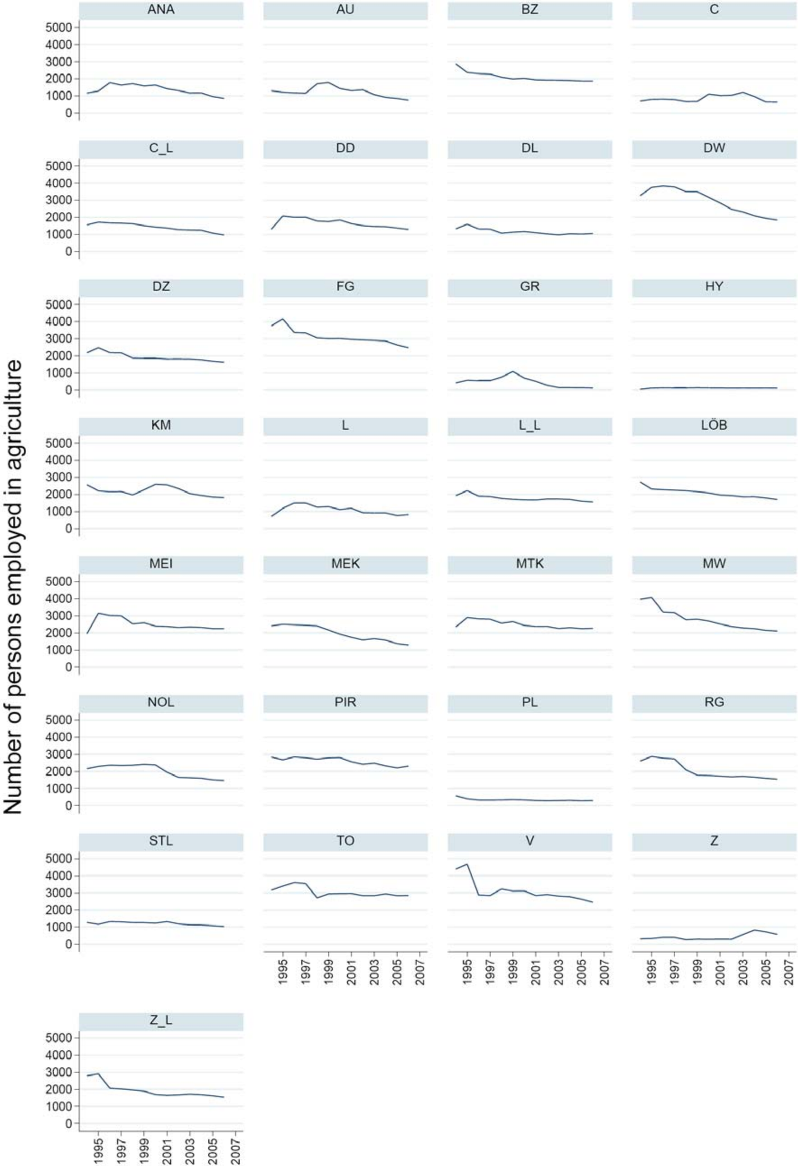

Source: Author's calculations based on unpublished data of the state ministries.

**Figure A-19: Agricultural labor force, Brandenburg, 1994-2006**



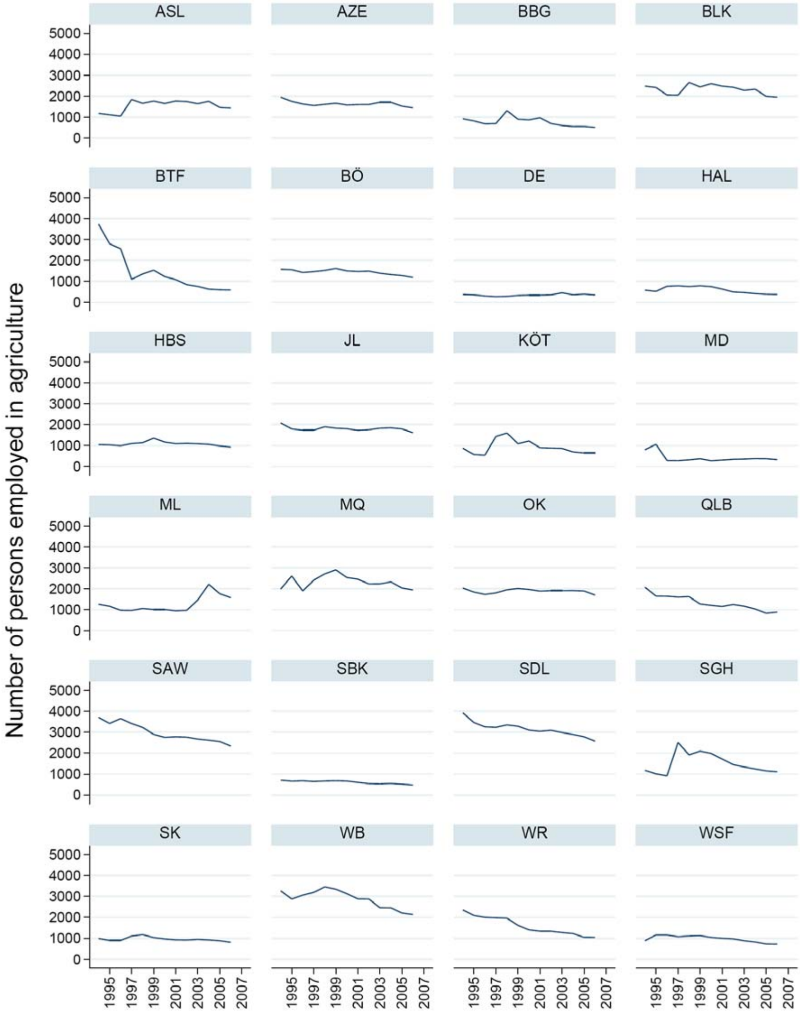

Source: Author'sdepiction based on SÄBL (2010a)

**Figure A-20: Agricultural labor force, Saxony, 1994-2006**



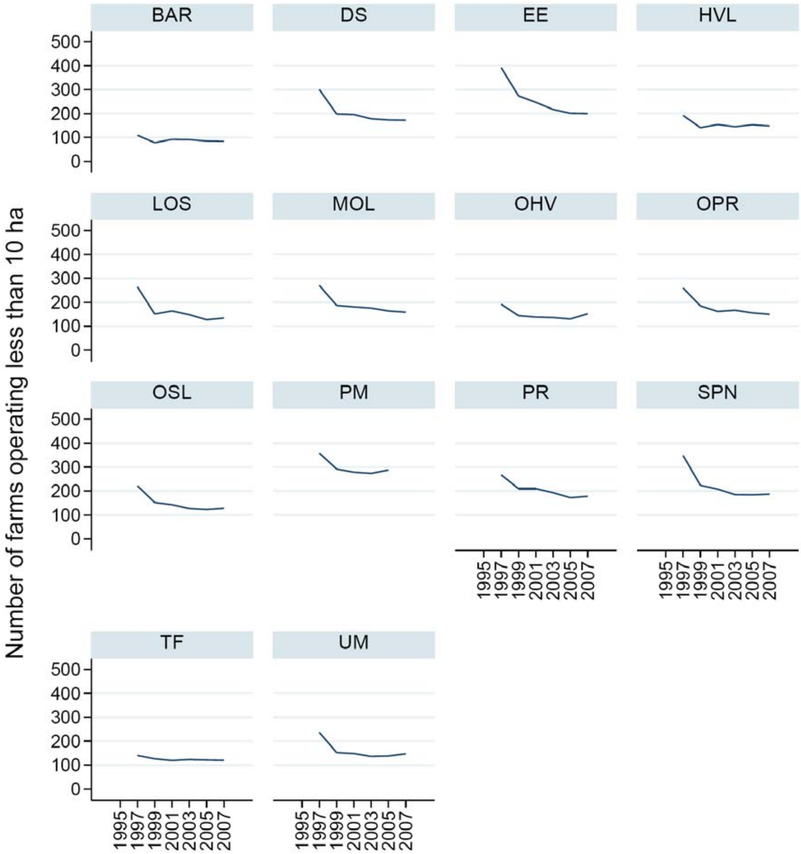

Source: Author'sdepiction based on SÄBL (2010a)

**Figure A-21: Agricultural labor force, Saxony-Anhalt, 1994-2006**




Source: Author'sdepiction based on SÄBL (2010a)

