Universitat d'Alacant
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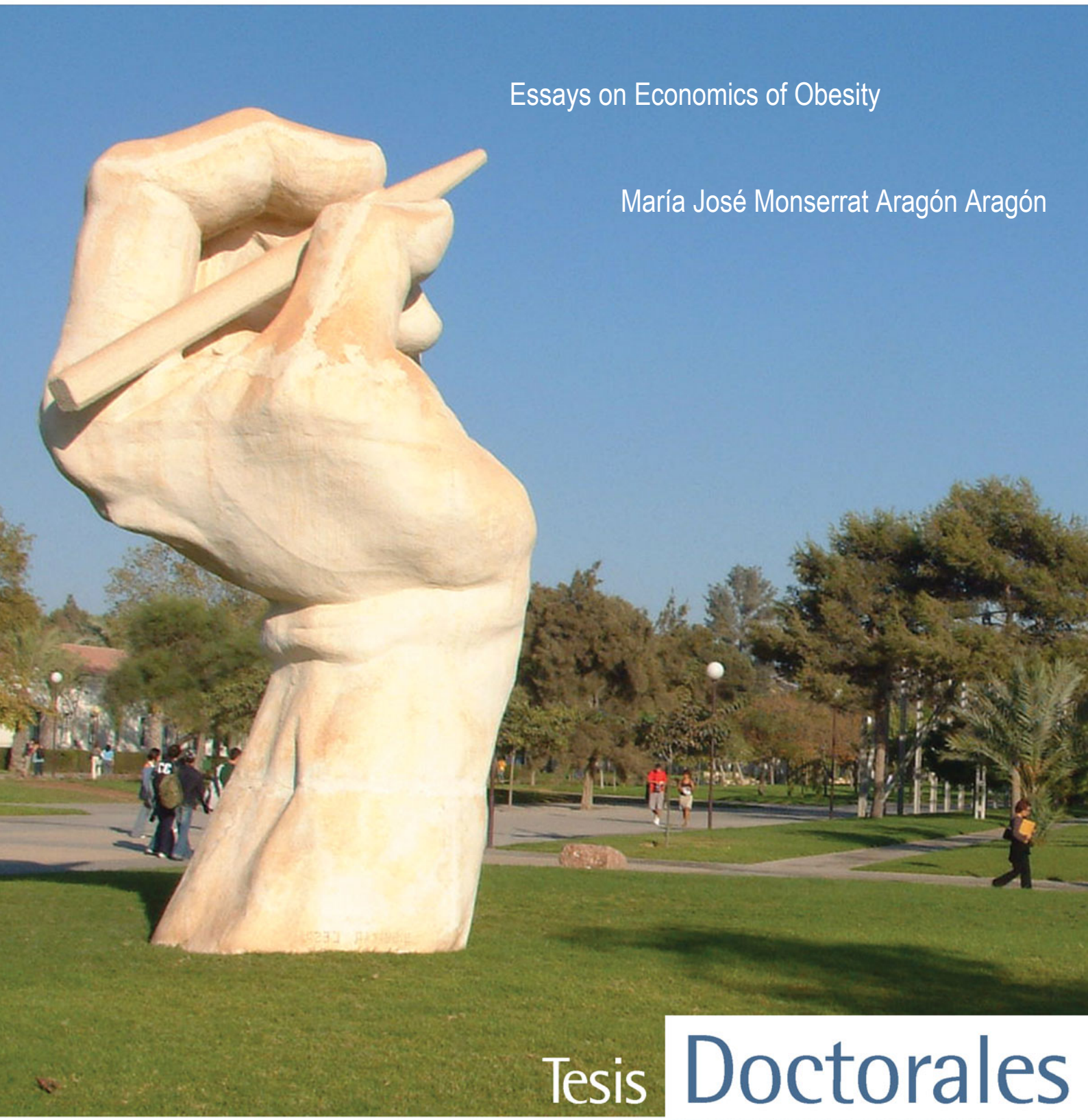
Essays on Economics of Obesity

María José Monserrat Aragón Aragón



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Essays on Economics of Obesity

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Introducción

La economía ha estudiado diferentes aspectos de la salud, partiendo por su significado, su relación con el bienestar del individuo y cómo medirla. También se han estudiado sus determinantes, tanto genéticos como ambientales, considerando la salud como una forma de capital que requiere inversión, que se deprecia y cuya demanda está relacionada con la de otras inversiones. Entre otros aspectos, la economía ha estudiado la oferta de servicios de salud como la de una industria con funciones de producción, mercados laborales y regulación propios; la costo-efectividad de distintas formas de proveer servicios de salud; y se han realizado comparaciones a nivel internacional de los diferentes sistemas de provisión de servicios de salud. [11]

Los comportamientos individuales que se relacionan con el estado de salud del individuo también han sido analizados desde una perspectiva económica. Los comportamientos riesgosos en términos de salud incluyen, entre otros, el tabaquismo, el consumo de alcohol, el uso de drogas, y las dietas no balanceadas y el sedentarismo, estos dos últimos están asociados con incrementos en el riesgo de obesidad. Todos estos comportamientos constituyen causas de muerte evitables. La economía ha estudiado estos comportamientos desde un punto de vista teórico, desarrollando modelos que intentan explicar por qué los individuos toman decisiones que implican un riesgo para su salud, y desde un punto de vista empírico, mostrando la relación entre estos comportamientos riesgosos en términos de salud y diferentes variables como, por ejemplo, la educación, el empleo, los salarios y el crimen. También se ha investigado cómo podrían modificarse estos comportamientos riesgosos, se han investigado la utilización de impuestos, subsidios e incentivos monetarios, la imposición de restricciones a la compra y al consumo, la entrega de información y la restricción de la publicidad. [9]

En las últimas décadas la prevalencia del sobrepeso y la obesidad ha aumentado significativamente a nivel mundial, este incremento ha llevado a muchos investigadores a interesarse en como la obesidad se relaciona con las decisiones tomadas por el individuo o con los resultados obtenidos por él.

La Organización Mundial de la Salud define el sobrepeso y la obesidad usando el índice de masa corporal, que se calcula utilizando el peso y la estatura del individuo a través de la siguiente fórmula: $\text{IMC} = \frac{\text{Peso[Kg]}}{(\text{Altura[m]})^2}$. Esta medida es la misma para todos los adultos, hombres y mujeres, independiente de su edad. Sin embargo, no siempre corresponde al mismo nivel de gordura en diferentes individuos, ya que no considera ni el porcentaje de grasa corporal ni su distribución, por lo tanto sólo puede ser considerada de manera indicativa. El IMC es considerado normal cuando se encuentra en el rango entre 18,5 y 25, individuos con un IMC igual o mayor a 25 son clasificados como con sobrepeso y aquellos con un IMC igual o mayor a 30 son considerados obesos [41]. La obesidad es causada por un desequilibrio energético entre las calorías consumidas por el individuo y las que utiliza en su actividad diaria. La obesidad se puede prevenir. A nivel mundial, la incidencia de la obesidad se ha casi duplicado desde 1980, en el año 2008 el sobrepeso afectaba a 35 por ciento de los adultos y la obesidad al 11 por ciento. El sobrepeso y la obesidad son factores de riesgo en la aparición de enfermedades no transmisibles, como las enfermedades

cardiovasculares y la diabetes [42].

En economía se ha estudiado la relación entre obesidad y distintas variables socioeconómicas, como la educación y el ingreso, encontrando una relación negativa entre la obesidad y estas variables, aunque también se observa una reducción en la diferencia entre los grupos con menor y mayor educación o ingreso, ya que la obesidad ha aumentado relativamente más rápido en este último grupo. La obesidad también ha sido relacionada con las preferencias temporales de los individuos (las preferencias temporales se refieren a la disponibilidad del individuo para intercambiar utilidad hoy por utilidad en el futuro), con resultados que indican que las personas con mayor IMC o que padecen obesidad son menos pacientes. También existe evidencia de que cuando las condiciones macroeconómicas empeoran la prevalencia de obesidad observada disminuye, esto puede deberse a cambios en los hábitos de los individuos, que pueden hacer más ejercicio y comen menos fuera de casa cuando trabajan menos horas. En términos de gastos en salud, se ha observado que en Estados Unidos el promedio de los gastos médicos del año 2006 de las personas obesas fue alrededor de un 40 por ciento más alto que el promedio de los gastos médicos de las personas con IMC normal ($18{,}5 < \text{IMC} \leq 25$). Estudios sobre el efecto de la obesidad en el empleo han obtenido distintos resultados, algunos encuentran que la obesidad reduce las posibilidades de empleo mientras que otros no encuentran un efecto de la obesidad sobre el empleo. Respecto de los salarios, los resultados indican, en general, que las personas con mayor IMC tienen menores salarios, sin embargo, los resultados varían entre distintos países y también se observan diferencias entre hombres y mujeres. [9]

Esta tesis analizará la relación de la obesidad con otras variables utilizando datos para Alemania, se analizará como la obesidad se relaciona con decisiones en el mercado del matrimonio, tanto matrimonios como divorcios, y con el salario observado en el mercado laboral. En economía el mercado del matrimonio (en inglés, marriage market) se refiere al proceso que determina cómo son emparejados hombres y mujeres a través del matrimonio. La relevancia de la obesidad en el mercado del matrimonio proviene de su relación con el atractivo físico, una característica valorada en este mercado, tanto en hombres como en mujeres. En el caso del matrimonio, el objetivo será determinar si existen compensaciones entre las características físicas y socioeconómicas de los cónyuges y si estas compensaciones son diferentes entre parejas en su primer matrimonio y parejas donde al menos uno de los cónyuges ha estado casado antes. El divorcio se analizará concentrándose en cómo la similitud de los cónyuges en términos de IMC en el año de su matrimonio se relaciona con el riesgo de divorcio posterior de la pareja. La relación entre obesidad y salarios se estudiará utilizando una medida relativa del IMC, a diferencia de la literatura existente que se concentra en medidas absolutas, para intentar saber si la relación entre obesidad y salarios depende de en que lugar de la distribución del IMC de los individuos en el mismo grupo de edad, del mismo género y que trabajan en la misma región se encuentra el individuo.

Los datos para esta investigación provienen del Panel Socio-Económico Alemán

(SOEP). El SOEP es un panel microeconómico representativo a nivel nacional que colecta datos con periodicidad anual desde 1984 en la República Federal de Alemania (Alemania Occidental) y desde 1990 en la Alemania re-unificada, cada año aproximadamente 11000 hogares, compuestos por alrededor de 20000 individuos, participan en la encuesta. A cada integrante del hogar que tenga 16 años o más se le pide que responda un cuestionario individual y el jefe de hogar responde también el cuestionario sobre las características del hogar. El SOEP incluye preguntas sobre estatura y peso en los cuestionarios individuales de los años 2002, 2004, 2006, 2008 y 2010, y los datos corresponden a las respuestas, en centímetros y kilos respectivamente, dadas por los participantes en la encuesta, no se realizan mediciones de peso ni de estatura.

A continuación se describen cada uno de los capítulos que forman esta tesis.

CAPITULO 1: Costos de la Obesidad en el Mercado del Matrimonio: Interacciones entre las Características Antropométricas y Socio-Económicas de los Cónyuges en Alemania.

El primer modelo de utilidad dentro del matrimonio fue propuesto por G. Becker en 1973 [1], en su modelo el matrimonio reportaba utilidad gracias a la producción de bienes en el hogar, dicha producción tenia como insumos el tiempo de los cónyuges y bienes de mercado adquiridos con el ingreso del hogar. En este modelo es óptimo que los cónyuges sean similares en características que no pueden ser transadas en un mercado, pero que están relacionadas la calidad del tiempo dedicado a la producción dentro del hogar, como la inteligencia, la educación, la salud, el atractivo y la etnicidad, ya que son complementarias en la producción en el hogar, mientras que en el caso de sustitutos en la producción, como los salarios, es óptimo que la correlación entre los cónyuges sea negativa. Es decir, el modelo predice que se formaran parejas formadas por individuos similares (en inglés, assortative mating) en características que no pueden ser transadas en un mercado y parejas disimiles (en inglés, negative assorative mating) cuando la característica a considerar son los salarios. El modelo también tiene predicciones en términos de compensaciones entre características, una correlación positiva entre las características que no pueden ser transadas en un mercado de un cónyuge y la riqueza del otro es siempre óptima.

Las predicciones sobre parejas formadas por individuos similares del modelo de Becker [1] han sido testadas para diferentes características y utilizando datos para diferentes países. Por ejemplo, hay evidencia de que las parejas son similares en términos de educación en Estados Unidos [35, 43], Europa [28], Reino Unido [10, 17]; etnicidad en Estados Unidos [24], Holanda [27], Reino Unido [38, 39]); estatus ocupacional en Estados Unidos [25]; preferencias políticas en Reino Unido [32]; atractivo y personalidad en Reino Unido [33].

En el caso de Alemania, hay evidencia de similitudes entre cónyuges en términos de educación, religión y ser fumador o no. Blossfeld y Timm (2003) [4] usaron datos de la República Federal de Alemania para calcular las probabilidades de cambiar el

estado civil pasando de soltero a casado con alguien con la misma, mayor o menor calificación, ellos encontraron que la homogamia en términos de educación a aumentado en cohortes más recientes, particularmente entre individuos con alto nivel educativo. Hendrickx et al. (1994) [20] encontraron que la religión ha perdido importancia como criterio de selección de pareja y que sólo es relevante para algunos grupos. Klein y Rüffer (2001) [29] encontraron homogamia entre los fumadores.

En relación con las compensaciones entre características de los cónyuges, sólo hay resultados para Estados Unidos y Suiza. Oreffice y Quintana-Domeque (2010) [40] encontraron que en Estados Unidos hay similitudes entre cónyuges en términos de IMC, peso y estatura, y que el IMC de las mujeres era penalizado en términos del ingreso y la educación del esposo, mientras que el IMC de los hombres no sufría tales penalizaciones. Franzen y Hartmann (2001) [13] estudiaron la elección de pareja en la región germano-parlante de Suiza y encontraron una correlación positiva entre el IMC de los cónyuges y que los hombres pueden compensar un bajo atractivo físico con educación pero que las mujeres no.

El IMC puede ser usado como un proxy del atractivo físico ya que hay evidencia de su correlación negativa con el atractivo tanto para hombres (Hönekopp et al. (2007) [22]) como para mujeres (Tovée y Cornelissen (2001) [45]). Hönekopp et al. pidieron a mujeres de Dresden y Leipzig que evaluaran el atractivo de hombres caucásicos de Chemnitz usando fotografías del cuerpo, de frente y de espaldas, y de la cara y encontraron una correlación negativa entre IMC y atractivo. Tovée y Cornelissen pidieron a estudiantes, hombres y mujeres, en el Reino Unido que evaluaran el atractivo de imágenes frontales y laterales de mujeres reales (con la cara borrosa para que los rasgos faciales no fueran considerados) y encontraron que hay una relación no lineal entre IMC y atractivo, que alcanza su máximo en el rango de IMC 18-20, y que hay una débil correlación negativa entre el atractivo y la proporción cintura-cadera, los resultados también muestran que el IMC explica una mayor parte de la varianza que la proporción cintura-cadera en las evaluaciones de atractivo de los individuos, es decir, el IMC es un determinante más fuerte del atractivo que la proporción cintura-cadera.

El objetivo de la investigación en este capítulo es determinar si existen compensaciones entre las características antropométricas y socio-económicas de los cónyuges en Alemania y si estas compensaciones son diferentes entre parejas en su primer matrimonio y parejas donde al menos uno de los cónyuges ha estado casado antes.

Las razones para casarse por primera vez y para volver a casarse pueden ser diferentes, ya que los divorciados pueden tener diferentes necesidades, atractivo y oportunidades en comparación con personas que nunca han estado casadas, algunas posibles diferencias son los efectos del divorcio en términos financieros y tener o no hijos del matrimonio anterior, además es posible que potenciales parejas consideren estar divorciado como una mala señal (de Graaf y Kalmjin (2003) [12]).

Las características antropométricas a considerar son estatura y peso, que son usadas

para calcular el IMC, que está relacionado con el atractivo físico, y las características socio-económicas son educación e ingreso. Es decir, el objetivo es saber si los hombres, las mujeres, o ambos enfrentan una recompensa (penalización) en el mercado del matrimonio en términos de las características del cónyuge si sus propias características (no) son deseables y si estas recompensas o penalizaciones son diferentes dependiendo de si es el primer matrimonio para ambos cónyuges o no.

El análisis se realizara sobre una muestra de parejas casadas recientemente (casadas como máximo por un periodo de tres años), sólo la primera observación disponible para cada pareja fue utilizada para poder observar las características de los cónyuges tan cerca de su matrimonio como sea posible.

Los resultados indican que las mujeres con mayor IMC enfrentan una penalización en términos del ingreso laboral y la educación de sus esposos y que los hombres con mayor IMC enfrentan una penalización ya que es menos probable que tengan una esposa con buena salud. En relación con las potenciales diferencias entre parejas en su primer matrimonio y parejas donde al menos uno de los cónyuges ha estado casado antes, los resultados no muestran diferencias significativas.

También se realizaron regresiones usando el peso y la estatura como variables dependientes. Los resultados para el peso son consistentes con los resultados para IMC, las correlaciones entre peso e ingreso y educación tienen el mismo signos que las correlaciones entre el IMC y estas variables: el IMC y el peso de las mujeres están negativamente correlacionados con el ingreso y la educación de sus esposos, y el IMC y el peso de los hombres están negativamente correlacionados con la salud de sus esposas. Los resultados para la estatura muestran que esta es recompensada, para los hombres en términos de la salud de sus esposas y para las mujeres en términos del ingreso de sus esposos.

CAPITULO 2: Índice de Masa Corporal (IMC) Relativo y Salarios. Evidencia de Alemania.

Este capítulo investiga la relación entre la obesidad y los salarios, y, a diferencia de investigaciones previas que se concentran en medidas absolutas, considera medidas *relativas*, es decir, si la relación depende de la "ubicación" en la distribución de la masa corporal de la población de referencia. Los resultados indican que tener un mayor IMC *relativo* está asociado con salarios más bajos tanto para hombres como para mujeres. Si comparáramos el salario del hombre promedio con el de un hombre que tiene IMC diez por ciento sobre el promedio pero que es promedio en todas las otras características, el salario se reduciría hasta en un uno por ciento, y si hiciéramos la misma comparación en el caso de las mujeres el salario podría reducirse hasta en un uno y medio por ciento.

La pregunta sobre si los salarios de los individuos son afectados por la masa corporal ha sido analizado extensamente, con resultados que indican una relación negativa entre ellos. En Estados Unidos, Cawley (2004) [7] usa medidas contemporáneas y

de años anteriores de masa corporal y también una variable instrumental (el peso de un hermano) y encuentra que sólo los salarios de las mujeres blancas son afectados por su peso en todas las regresiones. En Europa[1] Brunello y D'Hombres (2007) [5] usan el IMC promedio de los parientes para quienes está disponible la información como un instrumento para el IMC del individuo, y encuentran que los salarios son afectados negativamente por el IMC, el efecto es mayor para los hombres que para las mujeres y en países del sur de Europa que en países del norte de Europa. Greve (2008) [16] estudia la relación entre el IMC y el empleo y los salarios en Dinamarca usando como instrumento la prescripción de medicamentos para enfermedades relacionadas con la obesidad a los padres del individuo, y encontraron que no hay una relación entre IMC y salarios en el sector público y que en el sector privado la relación tiene la forma de una U invertida para los hombres y es decreciente para las mujeres.

La evidencia sobre la relación entre masa corporal y salarios en Alemania también muestra una relación negativa entre ellos. Usando datos del años 2002, Cawley et al. (2005) [8] encuentran que el IMC está negativamente correlacionado con los salarios de las mujeres, pero no encuentran causalidad cuando utilizan una variable instrumental (peso de uno de los padres). Mahler (2008) [34], usando datos del periodo 2002-2006, encuentra que la obesidad, controlando por el estado de salud, tiene un efecto negativo sólo en los salarios de las mujeres.

Todos los análisis empíricos discutidos anteriormente usan medidas absolutas de la masa corporal (por ejemplo, peso en Kilos, IMC, variables dummy para sobrepeso y obesidad), es decir, no toman en cuenta donde se encuentra el peso o IMC del individuo en la distribución de peso o IMC de la población del mismo género y edad en una región dada.

Blanchflower et al. (2009) [3] encontraron que la percepción de sobrepeso y la satisfacción con el peso corporal son afectados no sólo por el IMC y su cuadrado sino también por el IMC relativo (IMC del individuo dividido por el IMC promedio por género-edad-país) entre las mujeres europeas. También encontraron que la satisfacción con la vida de los hombres en Alemania está negativamente correlacionada con el IMC, IMC cuadrado y el IMC relativo (IMC del individuo dividido por el IMC promedio por género-edad-región). Estos resultados sugieren que las comparaciones en IMC son importantes, de manera que usar sólo el nivel absoluto de IMC puede no explicar completamente los fenómenos analizados.

Hamermesh (2012) [19] se pregunta si son las diferencias absolutas o las diferencias relativas las que afectan los resultados, y si este efecto cambia cuando el nivel de la característica en cuestión aumenta para todos los individuos. Uno de los casos que él analiza es el aumento de estatura en los hombres holandeses entre 1981-1982 y 2006-2010; él encuentra que el efecto de la estatura en los salarios disminuyo en ese periodo pero que ésto era causado por el hecho que en los últimos años sólo la estatura de los trabajadores mayores (que son en promedio más pequeños) era premiada en el mercado.

[1]Datos de Dinamarca, Bélgica, Irlanda, Italia, Grecia, España, Portugal, Austria y Finlandia.

Mensink et al. (2005) [37] estudia la prevalencia de sobrepeso y obesidad en adultos alemanes entre 25 y 69 años de edad en el periodo 1984-2003 usando datos de diferentes encuestas representativas realizadas en ese periodo. En general, encuentran que el sobrepeso permaneció estable y la obesidad aumento. Hay diferencias entre hombres y mujeres, y entre Este[2] y Oeste. La proporción de hombres con sobrepeso permaneció cerca del 50 por ciento y la obesidad aumentó, de 15,5 a 17,6 por ciento en el Oeste y de 20,8 a 23,6 por ciento en el Este. En el Oeste la proporción de mujeres con sobrepeso permaneció estable alrededor de 32 por ciento y la obesidad aumento de 17 a 20 por ciento, en el Este el sobrepeso aumentó de 31,6 a 36,8 por ciento y la obesidad permaneció estable alrededor de 25 por ciento.

La tendencia en la prevalencia de sobrepeso y obesidad en Alemania también puede ser observada comparando los datos del Microcenso para los años 1999 y 2009: La prevalencia general de sobrepeso permaneció estable y la de obesidad aumento. En ambos años 42 por ciento de los hombres y 27 por ciento de las mujeres tenían sobrepeso, la obesidad aumentó de 11,1 a 14,1 por ciento en el caso de los hombres y de 10,4 a 12,7 por ciento para las mujeres. [15]

Las diferencias en IMC entre Este y Oeste también han sido observadas en estudios que utilizan datos de reclutas militares alemanes[3]. Hiermeyer (2009) [21] analizó los datos de reclutas examinados en los años 2000 y 2001, y encontró diferencias en estatura e IMC entre las dos regiones. Jaeger et al. (2001) [23] reunieron datos históricos y actuales sobre la estatura y el peso de los reclutas militares alemanes, los datos para el periodo post-reunificación muestran diferencias entre Este y Oeste: El recluta promedio en el Oeste era más alto y más pesado que el promedio en el Este y esta diferencia se redujo en el periodo 1992-1998, en términos de IMC los datos muestran un patrón similar: el IMC promedio era más alto en el Oeste pero la diferencia se redujo en el periodo 1992-1998.

Los cambios en la prevalencia de sobrepeso y obesidad en Alemania podrían tener un impacto en la evidencia discutida anteriormente sobre la relación entre masa corporal e salarios, es decir, a medida que la prevalencia de obesidad aumenta, las percepciones de la gente pueden variar y por lo tanto su relación con los salarios podría cambiar también. Entonces el efecto puede ser diferente cuando se toma en cuenta el IMC relativo en vez de sólo el IMC. El IMC relativo es definido como la división del IMC del individuo por el promedio de su grupo de género-edad para el año en el cual la información es recolectada, calculándolo separadamente para Este y Oeste debido a las diferencias en las prevalencias del sobrepeso y la obesidad observadas en estas dos regiones.

Tomar en cuenta el IMC relativo en las relación entre obesidad y salarios produce

[2]Para el Este el periodo de análisis es 1991/92 - 2003 debido a la disponibilidad de datos.

[3]Los hombres alemanes deben presentarse en la oficina de reclutamiento militar después de terminar su educación secundaria para ser examinados por un médico para determinar si son aptos para el servicio militar.

resultados consistentes con la literatura previa, hay una relación negativa entre el IMC y los salarios. Los resultados muestran que el IMC absoluto y relativo tienen signos opuestos, pero el IMC relativo tiene un coeficiente mayor (en valor absoluto) que el IMC absoluto. Estos resultados indican que tener un mayor IMC relativo, es decir, estar sobre el promedio en un grupo de género-edad dado, está asociado con salarios más bajos tanto para hombres como para mujeres.

CAPITULO 3: Diferencias en Índice de Masa Corporal (IMC) y Divorcio. Evidencia de Alemania.

Este capítulo investiga si existe una relación entre las diferencias en Índice de Masa Corporal (IMC), un proxy del atractivo físico, entre cónyuges y su probabilidad de divorcio. Los resultados para una muestra de parejas alemanas casadas después de 2001 indican que las diferencias en IMC en el año de matrimonio tienen una relación débil con la probabilidad de divorcio, la comparación entre una pareja con una diferencia promedio en IMC donde el hombre tiene mayor IMC y una pareja con la misma diferencia en IMC pero donde la mujer tiene mayor IMC revela que el divorcio de la segunda pareja es alrededor de uno y medio por ciento menos probable.

En la primera parte de su teoría del matrimonio Becker (1973) [1] predice que la formación de parejas en las cuales las características de los cónyuges son similares es óptima cuando tales características son complementarias en la producción en el hogar, por ejemplo, belleza, inteligencia, y educación. En un artículo posterior, sobre inestabilidad matrimonial, Becker et al. (1977) [2] predicen que las diferencias entre las características de los cónyuges que son mayores que en un emparejamiento óptimo aumentan la probabilidad de divorcio.

El impacto de la similitud en las características de los cónyuges en el riesgo de divorcio ha sido estudiado antes. Frimmel et al. (2009) [14] encuentra que las parejas en que los cónyuges provienen de diferentes grupos étnicos o que tienen diferente religión tienen mas probabilidad de divorciarse en Austria. Kalmijn et al. (2005) [26] analiza datos de Holanda en el periodo 1974-1994, y encuentra que las parejas que son heterogéneas con respecto a la afiliación religiosa o nacionalidad tienen mas probabilidad de divorciarse que parejas que son similares en estas características. Smith et al. (2012) [44] usa datos holandeses más recientes (1995-2008) para estudiar si la etnicidad de los cónyuges afecta el riesgo de divorcio, ellos encuentran que las parejas con cónyuges con la misma etnicidad, ambos holandeses o ambos inmigrantes del mismo país de origen, tienen menos probabilidad de divorciarse que parejas formadas por un holandés y un inmigrante o parejas dónde ambos cónyuges son inmigrantes de diferentes países. McNulty et al. (2008) [36] no estudian el divorcio, sino la satisfacción con el matrimonio entre parejas casadas recientemente en Estados Unidos, ellos encuentran que el atractivo relativo de los cónyuges no afecta su satisfacción con el matrimonio.

En el caso de Alemania, Kraft y Neimann encuentran que no es la similitud entre los cónyuges en educación o religiosidad lo que afecta la probabilidad de divorcio,

sino el nivel de estas variables [31], y que las parejas en que las mujeres es la principal fuente de ingreso tienen más probabilidad de divorciarse que parejas dónde la mujer no trabaja o gana una baja proporción del ingreso del hogar [30], Guven et al. [18] encuentran que las diferencias en felicidad entre cónyuges tienen un impacto negativo en la probabilidad de divorcio. Kraft y Neimann (2009) [31] usan el Panel Socio-Económico Alemán (SOEP) para testar si la homogamia aumenta la estabilidad matrimonial, y encuentran que las parejas donde ambos cónyuges tienen niveles de educación medio o alto y las parejas donde ambos cónyuges asisten a oficios religiosos tienen menos probabilidad de divorciarse, mientras que cónyuges con baja educación y parejas que no asisten a oficios religiosos tienen mayor riesgo de divorcio, también encuentran que aumentos en la diferencia de edad entre cónyuges aumenta el riesgo de divorcio. Kraft y Neimann (2009) [30] usan el Panel Socio-Económico Alemán (SOEP) para testar si la especialización aumenta la estabilidad matrimonial, ellos testan si las parejas que se desvían del patrón de especialización tradicional con un hombre que es la principal fuente de ingreso y una mujer que se encarga del hogar tienen mayor probabilidad de divorciarse, y encuentran que las parejas donde la mujer es la principal fuente de ingreso y el hombre hace el trabajo del hogar y las parejas donde la mujer toma ambos roles tienen mayor probabilidad de divorcio que parejas con el patrón de especialización tradicional. Guven et al. (2012) [18] usan datos de tres países (Alemania, Reino Unido y Australia) para testar, por separado para cada uno de ellos, si las diferencias en felicidad afectan la estabilidad matrimonial, ellos encuentran que las parejas donde los cónyuges difieren en felicidad son menos estables y que hay una asimetría: Si la felicidad de la mujer es menor que la del hombre el divorcio es más probable que cuando los hombres son los que tienen menor felicidad.

Este capítulo plantea una pregunta similar a aquellas recién mencionadas, pero concentrándose en una característica diferente, el atractivo físico, usando como proxy el Índice de Masa Corporal (IMC).

Como se mencionó anteriormente (en la descripción del capítulo 1), el IMC puede ser usado como un proxy del atractivo físico ya que hay evidencia de su correlación negativa con el atractivo tanto para hombres como para mujeres. Hönekopp et al. (2007) [22] pidieron a mujeres de Dresden y Leipzig que evaluaran el atractivo de hombres caucásicos de Chemnitz usando fotografías del cuerpo, de frente y de espaldas, y de la cara y encontraron una correlación negativa entre IMC y atractivo. Tovée y Cornelissen (2001) [45] pidieron a estudiantes, hombres y mujeres, en el Reino Unido que evaluaran el atractivo de imágenes frontales y laterales de mujeres reales (con al cara borrosa para que los rasgos faciales no fueran considerados) y encontraron que hay una relación no lineal entre IMC y atractivo, que alcanza su máximo en el rango de IMC 18-20, y que hay una débil correlación negativa entre el atractivo y la proporción cintura-cadera, pero que el IMC explica más de la varianza entre las evaluaciones de atractivo de los individuos, es decir, el IMC es un determinante más fuerte del atractivo que la proporción cintura-cadera.

Las diferencias en IMC pueden ser interpretadas como diferencias en atractivo dada

la correlación entre estas dos variables. Quién tiene mayor IMC puede ser de importancia para el efecto de la diferencia en IMC entre cónyuges sobre la probabilidad de divorcio. Buss y Angleitner (1989) [6] encontraron que el atractivo físico del cónyuge es más importante para los hombres que para las mujeres en Estados Unidos y en la República Federal de Alemania. Buss y Angleitner pidieron a los participantes en ambos países que ordenaran diferentes características de una potencial pareja y encontraron que las mujeres valoraban tener buenos ingresos más que los hombres y que los hombres valoraban el atractivo físico más que las mujeres en ambos países.

El objetivo de este capítulo es investigar si las diferencias en IMC (diferencias en atractivo físico) entre los cónyuges afecta la probabilidad de que esa pareja se divorcie en el futuro. Esta pregunta será contestada usando datos del Panel Socio-Económico Alemán (SOEP) sobre parejas que se casaron en los años en los cuales se recolectó información sobre peso y estatura (2002, 2004, 2006 y 2008), para poder calcular el IMC correspondiente al año de su matrimonio.

Los resultados obtenidos indican que las diferencias en IMC en el año del matrimonio sólo están débilmente relacionadas con la probabilidad de divorcio, la comparación entre una pareja con una diferencia en IMC promedio donde el hombre tiene mayor IMC y una pareja con la misma diferencia en IMC pero donde la mujer tiene mayor IMC revela que el divorcio de la segunda pareja es alrededor de uno y medio por ciento menos probable. Sin embargo, los resultados se basan en una muestra relativamente corta en comparación con los resultados discutidos previamente que usaron todas los años del SOEP disponibles en su momento, mientras que este capítulo sólo considera matrimonios que ocurrieron en los años donde hay información sobre estatura y peso para poder calcular en IMC para cada cónyuge.