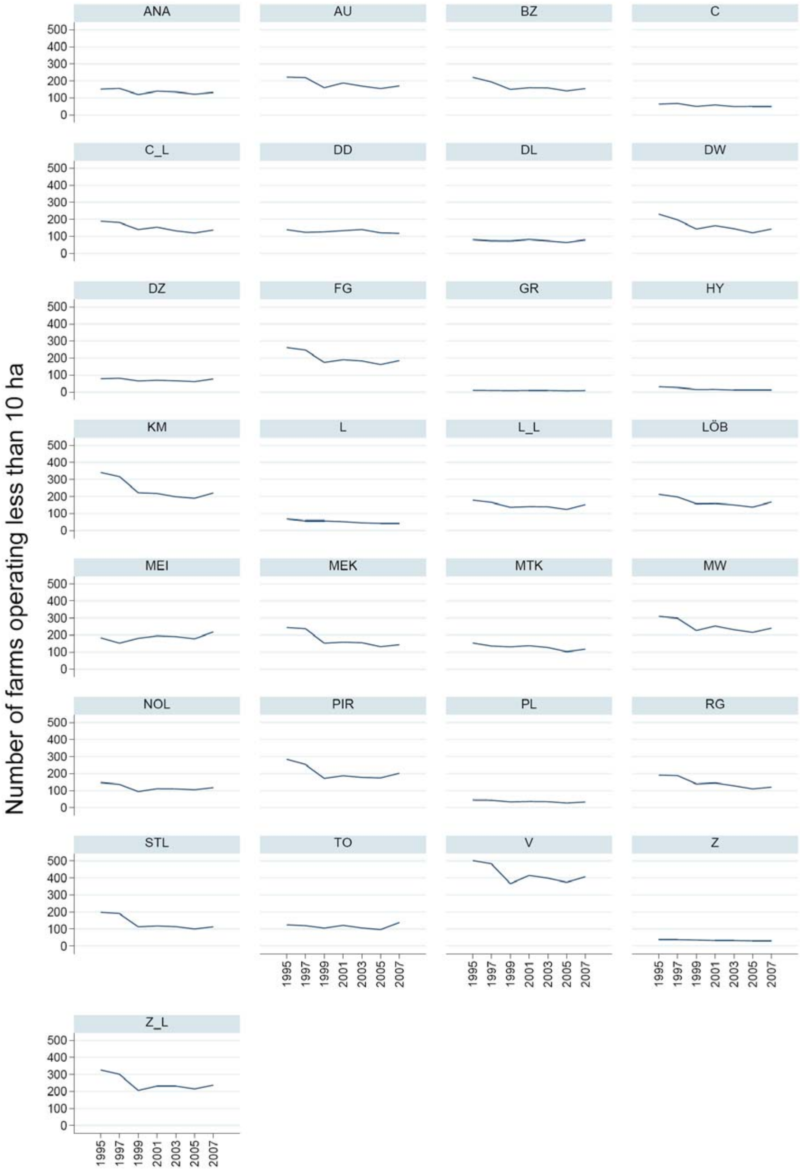
**Figure A-22: Number of farms smaller 10 ha, Brandenburg, 1997-2007**




Source: Author's calculations based on unpublished data of SÄBL.

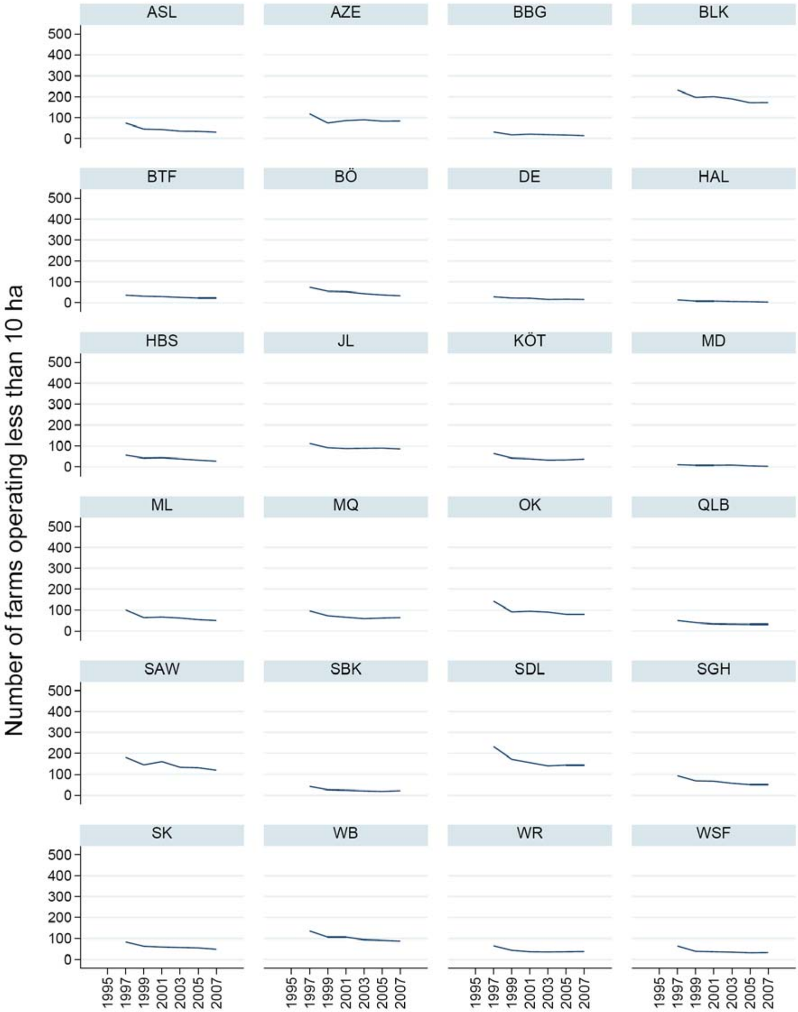
Note: The district-free cities Cottbus and Frankfurt(Oder) are dropped due to missing data at the NUTS-3 level.

## Figure A-23: Number of farms smaller 10 ha, Saxony, 1995-2007



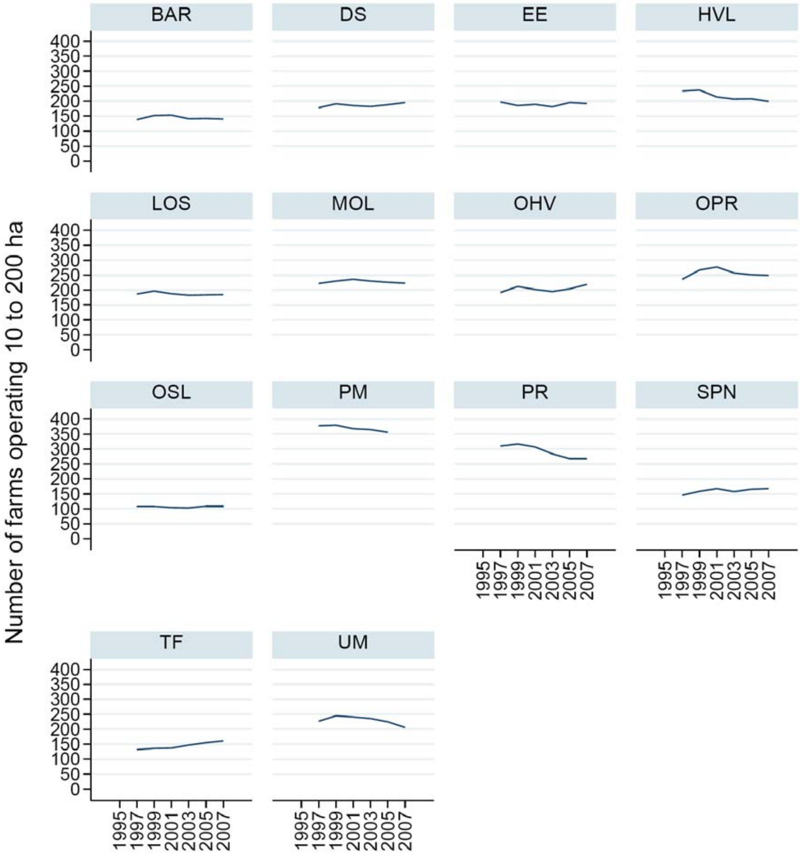

Source: Author’s calculations based on unpublished data of SÄBL.

**Figure A-24: Number of farms smaller 10 ha, Saxony-Anhalt, 1997-2007**




Source: Author's calculations based on unpublished data of SÄBL.

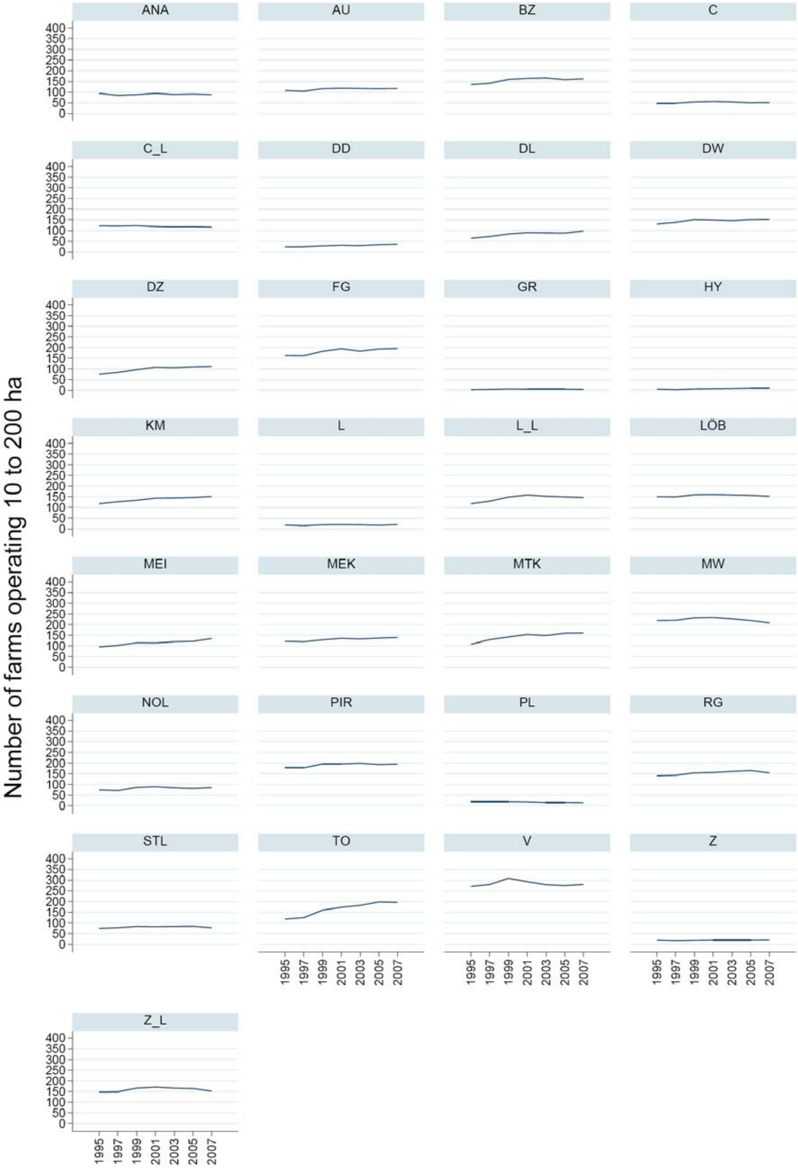
**Figure A-25: Number of farms operating 10 to 200 ha, Brandenburg, 1997-2007**