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Chapter 1

Marriage Market Costs of Obesity: Interactions between Spouses' Anthropometric and Socio-Economic Characteristics in Germany

1.1 Introduction

Becker (1973) [1] proposed a theory of marriage in which utility is derived from household produced goods and showed that it is optimal for spouses to have similar non-market characteristics, such as intelligence, education, health, attractiveness and ethnicity, since they are complements in household production, and in the case of substitutes, like wages, the correlation between them should be negative. That is, positive assortative mating by non-market characteristics and negative assortative mating by wages. On the other hand, there is also a trade-off between these characteristics; in Becker's model positive correlation between non-market traits of one spouse and the wealth of the other is always optimal, while the positive correlation between non-market traits of one spouse and earning power usually is.

The objective of this paper is to find whether there are trade-offs between spouses' physical and socio-economic characteristics in Germany and whether these trade-offs differ between couples in their first marriage and couples where at least one spouse was married before. The anthropometric characteristics to be considered are weight and height, which are used to calculate Body Mass Index (BMI), while the socio-economic characteristics are education and income. That is, the objective is to know if men, women or both face a reward (penalty) in the marriage market in terms of their spouses' characteristics if their own are (not) desirable and whether these rewards or penalties are different depending on it being the first marriage for both spouses or not.

The results indicate that among recently married couples (married for three years or less) women with a higher BMI face a penalty in terms of their husbands' labour income and education and men with higher BMI face a penalty in terms of being less likely to have a wife with good health. Regarding the potential difference between couples in the first marriage and couples where at least one spouse was married before, the results do not highlight any. The results in terms of weight (controlling for height) are consistent with those for BMI. Height (controlling for weight) is rewarded, taller men have healthy wives and taller women have husbands with higher income and more education.

The existing literature on spouses' characteristics in Germany focuses on assortative mating, considering one characteristic at a time, finding evidence of spousal similarities in different aspects. Blossfeld and Timm (2003) [2] used West German data to calculate the transition rates from single to married to a spouse with the same, higher or lower qualification; they found that educational homogamy has increased across cohorts, particularly for those with high educational level. Hendrickx et al. (1994) [14] found that religion has lost its importance as a criterion to choose a partner and that it is only relevant for some groups. Klein and Rüffer (2001) [16] found that there is homogamy between smokers.

To the best of my knowledge, there is no previous research about trade-offs between spouses' characterics for Germany, there are only results for the US and

Switzerland. Oreffice and Quintana-Domeque (2010) [18] found that in the US there is positive sorting among spouses' BMI, weight and height, and that women's BMI was penalised in terms of her husband's income and education, while men's BMI was not. Franzen and Hartmann (2001) [10] studied partner choice in the German-speaking region of Switzerland and found a positive correlation between partners' BMI and that men can compensate low physical attractiveness with education, whereas women cannot.

The remainder of the paper is organised as follows, Section 1.2 describes the data, Section 1.3 reports the results, and Section 1.4 concludes. The relevant literature is discussed in each section.

1.2 Data

The data used are waves 19, 21, 23 and 25 of the German Socio-Economic Panel (SOEP), these waves correspond to the years 2002, 2004, 2006 and 2008, respectively, and were chosen because they include questions about height and weight of the individuals. Additionally, wave 22 (year 2005) was used to obtain information about personality traits.

The German SOEP is a nationally representative micro-economic panel which has collected data on a yearly basis since 1984 in West Germany and since 1990 in the reunified country. Each household member aged 16 or older is asked to answer an individual questionnaire and the household head also answers the household questionnaire.

I consider a sample of recently married couples, i.e. couples that have been married for three years or less. Only the first available observation is used, in order to observe the characteristics of the spouses, and potential trade-offs between them, as close to their wedding as possible. Additionally, the sample is restricted to those where the man works, and both spouses are between 20 and 50 years of age.

The individual variables considered are marital status, marital duration, labour force status, height, weight, age, income, health status, education and personality traits.

The marital status question in the individual questionnaire gives the respondents five alternatives: Married living together, married separated, single, divorced and widowed. To determine how long a couple has been married it is necessary to use an additional data file with the marital biography of respondents which gives information about the different marital status spells experienced by each respondent (single, married, divorced, widowed), the information taken from this file is the year of marriage, to calculate how long they have been married, and the spell number, to differentiate between first and later marriages. Only couples where both spouses report the same marital status, married living together, and marital duration, three years or less, are considered in the sample.

The information about labour force status is used to differentiate working from non-working men in the sample, working men are those whose labour force status is either as "working" or "working, but non-working past 7 days".

The information about height and weight is self-reported and it is used to calculate the Body Mass Index (BMI) for each individual, which is defined as $\text{BMI} = \frac{\text{weight[Kg]}}{(\text{height[m]})^2}$. Extreme values of BMI were dropped, leaving out underweight and severe thinness (BMI < 18.5) and morbid obesity (BMI ≥ 40).

Individual age was calculated as the difference between the year of the survey and their respective year of birth.

The German SOEP provides information about current labour income, both gross and net, which is generated for all the employed respondents in each wave. For the regressions, the natural logarithm was used for all reported labour incomes, the results using gross and net labour income do not differ.

There is also information about other sources of income, such as pensions, unemployment benefits, maternity benefit, student grant and alimony. Since most of the individuals in the sample, 97 percent of men and 95 percent of women, do not to have any of these sources of income the results will be presented using only labour income.

The question about health status gives the respondents five alternatives to describe their current health: Very good, good, satisfactory, poor and bad. Using this information a dummy variable for good health was created, which takes the value one when the individual reports his health to be very good or good, and zero otherwise.

The information about education used in this paper is the number of years of education, which can vary from seven to eighteen years (i.e. from no degree to university degree).

The 2005 SOEP survey included a question about personality traits, respondents were asked to answer on a one to seven scale ranging from "does not apply to me at all" to "applies to me perfectly" to 15 adjectives describing their personality. This question is a short version of the Big Five Inventory developed for the SOEP survey by Gerlitz and Schupp (2005) [12], including three adjectives for each of the five personality traits: Openness to new experience, conscientiousness, extraversion, agreeableness and neuroticism. The variables corresponding to each personality trait were constructed following the normalisation suggested by Dehne and Schupp (2007) [7], which considers only the observations in which the respondent answered all 15 items and normalises them to mean zero and unitary standard deviation variables, these variables are then weighted in together to form five variables (one for each personality trait) that are finally normalised to have mean 50 and standard deviation 10. A brief description of the personality traits is given in the corresponding section.

At the household level the variables considered are the number of children age 0-1

years in the household and the region (Bundesland) where the household is located. The number of children age 0-1 is included to try to control for the weight changes associated with pregnancy. The region dummies are included to control for regional fixed effects.

Each observation also includes the year on which the information was collected, to control for year fixed effects.

The sample includes 785 recently married couples, in 550 of them both spouses are in their first marriage.

1.2.1 Descriptive Statistics

The descriptive statistics are presented in Table 3A.1.

When comparing men and women it can be observed that, on average, men are taller, heavier and have higher BMI, are more likely to be overweight, are around two years older, have higher labour income and are more likely to report good health than women. Men and women are similar in terms of education and in the likelihood to be obese.

The higher BMI and overweight incidence of men is consistent with the Microcensus data for 2009 [11], where men have higher BMI and higher overweight incidence than women for every age group, with the difference increasing as they get older. The 2003 Microcensus data reported in "Women in Germany" [8] shows the same pattern. The similar obesity incidence in the sample is also consistent with these reports.

According to the report "Women in Germany" [8] in the marriages that took place between 1994 and 2004 men were on average two years older than women and in 2004 men and women of the younger age groups had similar educational level, which is what it is observed in the sample. In terms of health, the report says that more women than men reported to be ill when interviewed, which is similar to the sample statistics of more men than women reporting good health.

The characteristics of the married couples in the 2009 Microcensus [25] show that in 60 percent of the couples in Germany both spouses had the same educational level and in 31 percent of cases the husband had higher educational level than his wife. In terms of age, in most couples the age difference was between one and three years and in 74 percent of them the husband was older and in 16 percent the wife was.

1.3 Results

1.3.1 Body Mass Index

The results are obtained using Seemingly Unrelated Regressions (SUR), the dependent variable is individual's BMI and the regressors are the individual's own age and the BMI and other characteristics of the spouse. There are four different specifications:

(1) $\mathrm{BMI_i} = \mathrm{BMI_i}(\mathrm{Age_i}, \mathrm{BMI_j})$

(2) $\mathrm{BMI_i} = \mathrm{BMI_i}(\mathrm{Age_i}, \mathrm{BMI_j}, \mathrm{Income_j})$

(3) $\mathrm{BMI_i} = \mathrm{BMI_i}(\mathrm{Age_i}, \mathrm{BMI_j}, \mathrm{Education_j})$

(4) $\mathrm{BMI_i} = \mathrm{BMI_i}(\mathrm{Age_i}, \mathrm{BMI_j}, \mathrm{Health_j})$

The results are reported in Table 1A.2, the top panel shows the results for the different specifications as indicated before, the bottom panel adds a dummy variable for couples where at least one of the spouses has been married before and interacts it with the spouse's characteristics.

Regarding age, previous research indicates that the correlation with BMI should be positive. The German Health Ministry, based on 2009 Microcensus data, reported that average BMI is higher for older age groups, for both men and women [11]. Also, Heineck (2006) [13] reports that younger cohorts of men and women have lower BMI than older ones.

Among recently married couples men's BMI is positively correlated with their age. This correlation is present in all specifications with significance of five or ten percent, the coefficient is around 0.05 which indicates that being one year older is associated with a BMI 0.05 points higher, i.e. on average[1] the weight of two men with a one year age difference differs approximately in 0.16 Kilograms [Kg]. Women's age is not significant in any specification, but the coefficient has a negative sign, which is not as expected given the evidence that older age groups have higher BMI.

In terms of spouses characteristics, Oreffice and Quintana-Domeque (2010) [18] found that in the US there is positive sorting among spouses' BMI, weight and height, and that women's BMI was penalised in terms of her husband's income and education, while men's BMI was not. Franzen and Hartmann (2001) [10] found a positive correlation between partners' BMI and a negative correlation between own BMI and partner's education in the German-speaking region of Switzerland.

Spouses' BMI are positively correlated, this could indicate positive sorting on BMI for recently married couples. This positive correlation between spouses' BMI is present in all specifications and is always significant at a one percent level. For men a one point BMI increase of the spouse is associated with around a 0.3 BMI

[1] Using average height of men to calculate BMI.

point increase, which expressed in Kilograms[2] is to say that a 2.80 Kg weight gain of women is associated with a 0.98 Kg gain of the men. The coefficients for women are greater than those for men: For women a one point BMI increase of the spouse is associated with a 0.4 BMI point increase, which expressed in Kilograms[3] is to say that a 3.26 Kg gain of men is associated with a 1.12 Kg gain of women.

We observe different results for men and for women. In specifications (2) and (3), men's BMI has no correlation with their wives' income or education, and women's BMI is negatively correlated with their husbands' income and education, this correlation is significant at a one percent level. For income the coefficient is -0.669, meaning that a ten percent increase in the income of the average man is associated with a wife's BMI 0.06 points lower, i.e. she would be 0.18 Kg lighter. For education the coefficient is -0.282, so if the average man gets an extra year of education his wife would have a BMI 0.28 points lower, which translates into 0.79 Kg. In specification (4) men's BMI is negatively correlated to wife's good health (significant at one percent), and women's BMI shows no correlation to the health status of the husband. Having young children (0-1 years) is not significantly correlated to women's BMI.

The reasons to go into first and second (and later) marriages might be different, people that have already divorced might have different needs, attractiveness and opportunities than those who have never been married, some differences have to do with the financial effects of divorce, the wish to have children, having children from the previous marriage, the lower participation of divorced people in typical marriage markets such as schools, and the possibility that some potential spouses consider being divorced as a bad signal (de Graaf and Kalmjin (2003) [6]).

To know whether the trade-offs between spouses' characteristics are different between couples depending on whether it is their first marriage or not the same regressions are run adding a dummy variable that takes value 1 if at least one of the spouses has been married before and zero for couples where both spouses are married for the first time, and interacting this dummy variable with the other regressors. The results are reported on the bottom panel of Table 1A.2, the dummy variable "Married Before" is significant in the regressions for men, at five or ten percent, its interaction with spouse's BMI is only significant for men (at ten percent), and its interaction with the other regressors is never significant. Including married before dummies specific for each spouse (not reported on the paper), i.e. one for when the woman was married before and one for when the man was married before, does not change these results.

Marriage Market Interpretation

What the previously described results mean in a marriage market context will depend on what is considered desirable in terms of the characteristics included in the regressions. We would expect desirable characteristics in one spouse to be rewarded

[2]Using average height of men and women to calculate BMI.
[3]Using average height of men and women to calculate BMI.

with desirable characteristics in the other spouse and not desirable characteristics to be penalised in terms of the characteristics of the spouse.

Men and women agree on what is considered physically attractive in women regarding BMI. Tovée and Cornelissen (2001) [24] asked UK students to rate the attractiveness of front and profile view images of real women (with the face blurred so facial traits were not taken into account) and found that there is a non-linear relationship between BMI and attractiveness, which peaks in the 18-20 BMI range, and that there is a weak negative correlation between attractiveness and waist-to-hip ratio (WHR), but BMI explains more of the variance among individuals' attractiveness ratings, i.e. BMI is a stronger determinant of attractiveness than WHR.

There is evidence that BMI relates to body attractiveness in men: Hönekopp et al. (2007) [15] asked women from Dresden and Leipzig to rate the attractiveness of Caucasian men from Chemnitz using body, front and back, and face photographs and found a negative correlation between BMI and attractiveness.

Buss and Angleitner (1989) [4] studied mate selection in the US and in West Germany in two studies. In the first one they asked students from the Universities of California (Berkeley) and Harvard in the US and from the Universities of Bielefeld and Düsseldorf in Germany to rank different characteristics of a potential mate and found that in both countries women ranked good earning capacity higher than men and men ranked physical attractiveness higher than women, German men and women ranked good housekeeper higher than in the US and American men and women ranked physical attractiveness and college graduate higher than in Germany. The second study had a bigger sample in both countries, it also included non-student subjects in the German sample (from neighbouring areas to the Universities) and two more Universities, Michigan and Texas, in the US sample, and asked the subjects to rate each characteristic instead of ranking them and to answer an additional questionnaire, the results confirmed those of the first study and also show that in both countries men and women prefer a marriage where the man is older.

Wilbur and Campbell (2010) [26] asked Canadian female undergraduates to rate the desirability of four different profiles, photo plus description, that were the combinations of high and low attractiveness and ambition, for three types of relationship that varied on duration, the results for long-term relationships show that women prefer ambitious and attractive men and that the effect of attractiveness is stronger when the man is ambitious, the authors interpret this result as indicating that being a good provider is a necessary, but not sufficient, condition to be a desirable long-term partner.

Wirth (1996) [27] analysed data for West Germany and reported that the percentage of marriages of men born between 1926-33 and 1958-65 that were educationally homogamous increased from 42.5 to 48.2 percent, while the percentage of marriages where the man had higher education decreased from 50.4 to 28.3 percent. She also found that in the younger cohorts men and women are as likely to marry someone

with a lower educational level. These results about educational homogamy are ex-post since they correspond to already married couples.

Blossfeld and Timm (2003) [2] used SOEP data for West Germany to estimate the transition rate from being single (everyone's original state) into being married with someone with the same, lower or higher education. The data showed that educational homogamy increased across cohorts, going from fifty to seventy percent, that in the older cohorts women were more likely to be less educated than their husbands and that the proportion of marriages in which the woman has higher education has remained stable, ranging between four and eight percent. The results of the transition rate regressions indicate that the rate of homogamous marriage for men and women increases with their educational level and when education acquisition is over, another results are that the probability of marrying someone with similar or higher education increases the longer women and men spend in the educational system and that this probability goes down as years passed after completing education, suggesting that educational systems are marriage markets where it is more likely to meet someone with similar or (later) higher education and that after finishing school, and leaving this homogamous environment, it is more likely to meet someone with different educational level.

Skopek et al. (2009) [21] analysed German data from on-line dating services, which allow them to observe the early stages of partner search as they had information about the characteristics of the sender and the receiver of messages between users that have not been in contact before, they focused on the educational level reported by the users of the dating service. The results indicate that men and women prefer to contact potential partners with similar education and that the effect is increasing in educational level, particularly for women, and that if not contacting someone with the same educational level women contact men with higher education and men contact women with lower.

Franzen and Hartmann (2001) [10] studied partner choice in the German-speaking region of Switzerland and found a positive correlation between partners' BMI. When focused on how attractiveness, measured as BMI or self-reported, relates to partner's education they found a negative correlation between own BMI and partner's education. They also found that women who perceived themselves as attractive are more likely to have partners with a higher educational level than women that do not consider themselves attractive, and that both attractive and not attractive women are as likely to have a less educated partner. In the case of men, those who perceived themselves as attractive are less likely to have partners with a higher educational level than those who consider themselves not attractive, and that attractive men are only slightly more likely than not attractive men to have a more educated partner, i.e. men can compensate low attractiveness with education and women cannot. When taking into account all characteristics in OLS regressions they found that partners' BMI are positively correlated and that women's BMI is negatively correlated to their education, to having a partner with more education than themselves and to having a partner with high income.

With these results in mind, we can interpret the results found here. In Table 1A.2, the negative correlation between women's BMI and their husbands' income [specification (2)] and education [specification (3)] could be considered penalties in the sense that women with higher BMI (less attractive) have husbands with less desirable characteristics (lower income and less educated). In the results for men there is no correlation between their BMI and their wives' income [specification (2)] and education [specification (3)], and there is a negative correlation with their wives' health [specification (4)], which could be interpreted as a penalty for men's BMI in terms of their wives health.

Taking into account whether it is the first marriage for both spouses or not does not change the results in terms of trade-offs. The dummy variable "Married Before" is significant only as intercept or interacted with spouse's BMI, and its interaction with the other regressors is never significant, suggesting that the trade-offs among couples with at least one spouse who was married before do not differ from those among couples in their first marriage.

Robustness Checks

The following robustness checks were performed on the regressions without the "Married Before" dummy variable.

Given that for women the correlation between BMI and age is negative (although not significant), unlike what could be expected given previous research, it is worth taking a closer look at age. To do so, other age variables were considered: Age squared, age brackets and the age difference between husband and wife. When adding age squared to the regressions the results show that age is negatively and age squared is positively correlated with BMI, significant only for women. Using five years age brackets, 20-25, 25-30, ..., 45-50, leaving the first bracket without dummy, the results show that women 25-35 have lower BMI than those aged 20-25. Using age difference (age of the husband - age of the wife) instead of age gives results where it is significant only for men, with a positive sign. These results indicate that the negative correlation between women's BMI and age seems to be driven by those women aged 25-35 that represent most of the sample.

Relative to the income variable we could control for whether the work is part-time and use working hours instead of labour income. When controlling whether the work is part-time we find the same pattern in terms of correlations between BMI and labour income and also that part-time working women's husbands have lower BMI. If we consider working hours instead of labour income we find a positive correlation between men's BMI and wives' working hours and a negative correlation between women's BMI and husbands' working hours.

The good health indicator used in the regressions is not the only variable that can give us information about the health status of the spouses. There are also questions about physical activity, but only in one wave which would reduce significantly the

sample size. It is also possible to know whether the spouses are smokers[4], this is relevant given the health risks associated with tobacco [19] and the fact that there is evidence of homogamy between smokers [16]. Adding dummies for smoker spouse to the regressions does not change the previous results, and these variables are never significant.

In terms of education it is possible to use educational levels instead of number of years. If the levels are considered relative to High School (HS), less than HS, HS and more than HS, the results show that women's BMI is negatively correlated to her husband having HS or more than HS level, consistent with the results obtained using the number of years. When the levels used are those defined by the ISCED[5]-1997 classification, the highest levels of education (higher vocational and higher education) of men are negatively correlated to women's BMI, again showing results consistent with those obtained using years of education.

Including the spouses own characteristics in the regressions does not change the results found in terms of correlations between one spouse's BMI and the other spouse's income, education or health.

Additional Results

Choo and Siow (2006) [5] propose an estimation of the gains of marriage, relative to remaining single, as the logarithm of the ratio of the number of marriages between men and women of different types to the geometric average of the singles of these types in the population. In our case, the men and women in the sample will be classified according to their BMI into two categories: Normal and overweight or obese.

First, we classify the married couples according to the BMI of the spouses: Table 1A.3 shows that there are less marriages where the woman is overweight or obese and the man has normal weight than when the one with higher BMI category is the man. Then we classify the single men and women in the same age range as the sample[6], and restricting to working men, according to their BMI (Table 1A.4).

Using this information it is possible to calculate the ratio proposed by Choo and Siow (2006) [5] (Table 1A.5). Among recently married couples the proportion of marriages between men and women in the same BMI category is higher than that of marriages across BMI categories. In terms of gains of marriage (logarithm of the ratios)[7] these results indicate that the gains of marriage are lower when the woman is in a higher BMI category than when the man is. The results discussed here are in line with the regression results for recently married couples, where women's BMI

[4]Individuals are asked whether they currently smoke or not, those who answered yes are considered smokers.

[5]International Standard Classification of Education.
http : //www.unesco.org/education/information/nfsunesco/doc/isced1997.htm

[6]As in the sample only one observation per individual is considered.

[7]Since all the ratios are smaller than one, the gains of marriage for all cases are negative.

was negatively correlated to some characteristics of their husbands, such as income and education, as those matches would report lower gains to the spouses.

1.3.2 Height and Weight

The regressions will now have as dependent variable the height (weight) of one spouse and as the regressors his/her own weight (height) and both characteristics of the spouse, along with the other regressors in each specification.

In terms of height, there is evidence that both men and women prefer couples where the husband is taller than the wife. Swami et al. (2008) [23] found that in the UK both men and women prefer relationships in which the woman is shorter than the man, participants in their study were asked to report their own height and to indicate the ideal height of a date, and the results indicate that women's ideal partner is significantly taller than the average man, while men's ideal partner is as tall as the average woman. Salska et al. (2008) [20] found similar preferences for height in the US.

Heineck (2006) [13], using SOEP data for 2002, found that average height increased since the 1950s, for both German men and women.

The German Health Ministry, based on 2009 Microcensus data, reported that average weight is higher for older age groups, and that younger age groups are on average slightly taller than the older ones [11].

As with BMI, there is positive correlation between spouses characteristics (second row in Tables 1A.6 and 1A.7). These results are similar to those of Oreffice and Quintana-Domeque (2010) [18] for the US.

The results in Table 1A.6 show that men's height is rewarded in terms of their wives' health [specification (4)] and women's height is rewarded in terms of their husbands' income [specification (2)] and education [specification (3)]. In Table 1A.7, men's weight is penalized in terms of their wives' health [specification (4)] and women's weight is penalised in terms of their husbands' income [specification (2)] and education [specification (3)].

The results for weight are consistent with those for BMI, looking at Tables 1A.2 and 1A.7 we can see correlations with the same sign between BMI or weight and income, education and health: Women's BMI and weight negatively correlated to their husband's income and education, and men's BMI and weight negatively correlated to their wife's health.

1.3.3 Personality Traits

As mentioned in the Data section, the question about personality includes fifteen items, three for each of the personality traits, that must be answered in a one to

seven scale ranging from "does not apply to me at all" to "applies to me perfectly". The question is "I see myself as someone who ..." and the adjectives (grouped by personality trait) are:

- Openness to Experience: ... is original, comes up with new ideas; ... values artistic experiences; ... has an active imagination.
- Conscientiousness: ... does a thorough job; ... does things effectively and efficiently; ... tends to be lazy (reversed).
- Extraversion: ... is communicative, talkative; ... is outgoing, sociable; ... is reserved (reversed).
- Agreeableness: ... is sometimes somewhat rude to others (reversed); ... has a forgiving nature; ... is considerate and kind to others.
- Neuroticism: ... worries a lot; ... gets nervous easily; ... is relaxed, handles stress well (reversed).

There is some previous research based on German data on how personality traits relate to some of the variables considered in this paper. Specht et al. (2011) [22] found that women with higher neuroticism were more likely to marry in the following years than more emotionally stable women, and that men and women became less extraverted and less open after marriage. Lundberg (2010) [17] found that women with higher extraversion, agreeableness and neuroticism and more conscientious men were more likely to ever be married by age 35, while the likelihood was lower for individuals more open to experiences.

Regarding the relationship between personality and BMI, Faith et al. (2001) [9] sampled 30 to 50 years old adults in four counties in the UK and found that BMI relates to different personality traits in men and women, although the correlations found were small, in women higher BMI was related to high neuroticism and low extraversion and in men it was related to high extraversion and psychoticism. Brummett et al. (2006) [3] used data from the University of North Carolina Alumni Heart Study, with participants averaging 42 years of age, and found that women's BMI was positively correlated with neuroticism and negatively correlated with extraversion, agreeableness and conscientiousness, and that men's BMI was positively correlated with extraversion and negatively correlated with agreeableness and conscientiousness.

Table 1A.8 reports the results of adding personality traits to regression (1) of Table 1A.2.

To include these variables it was necessary to restrict the sample to the couples that got married after the 2005 survey interview, as Specht et al. (2011) [22] provide evidence of changes in the personality traits associated with marriage, which reduced the sample to only 107 couples, and therefore the interpretation of the following results must be cautious.

The results show that men's BMI is negatively correlated with wives' extraversion, this correlation can be explained using previous results: Low extraversion is correlated with higher BMI among women (Faith et al. (2001) [9], Brummett et al. (2006) [3]) and BMI is positively correlated between spouses (Table 1A.2).

1.4 Conclusions

The objective of this paper was to investigate whether there are trade-offs between spouses' characteristics in Germany, specifically trade-offs between BMI, education and income, and whether these trade-offs are different for couples in their first and later marriages. This is done using the data from four waves of the German SOEP, the even years from 2002 to 2008.

Regarding the trade-offs between spouses' characteristics, the evidence presented in this paper indicates that there is assortative matching based on BMI, weight (controlling for height) and height (controlling for weight) among German couples who have been married for three years or less. Among these recently married couples women's BMI is penalised in terms of their husbands income and education, while men's BMI is penalised in terms of their wives' health. These trade-offs do not seem to differ for couples in first or later marriages.

The results in terms of weight (controlling for height) are consistent with those for BMI for recently married couples. Height (controlling for weight) is rewarded among recently married couples, taller men are more likely to have healthy wives and taller women have husbands with higher income and more education.

1A Tables

Table 1A.1: Descriptive Statistics - Recently Married Couples

	N	Mean	SD
Height Men [cm]	785	180.599	6.932
Height Women [cm]	785	167.327	6.529
Weight Men [Kg]	785	85.018	12.689
Weight Women [Kg]	785	67.614	12.321
BMI Men [Kg/m^2]	785	26.044	3.430
BMI Women [Kg/m^2]	785	24.122	4.024
Overweight Men [Proportion]	785	0.461	0.499
Overweight Women [Proportion]	785	0.231	0.421
Obese Men [Proportion]	785	0.118	0.323
Obese Women [Proportion]	785	0.099	0.299
Age Men	785	34.668	6.049
Age Women	785	32.084	6.169
Labour Income Men [€]	785	3031.983	1911.767
Labour Income Women [€]	511	1900.877	1406.815
Good Health Men [Proportion]	785	0.711	0.454
Good Health Women [Proportion]	785	0.661	0.474
Years of Education Men	764	12.972	2.799
Years of Education Women	761	12.956	2.593
Children Age 0-1 in HH [Proportion]	785	0.227	0.431

Table 1A.2: SUR - Dependent Variable: BMI

	(1)		(2)		(3)		(4)	
	Men	Women	Men	Women	Men	Women	Men	Women
Own Age	0.056 ***	-0.021	0.055 ***	-0.004	0.062 ***	-0.007	0.051 ***	-0.019
	(0.029)	(0.023)	(0.020)	(0.023)	(0.020)	(0.024)	(0.019)	(0.023)
BMI Spouse	0.310 ***	0.423 ***	0.311 ***	0.423 ***	0.285 ***	0.368 ***	0.302 ***	0.426 ***
	(0.029)	(0.040)	(0.029)	(0.040)	(0.031)	(0.041)	(0.029)	(0.041)
Labour Income [ln] Spouse	-	-	0.024	-0.669 ***	-	-	-	-
			(0.034)	(0.205)				
Years of Education Spouse	-	-	-	-	-0.041	-0.282 ***	-	-
					(0.048)	(0.052)		
Good Health Spouse	-	-	-	-	-	-	-0.659 ***	0.230
							(0.247)	(0.312)
Children Age 0-1 in HH	-	0.005	-	0.106	-	0.278	-	0.016
		(0.326)		(0.325)		(0.331)		(0.326)
N	785	785	785	785	743	743	785	785
R^2	0.1105	0.1065	0.1115	0.1193	0.1144	0.1508	0.1192	0.1073
χ^2 Test of Independence	27.238		27.197		21.504		27.158	
Own Age	0.042 *	-0.014	0.044 *	0.001	0.049 **	0.014	0.039 *	-0.012
	(0.022)	(0.026)	(0.023)	(0.026)	(0.024)	(0.028)	(0.022)	(0.026)
Married Before (MB)	2.976 *	1.634	3.632 **	6.461	3.910 *	1.192	2.694 *	0.971
	(1.539)	(2.411)	(1.607)	(4.485)	(2.272)	(2.988)	(1.598)	(2.539)
BMI Spouse	0.343 ***	0.440 ***	0.347 ***	0.444 ***	0.317 ***	0.385 ***	0.334 ***	0.440 ***
	(0.036)	(0.047)	(0.036)	(0.047)	(0.037)	(0.048)	(0.036)	(0.048)
BMI Spouse*MB	-0.107 *	-0.069	-0.117 *	-0.087	-0.090	-0.052	-0.104 *	-0.059
	(0.062)	(0.091)	(0.063)	(0.090)	(0.065)	(0.092)	(0.062)	(0.092)
Labour Income [ln] Spouse	-	-	0.050	-0.543 **	-	-	-	-
			(0.039)	(0.234)				
Labour Income [ln] Spouse*MB	-	-	-0.087	-0.544	-	-	-	-
			(0.074)	(0.465)				
Years of Education Spouse	-	-	-	-	0.000	-0.291 ***	-	-
					(0.057)	(0.062)		
Years of Education Spouse*MB	-	-	-	-	-0.112	-0.032	-	-
					(0.111)	(0.111)		
Good Health Spouse	-	-	-	-	-	-	-0.721 **	0.039
							(0.300)	(0.384)
Good Health Spouse*MB	-	-	-	-	-	-	0.249	0.589
							(0.522)	(0.646)
Children Age 0-1 in HH	-	0.015	-	0.122	-	0.269	-	0.028
		(0.326)		(0.326)		(0.331)		(0.326)
N	785	785	785	785	743	743	785	785
R^2	0.1163	0.1076	0.1195	0.1224	0.1182	0.1533	0.1249	0.1097
χ^2 Test of Independence	27.080		26.912		21.947		26.881	

Standard errors in parentheses. ***, ** and * denote 1%, 5% and 10% significance respectively.
Year, region and year-region dummies not reported on the table.