Source: Author's calculations based on unpublished data of SÄBL.

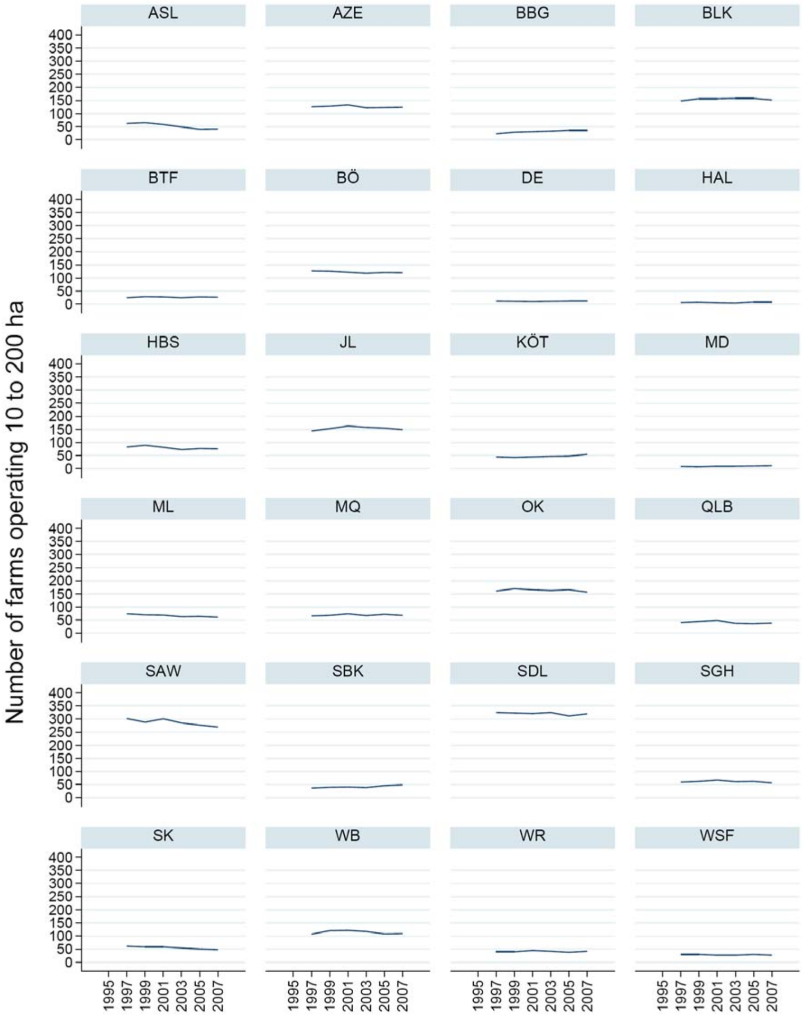
Note: The district-free cities Cottbus and Frankfurt (Oder) are dropped due to missing data at the NUTS-3 level.

**Figure A-26: Number of farms operating 10 to 200 ha, Saxony, 1995-2007**



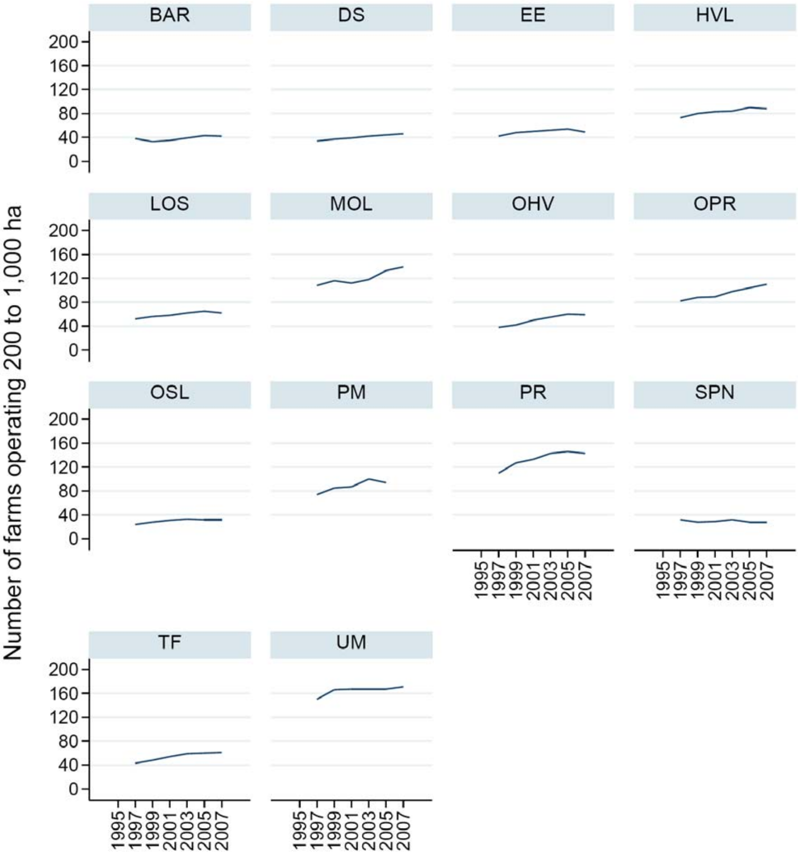

Source: Author's calculations based on unpublished data of SÄBL.

**Figure A-27: Number of farms operating 10 to 200 ha, Saxony-Anhalt, 1997-2007**




Source: Author’s calculations based on unpublished data of SÄBL.

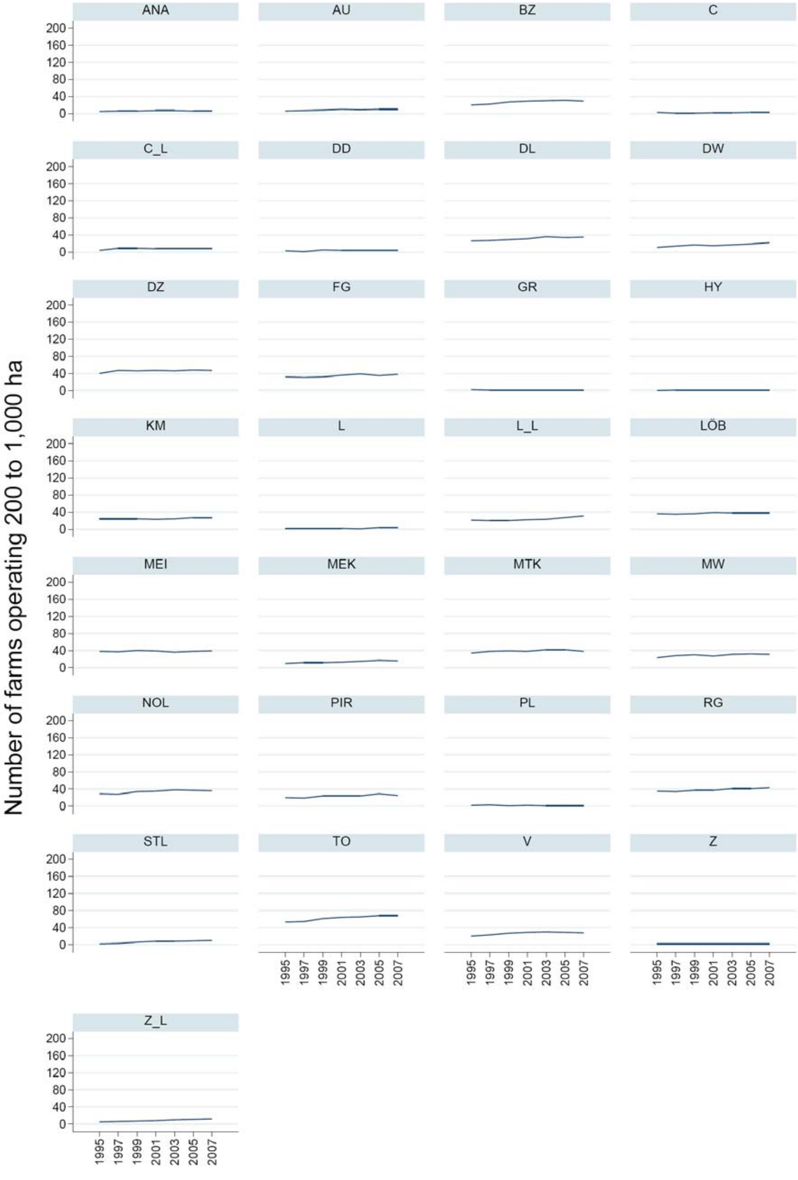
**Figure A-28: Number of farms operating 200 to 1,000 ha, Brandenburg, 1997-2007**




Source: Author's calculations based on unpublished data of SÄBL.