Table 1A.3: BMI Recently Married Couples

	Women		
Men	Normal	Overweight	Total
Normal	240	90	330
Overweight	286	169	455
Total	526	259	785

Table 1A.4: BMI Singles

	Men	Women
Normal	1311	1731
Overweight	851	498
Total	2162	2229

Table 1A.5: Gains to Marriage per Partner (Choo and Siow (2006) [5])

	Women	
Men	Normal	Overweight
Normal	0.1593	0.1114
Overweight	0.2356	0.2596

Table 1A.6: SUR - Dependent Variable: Height

	(1)		(2)		(3)		(4)	
	Men	Women	Men	Women	Men	Women	Men	Women
Own Age	-0.089 ***	0.022	-0.093 ***	-0.005	-0.095 ***	0.001	-0.083 **	0.019
	(0.034)	(0.033)	(0.035)	(0.033)	(0.035)	(0.034)	(0.034)	(0.033)
Height Spouse	0.575 ***	0.531 ***	0.571 ***	0.527 ***	0.539 ***	0.485 ***	0.572 ***	0.532 ***
	(0.034)	(0.031)	(0.034)	(0.031)	(0.036)	(0.032)	(0.034)	(0.032)
Own Weight	0.242 ***	0.203 ***	0.242 ***	0.207 ***	0.238 ***	0.206 ***	0.245 ***	0.203 ***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)
Weight Spouse	-0.111 ***	-0.108 ***	-0.111 ***	-0.109 ***	-0.095 ***	-0.092 ***	-0.108 ***	-0.110 ***
	(0.019)	(0.018)	(0.019)	(0.018)	(0.020)	(0.019)	(0.019)	(0.019)
Labour Income [ln] Spouse	-	-	-0.006	1.117 ***	-	-	-	-
			(0.059)	(0.292)				
Years of Education Spouse	-	-	-	-	0.101	0.357 ***	-	-
					(0.084)	(0.075)		
Good Health Spouse	-	-	-	-	-	-	0.910 **	-0.347
							(0.430)	(0.444)
Children Age 0-1 in HH	-	0.014	-	-0.113	-	-0.113	-	-0.008
		(0.463)		(0.464)		(0.469)		(0.464)
N	785	785	785	785	743	743	785	785
R^2	0.2844	0.2452	0.2859	0.2626	0.2897	0.2779	0.2896	0.2461
χ^2 Test of Independence	70.674		69.688		57.313		70.401	

Standard errors in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year, region and year-region dummies not reported on the table.

Table 1A.7: SUR - Dependent Variable: Weight

	(1)		(2)		(3)		(4)	
	Men	Women	Men	Women	Men	Women	Men	Women
Own Age	0.180 ***	-0.066 *	0.173 ***	-0.020	0.196 ***	-0.028	0.165 **	-0.060
	(0.064)	(0.064)	(0.065)	(0.065)	(0.066)	(0.066)	(0.064)	(0.064)
Weight Spouse	0.367 ***	0.365 ***	0.368 ***	0.366 ***	0.337 ***	0.319 ***	0.357 ***	0.368 ***
	(0.034)	(0.035)	(0.034)	(0.034)	(0.036)	(0.035)	(0.034)	(0.035)
Own Height	0.851 ***	0.756 ***	0.850 ***	0.778 ***	0.846 ***	0.790 ***	0.857 ***	0.756 ***
	(0.058)	(0.063)	(0.058)	(0.063)	(0.061)	(0.065)	(0.058)	(0.063)
Height Spouse	-0.309 ***	-0.334 ***	-0.310 ***	-0.341 ***	-0.285 ***	-0.274 ***	-0.308 ***	-0.338 ***
	(0.068)	(0.065)	(0.068)	(0.065)	(0.071)	(0.066)	(0.067)	(0.066)
Labour Income [ln] Spouse	-	-	0.086	-1.886 ***	-	-	-	-
			(0.112)	(0.578)				
Years of Education Spouse	-	-	-	-	-0.114	-0.781 ***	-	-
					(0.159)	(0.147)		
Good Health Spouse	-	-	-	-	-	-	-2.062 **	0.554
							(0.812)	(0.873)
Children Age 0-1 in HH	-	0.036	-	0.324	-	0.756	-	0.067
		(0.912)		(0.912)		(0.929)		(0.913)
N	785	785	785	785	743	743	785	785
R^2	0.3025	0.2520	0.3033	0.2628	0.3038	0.2858	0.3087	0.2525
χ^2 Test of Independence	27.919		27.849		22.077		27.837	

Standard errors in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year, region and year-region dummies not reported on the table.

Table 1A.8: SUR - Dependent Variable: BMI - Personality Traits

	(1)	
	Men	Women
Own Age	0.028	-0.003
	(0.052)	(0.073)
BMI Spouse	0.145 **	0.270 **
	(0.073)	(0.129)
Openness Spouse	-0.007	0.023
	(0.029)	(0.043)
Consciousness Spouse	0.040	-0.040
	(0.045)	(0.073)
Extraversion Spouse	-0.084 **	-0.060
	(0.043)	(0.063)
Neuroticism Spouse	0.003	0.021
	(0.043)	(0.064)
Ageeableness Spouse	0.022	-0.015
	(0.042)	(0.058)
Children Age 0-1 in HH	-	0.603
		(0.910)
N	107	107
R^2	0.3820	0.3179
χ^2 Test of Independence	1.065	

Standard errors in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year, region and year-region dummies not reported on the table.

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Chapter 2

Relative BMI and Wages. Evidence from Germany

2.1 Introduction

The question of whether individuals' wages are affected by body weight has been analysed extensively, with results indicating that earnings are negatively correlated to body weight. In the US, Cawley (2004) [5] uses contemporary and lagged measures of body weight as well as an instrumental variable (the weight of a sibling) and finds that only the wages of white women are affected by their weight in all regressions. In Europe[1] Brunello and D'Hombres (2007) [3] use the average body mass index (BMI) of relatives as an instrument for individual's BMI, and find that wages are negatively affected by BMI, the effect is bigger for men than for women and in southern European countries than northern European ones. Greve (2008) [9] studied the relationship between BMI and employment and wages in Denmark using as an instrument the prescription of medication for obesity related diseases to the individual's parents, and found that there is no relationship between BMI and wages in the public sector and that in the private sector the relationship describes an inverted-U shape for men and it is decreasing for women.

The evidence from Germany also shows a negative relationship between body weight and wages. Using data for 2002, Cawley et al. (2005) [6] find that BMI was negatively correlated to women' earnings, but there is no causality when using an instrumental variable (weight of a parent) approach. Mahler (2008) [13], using data for the period 2002-2006, finds that obesity, controlling for health status, has a negative effect only on women's wages.

All the empirical analyses discussed above use absolute measures of body weight (e.g. weight in Kilos, BMI, dummy variables for overweight and obese), i.e. they do not take into account where an individual's own weight or BMI stands in the weight or BMI distribution of the population of the same gender and age in a given region.

Blanchflower et al. (2009) [2] find that overweight perception and satisfaction with body weight are affected not only by BMI and BMI-squared but also by relative BMI (individual's BMI divided by gender-age-country average BMI) among European women. They also find that men's life satisfaction in Germany is negatively correlated to BMI, BMI-squared and relative BMI (individual's BMI divided by year-age-region average BMI). These results suggest that comparisons in BMI matter so that using only the absolute level of BMI might not fully explain the phenomena.

Hamermesh (2012) [10] asks whether absolute or relative differences affect outcomes, and whether this effect changes when the level of the characteristic in question increases for all individuals. One of the cases he analyses is the height increase among Dutch men between 1981-1982 and 2006-2010; he finds that the effect of height on earnings decreased over that period but this was caused by the fact that in later years only the height of older workers (who are on average shorter) was rewarded in the market.

[1] Data from Denmark, Belgium, Ireland, Italy, Greece, Spain, Portugal, Austria and Finland.

The World Health Organization defines overweight and obesity using the body mass index, BMI $= \frac{\text{Weight[Kg]}}{(\text{Height[m]})^2}$. This measure is the same for all adults. However, it does not always correspond to the same degree of fatness in different individuals, so it can only be considered a rough guide. Individuals with a BMI greater or equal to 25 are classified as overweight and those with a BMI greater or equal to 30 are considered obese [17]. Globally the incidence of obesity has almost doubled since 1980 [18].

Mensink et al. (2003) [14] study the prevalence of overweight and obesity in German adults between 25 and 69 years of age in the period 1984-2003 using data from different representative surveys conducted over that period. Overall they found that overweight remained stable and obesity increased. There are differences between men and women, and between East[2] and West. The proportion of overweight men remained close to 50 percent and obesity increased, from 15.5 to 17.6 percent in the West and from 20.8 to 23.6 percent in the East. In the West the proportion of overweight women remained stable at around 32 percent and obesity increased from 17 to 20 percent, in the East overweight increased from 31.6 to 36.8 percent and obesity remained stable around 25 percent.

The trend in the prevalence of overweight and obesity in Germany can also be observed comparing the Microcensus data for the years 1999 and 2009: The overall prevalence of overweight remained stable and that of obesity increased. In both years 42 percent of men and 27 percent of women were overweight, obesity increased from 11.1 to 14.1 percent for men and from 10.4 to 12.7 percent for women. [7]

The differences in BMI between East and West have also been reported using data from German military recruits[3]. Hiermeyer (2009) [11] analysed the data from recruits examined in the years 2000 and 2001, and reported differences in height and BMI between the two regions. Jaeger et al. (2001) [12] collected historical and current data on the height and weight of German military recruits, and the data for the period after German reunification shows differences between East and West: The average recruit in the West was taller and heavier than the average in the East and that this difference reduced in the period 1992-1998, in terms of BMI the data shows a similar pattern: BMI is higher in the West but the difference reduced in the period 1992-1998.

The changes in the prevalence of overweight and obesity in Germany could have an impact on the previously discussed evidence on the relationship between body weight and earnings, i.e. as obesity prevalence increases, people's perceptions can vary and therefore its relationship to earnings might change as well. So the effect could be different when taking into account the relative BMI instead of only BMI. Relative BMI is defined as the ratio of the individual's BMI to the average of his gender and age group for the year in which the information was collected, calculating them separately for East and West because of the differences in overweight and

[2]For the East the analysis period is 1991/92 - 2003 due to data availability.

[3]German males must report to the military draft office after finishing high school or vocational training to be examined by a physician to determine if they are fit to serve.

obesity prevalences observed in these two regions.

Taking relative BMI into account in the relationship between obesity and wages produces results consistent with previous literature, there is a negative relationship between BMI and wages. The results show that absolute and relative BMI have opposite signs, but relative BMI has a bigger (in absolute value) coefficient than absolute BMI. These results indicate that having a higher relative BMI, i.e. being above the average in a given gender-age group, is associated with lower wages for both men and women.

The rest of the paper is structured as follows: Section 2.2 describes the methodology used. Section 2.3 describes the data. Section 2.4 reports the results. Finally, conclusions can be found in Section 2.5.

2.2 Methodology

The following equation can be used to describe the relationship between wages and BMI:

$$ln(realwage) = \alpha_0 + \alpha_1 BMI + \alpha_2 X + \upsilon$$

X includes variables that are known to affect wages, e.g. education and tenure.

In this equation BMI might be endogenous as it could be correlated to the error due to simultaneity between BMI and wages or due to omitted variables, such as genetic or non-genetic factors that affect both BMI and wages. This endogeneity problem can be overcome using lagged values of BMI to avoid the simultaneity problem (but the possibility of omitted variables remains), using fixed effects (FE) regressions to address the existence of time-invariant unobserved factors, or finding an instrument for BMI (a variable that is correlated to BMI but not to the error). Cawley (2004) [5] analyses in detail the endogeneity of BMI.

In this paper, the addition of relative BMI to the wage equation would pose the same endogeneity problems, that could be solved in similar ways as those described before. The following wage equation will be estimated for all full-time workers, with no secondary occupation, excluding those self-employed, separately for men and women:

$$ln(realwage) = \beta_0 + \beta_1 BMI + \beta_2 BMI.REL + \beta_3 X + \upsilon$$

X includes age, education, tenure, and dummies for blue collar, good health, married, cohabiting, children in household, having a child in the last year (only for women), being German and living in what used to be East Germany, also year and region-year dummies will be included but not reported in the paper.

Several instruments have been used before to analyse the relationship between body weight and labour market outcomes: BMI of sibling, parent or child (Cawley (2000) [4], Cawley (2004) [5], Cawley et al. (2005) [6], Brunello and D'Hombres (2007) [3]),

lagged values of own weight (Behrman and Rosenzweig (2001) [1]), obesity prevalence in the area of residence (Morris (2006) [15], Morris (2007) [16]), prescription of medication to treat obesity related diseases to the parents (Greve (2008) [9]). It is not possible to use area of residence data in this paper since this information is taken into account in the relative BMI measure. If the error term in the wage equation is correlated over time, using lagged values of own BMI is not appropriate since that instrument would be correlated to the error term of the equation using current BMI. Using the BMI of a relative has the disadvantage of reducing significantly the sample size because only a subset of individuals has relatives that are also interviewed in the same survey; besides these instruments have been criticised because the genetic component of BMI can also be responsible for the transmission of other characteristics that affect labour market outcomes (Garcia and Quintana-Domeque (2007) [8]).

2.3 Data

The data used is from the German Socio Economic Panel (SOEP). The German SOEP is a nationally representative micro-economic panel which collects data on a yearly basis since 1984 in West Germany and since 1990 in the reunified country, each year approximately 11000 households, and 20000 individuals, are included in the survey. Each household member aged 16 or older is asked to answer an individual questionnaire and the household head also answers the household questionnaire.

I use three samples, restricted to full-time workers who do not have a secondary occupation, are not self employed and are not currently in school. The first one will consider the years on which there is information on height and weight (even years between 2002 and 2010) to use current BMI (absolute and relative) to estimate a wage equation. The second one will include lagged values of absolute and relative BMI (from year 2002) and the rest of the variables from 2003 to 2010. The third sample is a subset of the first one and includes individuals who have at least one sibling (same father and mother) who is also in that sample, the data of the sibling closest in age will be considered as an instrument.

The individual level variables considered are: BMI, labour income, hours of work, age, education, tenure, type of occupation, health, marital status, nationality, children.

The information on height and weight was collected in the even years between 2002 and 2010, both measures are reported by the respondent. This data is used to calculate BMI as previously explained. According to their BMI, individuals can be classified as underweight, normal, overweight or obese. The sample is restricted to those individuals with BMI between 18.5 and 40, i.e. not underweight nor morbidly obese.

Relative BMI is defined as the ratio of the individual's BMI to the average of his gender and age group in their region (East or West) for the year in which the

information was collected. Age groups are defined in five year intervals, as <20, 20≤age<25, ..., and 60≤age<65.

Wages are calculated using information on labour income in the month prior to the interview and the number of hours worked the week before the interview, including over-time and their payment. Since the time dimension of these two variables does not coincide, the number of hours per week is multiplied by 4.35, the average number of weeks per month. The Euro amounts are adjusted using the Consumer Price Index to leave them all expressed in December 2010 Euros.

Age is calculated as the difference between the year of the survey and the individual's year of birth. The sample is restricted to those under 65, i.e. before retirement. The standard retirement age in Germany in the period considered in this paper was 65 years.

Education is measured as the number of years spent in education or training[4], which can range from seven years, when the individual has no educational degree, to 18 years, when he has an university degree.

Individuals are asked when they started working for their current employer, so tenure can be calculated as the difference between the year of the survey and the answer to this question.

There is a question about occupational status that allows blue and white collar occupations to be distinguished. With this information a dummy variable that takes value 1 when blue collar was constructed.

An indicator for good health is constructed using self-reported information about health status, it takes value one if the individual reports his health to be very good or good, and zero when his health is reported to be satisfactory, poor or bad.

Individuals report their marital status. If not married and living together with the spouse they are asked whether they have a partner, and if they do, whether the partner lives in the household. Using this information two dummy variables are constructed, the first one takes value one if the individual reports to be married and living with the spouse, and the second takes value one if the individual has a partner and his/her partner lives in the household.

Individuals are asked whether they have German nationality, and if so, since when. Also, they are asked whether they were born in Germany or not. Using this information, a dummy variable was constructed, it takes value one if the individual was born in Germany and has the nationality since birth, and zero otherwise.

The survey records any changes in the family, for instance having a child. A dummy variable takes value one if the individual has had a child in the last year.

[4]This is a generated variable available in the SOEP.

From the household data only two variables are used: The presence of children under 16 in the household, and whether the household is located in what used to be East or West Germany.

To identify the siblings it was necessary to first know who are each individual's parents, this information can be obtained from the BIOPAREN data file. Knowing who the parents are it is possible to know who has siblings and how many, only siblings with the same father and mother are included in the sample. If an individual has only one sibling, his/her data on BMI, age, and gender will be used as instruments for the individual's BMI. If there are more siblings, the one closest in age will be considered as instrument.

2.3.1 Descriptive Statistics

The descriptive statistics of the current BMI sample are presented in Table 2A.1, those of the lagged BMI sample are presented in Table 2B.1, and the descriptive statistics of the IV sample are in Table 2C.1.

The top panel of Table 2A.1 reports the variables for all individuals in the same BMI and age range as the sample of workers, and the bottom panel are the variables for the sample of workers. The whole population is similar to the workers in terms of height, weight, BMI, overweight and obesity prevalence, and age, so it is appropiate to use age-gender groups as a reference to calculate relative BMI.

The three samples: current BMI (Table 2A.1), lagged BMI (Table 2B.1) and IV sample (Table 2C.1), have similar descriptive statistics. Men have higher BMI, are older and earn more per hour worked than women. Men have a longer tenure period, and are more likely to have a blue collar job. There are, proportionally, more married working men than married working women and less cohabiting working men than cohabiting working women. Men with children in their household or that had a child in the past year are more likely to be working than women.

2.4 Results

The results for the main explanatory variables in OLS and FE regressions are shown in Table 2.1, where wages are significantly correlated to BMI, both in absolute and in relative terms. The correlations are significant for men both in OLS regressions and FE regressions, while for women the correlations are significant only in the FE regressions. These variables show the same pattern in every case: BMI has a positive coefficient and relative BMI has a negative coefficient which is bigger in absolute terms than the one on BMI; these coefficients describe a negative relationship between BMI and wages, except in the FE regression for men where it is positive.

As mentioned in section 2.2, the OLS estimates are biased due to the endogeneity problems of BMI, while the FE results show the impact of BMI on wages without

Table 2.1: Dependent Variable: Ln(Real Wage) [Current BMI]

	Men		Women	
	OLS	FE	OLS	FE
BMI	0.0360 ***	0.0365 ***	0.0144	0.0390 ***
	(0.0105)	(0.0089)	(0.0127)	(0.0110)
Relative BMI	-0.9570 ***	-0.8671 ***	-0.4892	-0.9649 ***
	(0.2753)	(0.2279)	(0.3146)	(0.2645)
F	277.61	15.19	120.36	8.49
N	15616	15616	7817	7817

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Full Tables: Table 2A.2 for OLS and Table 2A.3 for Fixed Effects.

any individual-specific fixed effect. The FE coefficients are similar to the OLS ones for men, and both are significant, while for women only the FE coefficients are significant, and they are bigger (in absolute value) than the OLS ones. This suggests that the OLS results for women are affected by time-invariant unobserved factors.

Table 2.2 shows estimates with lagged BMI, all the wages in the period 2003-2010 are regressed on the BMI information for the year 2002. As in the current BMI sample, BMI has a positive coefficient and relative BMI has a negative coefficient that is bigger in absolute value, and they describe a negative relationship between BMI and wages. Comparing these coefficients with those of the OLS regressions with current BMI (Table 2.1) we observe similarities for men, but for women the lagged BMI coefficients are significant while the current BMI ones were not, this indicates that the simultaneity problems between BMI and wages are more important in the case of women.

Table 2.2: Dependent Variable: Ln(Real Wage) [Lagged BMI]

	Men	Women
	OLS	OLS
BMI 2002	0.0433 ***	0.0511 ***
	(0.0103)	(0.0126)
Relative BMI 2002	-1.1778 ***	-1.3873 ***
	(0.2702)	(0.3045)
F	176.05	81.00
N	21032	10198

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Full Table: Table 2B.2.

Despite the shortcomings of the use of relatives' data as instruments for individual's BMI discussed in Section 2.2, the results of IV regressions using the data of a sibling as instrument are presented next. The IV sample is much smaller than the previous two, around one tenth of their size, because only part of the respondents have information about who their parents are, which in turn allows identification of their

siblings, and there are individuals who do not have siblings. Regressions are run on this reduced sample using the information on BMI (absolute and relative), age, and gender of the sibling closest in age as instruments for the BMI, absolute and relative, of the individual. Also OLS and FE regressions without instruments were run as a comparison. Table 2.3 reports the results for the IV sample, the top panel for the regressions where BMI is instrumented by the sibling's BMI, age and gender, and the bottom panel for the regressions where BMI and relative BMI are instrumented by the sibling's BMI, relative BMI, age and gender. The coefficients on BMI and relative BMI are almost never significant. The first stage results (see Tables 2C.2 and 2C.3) have low (less than ten) F-statistics in most cases. These results indicate that using the sibling's data as instrument is not useful in this sample, as was to expect given the reduction in the sample size and the problems of using relatives as instruments.

Table 2.3: Dependent Variable: Ln(Real Wage) - IV

	Men				Women			
	OLS	OLS-IV	FE	FE-IV	OLS	OLS-IV	FE	FE-IV
BMI	0.0047	-0.0107	-0.0023	-0.0068	-0.0056	0.0009	-0.0215 **	-0.0473 *
	(0.0033)	(0.0153)	(0.0057)	(0.0799)	(0.0043)	(0.0110)	(0.0099)	(0.0260)
BMI	0.0076	0.2100	-0.0212	-0.0124	0.0248	-0.1544	-0.0156	0.0242
	(0.0158)	(0.1539)	(0.0152)	(0.1464)	(0.0217)	(0.2449)	(0.0215)	(0.3188)
Relative BMI	-0.0767	-5.8595	0.5026	1.7163	-0.7471	4.0092	-0.1479	-1.8179
	(0.3980)	(4.0680)	(0.3502)	(4.9585)	(0.5023)	(6.2183)	(0.4103)	(8.0979)
N	1510	1510	1510	1510	781	781	781	781

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Full Tables: Table 2C.2 for results instrumenting BMI and Table 2C.3 for results instrumenting BMI and relative BMI.

In Tables 2.1 and 2.2 the coefficients on BMI and *relative* BMI have opposite signs, but relative BMI's coefficients have higher absolute value. These results indicate that there is a negative relationship between BMI and wages for both men and women. If we could compare the wage of the average man and that of a man that has BMI ten percent above average but is average in all other characteristics, the wage would be reduced up to one percent, and if we did the same for women the wage would be reduced up to one and a half percent.

2.4.1 Robustness Checks

The OLS, with current and lagged BMI, and FE results are unaffected by changes in the BMI range that defines the sample, using a wider range (16 to 50) or a reduced one (18.5 to 35) does not change the results presented before. Also, restricting the sample to individuals up to 55 years old, leaving out those closer to retirement, leads to no changes in these results.

Adding squared terms for BMI and relative BMI does not change the OLS and FE results either, the regressions including the squared terms can be found in Tables 2A.2, 2A.3, and 2B.2.

Using the difference between the individual's BMI and the average of his gender and age group instead of the ratio between them as an alternative way to measure relative BMI does not change the results. Also, using the median or the 75th percentile of BMI instead of the mean to calculate relative BMI does not affect the results.

2.5 Conclusions

The objective of this paper was to investigate the relationship between *relative* BMI and wages in Germany. Relative BMI was defined as the ratio of the individual's BMI to the average of his gender and age group for the year in which the information was collected, calculating them separately for East and West Germany because of the differences in overweight and obesity prevalences observed in these two regions.

The coefficients on BMI and *relative* BMI have opposite signs: on the one hand having a higher BMI is associated with higher wages, while on the other hand having a higher *relative* BMI is associated with lower wages; they describe a negative relationship between BMI and wages for both men and women. According to the results of this paper, if we could compare the wage of the average man and that of a man that has BMI ten percent above average but is average in all other characteristics, the wage would be reduced up to one percent, and if we did the same for women the wage would be reduced up to one and a half percent.

2A Tables. OLS and FE

Table 2A.1: Descriptive Statistics - Current BMI Sample

	N	Mean	SD	N	Mean	SD
	Men			*Women*		
Height [cm]	40478	178.796	7.131	41648	166.063	6.392
Weight [Kg]	40478	83.689	13.290	41648	68.299	12.161
BMI [Kg/m^2]	40478	26.163	3.760	41648	24.775	4.262
Overweight [Proportion]	40478	0.426	0.495	41648	0.269	0.443
Obese [Proportion]	40478	0.153	0.360	41648	0.128	0.335
Age [Years]	40478	42.444	13.422	41648	42.515	13.147
	Working Men			*Working Women*		
Height [cm]	15616	179.303	6.846	7817	166.439	6.473
Weight [Kg]	15616	85.284	13.081	7817	68.658	12.015
BMI [Kg/m^2]	15616	26.498	3.571	7817	24.796	4.214
Overweight [Proportion]	15616	0.464	0.499	7817	0.258	0.438
Obese [Proportion]	15616	0.160	0.367	7817	0.133	0.340
Age [Years]	15616	43.618	10.119	7817	42.102	10.849
Wage [€/ Hour]	15616	18.527	11.114	7817	15.014	7.470
Years of Education	15616	12.800	2.745	7817	13.069	2.649
Tenure [Years]	15616	13.288	10.738	7817	11.733	9.871
Blue-Collar [Proportion]	15616	0.392	0.488	7817	0.138	0.345
Good Health [Proportion]	15616	0.587	0.492	7817	0.582	0.493
Married [Proportion]	15616	0.675	0.468	7817	0.511	0.500
Cohabiting [Proportion]	15616	0.122	0.327	7817	0.192	0.394
Children in HH [Proportion]	15616	0.386	0.487	7817	0.187	0.390
German [Proportion]	15616	0.946	0.225	7817	0.954	0.209
East [Proportion]	15616	0.253	0.435	7817	0.339	0.473
Child Last Year [Proportion]	15616	0.034	0.182	7817	0.004	0.061

Table 2A.2: OLS - Dependent Variable: Ln(Real Wage)

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
BMI	0.0001	0.0360 ***	0.1252 ***	-0.0051 ***	0.0144	0.0630 *
	(0.0013)	(0.0105)	(0.0382)	(0.0015)	(0.0127)	(0.0363)
BMI Squared	-	-	-0.0015 **	-	-	-0.0008
			(0.0006)			(0.0006)
Relative BMI	-	-0.9570 ***	-2.3482 **	-	-0.4892	-1.5084 *
		(0.2753)	(0.9961)		(0.3146)	(0.9159)
Relative BMI Squared	-	-	0.6100	-	-	0.4096
			(0.4403)			(0.3715)
Age	0.0060 ***	0.0032 ***	0.0025 **	0.0047 ***	0.0030 **	0.0022
	(0.0006)	(0.0011)	(0.0011)	(0.0007)	(0.0013)	(0.0014)
Education	0.0571 ***	0.0569 ***	0.0569 ***	0.0652 ***	0.0649 ***	0.0648 ***
	(0.0021)	(0.0021)	(0.0021)	(0.0024)	(0.0024)	(0.0024)
Tenure	0.0079 ***	0.0081 ***	0.0081 ***	0.0119 ***	0.0120 ***	0.0120 ***
	(0.0005)	(0.0005)	(0.0005)	(0.0008)	(0.0007)	(0.0008)
Blue Collar	-0.1773 ***	-0.1776 ***	-0.1777 ***	-0.2263 ***	-0.2264 ***	-0.2256 ***
	(0.0110)	(0.0110)	(0.0109)	(0.0181)	(0.0181)	(0.0182)
Health	0.0514 ***	0.0523 ***	0.0509 ***	0.0129	0.0129	0.0129
	(0.0079)	(0.0079)	(0.0079)	(0.0101)	(0.0101)	(0.0101)
Married	0.0810 ***	0.0768 ***	0.0741 ***	0.0272 **	0.0259 *	0.0245 *
	(0.0135)	(0.0135)	(0.0136)	(0.0138)	(0.0139)	(0.0140)
Cohabiting	0.0266 *	0.0246 *	0.0222	0.0132	0.0133	0.0123
	(0.0143)	(0.0142)	(0.0143)	(0.0149)	(0.0149)	(0.0149)
Children in HH	0.0898 ***	0.0858 ***	0.0840 ***	0.0452 ***	0.0474 ***	0.0475 ***
	(0.0097)	(0.0098)	(0.0098)	(0.0139)	(0.0139)	(0.0140)
German	0.0350 *	0.0343 *	0.0357 **	0.0156	0.0155	0.0159
	(0.0182)	(0.0182)	(0.0181)	(0.0349)	(0.0349)	(0.0348)
East	-0.3602 ***	-0.3659 ***	-0.3667 ***	-0.2901 ***	-0.2983 ***	-0.3015 ***
	(0.0145)	(0.0144)	(0.0145)	(0.0173)	(0.0176)	(0.0175)
Child Last Year	-	-	-	0.1041 *	0.1036 *	0.1023 *
				(0.0541)	(0.0542)	(0.0541)
F	287.60	277.61	254.25	123.21	120.36	110.30
R^2	0.4675	0.4683	0.4692	0.4280	0.4283	0.4285
N	15616	15616	15616	7817	7817	7817

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year and region-year dummies not reported on the table.

Table 2A.3: Fixed Effects - Dependent Variable: Ln(Real Wage)

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
BMI	0.0041 **	0.0365 ***	0.1463 ***	0.0006	0.0390 ***	0.1273 ***
	(0.0020)	(0.0089)	(0.0333)	(0.0023)	(0.0110)	(0.0352)
BMI Squared	-	-	-0.0019 ***	-	-	-0.0015 ***
			(0.0005)			(0.0006)
Relative BMI	-	-0.8671 ***	-3.5918 ***	-	-0.9649 ***	-1.7659 **
		(0.2279)	(0.8652)		(0.2645)	(0.8927)
Relative BMI Squared	-	-	1.2324 ***	-	-	0.3122
			(0.3749)			(0.3687)
Age	-0.0078	-0.0100	-0.0117	0.0076 **	0.0040	0.0047
	(0.0115)	(0.0115)	(0.0117)	(0.0030)	(0.0030)	(0.0032)
Education	0.0279 **	0.0264 **	0.0258 **	0.0073	0.0066	0.0072
	(0.0127)	(0.0127)	(0.0126)	(0.0188)	(0.0188)	(0.0185)
Tenure	0.0032 ***	0.0033 ***	0.0033 ***	0.0002	0.0003	0.0004
	(0.0008)	(0.0008)	(0.0008)	(0.0011)	(0.0011)	(0.0011)
Blue Collar	-0.0101	-0.0095	-0.0091	0.0090	0.0099	0.0106
	(0.0124)	(0.0124)	(0.0124)	(0.0233)	(0.0231)	(0.0231)
Health	0.0242 ***	0.0266 ***	0.0264 ***	0.0110 *	0.0109 *	0.0097
	(0.0050)	(0.0050)	(0.0050)	(0.0064)	(0.0064)	(0.0064)
Married	0.0473 ***	0.0446 ***	0.0425 ***	0.0652 ***	0.0620 ***	0.0579 ***
	(0.0140)	(0.140)	(0.0139)	(0.0178)	(0.0180)	(0.0180)
Cohabiting	0.0325 **	0.0313 **	0.0300 **	0.0174	0.0162	0.0120
	(0.0133)	(0.0132)	(0.0131)	(0.0136)	(0.0136)	(0.0135)
Children in HH	0.0242 ***	0.0215 ***	0.0198 **	0.0066	0.0056	0.0025
	(0.0079)	(0.0079)	(0.0079)	(0.0140)	(0.0139)	(0.0140)
East	-0.0689	-0.0612	-0.0570	-0.1002 *	-0.0948 *	-0.0976 *
	(0.0500)	(0.0499)	(0.0494)	(0.0559)	(0.0536)	(0.0542)
Child Last Year	-	-	-	-0.0098	-0.0061	-0.0077
				(0.0346)	(0.0351)	(0.0356)
F	15.45	15.19	14.02	8.23	8.49	7.9
N	15616	15616	15616	7817	7817	7817

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year and region-year dummies not reported on the table.