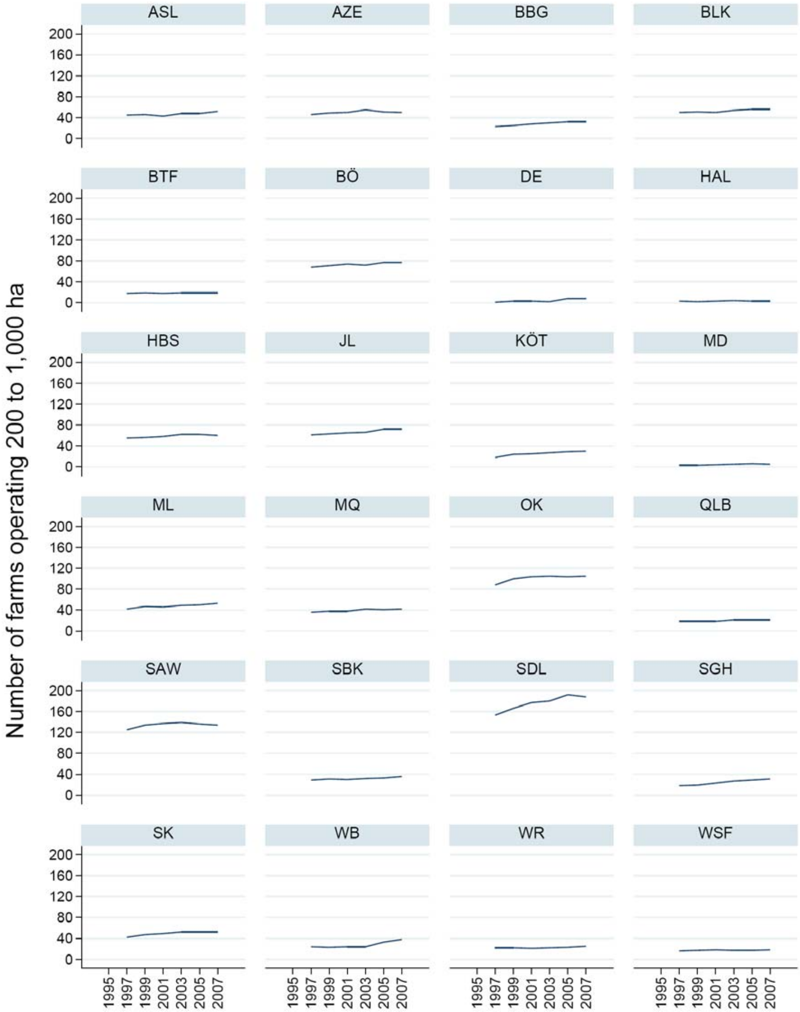
Note: The district-free cities Cottbus and Frankfurt(Oder) are dropped due to missing data at the NUTS-3 level.

**Figure A-29: Number of farms operating 200 to 1,000 ha, Saxony, 1995-2007**



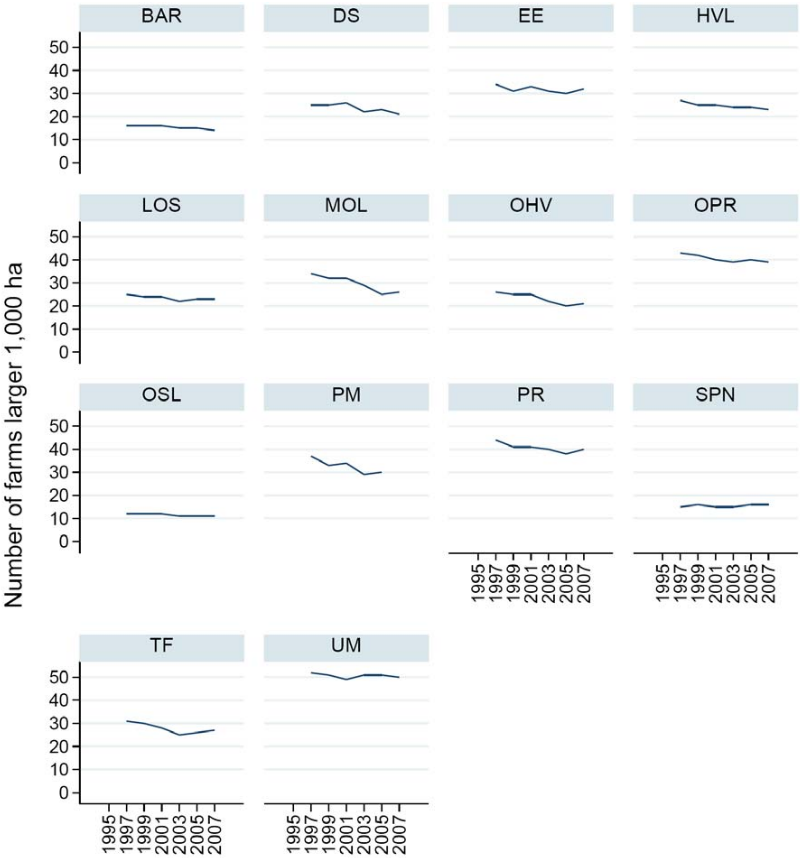

Source: Author's calculations based on unpublished data of SÄBL.

**Figure A-30: Number of farms operating 200 to 1,000 ha, Saxony-Anhalt, 1997-2007**




Source: Author's calculations based on unpublished data of SÄBL.

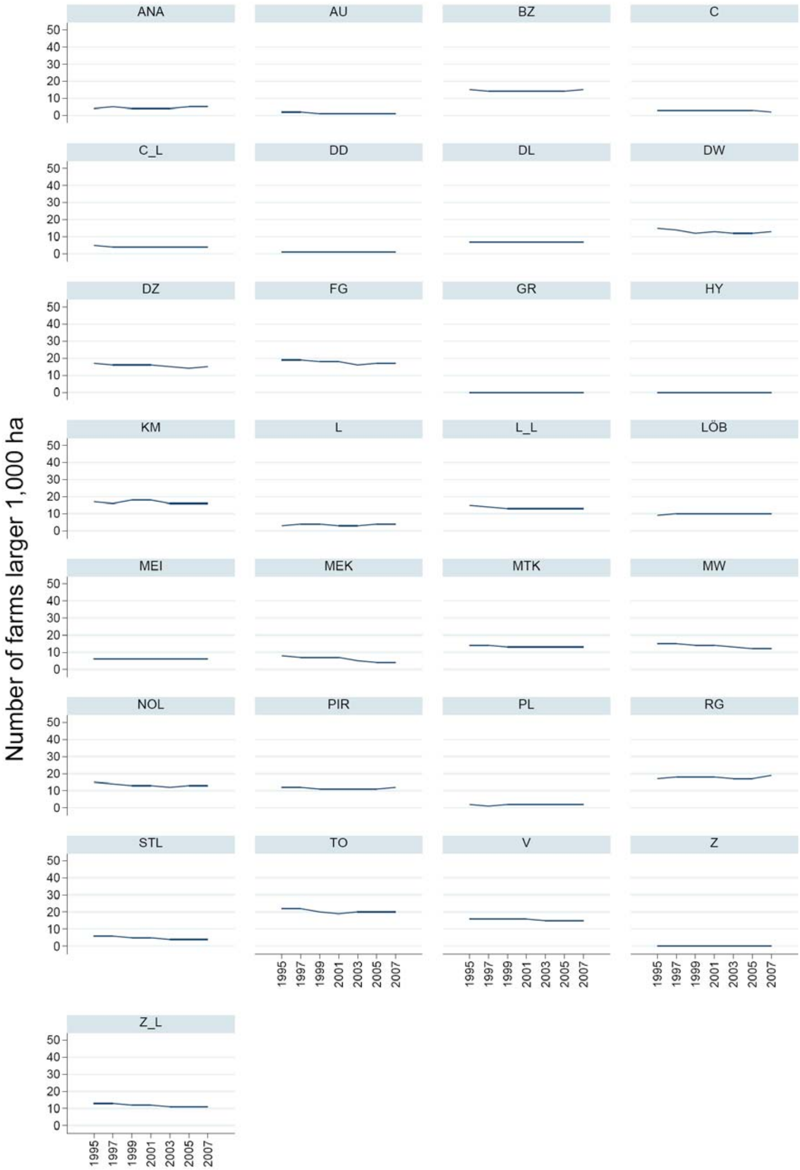
**Figure A-31: Number of farms larger 1,000 ha, Brandenburg, 1997-2007**




Note: The district-free cities Cottbus and Frankfurt(Oder) are dropped due to missing data at the NUTS-3 level.