2B Tables. Lagged BMI

Table 2B.1: Descriptive Statistics - Lagged BMI Sample

	N	Mean	SD	N	Mean	SD
	Working Men			*Working Women*		
BMI [Kg/m^2] in 2002	21032	26.059	3.461	10198	24.280	4.023
Age [Years]	21032	44.589	9.712	10198	43.187	10.430
Wage [€/ Hour]	21032	18.894	11.109	10198	15.311	7.126
Years of Education	21032	12.827	2.762	10198	13.119	2.680
Tenure [Years]	21032	13.980	10.786	10198	12.568	10.003
Blue-Collar [Proportion]	21032	0.391	0.488	10198	0.142	0.349
Good Health [Proportion]	21032	0.571	0.495	10198	0.570	0.495
Married [Proportion]	21032	0.697	0.460	10198	0.544	0.498
Cohabiting [Proportion]	21032	0.100	0.301	10198	0.159	0.366
Children in HH [Proportion]	21032	0.378	0.485	10198	0.184	0.388
German [Proportion]	21032	0.950	0.218	10198	0.954	0.210
East [Proportion]	21032	0.258	0.437	10198	0.341	0.474
Child Last Year [Proportion]	21032	0.029	0.168	10198	0.004	0.062

Table 2B.2: OLS - Dependent Variable: Ln(Real Wage) - Lagged BMI

	Men			Women		
	(1)	(2)	(3)	(1)	(2)	(3)
BMI 2002	-0.0014	0.0433 ***	0.0966 ***	-0.0054 ***	0.0511 ***	0.1083 ***
	(0.0016)	(0.0103)	(0.0374)	(0.0020)	(0.0126)	(0.0363)
BMI 2002 Squared	-	-	-0.0010	-	-	-0.0010 *
			(0.0007)			(0.0006)
Relative BMI 2002	-	-1.1778 ***	-1.7630 *	-	-1.3873 ***	-2.9236 ***
		(0.2702)	(1.0429)		(0.3045)	(0.8681)
Relative BMI 2002 Squared	-	-	0.2734	-	-	0.6486 *
			(0.4936)			(0.3450)
Age	0.0059 ***	0.0014	0.0011	0.0043 ***	-0.0025	-0.0036 *
	(0.0007)	(0.0013)	(0.0013)	(0.0008)	(0.0017)	(0.0018)
Education	0.0554 ***	0.0551 ***	0.0551 ***	0.0651 ***	0.0642 ***	0.0641 ***
	(0.0023)	(0.0023)	(0.0023)	(0.0027)	(0.0027)	(0.0027)
Tenure	0.0081 ***	0.0083 ***	0.0083 ***	0.0118 ***	0.0120 ***	0.0120 ***
	0.0006)	(0.0006)	(0.0006)	(0.0008)	(0.0008)	(0.0008)
Blue Collar	-0.1923 ***	-0.1932 ***	-0.1941 ***	-0.2413 ***	-0.2422 ***	-0.2414 ***
	(0.0123)	(0.0122)	(0.0122)	(0.0205)	(0.0204)	(0.0204)
Health	0.0428 ***	0.0438 ***	0.0429 ***	0.0188 *	0.0192 *	0.0191 *
	(0.0084)	(0.0084)	(0.0084)	(0.0107)	(0.0107)	(0.0107)
Married	0.0689 ***	0.0637 ***	0.0620 ***	0.0296 *	0.0219	0.0198
	(0.0149)	(0.0148)	(0.0149)	(0.0155)	(0.0155)	(0.0156)
Cohabiting	0.0253	0.0237	0.0227	0.0090	0.0054	0.0039
	(0.0169)	(0.0168)	(0.0168)	(0.0184)	(0.0182)	(0.0182)
Children in HH	0.1055 ***	0.0964 ***	0.0951 ***	0.0413 ***	0.0452 ***	0.0446 ***
	(0.0110)	(0.0112)	(0.0112)	(0.0155)	(0.0153)	(0.0154)
German	0.0363 *	0.0365 *	0.0369 *	0.0119	0.0103	0.0090
	(0.0208)	(0.0207)	(0.0207)	(0.0378)	(0.0377)	(0.0377)
East	-0.3790 ***	-0.3875 ***	-0.3874 ***	-0.2834 ***	-0.3081 ***	-0.3100 ***
	(0.0149)	(0.0149)	(0.0149)	(0.0178)	(0.0182)	(0.0182)
Child Last Year	-	-	-	0.0071	0.0095	0.0120
				(0.0524)	(0.0528)	(0.0524)
F	179.17	176.05	165.04	78.23	81.00	75.76
R^2	0.4702	0.4723	0.4728	0.4300	0.4342	0.4348
N	21032	21032	21032	10198	10198	10198

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year and region-year dummies not reported on the table.

2C Tables. IV: Sibling's Data as Instrument

Table 2C.1: Descriptive Statistics - IV: Sibling's BMI

	N	Mean	SD	N	Mean	SD
	Working Men			*Working Women*		
BMI [Kg/m^2]	1510	25.789	3.520	781	23.609	3.910
Age [Years]	1510	33.083	7.273	781	28.987	5.733
Wage [€/ Hour]	1510	15.790	7.398	781	13.015	5.820
Years of Education	1510	12.440	2.652	781	13.070	2.495
Tenure [Years]	1510	7.746	7.070	781	5.478	4.839
Blue-Collar [Proportion]	1510	0.476	0.500	781	0.097	0.297
Good Health [Proportion]	1510	0.739	0.439	781	0.741	0.438
Married [Proportion]	1510	0.431	0.495	781	0.218	0.413
Cohabiting [Proportion]	1510	0.125	0.330	781	0.239	0.427
Children in HH [Proportion]	1510	0.416	0.493	781	0.213	0.409
German [Proportion]	1510	0.920	0.272	781	0.948	0.223
East [Proportion]	1510	0.223	0.416	781	0.229	0.421
Child Last Year [Proportion]	1510	0.060	0.237	781	0.009	0.094
BMI [Kg/m^2] Sibling	1510	25.014	4.105	781	23.968	3.596
Age [Years] Sibling	1510	31.162	8.004	781	27.606	6.953

Table 2C.2: 2SLS, Instrumented: BMI - Dependent Variable: Ln(Real Wage)

	Men				Women			
	OLS	OLS-IV	FE	FE-IV	OLS	OLS-IV	FE	FE-IV
First Stage BMI								
BMI Sibling	-	0.2263 ***	-	0.0065	-	0.3900 ***	-	0.0283
		(0.0253)		(0.0272)		(0.0502)		(0.0580)
Age Sibling	-	-0.0502 ***	-	-0.0768 ***	-	-0.0842 ***	-	-0.1944 ***
		(0.0161)		(0.0274)		(0.0244)		(0.0507)
Gender Sibling	-	-0.0857	-	0.2806	-	-0.3726	-	-1.7402 ***
		(0.1811)		(0.3248)		(0.2755)		(0.6106)
F - First Stage		11.45		5.68		7.72		5.67
Second Stage								
BMI	0.0047	-0.0107	-0.0023	-0.0068	-0.0056	0.0009	-0.0215 **	-0.0473 *
	(0.0033)	(0.0153)	(0.0057)	(0.0799)	(0.0043)	(0.0110)	(0.0099)	(0.0260)
Age	0.0123 ***	0.0128 ***	0.0172 ***	0.0179 **	0.0179 ***	0.0173 ***	0.0228 ***	0.0279 ***
	(0.0025)	(0.0026)	(0.0041)	(0.0081)	(0.0051)	(0.0052)	(0.0082)	(0.0081)
Education	0.0590 ***	0.0570 ***	0.0757	0.0775 *	0.0531 ***	0.0553 ***	-0.0348	-0.0339
	(0.0061)	(0.0066)	(0.0623)	(0.0408)	(0.0071)	(0.0080)	(0.0569)	(0.0332)
Tenure	0.0115 ***	0.0119 ***	0.0020	0.0019	0.0136 ***	0.0135 ***	0.0055	0.0060
	(0.0025)	(0.0025)	(0.0037)	(0.0024)	(0.0047)	(0.0046)	(0.0059)	(0.0054)
Blue Collar	-0.0513	-0.0568 *	-0.0301	-0.0308	-0.1800 ***	-0.1774 ***	-0.0824 *	-0.0790
	(0.0315)	(0.0328)	(0.0537)	(0.0343)	(0.0597)	(0.0609)	(0.0465)	(0.0719)
Health	0.0422 *	0.0227	0.0300	0.0293	0.0235	0.0304	-0.0009	-0.0056
	(0.0226)	(0.0314)	(0.0190)	(0.0202)	(0.0292)	(0.0310)	(0.0179)	(0.0309)
Married	0.1475 ***	0.1665 ***	0.0587	0.0608	0.0012	-0.0010	0.0313	0.0561
	(0.0377)	(0.0428)	(0.0424)	(0.0454)	(0.0417)	(0.0414)	(0.0449)	(0.0518)
Cohabiting	0.0976 ***	0.1032 ***	0.0449	0.0465	-0.0268	-0.0295	-0.0036	0.0019
	(0.0347)	(0.0351)	(0.0446)	(0.0369)	(0.0341)	(0.0340)	(0.0412)	(0.0369)
Children in HH	0.0125	0.0072	0.0080	0.0081	-0.0196	-0.0219	0.0332	0.0480
	(0.0321)	(0.0340)	(0.0302)	(0.0286)	(0.0394)	(0.0388)	(0.0653)	(0.0535)
German	0.0469	0.0404	-	-	-0.0156	-0.0165	-	-
	(0.0330)	(0.0358)			(0.0652)	(0.0661)		
East	-0.2799 ***	-0.2806 ***	0.0184	0.0198	-0.2910 ***	-0.2871 ***	-0.2907 **	-0.3041 **
	(0.0540)	(0.0520)	(0.0992)	(0.0998)	(0.0518)	(0.0509)	(0.1202)	(0.1328)
Child Last Year	-	-	-	-	0.0460	0.0506	-0.0805	-0.1178
					(0.1431)	(0.1413)	(0.0794)	(0.1097)
N	1510	1510	1510	1510	781	781	781	781

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year and region-year dummies not reported on the table.

Table 2C.3: 2SLS, Instrumented: BMI and Relative BMI - Dependent Variable: Ln(Real Wage)

	Men				Women			
	OLS	OLS-IV	FE	FE-IV	OLS	OLS-IV	FE	FE-IV
First Stage BMI								
BMI Sibling	-	0.2135 **	-	0.1963 ***	-	-0.0507	-	0.0212
		(0.1049)		(0.0707)		(0.2244)		(0.1689)
Relative BMI Sibling	-	0.3320	-	-5.0041 ***	-	10.976 **		0.1766
		(2.6030)		(1.7230)		(5.3647)		(3.9353)
Age Sibling	-	-0.0486 **	-	-0.1013 ***	-	-0.0249		-0.1933 ***
		(0.0195)		(0.0286)		(0.0387)		(0.0543)
Gender Sibling	-	-0.0668	-	-0.0387	-	0.1990		-1.7294 ***
		(0.2315)		(0.3416)		(0.4025)		(0.6577)
F - First Stage		11.05		5.86		7.74		5.39
First Stage Relative BMI								
BMI Sibling	-	0.0057	-	0.0052 *	-	-0.0055		-0.0009
		(0.0040)		(0.0029)		(0.0093)		(0.0071)
Relative BMI Sibling	-	0.0731	-	-0.1540 **	-	0.5139 **		0.0394
		(0.1009)		(0.0697)		(0.2242)		(0.1662)
Age Sibling	-	-0.0019 ***		-0.0027 **	-	-0.0005	-	-0.0069 ***
		(0.0007)		(0.0012)		(0.0016)		(0.0024)
Gender Sibling	-	-0.0016		0.0022	-	0.0123	-	-0.0712 **
		(0.0090)		(0.0138)		(0.0168)		(0.0278)
F - First Stage		7.84		1.50		6.93		2.30

(Table continues in the next page)

Table 2C.3 cont.

	Men				Women			
	OLS	OLS-IV	FE	FE-IV	OLS	OLS-IV	FE	FE-IV
Second Stage								
BMI	0.0076	0.2100	-0.0212	-0.0124	0.0248	-0.1544	-0.0156	0.0242
	(0.0158)	(0.1539)	(0.0152)	(0.1464)	(0.0217)	(0.2449)	(0.0215)	(0.3188)
Relative BMI	-0.0767	-5.8595	0.5026	1.7163	-0.7471	4.0092	-0.1479	-1.8179
	(0.3980)	(4.0680)	(0.3502)	(4.9585)	(0.5023)	(6.2183)	(0.4103)	(8.0979)
Age	0.0120 ***	-0.0116	0.0199 ***	0.0184	0.0146 **	0.0345	0.0220 **	0.0183
	(0.0031)	(0.0173)	(0.0045)	(0.0212)	(0.0063)	(0.0280)	(0.0088)	(0.0435)
Education	0.0589 ***	0.0480 ***	0.0773	0.0586	0.0525 ***	0.0616 ***	-0.0350	-0.0372
	(0.0062)	(0.0092)	(0.0629)	(0.0411)	(0.0070)	(0.0125)	(0.0569)	(0.0370)
Tenure	0.0115 ***	0.0111 ***	0.0021	0.0032	0.0138 ***	0.0120 **	0.0056	0.0073
	(0.0025)	(0.0026)	(0.0037)	(0.0029)	(0.0046)	(0.0057)	(0.0059)	(0.0080)
Blue Collar	-0.0514	-0.0722 **	-0.0271	-0.0114	-0.1764 ***	-0.1936 ***	-0.0815 *	-0.0681
	(0.0315)	(0.0366)	(0.0536)	(0.0520)	(0.0613)	(0.0680)	(0.0465)	(0.0880)
Health	0.0422 *	0.0215	0.0299	0.0392 *	0.0227	0.0428	-0.0015	-0.0123
	(0.0226)	(0.0332)	(0.0191)	(0.0218)	(0.0295)	(0.0351)	(0.0179)	(0.0436)
Married	0.1470 ***	0.1325 ***	0.0575	0.0291	-0.0028	0.0175	0.0302	0.0421
	(0.0380)	(0.0493)	(0.0424)	(0.0562)	(0.0414)	(0.0543)	(0.0457)	(0.0812)
Cohabiting	0.0970 ***	0.0546	0.0437	0.0214	-0.0283	-0.0249	-0.0036	0.0018
	(0.0347)	(0.0503)	(0.0447)	(0.0469)	(0.0335)	(0.0411)	(0.0411)	(0.0377)
Children in HH	0.0119	-0.0340	0.0123	0.0217	-0.0142	-0.0535	0.0345	0.0643
	(0.0320)	(0.0450)	(0.0306)	(0.0521)	(0.0404)	(0.0672)	(0.0647)	(0.0910)
German	0.0471	0.0548	-	-	-0.0182	-0.0035	-	-
	(0.0329)	(0.0370)			(0.0659)	(0.0754)		
East	-0.2787 ***	-0.1839 **	0.0122	-0.0190	-0.2813 ***	-0.3342 ***	-0.2872 **	-0.2616
	(0.0546)	(0.0868)	(0.0996)	(0.1306)	(0.0517)	(0.0886)	(0.1202)	(0.2326)
Child Last Year	-	-	-	-	0.0320	0.1310	-0.0809	-0.1226
					(0.1447)	(0.1667)	(0.0793)	(0.1141)
N	1510	1510	1510	1510	781	781	781	781

Robust standard errors (clustered by individual) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year and region-year dummies not reported on the table.

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Chapter 3

BMI Gaps and Divorce. Evidence from Germany

3.1 Introduction

In the first part of his theory of marriage Becker (1973) [1] predicts that assortative mating in characteristics of the spouses is optimal when they are complementary in household production, e.g. beauty, intelligence, and education. In a later paper, about marital instability, Becker et al. (1977) [2] predict that differences between characteristics of spouses that are larger than in an optimal sorting increase the probability of divorce.

The impact of assortative mating in the risk of divorce has been studied before. Frimmel et al. (2009) [7] use register data, and find that couples where the spouses come from different ethnic backgrounds or have different religion are more likely to divorce in Austria. Kalmijn et al. (2005) [10] analyse register data from the Netherlands in the period 1974-1994, and find that couples that are heterogamous with respect to religion affiliation or nationality are more likely to divorce than couples that are similar in these characteristics. Smith et al. [17] use more recent Dutch data (1995-2008) to study whether the ethnicity of the spouses affects the risk of divorce, they find that couples with spouses of the same ethnicity, both Dutch or both immigrants with the same country of origin, are less likely to divorce than couples formed by a Dutch and an immigrant or couples where both spouses are immigrant from different countries. McNulty et al. [15] do not focus on divorce, but on marriage satisfaction among recently married couples in the US, they find that the relative attractiveness of spouses does not affect their satisfaction with the marriage.

In the case of Germany, Kraft and Neimann find that it is not spouses being similar on education or religion what affects the probability of divorce of the couple, but the level of these variables [13], and that couples where the woman is the main earner are more likely to divorce than couples where the woman does not work or earns a low proportion of household income [12], Guven et al. [8] report that happiness gaps between spouses have a negative impact on the probability of divorce. Kraft and Neimann (2009) [13] used the German Socio-Economic Panel (SOEP) to test whether homogamy increases marital stability, and found that couples where both spouses had medium or high education and couples where both spouses attended church are less likely to divorce, while spouses with low education and couples that do not attend church have a higher risk of divorce, they also found that increases in the age difference between spouses increases the risk of divorce. Kraft and Neimann (2009) [12] used the German Socio-Economic Panel (SOEP) to test whether specialization increases marital stability, they test whether couples that deviate from the traditional male breadwinner and housewife specialization pattern are more likely to divorce, and find that couples where the woman is the breadwinner and the man does the house work and couples where the woman takes on both roles are more likely to divorce than couples with the traditional specialization pattern. Guven et al. (2012) [8] use panel data from three countries (Germany, UK and Australia) to test, separately, whether happiness gaps affect marital stability, they find that couples where the spouses differ in reported happiness are less stable and that there is an asymmetry: If a woman's happiness is lower than her husband's divorce is

more likely than when men are the ones with lower happiness.

This paper will ask a similar question to those just discussed, but focusing on a different characteristic, physical attractiveness, proxied by the Body Mass Index (BMI).

The World Health Organization defines body mass index as $\text{BMI} = \frac{\text{Weight[Kg]}}{(\text{Height[m]})^2}$. This measure is the same for all adults. However, it does not always correspond to the same degree of fatness in different individuals, so it can only be considered a rough guide. Individuals with BMI greater or equal to 25 are classified as overweight and those with BMI greater or equal to 30 are considered obese. [16]

BMI can be used as a proxy for physical attractiveness since there is evidence of its negative correlation to attractiveness for both men (Hönekopp et al. (2007) [9]) and women (Tovée and Cornelissen (2001) [18]). Hönekopp et al. (2007) [9] asked women from Dresden and Leipzig to rate the attractiveness of Caucasian men from Chemnitz using body, front and back, and face photographs and found a negative correlation between BMI and attractiveness. Tovée and Cornelissen (2001) [18] asked UK students to rate the attractiveness of front and profile view images of real women (with the face blurred so facial traits were not taken into account) and found that there is a non-linear relationship between BMI and attractiveness, which peaks in the 18-20 BMI range, and that there is a weak negative correlation between attractiveness and waist-to-hip ratio (WHR), but BMI explains more of the variance among individuals' attractiveness ratings, i.e. BMI is a stronger determinant of attractiveness than WHR.

Differences in BMI can be interpreted as differences in attractiveness given the correlation between these two variables. Who has higher BMI can be of importance for the effect of the difference in BMI between spouses on the probability of divorce. Buss and Angleitner (1989) [3] found that physical attractiveness of the spouse is more important for men than for women in the US and in West Germany. Buss and Angleitner (1989) [3] asked participants in both countries to rank different characteristics of a potential mate and found that women ranked good earning capacity higher than men and men ranked physical attractiveness higher than women in both countries.

The main focus of this paper is whether differences in BMI (differences in attractiveness) between the spouses do affect the probability of that couple getting a divorce in the future. This question will be answered using data from the German Socio-Economic Panel (SOEP) on couples that got married on years when information about height and weight was collected (2002, 2004, 2006 and 2008), to be able to calculate BMI.

The results obtained in this paper indicate that differences in BMI in the year of marriage are only weakly related to the probability of divorce, the comparison between a couple with an average BMI gap where the man has a higher BMI and one

with the same BMI gap but where the woman has higher BMI indicates that the second couple is around one and a half percent less likely to divorce. However the results are based on a relatively short sample compared with the results discussed previously that used all the waves of the SOEP available at the time, this paper only considers marriages that took place in the years for which there is information on height and weight to be able to calculate BMI for each spouse.

The rest of the paper is structured as follows: Section 3.2 describes the methodology. Section 3.3 describes the divorce law in force during the analysis period and some divorce statistics for Germany. Section 3.4 describes the data used in the paper. Section 3.5 reports the results. Finally, conclusions can be found in Section 3.6.

3.2 Methodology

The following equation can be used to describe the relationship between divorce in period $t+1$ and BMI gaps:

$$Divorce_{t+1} = f(BMIGap_M, Wife, BMIGap_M * Wife, X_t)$$

where the sub-index M indicates at time of marriage, BMI Gap is the absolute value of the difference between the BMI of the spouses, and Wife is a dummy variable that takes value one if the wife is the one with higher BMI. X includes variables that are known to affect the probability of divorce, e.g. education and income of the spouses.

BMI gap at marriage is considered as an explanatory variable instead of the BMI gap in period t because the anticipation of divorce might affect the BMI of one or both spouses in the year before the divorce. Lundborg et al. [14] study the relationship between divorce risk, measured as the national divorce rate, and BMI in Europe[1], they find a negative correlation between the BMI of married individuals and the divorce rate in their country but no association with the BMI of singles, and do not find differences between the results for men and women, they cannot say whether higher divorce rates cause individuals to have a lower BMI as a way to be ready (attractive) in case of having to go to the marriage market again or whether married individuals perceive higher BMI as a bigger risk to their marital relations in countries with higher divorce rates and try to keep it lower.

X includes age, education and (log) income of both spouses, marital duration and a dummy for children in household, also year and region-year dummies will be included but not reported in the paper.

The main question is whether a marriage will end in the following year ($Divorce_{t+1} = 1$) or not ($Divorce_{t+1} = 0$), given the spouses' characteristics. That is, we want to know the probability of divorce given the couple's characteristics. To do so, we

[1]The data comes from the Survey of Health, Ageing, and Retirement in Europe (SHARE), including Denmark, Sweden, Austria, France, Germany, Switzerland, the Netherlands, Spain, Italy and Greece.

could use a discrete time duration model, such as the proportional hazard model for discrete time, since we only observe whether a couple remains married or not once a year. However, it has been shown that the same results can be obtained using a complementary log-log regression with pooled data and dummies for the different spell durations [4].

3.3 Divorce in Germany

Divorce in Germany is regulated by the German Civil Code (Bürgerliches Gesetzbuch - BGB), in Sections §1564 to §1568. The dissolution of the marriage can be requested by one or both spouses in a court of law. The marriage can be dissolved if it has broken down, a marriage has broken down if the spouses no longer live together and it is not expected that they do so again in the future. It is assumed that a marriage has broken down if the spouses have been living apart for a year and both ask for or agree to divorce, or if the spouses have not lived together for three years. The last changes made to the Sections regulating divorce were made in 1980. [5] [6]

The average duration of the marriages that ended in 2009 was 14 years and four months. In that year 53.3 percent of divorces were initiated by the wife, and 38.1 percent by the husband, in the vast majority of cases the other spouse agreed to divorce, 93.2 and 93.7 percent respectively; in the remaining 8.7 percent of cases divorce was requested by both spouses. Most divorces (82.8 percent) occur after the spouses have been living apart for a year, divorce followed three years of separation in 14.8 percent of cases, in 1.8 percent of cases divorce before one year of separation was allowed due to other factors (e.g. domestic abuse), and the remaining 0.6 percent corresponds to divorces under other provisions of law (e.g. divorce sentences where the law of another country applied). The risk of divorce in Germany is higher in the first five to six years of marriage. [11]

3.4 Data

The data is obtained from the German Socio Economic Panel (SOEP). The German SOEP is a nationally representative micro-economic panel which has collected data on a yearly basis since 1984 in West Germany and since 1990 in the reunified country, each year approximately 11000 households, and 20000 individuals, are included in the survey. Each household member aged 16 or older is asked to answer an individual questionnaire and the household head also answers the household questionnaire.

The sample used consists of couples married in the years when data on height and weight was collected (2002, 2004, 2006 and 2008), to calculate their BMI in the year of marriage. Only couples where both spouses report the same information about the beginning and end (if applicable) of their marriage are considered. Spouse's BMI is restricted to be between 18.5 and 40, i.e. leaving out the underweight (BMI$<$18.5) and the morbidly obese (BMI$\geq$40) individuals, and their age at marriage is restricted

to be up to 60 years.

The individual level variables considered are: BMI, labour income, age, education, and occupational status.

The information on height and weight is reported by the respondent. This data is used to calculate BMI as previously explained. According to their BMI, individuals can be classified as underweight, normal, overweight or obese. The sample is restricted to those individuals with BMI between 18.5 and 40, i.e. not underweight nor morbid obese.

The BMI gap between spouses is defined as the absolute value of the difference between the BMI of the spouses. Since who has a higher BMI might be of relevance, a dummy variable that takes value one when the wife is the one with higher BMI was included.

Respondents give information about their labour income, including over-time, on the month before the interview. The natural logarithm is calculated for the individuals who reported income and zero was assigned for those who did not.

Age is calculated as the difference between the year of the survey and the individual's year of birth. Only individuals who were not older than 60 years in the year of their marriage were considered in the sample.

Education is measured as the number of years spent in education or training[2], which can range from seven years, when the individual has no educational degree, to 18 years, when he has an university degree.

The information about the beginning and end of the marriages comes from a marital history file generated by the SOEP, BIOMARSY, that includes information about all the marital status spells of the individual. Using this information it was possible to identify the marriages that started in the years for which there is data about BMI and to know whether the marriage ended in the following years or not (marriages that ended due to the death of one spouse are not considered). The file also allows to distinguish between couples where both spouses are in their first marriage and couples where at least one of the spouses has been married before, a dummy variable that takes value one in the later case was created.

From the household data only two variables are used: The presence of children under 16 in the household, and the region (East or West) where the household is located.

Observations are weighted using household cross-sectional weights.

[2]This is a generated variable available in the SOEP.

3.4.1 Descriptive Statistics

The descriptive statistics for the pooled data can be found in Section 3A. The 1167 observations correspond to 274 couples that got married in the years 2002, 2004, 2006 or 2008. The couples are observed on average four times.

When married, the difference in BMI between spouses is around four BMI points and in 37 percent of cases the wife has higher BMI than the husband in the year of their marriage. The average marital duration is around two years. Forty two percent of the observations are of couples where at least one spouse has been married before, there are 110 such couples in the sample. Five percent of the observations are followed by divorce, they correspond to 57 couples.

Men have higher a BMI at marriage, are older, more likely to be working and have higher income than their wives. Over half of the households have children 16 years old or younger living in them.

3.5 Results

Table 3E.1 reports the coefficients on the main explanatory variables using Ordinary Least Squares (OLS) and complementary log-log (CLogLog) regressions. The results show no significant relation between BMI gaps at marriage and the probability of divorcing in the following years, but who has the higher BMI does seem to matter as the dummy for when the wife is the one with higher BMI and its interaction with the BMI gap are both significant at five percent.

Table 3E.1: Pooled Data - Dependent Variable: Divorce in t+1

	OLS	CLogLog
BMI Gap at Marriage	-0.0043	-0.0946
	(0.0050)	(0.0988)
Wife Higher BMI	-0.0901**	-1.5242**
	(0.0404)	(0.6743)
BMI Gap * Wife	0.0180 **	0.2751 **
	(0.0090)	(0.1196)
N	1167	918

Weighted regressions, using household weights.
Robust standard errors (clustered by household) in parentheses.
****, ** and * denote 1%, 5% and 10% significance respectively.
Full Table: 3A.2, it also includes a Probit regession.

According to the OLS results (first column, Table 3E.1) if we could compare a couple with an average BMI gap where the husband has a higher BMI to a couple with an average BMI gap where the wife has higher BMI (both of them average in other characteristics), we would observe that the second couple has a slightly lower probability of divorce, 1.6 percent lower. However the OLS results do not take into account that the probability of divorce must be between zero and one.

The coefficients of the complementary log-log results (second column, Table 3E.1) cannot be interpreted directly, to know about the magnitude of the relationship between the variables on the table and the probability of divorce it is necessary to calculate the marginal effects associated with the estimation.

Table 3E.2: Marginal Effects (ME) - Complementary Log Log Regression

	Average ME	ME at the mean	ME at the 75th perc.
BMI Gap at Marriage	-0.0067	-0.0047	-0.0036
	(0.0228)	(0.0202)	(0.0038)
Wife Higher BMI	-0.1087	-0.0770	-0.0579 **
	(0.3526)	(0.3167)	(0.0280)
BMI Gap * Wife	0.0196	0.0139	0.0104 *
	(0.0636)	(0.0572)	(0.0063)

The marginal effects in Table 3E.2 indicate, as the OLS results, that a couple with average BMI gap where the husband has higher BMI is slightly less likely to divorce than a couple with average BMI gap where the wife has higher BMI, but they are not significant on average (first column) or at the mean (second column), they are significant at the 75th percentile (third column), that is, they are significant only when all variables are set at the 75th percentile, which is not representative of the sample.

The results discussed in the previous paragraphs provide weak evidence of differences in the probability of divorce between couples that differ in terms of BMI gap, since the difference estimated by OLS in this probability between an "average" couple where the man has higher BMI and an "average" couple where the woman has higher BMI is small, divorce is 1.6 percent more likely for the first couple, and the marginal effects of the complementary log log regression are significant only when all variables are set at the 75th percentile.

The results are not affected when the sample is restricted only to West Germany or when there are no limits for the age at marriage.

3.6 Conclusions

The objective of this paper was to know whether differences in BMI, that can be considered as differences in attractiveness, between the spouses are related to the probability of a couple getting a divorce in the future. The results for a German sample of couples indicate that differences in BMI in the year of marriage are weakly related to the probability of divorce in the following years, with a slightly lower (and not always significant) probability of divorce for couples where the woman is the one with higher BMI.

The results are based on a relatively short sample compared with other papers that study the impact of differences in some characteristics on the risk of divorce, they

used all the waves of the SOEP available at the time while this paper only considers marriages that took place in the years where there is information on height and weight to be able to calculate BMI for each spouse.

3A Tables

Table 3A.1: Descriptive Statistics

	N	Mean	SD	N	Mean	SD
BMI Gap at Marriage [Kg/m^2]	1167	4.099	2.862			
Wife Higher BMI [Proportion]	1167	0.371	0.483			
Marital Duration [Years]	1167	2.228	1.964			
Not First Marriage [Proportion]	1167	0.420	0.494			
Divorce in t+1 [Proportion]	1167	0.049	0.216			
Individual Level Variables		*Men*			*Women*	
BMI at Marriage [Kg/m^2]	1167	25.858	3.210	1167	24.755	4.006
Age [Years]	1167	38.205	8.284	1167	35.211	8.239
Working [Proportion]	1167	0.890	0.313	1167	0.706	0.456
Labour Income [€/Month]	940	3082.414	1570.593	736	1903.234	1172.251
Years of Education	1167	13.035	2.836	1167	12.964	2.617
Household Level Variables						
Children in HH [Proportion]	1167	0.563	0.496			

This data corresponds to 274 couples that are observed on average four times.

Table 3A.2: Pooled Data - Dependent Variable: Divorce in t+1

	OLS	Probit	CLogLog
BMI Gap at Marriage	-0.0043	-0.0446	-0.0946
	(0.0050)	(0.0458)	(0.0988)
Wife Higher BMI	-0.0901**	-0.7509**	-1.5242**
	(0.0404)	(0.2985)	(0.6743)
BMI Gap * Wife	0.0180 **	0.1368 **	0.2751 **
	(0.0090)	(0.0584)	(0.1196)
Not First Marriage	0.0018	-0.0598	0.0114
	(0.0279)	(0.2327)	(0.5061)
Age Husband	-0.0016	-0.0054	-0.0262
	(0.0023)	(0.0206)	(0.0472)
Age Wife	0.0005	-0.0007	0.0047
	(0.0022)	(0.0198)	(0.0416)
Education Husband	-0.0018	-0.0301	-0.0499
	(0.0056)	(0.0452)	(0.1035)
Education Wife	0.0046	0.0397	0.0822
	(0.0050)	(0.0407)	(0.0887)
Working Husband	-0.0007	0.0987	0.2765
	(0.0436)	(0.3225)	(0.7452)
Working Wife	0.0188	0.2493	0.3636
	(0.0380)	(0.2932)	(0.6044)
Log Income Husband	-0.0035	-0.0260	-0.0686
	(0.0056)	(0.0362)	(0.0823)
Log Income Wife	-0.0020	-0.0235	-0.0335
	(0.0049)	(0.364)	(0.0747)
Children in HH	0.0135	0.1753	0.3004
	(0.0279)	(0.2363)	(0.5249)
R^2 (^{a} Pseudo- R^2)	0.0529	0.0727^a	
Log-Pseudolikelihood		-508470.7	-505941.6
N	1167	918	918

Weighted regressions, using household weights.
Robust standard errors (clustered by household) in parentheses.
***, ** and * denote 1%, 5% and 10% significance respectively.
Year and region-year dummies not reported on the table.

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