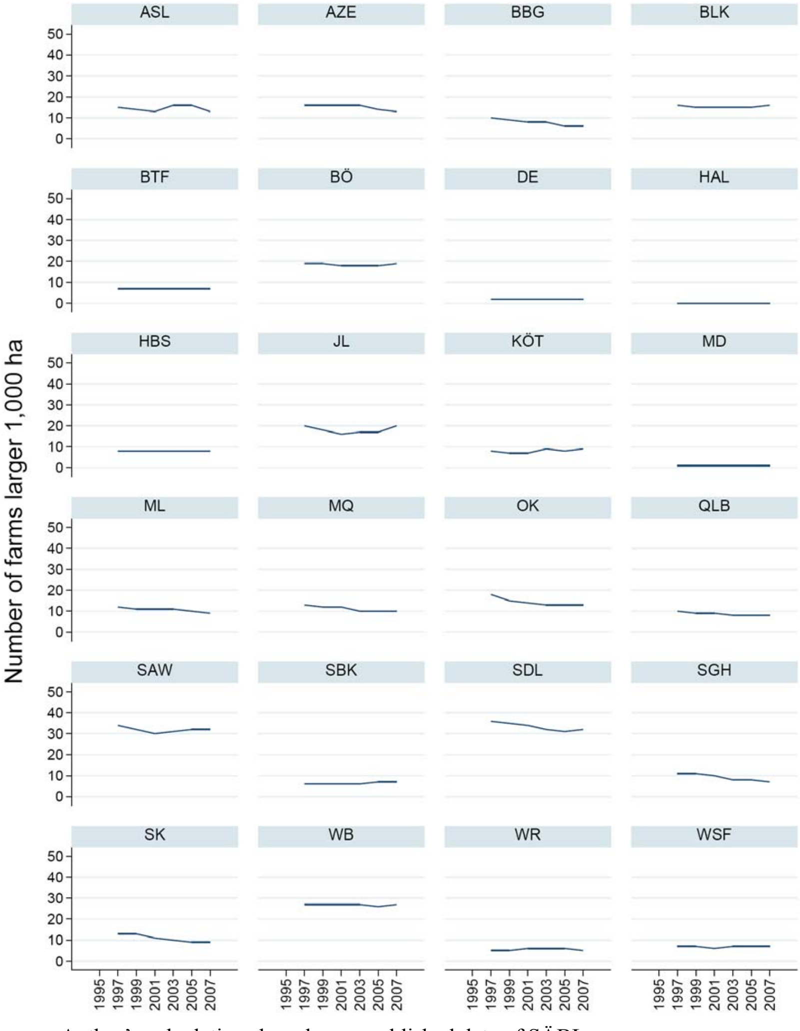
Source: Author's calculations based on unpublished data of SÄBL.

**Figure A-32: Number of farms larger 1,000 ha, Saxony, 1995-2007**



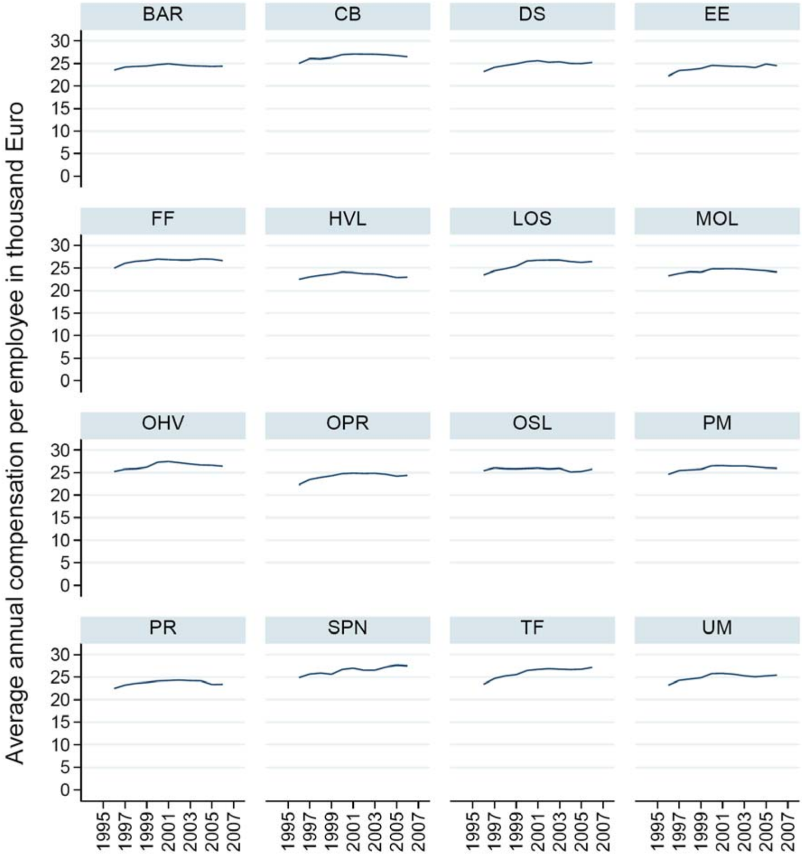

Source: Author's calculations based on unpublished data of SÄBL.

**Figure A-33: Number of farms larger 1,000 ha, Saxony-Anhalt, 1997-2007**



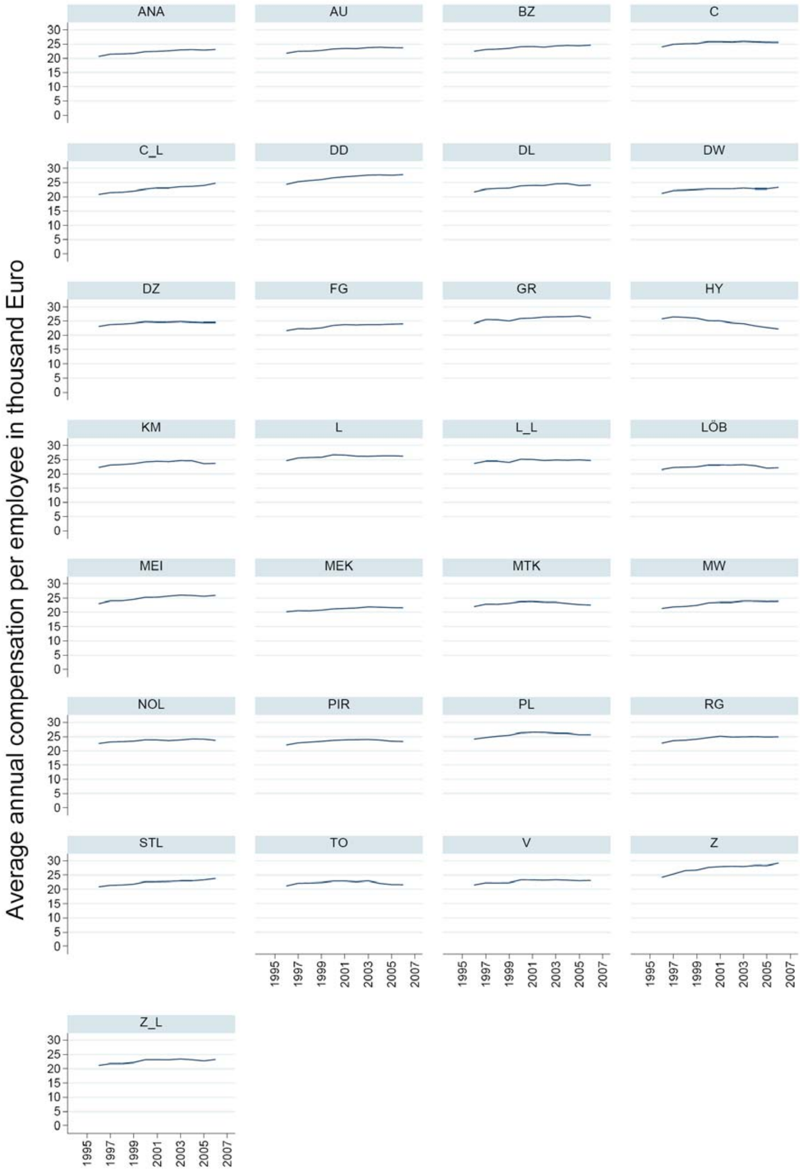

Source: Author’s calculations based on unpublished data of SÄBL.

**Figure A-34: Average annual compensation per employee, Brandenburg, 1996-2006**



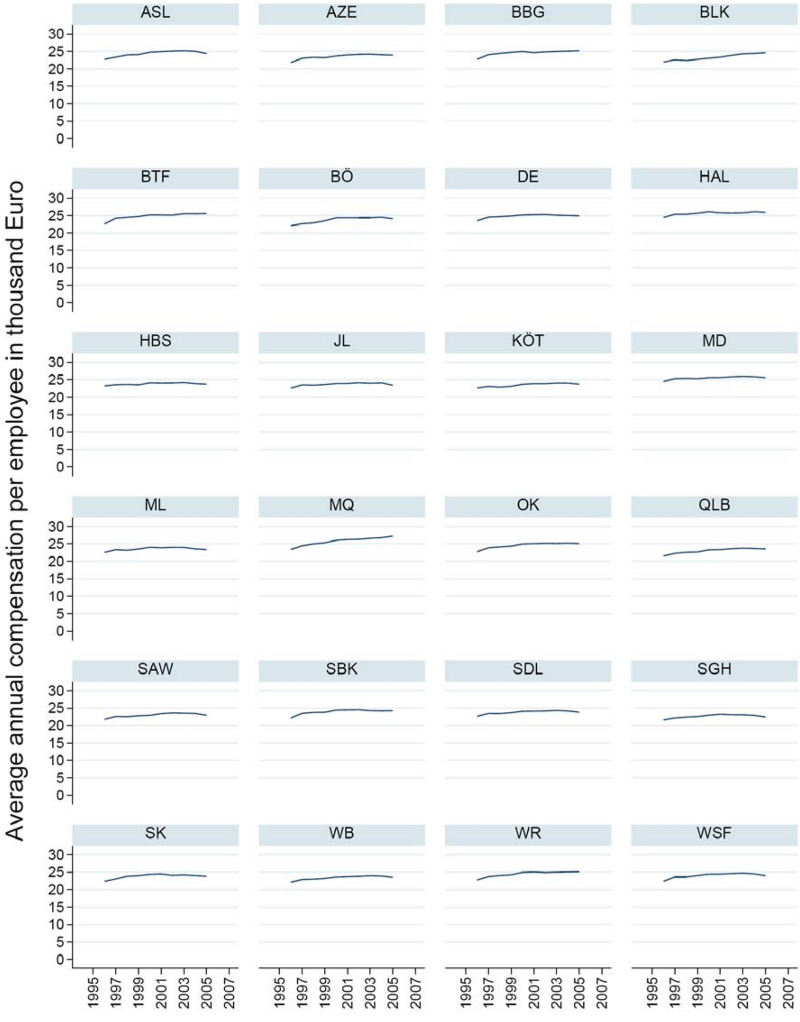

Source: Author's calculations based on SÄBL (2010b).

**Figure A-35: Average annual compensation per employee, Saxony, 1996-2006**



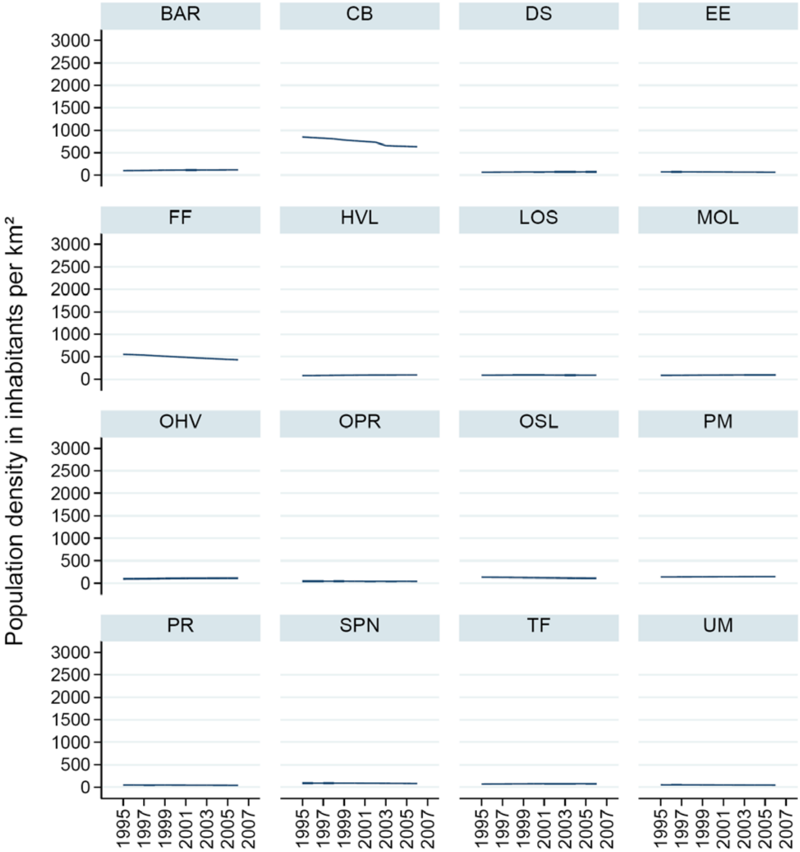

Source: Author’s calculations based on SÄBL (2010b).

**Figure A-36: Average annual compensation per employee, Saxony-Anhalt, 1996-2006**



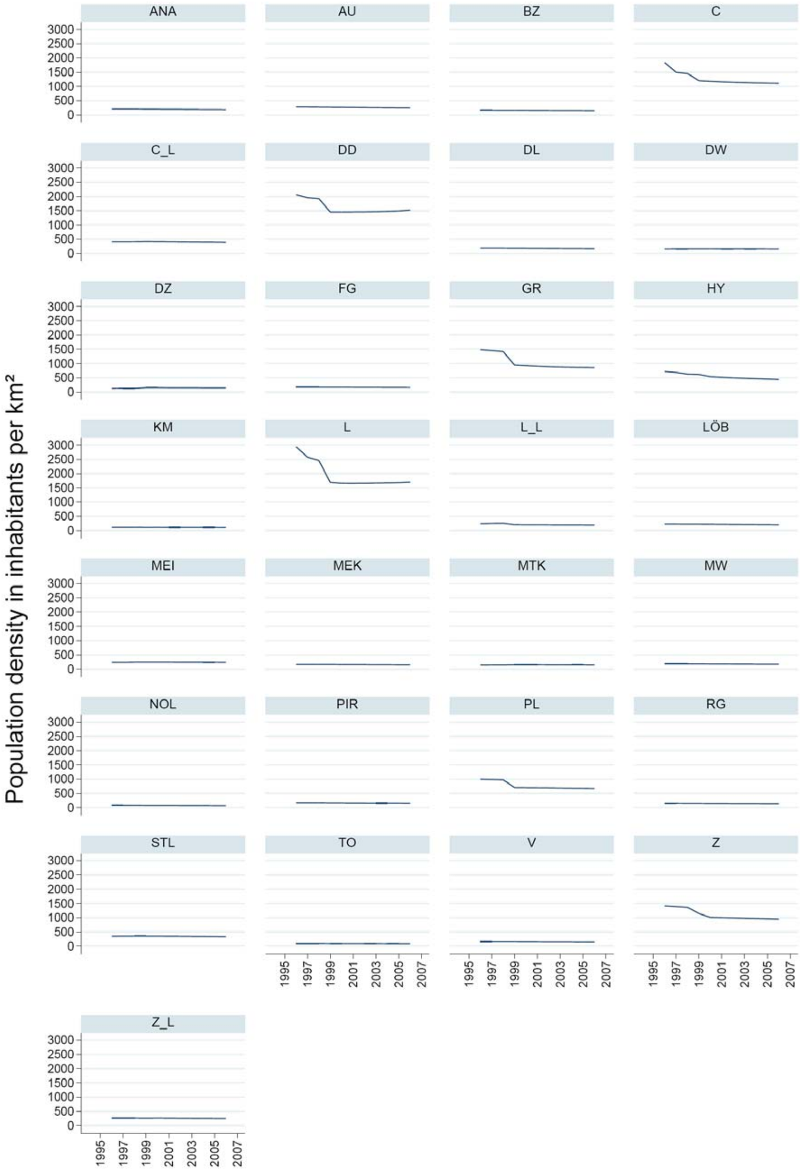

Source: Author's calculations based on SÄBL (2010b).

**Figure A-37: Population density, Brandenburg, 1996-2006**



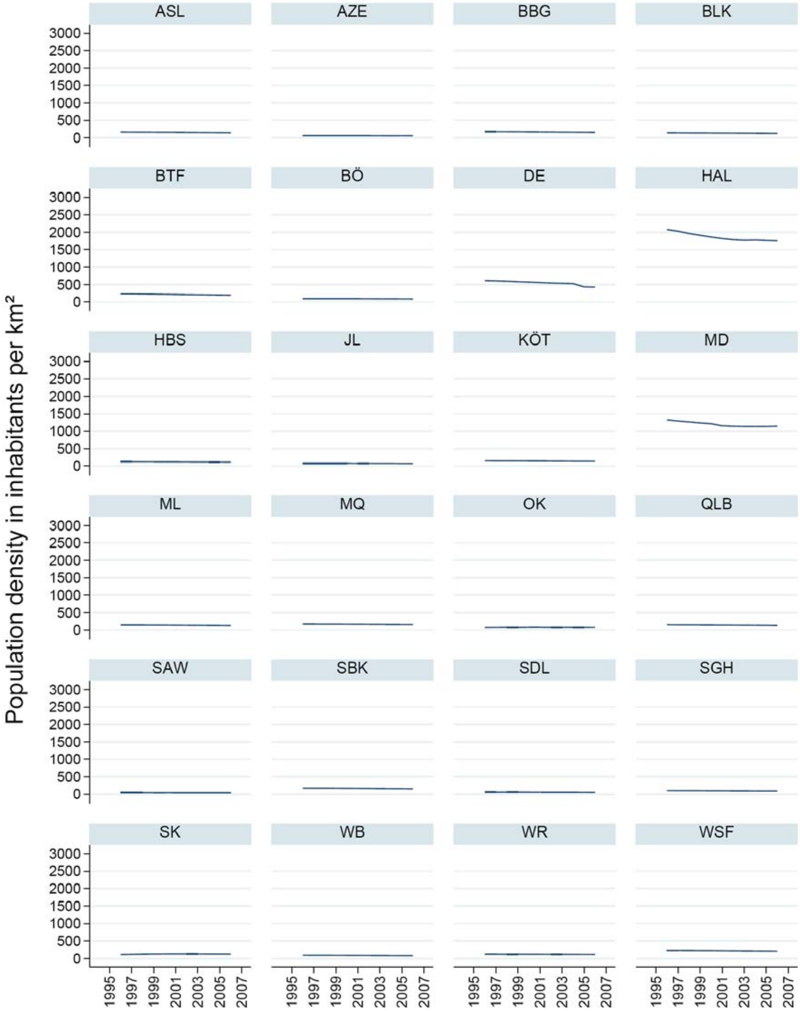

Source: Author’s calculations based on SÄBL (2011).

**Figure A-38: Population density, Saxony, 1996-2006**




Source: Author's calculations based on SÄBL (2011).

**Figure A-39: Population density, Saxony-Anhalt, 1996-2006**




Source: Author's calculations based on SÄBL (2011).

**Studies on the Agricultural and Food Sector in Central and Eastern Europe**
edited by Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO)
ISSN 1436-221X

Vol. 1 **The importance of institutions for the transition in Central and Eastern Europe with emphasis on agricultural and food industry**
ed. by Klaus Frohberg and Witold-Roger Poganietz
1998, 137 pages, ISBN 3-8175-0258-3

Vol. 2 **The significance of politics and institutions for the design and formation of agricultural Policies**
ed. by Klaus Frohberg and Peter Weingarten
1999, 254 pages, ISBN 3-8175-0289-3

Vol. 3 **Food processing and distribution in transition countries. Problems and perspectives**
ed. by Monika Hartmann and Jürgen Wandel
1999, 349 pages, ISBN 3-8175-0293-1

Vol. 4 **Die private Nachfrage nach Nahrungsmitteln im Transformationsprozeß Tschechiens und Polens**
Stephan Brosig (PhD)
2000, 171 Seiten, ISBN 3-8175-0319-9

Vol. 5 **Integrating Estonia into the EU: Quantitative analysis of the agricultural and food sector**
Achim Fock (PhD)
2000, 286 pages, ISBN 3-8175-0320-2

Vol. 6 **Competitiveness of agricultural enterprises and farm activities in transition countries**
ed. by Peter Tillack and Frauke Pirscher
2000, 216 pages, ISBN 3-8175-0322-9

Vol. 7 **Конкурентоспособность сельскохозяйственных предприятий и фермерской деятельности в странах переходного периода**
под редакцией Петера Тиллака и Фрауке Пиршер
2000, 253 страницы, ISBN 3-8175-0324-5

Vol. 8 **Perspectives on agriculture in transition: Analytical issues, modelling approaches, and case study results**
ed. by Witold-Roger Poganietz, Alberto Zezza, Klaus Frohberg and Kostas G. Stamoulis
2000, 433 pages, ISBN 3-8175-0323-7

Vol. 9 **Land ownership, land markets and their influence on the efficiency of agricultural production in Central and Eastern Europe**
ed. by Peter Tillack and Eberhard Schulze
2000, 485 pages, ISBN 3-8175-0325-3

Vol. 10 **Landwirtschaft und Industrie in Russland – Der Transformationsprozeß in der Ernährungsindustrie**
Jürgen Wandel (PhD)
2000, 361 Seiten, ISBN 3-8175-0334-2

Vol. 11 **Food consumption in Russia. An econometric analysis based on household data**
Karin Elsner (PhD)
2001, 256 pages, ISBN 3-8175-0335-0

Vol. 12 **Alexander Wasiljewitsch Tschajanow – Die Tragödie eines großen Agrarökonomen**
hrsg. u. übers. von Eberhard Schulze
2001, 192 Seiten, ISBN 3-8175-0342-3

Vol. 13 **Analysis of food consumption in Central and Eastern Europe: Relevance and empirical methods**
ed. by Stephan Brosig and Monika Hartmann
2001, 253 pages, ISBN 3-8175-0349-0

Vol. 14 **Wettbewerbsprozesse und Firmenwachstum in der Transformation am Beispiel der polnischen Fleischindustrie**
Agata Pieniadz (PhD)
2002, 291 Seiten, ISBN 3-8175-0360-1

Vol. 15 **Agricultural enterprises in transition: Parallels and divergences in Eastern Germany, Poland and Hungary**
ed. by Ludger Hinners-Tobrägel and Jürgen Heinrich
2002, 455 pages, ISBN 3-8175-0366-0

Vol. 16 **Agricultural technology and economic development of Central and Eastern Europe. Results of the workshop in Halle, 2$^{nd}$-3$^{rd}$ July 2001**
ed. by Peter Tillack and Ulrich Fiege
2002, 160 pages, ISBN 3-86037-199-1

Vol. 17 **Региональные аспекты аграрных преобразований: Политика, реструктуризация, рыночная адаптация**
под редакцией Петера Тиллака и Виталия Зиновчука
2003, 236 страницы, ISBN 3-928466-55-0

Vol. 18 **Alexander Vasilievich Chayanov – The tragedy of an outstanding agricultural economist**
ed. by Eberhard Schulze
2003, 188 pages, ISBN 3-86037-201-7

Vol. 19 **Development of agricultural market and trade policies in the CEE Candidate Countries**
by the Network of Independent Agricultural Experts in the CEE Candidate Countries
2003, 72 pages, ISBN 3-86037-212-2

Vol. 20 **Large farm management**
ed. by Alfons Balmann and Alexej Lissitsa
2003, 396 pages, ISBN 3-86037-213-0

Vol. 21 **Success and failures of transition – The Russian agriculture between fall and resurrection**
ed. by Eberhard Schulze, Elke Knappe, Eugenia Serova, Peter Wehrheim
2003, 521 pages, ISBN 3-9809270-1-6

Vol. 22 **Subsistence agriculture in Central and Eastern Europe: How to break the vicious circle?**
ed. by Steffen Abele and Klaus Frohberg
2003, 233 pages, ISBN 3-9809270-2-4

Vol. 23 **Pfadabhängigkeiten und Effizienz der Betriebsstrukturen in der ukrainischen Landwirtschaft – Eine theoretische und empirische Analyse**
Andriy Nedoborovskyy (PhD)
2004, 197 Seiten, ISBN 3-86037-216-5

Vol. 24 **Nichtmonetäre Transaktionen in der ukrainischen Landwirtschaft: Determinanten, Spezifika und Folgen**
Olena Dolud (PhD)
2004, 190 Seiten, ISBN 3-9809270-3-2

Vol. 25 **The role of agriculture in Central and Eastern European rural development: Engine of change or social buffer?**
ed. by Martin Petrick and Peter Weingarten
2004, 426 pages, ISBN 3-9809270-4-0

Vol. 26 **Credit rationing of Polish farm households – A theoretical and empirical analysis**
Martin Petrick (PhD)
2004, 254 pages, ISBN 3-9809270-6-7

Vol. 27 **Drei Jahrhunderte Agrarwissenschaft in Russland: Von 1700 bis zur Gegenwart**
Alexander Alexandrowitsch Nikonow und Eberhard Schulze
2004, 232 Seiten, ISBN 3-9809270-8-3

Vol. 28 **Russlands Weg vom Plan zum Markt: Sektorale Trends und regionale Spezifika**
Peter Voigt (PhD)
2004, 270 Seiten, ISBN 3-9809270-9-1

Vol. 29 **Auswirkungen des Transformationsprozesses auf die sozio-ökonomischen Funktionen ukrainischer Landwirtschaftsunternehmen**
Helga Biesold (PhD)
2004 182 Seiten, ISBN 3-938584-00-9

Vol. 30 **Agricultural policies and farm structures – Agent-based modelling and application to EU-policy reform**
Kathrin Happe (PhD)
2004, 291 pages, ISBN 3-938584-01-7

Vol. 31 **How effective is the invisible hand? Agricultural and food markets in Central and Eastern Europe**
ed. by Stephan Brosig and Heinrich Hockmann
2005, 361 pages, ISBN 3-938584-03-3

Vol. 32 **Erfolgsfaktoren von landwirtschaftlichen Unternehmen mit Marktfruchtanbau in Sachsen-Anhalt**
Kirsti Dautzenberg (PhD)
2005, 161 Seiten, ISBN 3-938584-06-8

Vol. 33 **Agriculture in the face of changing markets, institutions and policies: Challenges and strategies**
ed. by Jarmila Curtiss, Alfons Balmann, Kirsti Dautzenberg, Kathrin Happe
2006, 544 pages, ISBN 3-938584-10-6

Vol. 34 **Making rural households' livelihoods more resilient – The importance of social capital and the underlying social networks**
ed. by Gertrud Buchenrieder and Thomas Dufhues
2006, 106 pages, ISBN 3-938584-13-0

Vol. 35 **Außerlandwirtschaftliche Diversifikation im Transformationsprozess. Diversifikationsentscheidungen und -strategien ländlicher Haushalte in Slowenien und Mazedonien**
Judith Möllers (PhD)
2006, 323 Seiten, ISBN 3-938584-14-9

Vol. 36 **Accessing rural finance – The rural financial market in Northern Vietnam**
Thomas Dufhues (PhD)
2007, 166 Seiten, ISBN 3-938584-16-5

Vol. 37 **Страхование посевов в Казахстане: Анализ возможностей эффективного управления рисками**
Раушан Бокушева, Олаф Хайдельбах, Талгат Кусайынов
2007, 82 Seiten, ISBN 3-938584-17-3

Vol. 38 **Rethinking agricultural reform in Ukraine**
Zvi Lerman, David Sedik, Nikolai Pugachov, Aleksandr Goncharuk
2007, 167 Seiten, ISBN 3-938584-18-1

Vol. 39 **Sustainable rural development: What is the role of the agri-food sector?**
ed. by Martin Petrick, Gertrud Buchenrieder
2007, 293 pages, ISBN 3-938584-22-X

Vol. 40 **Efficiency of selected risk management instruments – An empirical analysis of risk reduction in Kazakhstani crop production**
Olaf Heidelbach (PhD)
2007, 223 Seiten, ISBN 3-938584-19-X

Vol. 41 **Marktstruktur und Preisbildung auf dem ukrainischen Markt für Rohmilch**
Oleksandr Perekhozhuk (PhD)
2007, 274 Seiten, ISBN 978-3-938584-24-8

Vol. 42 **Labor market behavior of Chinese rural households during transition**
Xiaobing Wang (PhD)
2007, 140 Seiten, ISBN 978-3-938584-25-5

Vol. 43 **Continuity and change: Land and water use reforms in rural Uzbekistan. Socio-economic and legal analyses for the region Khorezm**
ed. by Peter Wehrheim, Anja Schoeller-Schletter, Christopher Martius
2008, 211 Seiten, ISBN 978-3-938584-27-9

Vol. 44 **Agricultural economics and transition: What was expected, what we observed, the lessons learned (Vol I and II)**
ed. by Csaba Csáki, Csaba Forgács
2008, 634 Seiten, ISBN 978-3-938584-31-6

Vol. 45 **Theoretical and methodological topics in the institutional economics of European agriculture. With applications to farm organisation and rural credit arrangement**
Martin Petrick
2008, 223 Seiten, ISBN 978-3-938584-31-6

Vol. 46 **Agri-food business: Global challenges – Innovative solutions**
ed. by Thomas Glauben, Jon H. Hanf, Michael Kopsidis, Agata Pieniadz, Klaus Reinsberg
2008, 152 pages, ISBN 978-3-938584-33-0

Vol. 47 **Eine Analyse der Transformationsberatung für die "kollektive Landwirtschaft" während der ersten Transformationsphase (1989-1991) am Beispiel Ostdeutschlands: Lehren für Korea**
Jeong Nam Choi (PhD)
2009, 225 Seiten, ISBN 978-3-938584-36-1

Vol. 48 **Croatia's EU accession. Socio-economic assessment of farm households and policy recommendations**
Judith Möllers, Patrick Zier, Klaus Frohberg, Gertrud Buchenrieder and Štefan Bojnec
2009, 196 Seiten, ISBN 978-3-938584-35-4

Vol. 49 **Structural change in Europe's rural regions. Farm livelihoods between subsistence orientation, modernisation and non-farm diversification**
ed. by Gertrud Buchenrieder Judith Möllers
2009, 166 Seiten, ISBN 978-3-938584-39-2

Vol. 50 **Motive beim Weinkonsum – Unterschiede zwischen deutschen und ukrainischen Konsumenten**
Astrid Lucie Rewerts (PhD)
2009, 267 Seiten, ISBN 978-3-938584-40-8

Vol. 51 **Rural development as provision of local public goods: Theory and evidence from Poland**
Andreas Gramzow (PhD)
2009, 203 Seiten, ISBN 978-3-938584-41-5

Vol. 52 **Multi-level Processes of Integration and Disintegration. Proceedings of the Third Green Week Scientific Conference**
ed. by Franziska Schaft, Alfons Balmann
2009, 216 Seiten, ISBN 978-3-938584-42-2

Vol. 53 **Zur Bestimmung der Wettbewerbsfähigkeit des weißrussischen Milchsektors: Aussagefähigkeit von Wettbewerbsindikatoren und Entwicklung eines kohärenten Messungskonzepts**
Mikhail Ramanovich (PhD)
2010, 202 Seiten, ISBN 978-3-938584-44-6

Vol. 54 **Die Internationalisierung landwirtschaftlicher Unternehmen. Das Beispiel deutscher, dänischer und niederländischer Direktinvestitionen in den ukrainischen Agrarsektor**
Henriette Stange (PhD)
2010, 296 Seiten, ISBN 978-3-938584-45-3

Vol. 55 **Verhandlungsverhalten und Anspruchsanpassung im internationalen Verhandlungsprozess: Die WTO-Agrarverhandlungen zum Abbau exportwettbewerbsfördernder Maßnahmen**
Ildiko Lajtos (PhD)
2010, 195 Seiten, ISBN 978-3-938584-48-4

Vol. 56 **Challenges of education and innovation. Proceedings of the Fourth Green Week Scientific Conference**
ed. by Kelly Labar, Martin Petrick, Gertrud Buchenrieder
2010, 155 Seiten, ISBN 978-3-938584-49-1

Vol. 57 **Agriculture in the Western Balkan Countries**
ed. by Tina Volk
2010, 249 Seiten, ISBN 978-3-938584-51-4

Vol. 58 **Perspectives on Institutional Change – Water Management in Europe**
ed. by Insa Theesfeld, Frauke Pirscher
2011, 127 Seiten, ISBN 978-3-938584-52-1

Vol. 59 **Der ukrainische Außenhandel mit Produkten der Agrar- und Ernährungswirtschaft: Eine quantitative Analyse aus Sicht traditioneller und neuer Außenhandelstheorien**
Inna Levkovych (PhD)
2011, 232 Seiten, ISBN 978-3-938584-53-8

Vol. 60 **Regional structural change in European agriculture: Effects of decoupling and EU accession**
Christoph Sahrbacher (PhD)
2011, 244 Seiten, ISBN 978-3-938584-58-3

Vol. 61 **Structural Change in Agriculture and Rural Livelihoods: Policy Implications for the New Member States of the European Union**
ed. by Judith Möllers, Gertrud Buchenrieder, Csaba Csáki
2011, 247 Seiten, ISBN 978-3-938584-59-0

Vol. 62 **Improving the functioning of the rural financial markets of Armenia**
Milada Kasarjyan (PhD)
2011, 121 Seiten, ISBN 978-3-938584-60-6

Vol. 63 **Integrierte Strukturen im Agrar- und Ernährungssektor Russlands: Entstehungsgründe, Funktionsweise, Entwicklungsperspektiven und volkswirtschaftliche Auswirkungen**
Jürgen Wandel
2011, 758 Seiten, ISBN 978-3-938584-61-3

Vol. 64 **Goal Achievement in Supply Chain Networks – A Study of the Ukrainian Agri-Food Business**
Taras Gagalyuk (PhD)
2012, 204 Seiten, ISBN 978-3-938584-63-7

Vol. 65 **Impacts of CAP reforms on farm structures and performance disparities – An agent-based approach**
Amanda Sahrbacher (PhD)
2012, 284 Seiten, ISBN 978-3-938584-64-4

Vol. 66 **Land fragmentation and off-farm labor supply in China**
Lili Jia (PhD)
2012, 143 Seiten, ISBN 978-3-938584-65-1

Vol. 67 **Ausprägung interregionaler Disparitäten und Ansätze zur Entwicklung ländlicher Räume in Mittel- und Osteuropa**
Sabine Baum (PhD)
2012, 214 Seiten, ISBN 978-3-938584-68-2

Vol. 68 **Patterns Behind Rural Success Stories in the European Union: Major Lessons of Former Enlargements**
ed. by Axel Wolz, Carmen Hubbard, Judith Möllers, Matthew Gorton, Gertrud Buchenrieder
2012, 190 Seiten, ISBN 978-3-938584-69-9

Vol. 69 **Motives for remitting from Germany to Kosovo**
Wiebke Meyer (PhD)
2012, 142 Seiten, ISBN 978-3-938584-70-5

Vol. 70 **Effizienz russischer Geflügelfleischproduzenten: Entwicklung und Determinanten**
Elena Epelstejn (PhD)
2013, 272 Seiten, ISBN 978-3-938584-72-9

Vol. 71 **Econometric impact assessment of the Common Agricultural Policy in East German agriculture**
Patrick Zier (PhD)
2013, 172 Seiten, ISBN 978-3-938584-73-6

In der Schriftenreihe *Studies on the Agricultural and Food Sector in Central and Eastern Europe* werden durch das IAMO Monographien und Tagungsberichte herausgegeben, die sich mit agrarökonomischen Fragestellungen zu Mittel- und Osteuropa beschäftigen. Wissenschaftlern, die in diesem Bereich forschen, steht die Schriftenreihe als Diskussionsforum offen.

In its series *Studies on the Agricultural and Food Sector in Central and Eastern Europe* IAMO publishes monographs and proceedings focusing on agricultural economic issues specific to Central and Eastern Europe. This series offers a forum to researchers studying this area.

ISSN 1436-221X
ISBN 978-3-938584-73-6